SPECIFICATIONS
(FOR CONSTRUCTION CONTRACT)

SOLICITATION NO. W9128F-04-B-0011

ADAL PHYSICAL FITNESS CENTER
PDC NO. QJVF 8800034R2

MINOT AFB, North Dakota

VOLUME 1 OF 3 – DIVISION 00 THRU DIVISION 02

JULY 2004

Prepared By : U.S. Army Corps of Engineers
Omaha District

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SPECIFICATIONS FOR
ADAL PHYSICAL FITNESS CENTER
MINOT AFB, NORTH DAKOTA

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	W9128F-04-B-0011	☒ SEALED BID (IFB) ☐ NEGOTIATED (RFP)	8 JUL 2004	1 OF 3

IMPORTANT - The "offer" section on the reverse must be fully completed by offeror.

4. CONTRACT NO.	5. REQUISITION/PURCHASE REQUEST NO.	6. PROJECT NO.

7. ISSUED BY CODE CT

U S ARMY ENGINEER DISTRICT, OMAHA
106 SOUTH 15TH STREET
OMAHA, NE 68102-1618

8. ADDRESS OFFER TO

US ARMY CORPS OF ENGINEERS
Attn: CONTRACTING DIVISION (CENWO-CT)
106 SOUTH 15TH STREET
OMAHA, NE 68102-1618

9. FOR INFORMATION CALL:	A. NAME	B. TELEPHONE NO. (Include area code) (NO COLLECT CALLS)
▶	Mel Vogt	(402) 221-4298

SOLICITATION

NOTE: In sealed bid solicitations "offer" and "offeror" mean "bid" and "bidder".

10. THE GOVERNMENT REQUIRES PERFORMANCE OF THE WORK DESCRIBED IN THESE DOCUMENTS (Title, identifying no., date):

The Offeror hereby agrees to do all the work described in these documents entitled:

ADAL PHYSICAL FITNESS CENTER
Minot Air Force Base, North Dakota

RETURN WITH BIDS: SECTION 00010 (SF1442), SECTION 00600 REPRESENTATIONS, CERTIFICATIONS & OTHER STATEMENTS OF BIDDERS, and all Bonding Requirements, See SECTION 00700 CONTRACT CLAUSES and SECTION 00100 for Performance and Payment Bonds.

11. The Contractor shall begin performance within 10 calendar days and complete it within ** calendar days after receiving

☐ award, ☒ notice to proceed. This performance period is ☒ mandatory, ☐ negotiable. (See ** Section 00800 .)

12A. THE CONTRACTOR MUST FURNISH ANY REQUIRED PERFORMANCE AND PAYMENT BONDS? (If "YES," indicate within how many calendar days after award in Item 12B.)	12B. CALENDAR DAYS
☒ YES ☐ NO	

13. ADDITIONAL SOLICITATION REQUIREMENTS:

A. Sealed offers in original and 0 copies to perform the work required are due at the place specified in Item 8 by 1400 (hour) local time 19 AUG 2004 (date). If this is a sealed bid solicitation, offers must be publicly opened at that time. Sealed envelopes containing offers shall be marked to show the offeror's name and address, the solicitation number, and the date and time offers are due.

B. An offer guarantee ☒ is, ☐ is not required.

C. All offers are subject to the (1) work requirements, and (2) other provisions and clauses incorporated in the solicitation in full text or by reference.

D. Offers providing less than 60 calendar days for Government acceptance after the date offers are due will not be considered and will be rejected.

14. NAME AND ADDRESS OF OFFEROR (Include ZIP Code)	15. TELEPHONE NO. (Include area code)
DUNS Number:_____	16. REMITTANCE ADDRESS (Include only if different than Item 14)
CODE FACILITY CODE	

17. The offeror agrees to perform the work required at the prices specified below in strict accordance with the terms of this solicitation, if this offer is accepted by the Government in writing within 60 calendar days after the date offers are due. (Insert any number equal to or greater than the minimum requirement stated in Item 13D. Failure to insert any number means the offeror accepts the minimum in Item 13D.)

AMOUNTS ▶ See Proposal Schedule
Contractor's Fax No._____ CAGE Code:_____
Contractor's e-mail Address:_____

18. The offeror agrees to furnish any required performance and payment bonds.

19. ACKNOWLEDGMENT OF AMENDMENTS
(The offeror acknowledges receipt of amendments to the solicitation - give number and date of each)

AMENDMENT NO.										
DATE										

20A. NAME AND TITLE OF PERSON AUTHORIZED TO SIGN OFFER (Type or print)	20B. SIGNATURE	20C. OFFER DATE

AWARD (To be completed by Government)

21. ITEMS ACCEPTED:

22. AMOUNT	23. ACCOUNTING AND APPROPRIATION DATA

24. SUBMIT INVOICES TO ADDRESS SHOWN IN (4 copies unless otherwise specified) ▶	ITEM 26	25. OTHER THAN FULL AND OPEN COMPETITION PURSUANT TO ☐ 10 U.S.C. 2304(c) ( ) ☐ 41 U.S.C. 253(c) ( )

26. ADMINISTERED BY CODE	27. PAYMENT WILL BE MADE BY
US ARMY ENGINEER DISTRICT, OMAHA 106 SOUTH 15TH STREET OMAHA, NE 68102-1618	USAED OMAHA C/O USACE FINANCE CENTER 5722 INTEGRITY DRIVE MILLINGTON, TN 38054-5005

CONTRACTING OFFICER WILL COMPLETE ITEM 28 OR 29 AS APPLICABLE

☐ 28. NEGOTIATED AGREEMENT (contractor is required to sign this document and return_____ copies to issuing office.) Contractor agrees to furnish and deliver all items or perform all work, requisitions identified on this form and any continuation sheets for the consideration stated in this contract. The rights and obligations of the parties to this contract shall be governed by (a) this contract award, (b) the solicitation, and (c) the clauses, representations, certifications, and specifications incorporated by reference in or attached to this contract.	☐ 29. AWARD (Contractor is not required to sign this document.) Your offer on this solicitation, is hereby accepted as to the items listed. This award consummates the contract, which consists of (a) the Government solicitation and your offer, and (b) this contract award. No further contractual document is necessary.
30A. NAME AND TITLE OF CONTRACTOR OR PERSON AUTHORIZED TO SIGN (Type or print)	31A. NAME OF CONTRACTING OFFICER (Type or print)

30B. SIGNATURE	30C. DATE	31B. UNITED STATES OF AMERICA BY	31C. AWARD DATE

STANDARD FORM 1442 BACK (REV. 4-85)

PRICING SCHEDULE

BASIC BID ITEMS				
Item No.	**Description**	**Quantity**	**Unit**	**Total Amount**
1	All work complete for **ADAL Physical Fitness Center, Minot AFB, North Dakota**	**JOB**	**LUMP SUM**	**$_____**

OPTION ITEMS				
Item No.	**Description**	**Quantity**	**Unit**	**Total Amount**
O-1	All work complete for larger gymnasium and corresponding 1/8th mile running track.	**JOB**	**LUMP SUM**	**$_____**
O-2	All work complete for larger 212 stall parking lot.	**JOB**	**LUMP SUM**	**$_____**
O-3	All work complete to add brick veneer to the south and east exterior walls of the existing racquetball courts	**JOB**	**LUMP SUM**	**$_____**
O-4	All work complete to add metal lockers at Rooms 154 and 170	**JOB**	**LUMP SUM**	**$_____**
O-5	All work complete to upgrade existing finishes at Rooms 125, 129, 130, 131 to the new finishes shown on the Room Finish Schedule	**JOB**	**LUMP SUM**	**$_____**
O-6	All work complete for adding gymnasium curtains to the Base Bid gymnasium scheme	**JOB**	**LUMP SUM**	**$_____**
O-7	Demolish existing Field House Gym #2 and eliminate work at Room 99. Eliminate new construction at Room 193.	**JOB**	**LUMP SUM**	**$_____**
O-8	Complete the project in two phases rather than the five phases shown on Drawing A0.00.	**JOB**	**LUMP SUM**	**$_____**

TOTAL AMOUNT	
TOTAL AMOUNT (BASIC AMOUNT + OPTION ITEMS)	**$_____**

NOTES:

1. Bid prices must be entered for all line items on the schedule. Total amount bids submitted without bid prices for individual line items will be rejected. Additions will be subject to verification by the Government. In case of variation between the lump-sum prices and the total amount, the lump-sum prices will be considered the bid.

2. A modification to a bid, which provides for a single adjustment to the total amount bid, should state the application of the adjustment to each respective lump-sum price affected. If the modification is not so apportioned, the single adjustment will be applied to Basic Item No. 1.

3. See Section 00100: INSTRUCTIONS, CONDITIONS, AND NOTICES TO OFFERORS for evaluation of options. The Government reserves the right to exercise options O-2 through O-7 within 120 days after issuance of Notice to Proceed. The Government reserves the right to exercise options O-1 and O-8 prior to issuance of Notice to Proceed.

SECTION 00100

INSTRUCTIONS, CONDITIONS & NOTICES TO BIDDERS
(July 2000, Revised May 2004)

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SECTION 00100

INSTRUCTIONS, CONDITIONS & NOTICES TO BIDDERS

1 GENERAL BIDDING INFORMATION

Bids shall be either mailed or hand-carried as indicated below. Bid will be PUBLICLY opened at the bid time indicated on Standard Form SF 1442 (Page 00010-1).

1.1 MAILED BIDS AND HAND-CARRIED BIDS

a. Mailed bids shall be addressed to the location as indicated on Standard Form SF 1442 (Page 00010-1), Item No. 8.

b. Due to heightened security at Government installations, those bidders who have their bids hand-carried* shall contact Mel Vogt, Contract Specialist at (402) 221-4298 or (402) 221-4100 prior to delivering to the U. S. Army Corps of Engineer District, Omaha, 106 South 15th Street, Omaha, NE.

c. On the date specified and for thirty (30) minutes prior to time specified on Standard Form SF 1442, Page 00010-1, item 13.A, a Contracting representative will be in the lobby to receive bids. At the time specified on Standard SF 1442 Page 00010-1, item 13.A, the designated bid opening official will announce that receipt of bids is closed. Official time will be established by time/stamp clock located in the area where bids are received.

d. Anyone wishing to attend this public opening will be required to present photo identification to sign in and then will be escorted to the facility where bids will be opened. Once bids have been opened, read and recorded, attendees will then be escorted to exit the building.

e. **RETURN ADDRESS REQUIREMENTS**

Bidder(s) must ensure that **ALL** mail sent to the Omaha District, U.S. Army Corps of Engineers, either pre-contract or post-contract award, has a return mailing address on the outside of the envelope, package, box, etc. **ANY MAIL** addressed to the U.S. Army Corps of Engineers, including but not limited to bids, modifications to bids, proposals, revised proposals, bid guarantees, bonds, correspondence, etc., **will be REJECTED** by the US Army Corps of Engineers mail room facility located at 106 South Street, Omaha, Nebraska 68102-1618 if it does not contain a return mailing address. **There will be no exceptions.**

*This instruction shall also apply to those bids delivered through a delivery or parcel service.

1.2 SOLICITATION RESTRICTIONS

This solicitation is unrestricted and open to both large and small business participation.

1.3 BASIS FOR AWARD.

IT IS INTENDED THAT AWARD WILL BE MADE TO ONE BIDDER FOR THE ENTIRE WORK.

1.4 DESCRIPTION OF WORK

The scope of this project is to furnish all plant, labor, materials, and equipment and performing all work for ADAL Physical Fitness Center, Minot AFB, North Dakota. Work shall be in accordance with plans and specifications issued with this solicitation. Work includes demolition of existing large gym, construction of new gym, reconfiguration and renovation of existing administration area, reconfiguration and renovation of existing small gym, and replacement of lighting, electrical, and HVAC in existing facility.

1.5 ESTIMATED CONSTRUCTION COST

The estimated construction cost of this project is between $7,500,000 and $10,000,000.

2 (FAR 52.214-6) EXPLANATION TO PROSPECTIVE BIDDERS (APRIL 1984).

Any prospective bidder desiring an explanation or interpretation of the solicitation, drawings, specifications, etc., must request it in writing soon enough to allow a reply to reach all prospective bidders before the submission of their bids. Oral explanations or instructions given before the award of a contract will not be binding. Any information given a prospective bidder concerning a solicitation will be furnished promptly to all other prospective bidders as an amendment to the solicitation, if that information is necessary in submitting bids or if the lack of it would be prejudicial to other prospective bidders.

3 RESERVED

(NOTE: FACSIMILE, ELECTRONIC COMMERCE OR TELEGRAPHIC BIDS ARE NOT AUTHORIZED AND WILL NOT BE ACCEPTED. TELEGRAPHIC MODIFICATIONS OR WITHDRAWAL OF BIDS ARE AUTHORIZED. FACSIMILE MODIFICATIONS OR WITHDRAWAL ARE NOT AUTHORIZED.)

4 (FAR 52.214-5) SUBMISSION OF BIDS (MAR 1997).

(a) Bids and bid modifications shall be submitted in sealed envelopes or packages (unless submitted by electronic means) (1) addressed to the office specified in the solicitation and (2) showing the time and date specified for receipt, the solicitation number, and the name and address of the bidder.

(b) Bidders using commercial carrier services shall ensure that the bid is addressed and marked on the outermost envelope or wrapper as prescribed in subparagraphs (a) (1) and (2) of this provision when delivered to the office specified in the solicitation.

(c) Telegraphic bids will not be considered unless authorized by the

solicitation; however, bids may be modified or withdrawn by written or telegraphic notice.

(d) Facsimile bids, modifications, or withdrawals, will not be considered unless authorized by the solicitation

(e) Bids submitted by electronic commerce shall be considered only if the electronic commerce method was specifically stipulated or permitted by the solicitation.

5 (FAR 52.214-18) PREPARATION OF BIDS - CONSTRUCTION (APRIL 1984).

(a) Bids must be--

(1) Submitted on the forms furnished by the Government or on copies of those forms, and
(2) **Manually signed**. The person signing a bid must initial each erasure or change appearing on any bid form.

(b) The bid form may require bidders to submit bid prices for one or more items on various bases, including--

(1) Lump sum bidding;

(2) Alternate prices;

(3) Units of construction; or

(4) Any combination of subparagraphs (1) through (3) above.

(c) If the solicitation requires bidding on all items, failure to do so will disqualify the bid. If bidding on all items is not required, bidders should insert the words "no bid" in the space provided for any item on which no price is submitted.

(d) Alternate bids will not be considered unless this solicitation authorizes their submission.

6 (FAR 52.214-4) FALSE STATEMENTS IN BIDS (APRIL 1984).

Bidders must provide full, accurate, and complete information as required by this solicitation and its attachments. The penalty for making false statements in bids is prescribed in 18 U.S.C. 1001.

(NOTE: FACSIMILE, ELECTRONIC COMMERCE OR TELEGRAPHIC BIDS ARE NOT AUTHORIZED AND WILL NOT BE ACCEPTED. TELEGRAPHIC MODIFICATIONS OR WITHDRAWAL OF BIDS ARE AUTHORIZED. FACSIMILE MODIFICATIONS OR WITHDRAWAL ARE NOT AUTHORIZED.)

7 (FAR 52.214-7) LATE SUBMISSIONS, MODIFICATIONS, AND WITHDRAWALS OF BIDS (NOV 1999).

(a) Bidders are responsible for submitting bids, and any modifications or withdrawals, so as to reach the Government office designated in the invitation for bids (IFB) by the time specified in the IFB. If no time is

specified in the IFB, the time for receipt is 4:30 p.m., local time, for the designated Government office on the date that bids are due.

(b)(1) Any bid, modification, or withdrawal received at the Government office designated in the IFB after the exact time specified for receipt of bids is “late” and will not be considered unless it is received before award is made, the Contracting Officer determines that accepting the late bid would not unduly delay the acquisition; and—

(i) If it was transmitted through an electronic commerce method authorized by the IFB, it was received at the initial point of entry to the Government infrastructure not later than 5:00 p.m. one working day prior to the date specified for receipt of bids; or

(ii) There is acceptable evidence to establish that it was received at the Government installation designated for receipt of bids and was under the Government’s control prior to the time set for receipt of bids.

(2) However, a late modification of an otherwise successful bid that makes its terms more favorable to the Government, will be considered at any time it is received and may be accepted.

(c) Acceptable evidence to establish the time of receipt at the Government installation includes the time/date stamp of that installation on the bid wrapper, other documentary evidence of receipt maintained by the installation, or oral testimony or statements of Government personnel.

(d) If an emergency or unanticipated event interrupts normal Government processes so that bids cannot be received at the Government office designated for receipt of bids by the exact time specified in the IFB and urgent Government requirements preclude amendment of the IFB, the time specified for receipt of bids will be deemed to be extended to the same time of day specified in the solicitation on the first work day on which normal Government processes resume.

(e) Bids may be withdrawn by written notice received at any time before the exact time set for receipt of bids. If the IFB authorizes facsimile bids, bids may be withdrawn via facsimile received at any time before the exact time set for receipt of bids, subject to the conditions specified in the provision at 52.214-31, Facsimile Bids. A bid may be withdrawn in person by a bidder or its authorized representative if, before the exact time set for receipt of bids, the identity of the person requesting withdrawal is established and the person signs a receipt for the bid.

(End of provision)

8 INFORMATION FOR MODIFYING BIDS.

Bids which have been delivered to the designated bid receiving office may be modified or withdrawn by mail, mailgram, or telegram received at any time before the exact time set for receipt of bids. Modifications or withdrawals sent by mail should be transmitted to the place of bid opening Standard Form SF1442 (Page 00010-1), Item 8. Telephone modifications or withdrawals, other than telecopier, will not be accepted. All bid modifications or withdrawals must be signed by the bidder or its authorized representative. Any questions regarding these procedures should be directed to the Omaha District's Contracting Division at (402) 221-4298. This number should also be used to verify the receipt of messages.

(NOTE: NOT REQUIRED FOR PROJECTS LESS THAN $100,000)

9 BID GUARANTEE.

See Contract Clauses FAR 52.228-1, BID GUARANTEE. The Bid Guarantee must include original signatures and be accompanied by a Power of Attorney appointing an attorney-in-fact with authority to bind the surety so that, at the time of bid opening, the bond is enforceable against the surety should the bidder fail to meet its obligation. The Power of Attorney must include a Certification as to the authority of the surety's agents that either has an original (wet) signature of an officer of the surety or has a mechanically applied or facsimile signature that is supported by a resolution of the surety authorizing their use and committing it to be bound by them.

(This provision is Not Required for projects less than $100,000. See paragraph: PAYMENT PROTECTION.)

10 PERFORMANCE AND PAYMENT BONDS.

See Contract Clauses clause FAR 52.228-15, PERFORMANCE AND PAYMENT BONDS. To have the bond considered valid, both the bond and the Power of Attorney must be original. Facsimile copies will not be acceptable, and will render the bid invalid, therefore eliminating it from competition.

(NOTE: FOR THE PURPOSES OF THIS SOLICITATION, THE WORD "ITEM" SHALL BE CONSIDERED TO MEAN "SCHEDULE.")

11 (FAR 52.214-19) CONTRACT AWARD - SEALED BIDDING - CONSTRUCTION (AUG 1996).

(a) The Government will evaluate bids in response to this solicitation without discussions and will award a contract to the responsible bidder whose bid, conforming to the solicitation, will be most advantageous to the Government, considering only price and the price-related factors specified elsewhere in the solicitation.

(b) The Government may reject any or all bids, and waive informalities or minor irregularities in bids received.

(c) The Government may accept any item or combination of items, unless doing so is precluded by a restrictive limitation in the solicitation of the bid.

(d) The Government may reject a bid as nonresponsive if the prices bid are materially unbalanced between line items or subline items. A bid is materially unbalanced when it is based on prices significantly less than cost for some work, and prices which are significantly overstated in relation to cost for other work, and if there is a reasonable doubt that the bid will result in the lowest overall cost to the Government even though it may be the low evaluated bid, of it is so unbalanced as to be tantamount to allowing an advance payment.

12 NORTH AMERICAN CLASSIFICATION SYSTEM (NAICS).

In accordance with NAICS Manual, the work in this solicitation is assigned classification code 236220.

13 SMALL BUSINESS SIZE STANDARD.

This solicitation is not limited to small business concerns, but, for definition purposes, a concern is small if its average annual receipts for its preceding 3 fiscal years did not exceed $28.5million. (based on FAR 19.102)

(NOTE: NOT REQUIRED FOR PROJECTS OVER $100,000)

14 PAYMENT PROTECTION.

For projects less than $100,000, the Contractor shall be responsible for providing payment protections in accordance with Section 00700 CONTRACT CLAUSES clauses "Alternative Payment Protections" and "Inapplicable Provisions and Clauses".

15 (FAR 52.214-3) AMENDMENTS TO INVITATIONS FOR BIDS (DECEMBER 1989).

(a) If this solicitation is amended, then all terms and conditions which are not modified remain unchanged.
(b) Bidders shall acknowledge receipt of any amendment to this solicitation (1) by signing and returning the amendment, (2) by identifying the amendment number and date in the space provided for this purpose on the form for submitting a bid, (3) by letter or telegram or (4) by facsimile, if facsimile bids are authorized in the solicitation. The Government must receive the acknowledgment by the time and at the place specified for receipt of bids. (FAR 52.214-3.)

16 CHANGES PRIOR TO OPENING BIDS.

The right is reserved, as the interest of the Government may require, to revise the specifications and/or drawings prior to the date set for opening bids. Such revisions will be announced by an amendment or amendments to this Invitation for Bids. **It shall be the responsibility of the prospective bidder to obtain copies of amendments from the website listed in paragraph: PLAN HOLDER'S LIST below**. The Government may (but not required) send an amendment notification to let prospective bidders know that an amendment has been issued. If the revisions and amendments are of a nature which requires material changes in quantities or prices to be bid, the date set for opening bids may be postponed as necessary, in the opinion of the Commander, to enable bidders to revise their bids. In such cases, the amendment will include an announcement of the new date for opening bids.

17 (FAR 52.214-34) SUBMISSION OF OFFERS IN THE ENGLISH LANGUAGE (APR 1991)

Offers submitted in response to this solicitation shall be in the English language. Offers received in other than English shall be rejected.

(End of provision)

18 (FAR 52.214-35) SUBMISSION OF OFFERS IN U.S. CURRENCY (APR 1991)

Offers submitted in response to this solicitation shall be in terms of U.S. dollars. Offers received in other than U.S. dollars shall be rejected.

(End of provision)

19 (EFARS 52.214-5000) ARITHMETIC DISCREPANCIES.

(a) For the purpose of initial evaluation of bids, the following will be utilized in resolving arithmetic discrepancies found on the face of the bidding schedule as submitted by the bidder:

(1) Obviously misplaced decimal points will be corrected;

(2) In case of discrepancy between unit price and extended price, the unit price will govern;

(3) Apparent errors in extension of unit prices will be corrected;

(4) Apparent errors in addition of lump sum and extended prices will be corrected.

(b) For the purposes of bid evaluation, the Government will proceed on the assumption that the bidder intends his bid to be evaluated on the basis of the unit prices, extensions, and totals arrived at by resolution of arithmetic discrepancies as provided above and the bid will be so reflected on the abstract of bids.

(c) These correction procedures shall not be used to resolve any ambiguity concerning which bid is low.

20 (FAR 52.217-5) EVALUATION OF OPTIONS (JUL 1990).

Except when it is determined in accordance with FAR 17.206(b) not to be in the Government's best interests, the Government will evaluate offers for award purposes by adding the total price for all options to the total price for the basic requirement. Evaluation of options will not obligate the Government to exercise the option(s).

21 OPTIONS.

The Government may reject an offer as nonresponsive if it is materially unbalanced as to prices for the basic requirement and the option quantities. An offer is unbalanced when it is based on prices significantly less than cost for some work and prices which are significantly overstated for other work.

22 AVAILABILITY OF SPECIFICATIONS, STANDARDS, AND DESCRIPTIONS.

Specifications, standards, and descriptions cited in this solicitation are available as indicated below:

22.1 (FAR 52.211-2) AVAILABILITY OF SPECIFICATIONS LISTED IN THE DOD INDEX OF SPECIFICATIONS AND STANDARDS (DODISS) AND DESCRIPTIONS LISTED IN THE ACQUISITION MANAGEMENT SYSTEMS AND DATA REQUIREMENTS CONTROL LIST, DOD 5010.12-L (DEC 2003).

Copies of specifications, standards, and data item descriptions cited in this solicitation may be obtained—

(a) From the ASSIST database via the Internet at http://assist.dla.mil; or

(b) By submitting a request to the—

Department of Defense Single Stock Point (DoDSSP)
Building 4, Section D
700 Robbins Avenue
Philadelphia, PA 19111-5094
Telephone (215) 697-2179
Facsimile (215) 697-1462.

(End of provision)

22.2 CORPS OF ENGINEERS SPECIFICATIONS.

Corps of Engineers specifications of the CRD-C series may be obtained from the National Institute of Building Sciences Construction Criteria Base (CCB) on CD-ROM. Contact the CCB directly at (202) 289-7800 for an order form or obtain an order form at the following internet address: http://www.ccb.org/ccbsubscribe/Subsmain.asp. There is a regular annual subscription fee to CCB of $700 per year. (Note: This is considered to be the Contractor's responsibility and cost). This will include CCB on CD-ROM or DVD plus unlimited internet access plus access to the new Whole Building Design Guide, now under construction and scheduled for launch in October 2001. Selected Corps of Engineers specifications of CRD-C series are available in Acrobat Reader .pdf file format at the following internet address: http://www.wes.army.mil/SL/MTC/handbook/handbook.htm.

22.3 COMMERCIAL (NON-GOVERNMENT) SPECIFICATIONS, STANDARDS, AND DESCRIPTIONS.

These specifications, standards, and descriptions are not available from Government sources. They may be obtained from the publishers.

23 AVAILABLE PLANT.

Each bidder shall, upon request of the Contracting Officer, furnish a list of the plant available to the bidder and proposed for use on the work.

24 EQUIPMENT OWNERSHIP AND OPERATING EXPENSE SCHEDULE.

Whenever a contract or modification of contract price is negotiated, the Contractor's cost proposals for equipment ownership and operating expenses shall be determined in accordance with the requirements of paragraph: EQUIPMENT OWNERSHIP AND OPERATING EXPENSE SCHEDULE, contained in Section: 00800, SPECIAL CONTRACT REQUIREMENTS of the specifications. A copy of EP 1110-1-8 "Construction Equipment Ownership and Operating Expense Schedule" is

available for review at the office listed in paragraph: SITE VISIT (CONSTRUCTION) herein or at the following internet address: http://www.usace.army.mil/inet/usace-docs/eng-pamphlets/ep.htm. (copy also included on CD-ROM issued with this solicitation). .

25 NOTICE REGARDING BUY AMERICAN ACT.

The Buy American Act (41 U.S.C. 10a-10d) generally requires that only domestic construction material be used in the performance of this contract. Exception from the Buy American Act shall be permitted only in the case of nonavailability of domestic construction materials. A bid or proposal offering nondomestic construction material will not be accepted unless specifically approved by the Government. When a bidder or offeror proposes to furnish nondomestic construction material, his bid or proposal must set forth an itemization of the quantity, unit price, and intended use of each item of such nondomestic construction material. When offering nondomestic construction material pursuant to this paragraph, bids or proposals may also offer, at stated prices, any available comparable domestic construction material, so as to avoid the possibility that failure of a nondomestic construction material to be acceptable under this paragraph will cause rejection of the entire bid. All bidders are cautioned that, prior Government conduct notwithstanding, the Contractor's selection of a domestic construction material (as defined in FAR 52.225-5 Buy American Act-Construction Materials) which would require the subsequent selection of a foreign construction material for compatibility is not a justification for waiver of the Buy American Act. It is the Contractor's responsibility to verify, prior to submitting the materials for approval, that each system can be built to meet the contract specifications without the use of foreign construction materials.

26 TAXES - NORTH DAKOTA.

26.1 UNEMPLOYMENT TAX SURCHARGE.

The State of North Dakota has enacted legislation applicable to certain some contractors concerning an unemployment tax surcharge. See the North Dakota Century Code, Section 52-04-06.1, Incremental Bond for Impact Projects. The law provides for an unemployment tax surcharge in addition to regular unemployment tax liability. Bidders should investigate the effect, if any, that this law may have upon their bid prices. Inquiries should be directed to Job Service of North Dakota, Post Office Box 1537, Bismarck, North Dakota 58502. Telephone: (701) 224-3470 (Department of Revenue).

26.2 USE TAX.

Bidders are advised of the possible applicability of North Dakota Use Tax. Government furnished Construction material used by the Contractor may be subject to Use Tax. The value of material furnished is set forth in the SECTION 00800, SPECIAL CONTRACT REQUIREMENTS Clause "Government-Furnished Property." Specific inquiries as to the applicability of North Dakota Use Tax should be referred to the North Dakota State Tax Commission.

27 (FAR 52.236-27) SITE VISIT (CONSTRUCTION) (FEB 1995).

(a) The clauses at 52.236-2, Differing Site Conditions, and 52.236-3, Site Investigations and Conditions Affecting the Work, will be included in any contract awarded as a result of this solicitation. Accordingly, offerors or quoters are urged and expected to inspect the site where the work will be performed.

(b) Contractors interested in inspecting the site of the proposed work should contact the Minot AFB Resident Office, Minot Project Engineer, U.S. Army Corps of Engineers, c/o Base Post Office, Minot AFB, ND 58704 for mail and 209 Tanker Trail, Minot AFB, North Dakota 58704 for site inspection, Telephone: (701) 727-6127. FAX (701) 727-6128.

28 BIDDER'S QUESTIONS AND COMMENTS.

Questions and/or comments relative to these bidding documents should be submitted via e-mail or mailed to the address identified in paragraph: AVAILABILITY OF BID RESULTS below. Comments should reach this office no later than 20 calendar days prior to the date set for opening of bids, if feasible, in order that changes, if needed, may be added by amendment. E-mail addresses, FAX numbers, items for question and points of contact are listed below. Phone calls with questions should be made between 8:30 a.m. and 3:30 p.m. (Central Standard Time) Monday through Friday.

Note: A courtesy copy of all questions shall be sent to the Contract Specialist (Contractual Matters Point of Contact), the Program Manager and Specifications Section (Technical Content Points of Contact).

Items for Question	Points of Contact/ Phone numbers/ FAX Numbers	E-mail Addresses
Contractual Matters: Ordering CD-Rom of the plans and specifications (limit One per firm)/ amendments**/ Bid Results (See Paragraph AVAILABILITY OF BID RESULTS, below)/ Receipt of Bids	Mel Vogt 402-221-4298 (phone) 402-221-4199 (Fax)	Mel.E.Vogt@usace.army.mil
Planholder's List	See paragraph: PLAN HOLDER'S LIST, below.	
Small Business Matters	Hubert Carter 402-221-4110 (phone)	hubert.j.carter@usace.army.mil
Technical Contents Of Plans and Specification	Larry Bringewatt 402-221-3894 (phone) 402-221-4828 (Fax) Or	Larry.G.Bringewatt@usace.army.mil

	Specifications Section Joel Woods 402-221-4529 (Phone) 402-221-3842 (Fax)	Joel.D.Woods@usace.army.mil
Site Inspection	See Paragraph: SITE VISIT (CONSTRUCTION), above	

**** - The Government may elect to send a notification that an amendment has been posted to the Government's web address. It shall be the Contractor's, Subcontractor's and Supplier's responsibility to check the Government's web address for amendments.**

28.1 PLAN HOLDER'S LIST.

The CD-Rom will provide a list of plan holders that have registered at the time the CD-Rom was created. It is bidder's responsibility to check for any updates to the plan holder's list, which is available at the following web address:

http://ebs-nwo.wes.army.mil/

28.2 AVAILABILITY OF BID RESULTS (Local Clause/Provision)

Bid results will be available after bid opening on the Governent's web address:
http://ebs-nwo.wes.army.mil/. Official bid abstracts will be available and may be requested by sending a self-addressed stamped envelope to: U.S. Army Corps of Engineers, Omaha District, ATTN: CENWO-CT-M (Vogt), 106 South 15th Street, Omaha, NE 68102-1618.

29 (FAR 52.233-2) SERVICE OF PROTEST (AUG 1996).

(a) Protests, as defined in section 33.101 of the Federal Acquisition Regulation, that are filed directly with an agency, and copies of any protests that are filed with the General Accounting Office (GAO), shall be served on the Contracting Officer (addressed as follows) by obtaining written and dated acknowledgement of receipt from District Counsel, 106 South 15th Street, Omaha, Nebraska 68102-1618.

(b) The copy of any protest shall be received in the office designated above within one day of filing a protest with the GAO.

30 PRE-AWARD SURVEY INFORMATION (Local Provision) (Sep 93)

In accordance with Paragraph PERFORMANCE AND PAYMENT BONDS, request that the following information be submitted with your bid. This facilitates the award process.

1. Financial
   - Name, address, and fax number of Financial Institution
   - Name and phone number of finance individual (primary and

alternate) to be contacted for information

2. Bonding Information
- Provide the name, address, regular phone number and fax number of your Surety Company.

3. Performance
- Provide three (3) references to be contacted on your company's performance

The following information should be submitted:
Name and Fax number of Owner/User
Project Name, Location, Contract Number, and dollar value
Name and phone number of individuals (primary and alternate) that can verify performance of the project

31 DATA UNIVERSAL NUMBERING SYSTEM (DUNS) NUMBER

(a) The offeror shall enter, in the block with its name and address on the cover page of its offer, the annotation "DUNS" followed by the DUNS number that identifies the offeror's name and address exactly as stated in the offer. The DUNS number is a nine-digit number assigned by Dun and Bradstreet Information Services.

(b) If the offeror does not have a DUNS number, it should contact Dun and Bradstreet directly to obtain one. A DUNS number will be provided immediately by telephone at no charge to the offeror. For information on obtaining a DUNS number, the offeror, if located within the United States, should call Dun and Bradstreet at 1-800-333-0505. The offeror should be prepared to provide the following information:

(1) Company name.

(2) Company address.

(3) Company telephone number.

(4) Line of business.

(5) Chief executive officer/key manager.

(6) Date the company was started.

(7) Number of people employed by the company.

(8) Company affiliation.

(c) Offerors located outside the United States may obtain the location and phone number of the local Dun and Bradstreet Information Services office from the Internet home page at http://www.customerservice@dnb.com. If an offeror is unable to locate a local service center, it may send an e-mail to Dun and Bradstreet at globalinfo@mail.dnb.com.

(End of provision)

32 (FAR 52.216-1) TYPE OF CONTRACT (APR 1984).

The Government contemplates award of a Firm Fixed Price contract resulting from this solicitation.

33 SUBCONTRACTING PLAN/SUBCONTRACTING GOALS REGARDING THE UTILIZATION OF SMALL BUSINESS CONCERNS.

a. Application. This clause applies only to large business concerns submitting bids for services exceeding $500,000 or for construction exceeding $1,000,000.

b. Federal Acquisition Regulations (FAR). Attention is directed to the following FAR and DFAR provisions contained in this solicitation:

52.219-8, Utilization of Small Business Concerns (Alternate I)

52.219-9, Small Business Subcontracting Plan (Alternate I)

52.219-16, Liquidated Damages - Small Business Subcontracting Plan

252.226-7001, Utilization Of Indian Organizations, Indian-Owned Economic Enterprises, And Native Hawaiian Small Business Concerns

c. Goals. The U.S. Army Corps of Engineers considers the following goals reasonable and achievable for fiscal year 2004 and for the performance of the resultant contract:

(1) 57.2% of planned subcontracting dollars with small business concerns.

(2) 10.0% of planned subcontracting dollars with those small business concerns owned and controlled by socially and economically disadvantaged individuals.

(3) 10.0% of planned subcontracting dollars with those small business concerns owned and controlled by women.

(4) 3.0% of planned subcontracting dollars with those small business concerns owned and controlled by Service-Disabled Veterans.

(5) 3.0% of planned subcontracting dollars with those small business concerns owned and controlled by HubZones.

d. Submission and Review of Subcontracting Plan.

SUBMISSION OF SMALL BUSINESS SUBCONTRACTING PLAN IS NOT APPLICABLE TO SMALL BUSINESSES.

(1) The apparent low bidder must submit a subcontracting plan within five (5) calendar days after bid opening (a longer period maybe granted by the Contracting Officer upon request) within 24 hours after notification by the Government to the Contracting Activity.

(2) Goals included in the subcontracting plan should be at least equal to those indicated above. If lesser goals are proposed, the bidder may be required to substantiate how the proposed plan represents the bidder's best effort to comply with the terms and conditions of the

solicitation. Bidders are highly encouraged to become familiar with the intent of the solicitation provisions and the elements of the subcontracting plan.

(3) The subcontracting plan must contain, as a minimum, the elements set forth in FAR provision 52.219-9. An example subcontracting plan will be furnished to the apparent low bidder (upon request). The example subcontracting plan (if requested) should not be construed as an acceptable subcontracting plan. Any format will be acceptable provided that the plan addresses each element as required by the Federal Acquisition Regulations and its supplements.

(4) Proposed plans will be reviewed by the Government to ensure the plan represents the firm's best efforts to maximize subcontracting opportunities for small, small disadvantaged and women-owned businesses.

(5) Subcontracting plans are required to be approved prior to Contract Award. The approved subcontracting plan (to include goals) will become a material part of the contract.

e. Failing to Submit An Acceptable Subcontracting Plan. An apparent low bidder failing to submit a subcontracting plan which demonstrates a reasonable effort to meet the goals listed above or provide an explanation why lesser goals are proposed (upon request), will be considered as non-responsive and not considered eligible for award of the contract.

f. Questions or Assistance Needed in Developing Subcontracting Plan. For any questions or assistance needed in developing the subcontracting plan, contact the Contract Specialist or District's Deputing for Small Business (See paragraph: BIDDER QUESTIONS AND COMMENTS, Contract Specialist [Bid Results] or the District's Deputy for Small Business [Small Business] or fax your inquiries to 402-221-4199).

34 RESERVED

REQUIRED CENTRAL CONTRACTOR REGISTRATION (CCR)

Register Now: Don't wait until you submit an offer on a solicitation. You must be registered to receive the contract award. It can often take 30 days for CCR to process your registration information.

Register One of Three Ways:

Internet: http://www.ccr.gov

Value Added Network (VAN) for EDI users: Contact your VAN for information. If you need to find a VAN look at http://www.acq.osd.mil/ec/ecip/van_list.htm

FAX or Mail: Call (888)227-2423 or (616)961-4725 to receive a registration package. FAX or mail the completed information to the CCR Assistance Center. It can take up to 30 days to process a faxed or mailed package.

CCR Assistance Center
74 Washington Street North, Suite 7
Battle Creek, MI 49017-3084
FAX: (616)961-7243

SECTION 00600
REPRESENTATIONS, CERTIFICATIONS & OTHER STATEMENTS OF BIDDERS

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SECTION 00600
REPRESENTATIONS, CERTIFICATIONS & OTHER STATEMENTS OF BIDDERS

The bidder (offeror) makes the following certification and representations as a part of the bid, shall check the appropriate boxes, fill in the appropriate information, and provide signatures on the attached "Solicitation Form" (00600) pages, and submit with Standard Form 1442 (Section 00010).

1. (FAR 52.203-2) CERTIFICATE OF INDEPENDENT PRICE DETERMINATION (APR 1985).

(a) The offeror certifies that -

(1) The prices in this offer have been arrived at independently, without, for the purpose of restricting competition, any consultation, communication, or agreement with any other offeror or competitor relating to (i) those prices, (ii) the intention to submit an offer, or (iii) the methods or factors used to calculate the prices offered;

(2) the prices in this offer have not been and will not be knowingly disclosed by the offeror, directly or indirectly, to any other offeror or competitor before bid opening (in the case of a Sealed Bid solicitation) or contract award (in the case of a negotiated solicitation) unless otherwise required by law; and

(3) no attempt has been made or will be made by the offeror to induce any other concern to submit or not to submit an offer for the purpose of restricting competition.

(b) Each signature on the offer is considered to be a certification by the signatory that the signatory -

(1) is the person in the offeror's organization responsible for determining the prices being offered in this bid or proposal, and that the signatory has not participated and will not participate in any action contrary to subparagraphs (a)(1) through (a)(3) above; or

(2)(i) has been authorized, in writing, to act as agent for the following principals in certifying that those principals have not participated, and will not participate in any action contrary to subparagraphs (a)(1) through (a)(3) above

_____

_____

_____ [insert full name of person(s) in the offeror's organization responsible for determining the prices offered in this bid or proposal, and the title of his or her position in the offeror's organization];

(ii) as an authorized agent, does certify that the principals named in subdivision (b)(2)(i) above have not participated, and will not participate, in any action contrary to subparagraphs (a)(1) through (a)(3) above; and

(iii) as an agent, has not personally participated, and will not participate, in any action contrary to subparagraphs (a)(1) through (a)(3) above.

(c) If the offeror deletes or modifies subparagraph (a)(2) above, the offeror must furnish with its offer a signed statement setting forth in detail the circumstances of the disclosure.

2. (FAR 52.203-11) CERTIFICATION AND DISCLOSURE REGARDING PAYMENTS TO INFLUENCE CERTAIN FEDERAL TRANSACTIONS (APR 1991).

(a) The definitions and prohibitions contained in the clause, at FAR 52.203-12, Limitation on Payments to Influence Certain Federal Transactions, included in this solicitation, are hereby incorporated by reference in paragraph (b) of this certification.

(b) The offeror, by signing its offer, hereby certifies to the best of his or her knowledge and belief that on or after December 23, 1989, -

(1) No Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress on his or her behalf in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment or modification of any Federal contract, grant, loan, or cooperative agreement;

(2) If any funds other than Federal appropriated funds (including profit or fee received under a covered Federal transaction) have been paid, or will be paid, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress on his or her behalf in connection with this solicitation, the offeror shall complete and submit, with its offer, OMB standard form LLL, Disclosure of Lobbying Activities, to the Contracting Officer; and

(3) He or she will include the language of this certification in all subcontract awards at any tier and require that all recipients of subcontract awards in excess of $100,000 shall certify and disclose accordingly.

(c) Submission of this certification and disclosure is a prerequisite for making or entering into this contract imposed by section 1352, title 31, United States Code. Any person who makes an expenditure prohibited under this provision or who fails to file or amend the disclosure form to be filed or amended by this provision, shall be subject to a civil penalty of not less than $10,000, and not more than $100,000, for each such failure.

3. TAXPAYER IDENTIFICATION (Local Provison).

(a) Definitions.

"Common parent," as used in this provision, means that corporate entity that owns or controls an affiliated group of corporations that files its Federal income tax returns on a consolidated basis, and of which the offeror is a member.

"Taxpayer Identification Number (TIN)," as used in this provision, means the number required by the Internal Revenue Service (IRS) to be used by the offeror in reporting income tax and other returns. The TIN may be either a Social Security Number or an Employer Identification Number.

(b) All offerors must submit the information required in paragraphs (d) through (f) of this provision to comply with debt collection requirements of 31 U.S.C. 7701(c) and 3325(d), reporting requirements of 26 U.S.C. 6041, 6041A, and 6050M, and implementing regulations issued by the IRS. If the resulting contract is subject to the payment reporting requirements described in Federal Acquisition Regulation (FAR) 4.904, the failure or refusal by the offeror to furnish the information may result in a 31 percent reduction of payments otherwise due under the contract.

(c) The TIN may be used by the Government to collect and report on any delinquent amounts arising out of the offeror's relationship with the Government (31 U.S.C. 7701(c)(3)). If the resulting contract is subject to the payment reporting requirements described in FAR 4.904, the TIN provided hereunder may be matched with IRS records to verify the accuracy of the offeror's TIN.

(d) Taxpayer Identification Number (TIN).

[ ] TIN: _____.

[ ] TIN has been applied for.

[ ] TIN is not required because:

[ ] Offeror is a nonresident alien, foreign corporation, or foreign partnership that does not have income effectively connected with the conduct of a trade or business in the United States and does not have an office or place of business or a fiscal paying agent in the United States;

[ ] Offeror is an agency or instrumentality of a foreign government;

[ ] Offeror is an agency or instrumentality of the Federal Government.

(e) Type of organization.

[ ] Sole proprietorship;

[ ] Partnership;

[ ] Corporate entity (not tax-exempt);

[ ] Corporate entity (tax-exempt);

[ ] Government entity (Federal, State, or local);

[ ] Foreign government;

[ ] International organization per 26 CFR 1.6049-4;

[ ] Other _____.

(f) Common parent.

[ ] Offeror is not owned or controlled by a common parent as defined in paragraph (a) of this provision.

[ ] Name and TIN of common parent:

Name _____

TIN _____

(End of provision)

4. (FAR 52.204-5) WOMEN-OWNED BUSINESS (OTHER THAN SMALL BUSINESS) [MAY 1999]

(a) *Definition*. Women-owned business concern, as used in this provision, means a concern that is

at least 51 percent owned by one or more women; or in the case of any publicly owned business, at least 51 percent of its stock is owned by one or more women; and whose management and daily business operations are controlled by one or more women.

(b) *Representation. [Complete only if the offeror is a women-owned business concern and has not represented itself as a small business concern in paragraph (b)(1) of FAR 52.219–1, Small Business Program Representations, of this solicitation.]* The offeror represents that it [ ] is a women-owned business concern.
(End of provision)

5. (DFARS 252.204-7001) COMMERCIAL AND GOVERNMENT ENTITY (CAGE) CODE REPORTING (AUG 1999).

(a) The offeror is requested to enter its CAGE code on its offer in the block with its name and address. The CAGE code entered must be for that name and address. Enter "CAGE" before the number.

(b) If the offeror does not have a CAGE code, it may ask the Contracting Officer to request one from the Defense Logistics Information Service (DLIS). The Contracting Officer will-

(1) Ask the Contractor to complete section B of a DD Form 2051, Request for Assignment of a Commercial and Government Entity (CAGE) Code;

(2) Complete section A and forward the form to DLIS; and

(3) Notify the Contractor of its assigned CAGE code.

(c) Do not delay submission of the offer pending receipt of a CAGE code.

6. (FAR 52.209-5) CERTIFICATION REGARDING DEBARMENT, SUSPENSION, PROPOSED DEBARMENT, AND OTHER RESPONSIBILITY MATTERS (DEC 2001).

(a)(1) The Offeror certifies, to the best of its knowledge and belief, that—
(i) The Offeror and/or any of its Principals—
(A) Are [ ] are not [ ] presently debarred, suspended, proposed for debarment, or declared ineligible for the award of contracts by any Federal agency;
(B) Have [ ] have not [ ], within a three-year period preceding this offer, been convicted of or had a civil judgment rendered against them for: commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, state, or local) contract or subcontract; violation of Federal or state antitrust statutes relating to the submission of offers; or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, tax evasion, or receiving stolen property; and
(C) Are [ ] are not [ ] presently indicted for, or otherwise criminally or civilly charged by a governmental entity with, commission of any of the offenses enumerated in paragraph (a)(1)(i)(B) of this provision.
(ii) The Offeror has [ ] has not [ ], within a three-year period preceding this offer, had one or more contracts terminated for default by any Federal agency.
(2) "Principals," for the purposes of this certification, means officers; directors; owners; partners; and, persons having primary management or supervisory responsibilities within a business entity *(e.*g., general manager; plant manager; head of a subsidiary, division, or business segment, and similar positions).

This Certification Concerns a Matter Within the Jurisdiction of an Agency of the United States and the Making of a False, Fictitious, or Fraudulent Certification May Render the Maker Subject

to Prosecution Under Section 1001, Title 18, United States Code.

(b) The Offeror shall provide immediate written notice to the Contracting Officer if, at any time prior to contract award, the Offeror learns that its certification was erroneous when submitted or has become erroneous by reason of changed circumstances.

(c) A certification that any of the items in paragraph (a) of this provision exists will not necessarily result in withholding of an award under this solicitation. However, the certification will be considered in connection with a determination of the Offeror's responsibility. Failure of the Offeror to furnish a certification or provide such additional information as requested by the Contracting Officer may render the Offeror nonresponsible.

(d) Nothing contained in the foregoing shall be construed to require establishment of a system of records in order to render, in good faith, the certification required by paragraph (a) of this provision. The knowledge and information of an Offeror is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.

(e) The certification in paragraph (a) of this provision is a material representation of fact upon which reliance was placed when making award. If it is later determined that the Offeror knowingly rendered an erroneous certification, in addition to other remedies available to the Government, the Contracting Officer may terminate the contract resulting from this solicitation for default. (End of Provision)

7. (DFARS 252.209-7001) DISCLOSURE OF OWNERSHIP OR CONTROL BY A FOREIGN GOVERNMENT THAT SUPPORTS TERRORISM (MAR 1998). [For Contracts exceeding $100,000]

(a) Definitions.

As used in this provision-

(1) "Government of a terrorist country" includes the state and the government of a terrorist country, as well as any political subdivision, agency, or instrumentality thereof.

(2) "Terrorist country" means a country determined by the Secretary of State, under section 6(j)(1)(A)) of the Export Administration Act of 1979 (50 U.S.C. App. 2405(j)(i)(A)), to be a country the government of which has repeatedly provided support for acts of international terrorism. As of the date of this provision, terrorist countries include: Cuba, Iran, Iraq, Libya, North Korea, Sudan, and Syria.

(3) "Significant interest" means-

(i) Ownership of or beneficial interest in 5 percent or more of the firm's or subsidiary's securities. Beneficial interest includes holding 5 percent or more of any class of the firm's securities in "nominee shares," "street names," or some other method of holding securities that does not disclose the beneficial owner;

(ii) Holding a management position in the firm, such as a director or officer;

(iii) Ability to control or influence the election, appointment, or tenure of directors or officers in the firm;

(iv) Ownership of 10 percent or more of the assets of a firm such as equipment, buildings, real estate, or other tangible assets of the firm; or

(v) Holding 50 percent or more of the indebtedness of a firm.

(b) Prohibition on award. In accordance with 10 U.S.C. 2327, no contract may be awarded to a firm or a subsidiary of a firm if the government of a terrorist country has a significant interest in the firm or subsidiary [or, in the case of a subsidiary, the firm that owns the subsidiary], unless a waiver is granted by the Secretary of Defense.

(c) Disclosure.

The Offeror shall disclose any significant interest the government of each of the following countries has in the Offeror or a subsidiary of the Offeror. If the Offeror is a subsidiary, it shall also disclose any significant interest the government of a terrorist country has in any firm that owns or controls the subsidiary. The disclosure shall include--

(1) Identification of each government holding a significant interest; and
(2) A description of the significant interest held by each Government.
(End of provision)

8. (FAR 52.211-6) BRAND NAME OR EQUAL (AUG 1999).

(a) If an item in this solicitation is identified as "brand name or equal," the purchase description reflects the characteristics and level of quality that will satisfy the Government's needs. The salient physical, functional, and other characteristics that "equal" products must meet are specified in the solicitation.

(b) To be considered for award, offers of "equal" products, including "equal" products of the brand name manufacturer, must--

(1) Meet the salient physical, functional, and other characteristics specified in the solicitation;

(2) Clearly identify the item by--

(i) Brand name, if any; and

(ii) Make or model number;

(3) Include descriptive literature such as cuts, illustrations, drawings, or a clear reference to previously furnished descriptive data or information available to the Contracting Officer; and

(4) Clearly describe any modifications the offeror plans to make in a product to make it conform to the solicitation requirements. Mark any descriptive material to clearly show the modifications.

(c) The Contracting Officer will evaluate "equal" products on the basis of information by the offeror or identified in the offer and reasonably available to the Contracting Officer. The Contracting Officer is not responsible for locating or securing any information not identified in the offer.

(d) Unless the offeror clearly indicates in its offer that the product being offered is an "equal" product, the offeror shall provide the brand name product referenced in the solicitation.

9. RESERVED

10. RESERVED

11. (FAR 52.219-1) SMALL BUSINESS PROGRAM REPRESENTATIONS (MAY 2004) ALTERNATE I (APR 2002)

(a)(1) The North American Industry Classification System (NAICS) code for this acquisition is _____ [*insert NAICS code*].

(2) The small business size standard is _____ [*insert size standard*].

(3) The small business size standard for a concern which submits an offer in its own name, other than on a construction or service contract, but which proposes to furnish a product which it did not itself manufacture, is 500 employees.

(b) *Representations*. (1) The offeror represents as part of its offer that it [ ] is, [ ] is not a small

business concern.

(2) [*Complete only if the offeror represented itself as a small business concern in paragraph (b)(1) of this provision*.] The offeror represents, for general statistical purposes, that it [ ] is, [ ] is not, a small disadvantaged business concern as defined in 13 CFR 124.1002.

(3) [*Complete only if the offeror represented itself as a small business concern in paragraph (b)(1) of this provision*.] The offeror represents as part of its offer that it [ ] is, [ ] is not a women-owned small business concern.

(4) [*Complete only if the offeror represented itself as a small business concern in paragraph (b)(1) of this provision*.] The offeror represents as part of its offer that it [ ] is, [ ] is not a veteran-owned small business concern.

(5) [*Complete only if the offeror represented itself as aveteran-owned small business concern in paragraph (b)(4) of this provision*.] The offeror represents as part of its offer that it [ ] is, [ ] is not a service-disabled veteran-owned small business concern.

(6) *[Complete only if the offeror represented itself as a small business concern in paragraph (b)(1) of this provision*.] The offeror represents, as part of its offer, that—

(i) It [ ] is, [ ] is not a HUBZone small business concern listed, on the date of this representation, on the List of Qualified HUBZone Small Business Concerns maintained by the Small Business Administration, and no material change in ownership and control, principal office, or HUBZone employee percentage has occurred since it was certified by the Small Business Administration in accordance with 13 CFR part 126; and

(ii) It [ ] is, [ ] is not a joint venture that complies with the requirements of 13 CFR part 126, and the representation in paragraph (b)(6)(i) of this provision is accurate for the HUBZone small business concern or concerns that are participating in the joint venture. [*The offeror shall enter the name or names of the HUBZone small business concern or concerns that are participating in the joint venture:*_____.] Each HUBZone small business concern participating in the joint venture shall submit a separate signed copy of the HUBZone representation.

(7) [*Complete if offeror represented itself as disadvantaged in paragraph (b)(2) of this provision.*] The offeror shall check the category in which its ownership falls:

_____ Black American.
_____ Hispanic American.
_____ Native American (American Indians, Eskimos, Aleuts, or Native Hawaiians).
_____ Asian-Pacific American (persons with origins from Burma, Thailand, Malaysia, Indonesia, Singapore, Brunei, Japan, China, Taiwan, Laos, Cambodia (Kampuchea),Vietnam, Korea, The Philippines, U.S. Trust Territory of the Pacific Islands (Republic of Palau), Republic of the Marshall Islands, Federated States of Micronesia, the Commonwealth of the Northern Mariana Islands, Guam, Samoa, Macao, Hong Kong, Fiji, Tonga, Kiribati, Tuvalu, or Nauru).
_____ Subcontinent Asian (Asian-Indian) American (persons with origins from India, Pakistan, Bangladesh, Sri Lanka, Bhutan, the Maldives Islands, or Nepal).
_____ Individual/concern, other than one of the preceding.

(c) *Definitions*. As used in this provision—

"Service-disabled veteran-owned small business concern"—

(1) Means a small business concern—

(i) Not less than 51 percent of which is owned by one or more service-disabled veterans or, in the case of any publicly owned business, not less than 51 percent of the stock of which is owned by one or more service-disabled veterans; and

(ii) The management and daily business operations of which are controlled by one or more service-disabled veterans or, in the case of a service-disabled veteran with permanent and severe disability, the spouse or permanent caregiver of such veteran.

(2) Service-disabled veteran means a veteran, as defined in 38 U.S.C. 101(2), with a disability that is service connected, as defined in 38 U.S.C. 101(16).

"Small business concern" means a concern, including its affiliates, that is independently owned and operated, not dominant in the field of operation in which it is bidding on Government contracts, and qualified as a small business under the criteria in 13 CFR part 121 and the size standard in paragraph (a) of this provision.

"Veteran-owned small business concern" means a small business concern—

(1) Not less than 51 percent of which is owned by one or more veterans (as defined at 38 U.S.C. 101(2)) or, in the case of any publicly owned business, not less than 51 percent of the stock of which is owned by one or more veterans; and

(2) The management and daily business operations of which are controlled by one or more veterans.

"Women-owned small business concern" means a small business concern—

(1) That is at least 51 percent owned by one or more women; or, in the case of any publicly owned business, at least 51 percent of the stock of which is owned by one or more women; and

(2) Whose management and daily business operations are controlled by one or more women.

(d) *Notice*. (1) If this solicitation is for supplies and has been set aside, in whole or in part, for small business concerns, then the clause in this solicitation providing notice of the set-aside contains restrictions on the source of the end items to be furnished.

(2) Under 15 U.S.C. 645(d), any person who misrepresents a firm's status as a small, HUBZone small, small disadvantaged, or women-owned small business concern in order to obtain a contract to be awarded under the preference programs established pursuant to section 8(a), 8(d), 9, or 15 of the Small Business Act or any other provision of Federal law that specifically references section 8(d) for a definition of program eligibility, shall—

(i) Be punished by imposition of fine, imprisonment, or both;

(ii) Be subject to administrative remedies, including suspension and debarment; and

(iii) Be ineligible for participation in programs conducted under the authority of the Act.

(End of provision)

12. (FAR 52.219-2) <u>EQUAL LOW BIDS (OCT 1995)</u>

(a) This provision applies to small business concerns only.

(b) The bidder's status as a labor surplus area (LSA) concern may affect entitlement to award in case of tie bids. If the bidder wishes to be considered for this priority, the bidder must identify, in the following space, the LSA in which the costs to be incurred on account of manufacturing or production (by the bidder or the first-tier subcontractors) amount to more than 50 percent of the contract price.

_____ _____

_____ _____

(c) Failure to identify the labor surplus areas as specified in paragraph (b) of this provision will preclude the bidder from receiving priority consideration. If the bidder is awarded a contract as a result of receiving priority consideration under this provision and would not have otherwise received award, the bidder shall perform the contract or cause the contract to be performed in accordance with the obligations of an LSA concern.

13. RESERVED

14. (FARS 52.219-19) SMALL BUSINESS CONCERN REPRESENTATION FOR THE SMALL BUSINESS COMPETITIVENESS DEMONSTRATION PROGRAM (OCT 2000).

(a) *Definition*. "Emerging small business" as used in this solicitation, means a small business concern whose size is no greater than 50 percent of the numerical size standard applicable to the North American Industry Classification System (NAICS) code assigned to a contracting opportunity.

(b) (Complete only if Offeror has represented itself under the provision at FAR 52.219-1 as a small business concern under the size standards of this solicitation.) The Offeror [ ] is, [ ] is not an emerging small business.

(c) (Complete only if the Offeror is a small business or an emerging small business, indicating its size range.)

Offeror's number of employees for the past 12 months (check this column if size standard stated in solicitation is expressed in terms of number of employees) or Offeror's average annual gross revenue for the last 3 fiscal years (check this column if size standard stated in solicitation is expressed in terms of annual receipts). (Check one of the following.)

No. of Employees	Average Annual Gross Revenues
_____50 or fewer	_____$1 million or less
_____51 - 100	_____$1,000,001 - $2 million
_____101 - 250	_____$2,000,001 - $3.5 million
_____251 - 500	_____$3,500,001 - $5 million
_____501 - 750	_____$5,000,001 - $10 million
_____751 - 1,000	_____$10,000,001 - $17 million
_____Over 1,000	_____Over $17 million

15. (FARS 52.219-21) SMALL BUSINESS SIZE REPRESENTATION FOR TARGETED INDUSTRY CATEGORIES UNDER THE SMALL BUSINESS COMPETITIVENESS DEMONSTRATION PROGRAM (MAY 1999).

[Complete only if the Offeror has represented itself under the provision at 52.219-1 as a small business concern under the size standards of this solicitation.]

Offeror's number of employees for the past 12 months *[check this column if size standard stated in solicitation is expressed in terms of number of employees]* or Offeror's average annual gross revenue for the last 3 fiscal years [check this column if size standard in solicitation is expressed in terms of annual receipts]. *[Check one of the following.]*

No. of Employees	Average Annual Gross Revenues
_____50 or fewer	_____$1 million or less
_____51 - 100	_____$1,000,001 - $2 million
_____101 - 250	_____$2,000,001 - $3.5 million
_____251 - 500	_____$3,500,001 - $5 million
_____501 - 750	_____$5,000,001 - $10 million
_____751 - 1,000	_____$10,000,001 - $17 million
_____Over 1,000	_____Over $17 million

16. (FAR 52.222-21) CERTIFICATION OF NONSEGREGATED FACILITIES (FEB 1999)

(a) "Segregated facilities," as used in this clause, means any waiting rooms, work areas, rest rooms and wash rooms, restaurants and other eating areas, time clocks, locker rooms and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing facilities provided for employees, that are segregated by explicit directive or are in fact segregated on the basis of race, color, religion, sex, or national origin because of written or oral policies or employee custom. The term does not include separate or single-user rest rooms or necessary dressing or sleeping areas provided to assure privacy between the sexes.

(b) The Contractor agrees that it does not and will not maintain or provide for its employees any segregated facilities at any of its establishments, and that it does not and will not permit its employees to perform their services at any location under its control where segregated facilities are maintained. The Contractor agrees that a breach of this clause is a violation of the Equal Opportunity clause in this contract.

(c) The Contractor shall include this clause in every subcontract and purchase order that is subject to the Equal Opportunity clause of this contract.

(End of clause)

17. (FAR 52.222-22) PREVIOUS CONTRACTS AND COMPLIANCE REPORTS (FEB 1999).

The offeror represents that—

(a) It [ ] has, [ ] has not participated in a previous contract or subcontract subject the Equal Opportunity clause of this solicitation;

(b) It [ ] has, [ ] has not filed all required compliance reports; and

(c) Representations indicating submission of required compliance reports, signed by proposed subcontractors, will be obtained before subcontract awards.

(End of provision)

18. (FAR 52.223-4) RECOVERED MATERIAL CERTIFICATION (OCT 1997)

As required by the Resource Conservation and Recovery Act of 1976 (42 U.S.C. 6962(c)(3)(A)(i)), the offeror certifies, by signing this offer, that the percentage of recovered materials to be used in the performance of the contract will be at least the amount required by the applicable contract specifications.

(End of provision)

19. (FAR 52.223-13) CERTIFICATION OF TOXIC CHEMICAL RELEASE REPORTING (AUG 2003) [For Contracts over $100,000]

(a) Executive Order 13148, of April 21, 2000, Greening the Government through Leadership in Environmental Management, requires submission of this certification as a prerequisite for contract award.

(b) By signing this offer, the offeror certifies that—

(1) As the owner or operator of facilities that will be used in the performance of this contract that are subject to the filing and reporting requirements described in section 313 of the Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA) (42 U.S.C. 11023) and section 6607 of the Pollution Prevention Act of 1990 (PPA) (42 U.S.C. 13106), the offeror will file and continue to file for such facilities for the life of the contract the Toxic Chemical Release Inventory Form (Form R) as described in sections 313(a) and (g) of EPCRA and section 6607 of PPA; or

(2) None of its owned or operated facilities to be used in the performance of this contract is subject to the Form R filing and reporting requirements because each such facility is exempt for at least one of the following reasons: [*Chec k each block that is applicable*.]

[ ] (i) The facility does not manufacture, process, or otherwise use any toxic chemicals listed in 40 CFR 372.65;

[ ] (ii) The facility does not have 10 or more fulltime employees as specified in section 313(b)(1)(A) of EPCRA, 42 U.S.C. 11023(b)(1)(A);

[ ] (iii) The facility does not meet the reporting thresholds of toxic chemicals established under section 313(f) of EPCRA, 42 U.S.C. 11023(f) (including the alternate thresholds at 40 CFR 372.27, provided an appropriate certification form has been filed with EPA);

[ ] (iv) The facility does not fall within the following Standard Industrial Classification (SIC) codes or their corresponding North American Industry Classification System sectors:

(A) Major group code 10 (except 1011, 1081, and 1094.

(B) Major group code 12 (except 1241).

(C) Major group codes 20 through 39.

(D) Industry code 4911, 4931, or 4939 (limited to facilities that combust coal and/or oil for the purpose of generating power for distribution in commerce).

(E) Industry code 4953 (limited to facilities regulated under the Resource Conservation and Recovery Act, Subtitle C (42 U.S.C. 6921, *et seq*.), or 5169, or 5171, or 7389 (limited to facilities primarily engaged in solvent recovery services on a contract or fee basis); or

[ ] (v) The facility is not located in the United States or its outlying areas..

(End of provision)

20. (DFARS 252.225-7031) SECONDARY ARAB BOYCOTT OF ISRAEL (APR 2003)

(a) *Definitions.* As used in this provision-

(1) "Foreign person" means any person (including any individual, partnership, corporation, or other form of association) other than a United States person.

(2) "United States person" is defined in 50 U.S.C. App. 2415(2) and means-

(i) Any United States resident or national (other than an individual resident outside the United States who is employed by other than a United States person);

(ii) Any domestic concern (including any permanent domestic establishment of any foreign concern); and

(iii) Any foreign subsidiary or affiliate (including any permanent foreign establishment) of any domestic concern that is controlled in fact by such domestic concern.

(b) *Certification*. If the offeror is a foreign person, the offeror certifies, by submission of an offer, that it-

(1) Does not comply with the Secondary Arab Boycott of Israel; and

(2) Is not taking or knowingly agreeing to take any action, with respect to the Secondary Boycott of Israel by Arab countries, which 50 U.S.C. App. 2407(a) prohibits a United States person from taking.

(End of Provision)

21. (DFARS 252.247-7022) REPRESENTATION OF EXTENT OF TRANSPORTATION BY SEA (AUG 1992).

(a) The Offeror shall indicate by checking the appropriate blank in paragraph (b) of this provision whether transportation of supplies by sea is anticipated under the resultant contract. The term "supplies" is defined in the Transportation of Supplies by Sea clause of this solicitation.

(b) <u>REPRESENTATION</u>. The Offeror represents that it-

_____ Does anticipate that supplies will be transported by sea in the performance of any contract or subcontract resulting from this solicitation.

_____ Does not anticipate that supplies will be transported by sea in the performance of any contract or subcontract resulting from this solicitation.

(c) Any contract resulting from this solicitation will include the Transportation of Supplies by Sea Clause. If the Offeror represents that it will not use ocean transportation, the resulting contract will also include the Defense FAR Supplement clause at 252.247-7024, Notification of Transportation of Supplies by Sea.

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SECTION 00700

CONTRACT CLAUSES

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60. *FAR 52.225-10 NOTICE OF BUY AMERICAN ACT REQUIREMENT—CONSTRUCTION MATERIALS (MAY 2002) (Applicable with FAR 52.225-9)
61. *FAR 52.225-11 BUY AMERICAN ACT—CONSTRUCTION MATERIALS UNDER TRADE AGREEMENTS (JAN 2004) [For Contracts more than $6,481,000] ALTERNATE I (JAN 2004) [For Contracts between $6.481 and 7.304733 Million]

62. *FAR 52.225-12 NOTICE OF BUY AMERICAN ACT REQUIREMENT—CONSTRUCTION MATERIALS UNDER TRADE AGREEMENTS (JAN 2004) [Applicable with FAR 52.225-11] ALTERNATE II (JAN 2004) [For Contracts Between 6.481 and 7.344733 Million]
63. *FAR 52.225-13 RESTRICTIONS ON CERTAIN FOREIGN PURCHASES (DEC 2003)
64. DFARS 252.226-7001 UTILIZATION OF INDIAN ORGANIZATIONS, INDIAN-OWNED ECONOMIC ENTERPRISES, AND NATIVE HAWAIIAN SMALL BUSINESS CONCERNS (OCT 2003)
65. *FAR 52.227-1 AUTHORIZATION AND CONSENT (JUL 1995)
66. *FAR 52.227-2 NOTICE AND ASSISTANCE REGARDING PATENT AND COPYRIGHT INFRINGEMENT (AUG 1996)
67. *FAR 52.227-4 PATENT INDEMNITY--CONSTRUCTION CONTRACTS (APR 1984)
68. DFARS 252.227-7033 RIGHTS IN SHOP DRAWINGS (APR 1966)
69. FAR 52.228-1 BID GUARANTEE (SEP 1996) [NOTE: Not required for projects less than $100,000]
70. *FAR 52.228-2 ADDITIONAL BOND SECURITY (OCT 1997)
71. *FAR 52.228-5 INSURANCE--WORK ON A GOVERNMENT INSTALLATION (JAN 1997) [For Contracts Exceeding $100,000]
72. *FAR 52.228-11 PLEDGES OF ASSETS (FEB 1992)
73. *FAR 52.228-12 PROSPECTIVE SUBCONTRACTOR REQUESTS FOR BONDS (OCT 1995)
74. FAR 52.228-13 ALTERNATIVE PAYMENT PROTECTIONS (JULY 2000) [Applicable only for projects or delivery orders less than $100,000]
75. FAR 52.228-14 IRREVOCABLE LETTER OF CREDIT (DEC 1999)
76. FAR 52.228-15 PERFORMANCE AND PAYMENT BONDS (JULY 2000).
77. FAR 52.229-3 FEDERAL, STATE, AND LOCAL TAXES (APR 2003) [For Contracts Exceeding $100,000]
78. RESERVED
79. DFARS 252.231-7000 SUPPLEMENTAL COST PRINCIPLES (DEC 1991)
80. *FAR 52.232-5 PAYMENTS UNDER FIXED-PRICE CONSTRUCTION CONTRACTS (SEPT 2002)
81. RESERVED.
82. *FAR 52.232-17 INTEREST (JUN 1996)
83. *FAR 52.232-23 ASSIGNMENT OF CLAIMS (JAN 1986)
84. *FAR 52.232-27 PROMPT PAY FOR CONSTRUCTION CONTRACTS (OCT 2003)
85. *FAR 52.232-33 PAYMENT BY ELECTRONIC FUNDS TRANSFER –CENTRAL CONTRACTOR REGISTRATION (OCT 2003)
86. DFARS 252.232-7004 DOD PROGRESS PAYMENT RATES (OCT 2001)
87. DFARS 252.232-7005 REIMBURSEMENT OF SUBCONTRACTOR ADVANCE PAYMENTS--DOD PILOT MENTOR-PROTEGE PROGRAM (SEP 2001)
88. *FAR 52.233-1 DISPUTES (JULY 2002)
89. *FAR 52.233-3 PROTEST AFTER AWARD (AUG 1996)
90. RESERVED
91. FAR 52.236-2 DIFFERING SITE CONDITIONS (APR 1984)
92. *FAR 52.236-3 SITE INVESTIGATION AND CONDITIONS AFFECTING THE WORK (APR 1984)
93. *FAR 52.236-5 MATERIAL AND WORKMANSHIP (APR 1984)
94. RESERVED
95. *FAR 52.236-6 SUPERINTENDENCE BY THE CONTRACTOR (APR 1984)
96. FAR 52.236-7 PERMITS AND RESPONSIBILITIES (NOV 1991)
97. *FAR 52.236-8 OTHER CONTRACTS (APR 1984)
98. *FAR 52.236-9 PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES, AND IMPROVEMENTS (APR 1984)
99. *FAR 52.236-10 OPERATIONS AND STORAGE AREAS (APR 1984)
100. *FAR 52.236-11 USE AND POSSESSION PRIOR TO COMPLETION (APR 1984)
101. *FAR 52.236-12 CLEANING UP (APR 1984)
102. *FAR 52.236-13 ACCIDENT PREVENTION-ALTERNATE I (NOV 1991)
103. *FAR 52.236-14 AVAILABILITY AND USE OF UTILITY SERVICES (APR 1984)
104. FAR 52.236-15 SCHEDULES FOR CONSTRUCTION CONTRACTS (APR 1984)
105. *FAR 52.236-17 LAYOUT OF WORK (APR 1984)

106. FAR 52.236-21 SPECIFICATIONS AND DRAWINGS FOR CONSTRUCTION (FEB 1997)
107. *FAR 52.236-26 PRECONSTRUCTION CONFERENCE (FEB 1995)
108. DFARS 252.236-7000 MODIFICATION OF PROPOSALS - PRICE BREAKDOWN (DEC 1991)
109. DFARS 252.236-7008 CONTRACT PRICES - BIDDING SCHEDULES (DEC 1991)
110. *FAR 52.242-13 BANKRUPTCY (JUL 1995)
111. *FAR 52.242-14 SUSPENSION OF WORK (APR 1984)
112. FAR 52.243-4 CHANGES (AUG 1987)
113. DFARS 252.243-7001 PRICING OF CONTRACT MODIFICATIONS (DEC 1991)
114. DFARS 252.243-7002 REQUESTS FOR EQUITABLE ADJUSTMENT (MAR 1998)
115. *FAR 52.244-2 SUBCONTRACTS (AUG 1998)
116. FAR 52.244-6 SUBCONTRACTS FOR COMMERCIAL ITEMS (MAY 2004)
117. *FAR 52.245-2 GOVERNMENT PROPERTY (FIXED-PRICE CONTRACTS) (MAY 2004) [For Government Property over $100,000]
118. *FAR 52.245-4 GOVERNMENT-FURNISHED PROPERTY (SHORT FORM) (JUNE 2003) [For Government Property $100,000 or Less]
119. *FAR 52.246-12 INSPECTION OF CONSTRUCTION (AUG 1996)
120. *FAR 52.246-21 WARRANTY OF CONSTRUCTION (MAR 1994)
121. DFARS 252.247-7023 TRANSPORTATION OF SUPPLIES BY SEA (MAR 2000)
122. DFARS 252.247-7024 NOTIFICATION OF TRANSPORTATION OF SUPPLIES BY SEA (MAR 2000)
123. FAR 52.248-3 VALUE ENGINEERING--CONSTRUCTION (FEB 2000) (ALERNATE I (APR 1984)
124. *FAR 52.249-1 TERMINATION FOR CONVENIENCE OF THE GOVERNMENT (FIXED-PRICE) (SHORT FORM) (APR 1984) [For Contracts $100,000 or Less]
125. *FAR 52.249-2 TERMINATION FOR CONVENIENCE OF THE GOVERNMENT (FIXED-PRICE) (MAY 2004) ALTERNATE I (SEP 1996) [For Contracts Over $100,000]
126. *FAR 52.249-10 DEFAULT (FIXED-PRICE CONSTRUCTION) (APR 1984)
127. ENVIRONMENTAL LITIGATION (1974 NOV OCE)
128. EFARS 52.249-5000 BASIS FOR SETTLEMENT OF PROPOSALS
129. INAPPLICABLE PROVISIONS AND CLAUSES (Local Provision). [Applicable only for projects or delivery orders less than $100,000]

SECTION 00700

CONTRACT CLAUSES

1. FAR 52.252-2 CLAUSES INCORPORATED BY REFERENCE (FEB 1998)

This contract incorporates one or more clauses by reference, with the same force and effect as if they were given in full text. Upon request, the Contracting Officer will make their full text available. Also, the full text of a clause may be accessed electronically at this/these address(es):

http://www.arnet.gov/far

(End of clause)

* - CONTRACT CLAUSES THAT MAY BE INCORPORATED BY REFERENCE

2. DFARS 252.201-7000 CONTRACTING OFFICER'S REPRESENTATIVE (DEC 1991)

(a) Definition.

"Contracting officer's representative" means an individual designated in accordance with subsection 201.602-2 of the Defense Federal Acquisition Regulation Supplement and authorized in writing by the contracting officer to perform specific technical or administrative functions.

(b) If the Contracting Officer designates a contracting officer's representative (COR), the Contractor will receive a copy of the written designation. It will specify the extent of the COR's authority to act on behalf of the contracting officer. The COR is not authorized to make any commitments or changes that will affect price, quality, quantity, delivery, or any other term or condition of the contract.

(End of clause)

3. *FAR 52.202-1 DEFINITIONS (DEC 2001) ALTERNATE I (MAY 2001)

a) “Agency head” or “head of the agency” means the Secretary (Attorney General, Administrator, Governor, Chairperson, or other chief official, as appropriate) of the agency, unless otherwise indicated, including any deputy or assistant chief official of the executive agency.

(b) “Commercial component” means any component that is a commercial item.

(c) “Commercial item” means—

(1) Any item, other than real property, that is of a type customarily used by the general public or by non-governmental entities for purposes other than governmental purposes, and that—

(i) Has been sold, leased, or licensed to the general public; or

(ii) Has been offered for sale, lease, or license to the general public;

(2) Any item that evolved from an item described in paragraph (c)(1) of this clause through advances in technology or performance and that is not yet available in the commercial marketplace, but will be available in the commercial marketplace in time to satisfy the delivery requirements under a Government solicitation;

(3) Any item that would satisfy a criterion expressed in paragraphs (c)(1) or (c)(2) of this clause, but for—

(i) Modifications of a type customarily available in the commercial marketplace; or

(ii) Minor modifications of a type not customarily available in the commercial marketplace made to meet Federal Government requirements. “Minor” modifications means modifications that do not significantly alter the nongovernmental function or essential physical characteristics of an item or component, or

change the purpose of a process. Factors to be considered in determining whether a modification is minor include the value and size of the modification and the comparative value and size of the final product. Dollar values and percentages may be used as guideposts, but are not conclusive evidence that a modification is minor;

(4) Any combination of items meeting the requirements of paragraphs (c)(1), (2), (3), or (5) of this clause that are of a type customarily combined and sold in combination to the general public;

(5) Installation services, maintenance services, repair services, training services, and other services if—

(i) Such services are procured for support of an item referred to in paragraph (c)(1), (2), (3), or (4) of this definition, regardless of whether such services are provided by the same source or at the same time as the item; and

(ii) The source of such services provides similar services contemporaneously to the general public under terms and conditions similar to those offered to the Federal Government

(6) Services of a type offered and sold competitively in substantial quantities in the commercial marketplace based on established catalog or market prices for specific tasks performed under standard commercial terms and conditions. This does not include services that are sold based on hourly rates without an established catalog or market price for a specific service performed. For purposes of these services—

(i) "Catalog price" means a price included in a catalog, price list, schedule, or other form that is regularly maintained by the manufacturer or vendor, is either published or otherwise available for inspection by customers, and states prices at which sales are currently, or were last, made to a significant number of buyers constituting the general public; and

(ii) "Market prices" means current prices that are established in the course of ordinary trade between buyers and sellers free to bargain and that can be substantiated through competition or from sources independent of the offerors.

(7) Any item, combination of items, or service referred to in paragraphs (c)(1) through (c)(6), notwithstanding the fact that the item, combination of items, or service is transferred between or among separate divisions, subsidiaries, or affiliates of a Contractor; or

(8) A nondevelopmental item, if the procuring agency determines the item was developed exclusively at private expense and sold in substantial quantities, on a competitive basis, to multiple State and local Governments.

(d) "Component" means any item supplied to the Government as part of an end item or of another component, except that for use in 52.225-9, and 52.225-11 see the definitions in 52.225-9(a) and 52.225-11(a).

(e) "Contracting Officer" means a person with the authority to enter into, administer, and/or terminate contracts and make related determinations and findings. The term includes certain authorized representatives of the Contracting Officer acting within the limits of their authority as delegated by the Contracting Officer.

(f) "Nondevelopmental item" means—

(1) Any previously developed item of supply used exclusively for governmental purposes by a Federal agency, a State or local government, or a foreign government with which the United States has a mutual defense cooperation agreement;

(2) Any item described in paragraph (f)(1) of this definition that requires only minor modification or modifications of a type customarily available in the commercial marketplace in order to meet the requirements of the procuring department or agency; or

(3) Any item of supply being produced that does not meet the requirements of paragraph (f)(1) or (f)(2) solely because the item is not yet in use.

(End of clause)

4. *FAR 52.203-3 GRATUITIES (APR 1984)

(a) The right of the Contractor to proceed may be terminated by written notice if, after notice and hearing, the agency head or a designee determines that the Contractor, its agent, or another representative--

(1) Offered or gave a gratuity (e.g., an entertainment or gift) to an officer, official, or employee of the Government; and

(2) Intended, by the gratuity, to obtain a contract or favorable treatment under a contract.

(b) The facts supporting this determination may be reviewed by any court having lawful jurisdiction.

(c) If this contract is terminated under paragraph (a) above, the Government is entitled--

(1) To pursue the same remedies as in a breach of the contract; and

(2) In addition to any other damages provided by law, to exemplary damages of not less than 3 nor more than 10 times the cost incurred by the Contractor in giving gratuities to the person concerned, as determined by the agency head or a designee. (This subparagraph (c)(2) is applicable only if this contract uses money appropriated to the Department of Defense.)

(d) The rights and remedies of the Government provided in this clause shall not be exclusive and are in addition to any other rights and remedies provided by law or under this contract.

5. *FAR 52.203-5 COVENANT AGAINST CONTINGENT FEES (APR 1984)

(a) The Contractor warrants that no person or agency has been employed or retained to solicit or obtain this contract upon an agreement or understanding for a contingent fee, except a bona fide employee or agency. For breach or violation of this warranty, the Government shall have the right to annul this contract without liability or, in its discretion, to deduct from the contract price or consideration, or otherwise recover, the full amount of the contingent fee.

(b) "Bona fide agency," as used in this clause, means an established commercial or selling agency, maintained by a contractor for the purpose of securing business, that neither exerts nor proposes to exert improper influence to solicit or obtain Government contracts nor holds itself out as being able to obtain any Government contract or contracts through improper influence.

"Bona fide employee," as used in this clause, means a person, employed by a contractor and subject to the contractor's supervision and control as to time, place, and manner of performance, who neither exerts nor proposes to exert improper influence to solicit or obtain Government contracts nor holds out as being able to obtain any Government contract or contracts through improper influence.

"Contingent fee," as used in this clause, means any commission, percentage, brokerage, or other fee that is contingent upon the success that a person or concern has in securing a Government contract.

"Improper influence," as used in this clause, means any influence that induces or tends to induce a Government employee or officer to give consideration or to act regarding a Government contract on any basis other than the merits of the matter.

6. *FAR 52.203-7 ANTI-KICKBACK PROCEDURES (JUL 1995)

(a) Definitions.

"Kickback," as used in this clause, means any money, fee, commission, credit, gift, gratuity, thing of value, or compensation of any kind which is provided, directly or indirectly, to any prime Contractor, prime Contractor employee, subcontractor, or subcontractor employee for the purpose of improperly obtaining or rewarding favorable treatment in connection with a prime contract or in connection with a subcontract relating to a prime contract. "Person," as used in this clause, means a corporation, partnership, business association of any kind, trust, joint-stock company, or individual.

"Prime contract," as used in this clause, means a contract or contractual action entered into by the United States for the purpose of obtaining supplies, materials, equipment, or services of any kind.

"Prime Contractor," as used in this clause, means a person who has entered into a prime contract with the United States.

"Prime Contractor employee," as used in this clause, means any officer, partner, employee, or agent of a prime Contractor.

"Subcontract," as used in this clause, means a contract or contractual action entered into by a prime Contractor or subcontractor for the purpose of obtaining supplies, materials, equipment, or services of any kind under a prime contract.

"Subcontractor," as used in this clause, (1) means any person, other than the prime Contractor, who offers to furnish or furnishes any supplies, materials, equipment, or services of any kind under a prime contract or a

subcontract entered into in connection with such prime contract, and (2) includes any person who offers to furnish or furnishes general supplies to the prime Contractor or a higher tier subcontractor.

"Subcontractor employee," as used in this clause, means any officer, partner, employee, or agent of a subcontractor.

(b) The Anti-Kickback Act of 1986 (41 U.S.C. 51-58) (the Act), prohibits any person from--

(1) Providing or attempting to provide or offering to provide any kickback;

(2) Soliciting, accepting, or attempting to accept any kickback; or

(3) Including, directly or indirectly, the amount of any kickback in the contract price charged by a prime Contractor to the United States or in the contract price charged by a subcontractor to a prime Contractor or higher tier subcontractor.

(c) (1) The Contractor shall have in place and follow reasonable procedures designed to prevent and detect possible violations described in paragraph (b) of this clause in its own operations and direct business relationships.

(2) When the Contractor has reasonable grounds to believe that a violation described in paragraph (b) of this clause may have occurred, the Contractor shall promptly report in writing the possible violation. Such reports shall be made to the inspector general of the contracting agency, the head of the contracting agency if the agency does not have an inspector general, or the Department of Justice.

(3) The Contractor shall cooperate fully with any Federal agency investigating a possible violation described in paragraph (b) of this clause.

(4) The Contracting Officer may

(i) offset the amount of the kickback against any monies owed by the United States under the prime contract and/or

(ii) direct that the Prime Contractor withhold from sums owed a subcontractor under the prime contract the amount of the kickback. The Contracting Officer may order that monies withheld under subdivision (c)(4)(ii) of this clause be paid over to the Government unless the Government has already offset those monies under subdivision (c)(4)(i) of this clause. In either case, the Prime Contractor shall notify the Contracting Officer when the monies are withheld.

(5) The Contractor agrees to incorporate the substance of this clause, including subparagraph (c)(5) but excepting subparagraph (c)(1), in all subcontracts under this contract which exceed $100,000.

7. *FAR 52.203-8 CANCELLATION, RESCISSION, AND RECOVERY OF FUNDS FOR ILLEGAL OR IMPROPER ACTIVITY (JAN 1997)

(a) If the Government receives information that a contractor or a person has engaged in conduct constituting a violation of subsection (a), (b), (c), or (d) of Section 27 of the Office of Federal Procurement Policy Act (41 U.S.C. 423) (the Act), as amended by section 4304 of the National Defense Authorization Act for Fiscal Year 1996 (Pub. L. 104-106), the Government may--

(1) Cancel the solicitation, if the contract has not yet been awarded or issued; or

(2) Rescind the contract with respect to which--

(i) The Contractor or someone acting for the Contractor has been convicted for an offense where the conduct constitutes a violation of subsection 27 (a) or (b) of the Act for the purpose of either--

(A) Exchanging the information covered by such subsections for anything of value; or

(B) Obtaining or giving anyone a competitive advantage in the award of a Federal agency procurement contract; or

(ii) The head of the contracting activity has determined, based upon a preponderance of the evidence, that the Contractor or someone acting for the Contractor has engaged in conduct constituting an offense punishable under subsection 27(e)(1) of the Act.

(b) If the Government rescinds the contract under paragraph (a) of this clause, the Government is entitled to recover, in addition to any penalty prescribed by law, the amount expended under the contract.

(c) The rights and remedies of the Government specified herein are not exclusive, and are in addition to any other rights and remedies provided by law, regulation, or under this contract.

8. DFARS 252.203-7001 PROHIBITION ON PERSONS CONVICTED OF FRAUD OR OTHER DEFENSE—CONTRACT-RELATED FELONIES (MARCH 1999)

(a) Definitions.

As used in this clause--

(1) "Arising out of a contract with the "DoD" means any any act in connection with--

(i) Attempting to obtain;

(ii) Obtaining; or

(iii) Performing a contract or first-tier subcontract of any department, or component of the Department of Defense (DoD).

(2) "Conviction of fraud or any other felony," means any conviction for fraud or a felony in violation of state or Federal criminal statutes, whether entered on a verdict or plea, including a plea of nolo contendere, for which sentence has been imposed.

(3) "Date of conviction," means the date judgement was entered against the individual.

(b) Any individual who is convicted after September 29, 1988 of fraud or any other felony arising out of a contract with the DoD is prohibited from serving--

(1) In a management or supervisory capacity on any DoD contract or first-tier subcontract;

(2) On board of directors of any DoD Contractor or first-tier subcontractor;

(3) As a consultant to any DoD Contractor or first-tier subcontractor; or

(4) In any other capacity with the authority to influence, advise, or control the decisions of any DoD contractor or subcontractor with regard to any DoD contract or first-tier subcontract.

(c) Unless waived, the prohibition in paragraph (b) of this clause applies for not less than five years from the date of conviction.

(d) 10 U.S.C. 2408 provides that a defense Contractor or first-tier subcontractor shall be subject to a criminal penalty of not more than $500,000 if convicted of knowingly--

(1) Employing a person under a prohibition in paragraph (b) of this clause;

(2) Allowing such a person to serve on the board of directors of Contractor or first-tier subcontractor.

(e) In addition to the criminal penalties contained in 10 U.S.C. 2408, the Government may consider other available remedies, such as--

(1) Suspension or debarment;

(2) Cancellation of the contract at no cost to the Government; or

(3) Termination of the contract for default.

(f) The Contractor may submit written requests for waiver of the prohibition in paragraph (b) of this clause to the Contracting Officer. Requests shall clearly identify--

(1) The person involved;

(2) The nature of the conviction and resultant sentence or punishment imposed;

(3) The reasons for the requested waiver; and

(4) An explanation of why a waiver is in the interest of national security.

(g) The Contractor agrees to include the substance of this clause appropriately modified to reflect the identity and relationship of the parties, in all first-tier subcontracts exceeding the simplified acquisition threshold in Part 2 of the Federal Acquisition Regulation, except those for commercial items or components.

(h) Pursuant to 10 U.S.C.2408(c), defense contractors and subcontractors may obtain information as to whether a particular has been convicted of fraud or any other felony arising out of a contract with the DoD by contracting The Office of Justice Programs, The Denial of Federal Benefits Office, U.S. Department of Justice, telephone (202) 616-3507.

9. DFARS 252.203-7002 DISPLAY OF DOD HOTLINE POSTER (DEC 1991) (<u>For Military Contracts Exceeding $5,000,000</u>)

(a) The Contractor shall display prominently in common work areas within business segments performing work under Department of Defense (DoD) contracts, DoD Hotline Posters prepared by DoD Office of the Inspector General.

(b) DoD Hotline Posters may be obtained from the DoD Inspector General, ATTN: Defense Hotline, 400 Army Navy Drive, Washington DC 22202-2884.

(c) The Contract need not comply with paragraph (a) of this clause if it has established a mechanism, such as a hotline, by which employees may report suspected instances of improper conduct, and instructions that encourage employees to make such reports.

10. *FAR 52.203-10 PRICE OR FEE ADJUSTMENT FOR ILLEGAL OR IMPROPER ACTIVITY (JAN 1997)

(a) The Government, at its election, may reduce the price of a fixed-price type contract and the total cost and fee under a cost-type contract of profit or fee determined as set forth in paragraph (b) of this clause if the head of the contracting activity or designee determines that there was a violation of subsection 27(a), (b), or (c) of the Office of Federal Procurement Policy Act, as amended (41 U.S.C. 423), as implemented in section 3.104 of the Federal Acquisition Regulation.

(b) The price or fee reduction referred to in paragraph (a) of this clause shall be--

(1) For cost-plus-fixed-fee contracts, the amount of the fee specified in the contract at the time of award;

(2) For cost-plus-incentive-fee contracts, the target fee specified in the contract at the time of award, notwithstanding any minimum fee or "fee floor" specified in the contract;

(3) For cost-plus-award-fee contracts--

(i) The base fee established in the contract at the time of contract award;

(ii) If no base fee is specified in the contract, 30 percent of the amount of each award fee otherwise payable to the Contractor for each award fee evaluation period or at each award fee determination point.

(4) For fixed-price-incentive contracts, the Government may--

(i) Reduce the contract target price and contract target profit both by an amount equal to the initial target profit specified in the contract at the time of contract award; or

(ii) If an immediate adjustment to the contract target price and contract target profit would have a significant adverse impact on the incentive price revision relationship under the contract, or adversely affect the contract financing provisions, the Contracting Officer may defer such adjustment until establishment of the total final price of the contract. The total final price established in accordance with the incentive price revision provisions of the contract shall be reduced by an amount equal to the initial target profit specified in the contract at the time of contract award and such reduced price shall be the total final contract price.

(5) For firm-fixed-price contracts, by 10 percent of the initial contract price or a profit amount determined by the Contracting Officer from records or documents in existence prior to the date of the contract award.

(c) The Government may, at its election, reduce a prime contractor's price or fee in accordance with the procedures of paragraph (b) of this clause for violations of the Act by its subcontractors by an amount not to exceed the amount of profit or fee reflected in the subcontract at the time the subcontract was first definitively priced.

(d) In addition to the remedies in paragraphs (a) and (c) of this clause, the Government may terminate this contract for default. The rights and remedies of the Government specified herein are not exclusive, and are in addition to any other rights and remedies provided by law or under this contract.

11. *FAR 52.203-12 LIMITATION ON PAYMENTS TO INFLUENCE CERTAIN FEDERAL TRANSACTIONS (JUNE 2003)

(a) Definitions.

"Agency," as used in this clause, means executive agency as defined in 2.101.

"Covered Federal Action," as used in this clause, means any of the following Federal actions:

(1) The awarding of any Federal contract.

(2) The making of any Federal grant.

(3) The making of any Federal loan.

(4) The entering into of any cooperative agreement.

(5) The extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

"Indian tribe" and "tribal organization," as used in this clause, have the meaning provided in section 4 of the Indian Self-Determination and Education Assistance Act (25 U.S.C. 450B) and include Alaskan Natives.

"Influencing or attempting to influence," as used in this clause, means making, with the intent to influence, any communication to or appearance before an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with any covered Federal action.

"Local government," as used in this clause, means a unit of government in a State and, if chartered, established, or otherwise recognized by a State for the performance of a governmental duty, including a local public authority, a special district, an intrastate district, a council of governments, a sponsor group representative organization, and any other instrumentality of a local government.

"Officer or employee of an agency," as used in this clause, includes the following individuals who are employed by an agency:

(1) An individual who is appointed to a position in the Government under title 5, United States Code, including a position under a temporary appointment.

(2) A member of the uniformed services, as defined in subsection 101(3), title 37, United States Code.

(3) A special Government employee, as defined in section 202, title 18, United States Code.

(4) An individual who is a member of a Federal advisory committee, as defined by the Federal Advisory Committee Act, title 5, United States Code, appendix 2.

"Person," as used in this clause, means an individual, corporation, company, association, authority, firm, partnership, society, State and local government, regardless of whether such entity is operated for profit, or not for profit. This term excludes an Indian tribe, tribal organization, or any other Indian organization with respect to expenditures specifically permitted by other Federal law.

"Reasonable compensation," as used in this clause, means, with respect to a regularly employed officer or employee of any person, compensation that is consistent with the normal compensation for such officer or employee for work that is not furnished to, not funded by, or not furnished in cooperation with the Federal Government.

"Reasonable payment," as used in this clause, means, with respect to professional and other technical services, a payment in an amount that is consistent with the amount normally paid for such services in the private sector.

"Recipient," as used in this clause, includes the Contractor and all subcontractors. This term excludes an Indian tribe, tribal organization, or any other Indian organization with respect to expenditures specifically permitted by other Federal law.

"Regularly employed," as used in this clause, means, with respect to an officer or employee of a person requesting or receiving a Federal contract, an officer or employee who is employed by such person for at least 130 working days within 1 year immediately preceding the date of the submission that initiates agency consideration of such person for receipt of such contract. An officer or employee who is employed by such person for less than 130 working days within 1 year immediately preceding the date of the submission that initiates agency consideration of such person shall be considered to be regularly employed as soon as he or she is employed by such person for 130 working days.

"State," as used in this clause, means a State of the United States, the District of Columbia, or an outlying area of the United States, an agency or instrumentality of a State, and multi-State, regional, or interstate entity having governmental duties and powers.

(b) Prohibitions.

(1) Section 1352 of title 31, United States Code, among other things, prohibits a recipient of a Federal Contract, grant, loan, or cooperative agreement from using appropriated funds to pay any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with any of the following covered Federal actions: The awarding of any Federal contract; the making of any Federal grant; the making of any Federal loan; the entering into of any cooperative agreement; or the modification of any Federal contract, grant, loan, or cooperative agreement.

(2) The Act also requires Contractors to furnish a disclosure if any funds other than Federal appropriated funds (including profit or fee received under a covered Federal transaction) have been paid, or will be paid, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with a Federal contract, grant, loan, or cooperative agreement.

(3) The prohibitions of the Act do not apply under the following conditions:

(i) Agency and legislative liaison by own employees.

(A) The prohibition on the use of appropriated funds, in subparagraph (b)(1) of this clause, does not apply in the case of a payment of reasonable compensation made to an officer or employee of a person requesting or receiving a covered Federal action if the payment is for agency and legislative liaison activities not directly related to a covered Federal action.

(B) For purposes of subdivision (b)(3)(i)(A) of this clause, providing any information specifically requested by an agency or Congress is permitted at any time.

(C) The following agency and legislative liaison activities are permitted at any time where they are not related to a specific solicitation for any covered Federal action:

(1) Discussing with an agency the qualities and characteristics (including individual demonstrations) of the person's products or services, conditions or terms of sale, and service capabilities.

(2) Technical discussions and other activities regarding the application or adaptation of the person's products or services for an agency's use.

(D) The following agency and legislative liaison activities are permitted where they are prior to formal solicitation of any covered Federal action--

(1) Providing any information not specifically requested but necessary for an agency to make an informed decision about initiation of a covered Federal action;

(2) Technical discussions regarding the preparation of an unsolicited proposal prior to its official submission; and

(3) Capability presentations by persons seeking awards from an agency pursuant to the provisions of the Small Business Act, as amended by Pub. L. 95-507, and subsequent amendments.

(E) Only those services expressly authorized by subdivision (b)(3)(i)(A) of this clause are permitted under this clause.

(ii) Professional and technical services.

(A) The prohibition on the use of appropriated funds, in subparagraph (b)(1) of this clause, does not apply in the case of--

(1) A payment of reasonable compensation made to an officer or employee f a person requesting or receiving a covered Federal action or an extension, continuation, renewal, amendment, or modification of a covered Federal action, if payment is for professional or technical services rendered directly in the preparation, submission, or negotiation of any bid, proposal, or application for that Federal action or for meeting requirements imposed by or pursuant to law as a condition for receiving that Federal action.

(2) Any reasonable payment to a person, other than an officer or employee of a person requesting or receiving a covered Federal action or an extension, continuation, renewal, amendment, or modification of a covered Federal action if the payment is for professional or technical services rendered directly in the preparation, submission, or negotiation of any bid, proposal, or application for that Federal action or for meeting requirements imposed by or pursuant to law as a condition for receiving that Federal action. Persons other than officers or employees of a person requesting or receiving a covered Federal action include consultants and trade associations.

(B) For purposes of subdivision (b)(3)(ii)(A) of this clause, "professional and technical services" shall be limited to advice and analysis directly applying any professional or technical discipline. For example, drafting of a legal document accompanying a bid or proposal by a lawyer is allowable. Similarly, technical advice provided by an engineer on the performance or operational capability of a piece of equipment rendered directly in the negotiation of a contract is allowable. However, communications with the intent to influence made by a professional (such as a licensed lawyer) or a technical person (such as a licensed accountant) are not allowable under this section unless they provide advice and analysis directly applying their professional or technical expertise and unless the advice or analysis is rendered directly and solely in the preparation, submission or

negotiation of a covered Federal action. Thus, for example, communications with the intent to influence made by a lawyer that do not provide legal advice or analysis directly and solely related to the legal aspects of his or her client's proposal, but generally advocate one proposal over another are not allowable under this section because the lawyer is not providing professional legal services. Similarly, communications with the intent to influence made by an engineer providing an engineering analysis prior to the preparation or submission of a bid or proposal are not allowable under this section since the engineer is providing technical services but not directly in the preparation, submission or negotiation of a covered Federal action.

(C) Requirements imposed by or pursuant to law as a condition for receiving a covered Federal award include those required by law or regulation and any other requirements in the actual award documents.

(D) Only those services expressly authorized by subdivisions (b)(3)(ii)(A)(1) and (2) of this clause are permitted under this clause.

(E) The reporting requirements of FAR 3.803(a) shall not apply with respect to payments of reasonable compensation made to regularly employed officers or employees of a person.

(iii) Disclosure.

(A) The Contractor who requests or receives from an agency a Federal contract shall file with that agency a disclosure form, OMB standard form LLL, Disclosure of Lobbying Activities, if such person has made or has agreed to make any payment using nonappropriated funds (to include profits from any covered Federal action), which would be prohibited under subparagraph (b)(1) of this clause, if paid for with appropriated funds.

(B) The Contractor shall file a disclosure form at the end of each calendar quarter in which there occurs any event that materially affects the accuracy of the information contained in any disclosure form previously filed by such person under subparagraph (c)(1) of this clause. An event that materially affects the accuracy of the information reported includes--

(1) A cumulative increase of $25,000 or more in the amount paid or expected to be paid for influencing or attempting to influence a covered Federal action; or

(2) A change in the person(s) or individual(s) influencing or attempting to influence a covered Federal action; or

(3) A change in the officer(s), employee(s), or Member(s) contacted to influence or attempt to influence a covered Federal action.

(C) The Contractor shall require the submittal of a certification, and if required, a disclosure form by any person who requests or receives any subcontract exceeding $100,000 under the Federal contract.

(D) All subcontractor disclosure forms (but not certifications) shall be forwarded from tier to tier until received by the prime Contractor. The prime Contractor shall submit all disclosures to the Contracting Officer at the end of the calendar quarter in which the disclosure form is submitted by the subcontractor. Each subcontractor certification shall be retained in the subcontract file of the awarding Contractor.

(iv) Agreement. The Contractor agrees not to make any payment prohibited by this clause.

(v) Penalties.

(A) Any person who makes an expenditure prohibited under paragraph (a) of this clause or who fails to file or amend the disclosure form to be filed or amended by paragraph (b) of this clause shall be subject to civil penalties as provided for by 31 U.S.C. 1352. An imposition of a civil penalty does not prevent the Government from seeking any other remedy that may be applicable.

(B) Contractors may rely without liability on the representation made by their subcontractors in the certification and disclosure form.

(vi) Cost allowability. Nothing in this clause makes allowable or reasonable any costs which would otherwise be unallowable or unreasonable. Conversely, costs made specifically unallowable by the requirements in this clause will not be made allowable under any other provision.

12. *FAR 52.204-4 PRINTED OR COPIED DOUBLE-SIDED ON RECYCLED PAPER (AUG 2000)

(a) Definitions. As used in this clause—

"Postconsumer material" means a material or finished product that has served its intended use and has been discarded for disposal or recovery, having completed its life as a consumer item. Postconsumer material is a part of the broader category of "recovered material." For paper and paper products, postconsumer material means "postconsumer fiber" defined by the U.S. Environmental Protection Agency (EPA) as—

(1) Paper, paperboard, and fibrous materials from retail stores, office buildings, homes, and so forth, after they have passed through their end-usage as a consumer item, including: used corrugated boxes; old newspapers; old magazines; mixed waste paper; tabulating cards; and used cordage; or

(2) All paper, paperboard, and fibrous materials that enter and are collected from municipal solid waste; but not

(3) Fiber derived from printers' over-runs, converters' scrap, and over-issue publications.

"Printed or copied double-sided" means printing or reproducing a document so that information is on both sides of a sheet of paper.

"Recovered material," for paper and paper products, is defined by EPA in its Comprehensive Procurement Guideline as "recovered fiber" and means the following materials:

(1) Postconsumer fiber; and

(2) Manufacturing wastes such as—

(i) Dry paper and paperboard waste generated after completion of the papermaking process (that is, those manufacturing operations up to and including the cutting and trimming of the paper machine reel into smaller rolls or rough sheets) including: envelope cuttings, bindery trimmings, and other paper and paperboard waste resulting from printing, cutting, forming, and other converting operations; bag, box, and carton manufacturing wastes; and butt rolls, mill wrappers, and rejected unused stock; and

(ii) Repulped finished paper and paperboard from obsolete inventories of paper and paperboard manufacturers, merchants, wholesalers, dealers, printers, converters, or others.

(b) In accordance with Section 101 of Executive Order 13101 of September 14, 1998, Greening the Government through Waste Prevention, Recycling, and Federal Acquisition, the Contractor is encouraged to submit paper documents, such as offers, letters, or reports, that are printed or copied double-sided on recycled paper that meet minimum content standards specified in Section 505 of Executive Order 13101, when not using electronic commerce methods to submit information or data to the Government.

(c) If the Contractor cannot purchase high-speed copier paper, offset paper, forms bond, computer printout paper, carbonless paper, file folders, white wove envelopes, writing and office paper, book paper, cotton fiber paper, and cover stock meeting the 30 percent postconsumer material standard for use in submitting paper documents to the Government, it should use paper containing no less than 20 percent postconsumer material. This lesser standard should be used only when paper meeting the 30 percent postconsumer material standard is not obtainable at a reasonable price or does not meet reasonable performance standards.

(End of clause)

13. *FAR 52.204-7 CENTRAL CONTRACTOR REGISTRATION (OCT 2003)

(a) Definitions. As used in this clause—

"Central Contractor Registration (CCR) database" means the primary Government repository for Contractor information required for the conduct of business with the Government.

"Data Universal Numbering System (DUNS) number" means the 9-digit number assigned by Dun and Bradstreet, Inc. (D&B) to identify unique business entities.

"Data Universal Numbering System +4 (DUNS+4) number" means the DUNS number assigned by D&B plus a 4-character suffix that may be assigned by a business concern. (D&B has no affiliation with this 4-character suffix.) This 4-character suffix may be assigned at the discretion of the business concern to establish additional CCR records for identifying alternative Electronic Funds Transfer (EFT) accounts (see the FAR at Subpart 32.11) for the same parent concern.

"Registered in the CCR database" means that—

(1) The Contractor has entered all mandatory information, including the DUNS number or the DUNS+4 number, into the CCR database; and

(2) The Government has validated all mandatory data fields and has marked the record "Active".

(b)(1) By submission of an offer, the offeror acknowledges the requirement that a prospective awardee shall be registered in the CCR database prior to award, during performance, and through final payment of any contract, basic agreement, basic ordering agreement, or blanket purchasing agreement resulting from this solicitation.

(2) The offeror shall enter, in the block with its name and address on the cover page of its offer, the annotation "DUNS" or "DUNS +4" followed by the DUNS or DUNS +4 number that identifies the offeror's name and address exactly as stated in the offer. The DUNS number will be used by the Contracting Officer to verify that the offeror is registered in the CCR database.

(c) If the offeror does not have a DUNS number, it should contact Dun and Bradstreet directly to obtain one.

(1) An offeror may obtain a DUNS number—

(i) If located within the United States, by calling Dun and Bradstreet at 1-866-705-5711 or via the Internet at *http://www.dnb.com*; or

(ii) If located outside the United States, by contacting the local Dun and Bradstreet office.

(2) The offeror should be prepared to provide the following information:

(i) Company legal business.

(ii) Tradestyle, doing business, or other name by which your entity is commonly recognized.

(iii) Company Physical Street Address, City, State, and Zip Code.

(iv) Company Mailing Address, City, State and Zip Code (if separate from physical).

(v) Company Telephone Number.

(vi) Date the company was started.

(vii) Number of employees at your location.

(viii) Chief executive officer/key manager.

(ix) Line of business (industry).

(x) Company Headquarters name and address (reporting relationship within your entity).

(d) If the Offeror does not become registered in the CCR database in the time prescribed by the Contracting Officer, the Contracting Officer will proceed to award to the next otherwise successful registered Offeror.

(e) Processing time, which normally takes 48 hours, should be taken into consideration when registering. Offerors who are not registered should consider applying for registration immediately upon receipt of this solicitation.

(f) The Contractor is responsible for the accuracy and completeness of the data within the CCR database, and for any liability resulting from the Government's reliance on inaccurate or incomplete data. To remain registered in the CCR database after the initial registration, the Contractor is required to review and update on an annual basis from the date of initial registration or subsequent updates its information in the CCR database to ensure it is current, accurate and complete. Updating information in the CCR does not alter the terms and conditions of this contract and is not a substitute for a properly executed contractual document.

(g) (1) (i) If a Contractor has legally changed its business name, "doing business as" name, or division name (whichever is shown on the contract), or has transferred the assets used in performing the contract, but has not completed the necessary requirements regarding novation and change-of name agreements in Subpart 42.12, the Contractor shall provide the responsible Contracting Officer a minimum of one business day's written notification of

its intention to (A) change the name in the CCR database; (B) comply with the requirements of Subpart 42.12 of the FAR; and (C) agree in writing to the timeline and procedures specified by the responsible Contracting Officer. The Contractor must provide with the notification sufficient documentation to support the legally changed name.

(ii) If the Contractor fails to comply with the requirements of paragraph (g)(1)(i) of this clause, or fails to perform the agreement at paragraph (g)(1)(i)(C) of this clause, and, in the absence of a properly executed novation or change-of name agreement, the CCR information that shows the Contractor to be other than the Contractor indicated in the contract will be considered to be incorrect information within the meaning of the "Suspension of Payment" paragraph of the electronic funds transfer (EFT) clause of this contract.

(2) The Contractor shall not change the name or address for EFT payments or manual payments, as appropriate, in the CCR record to reflect an assignee for the purpose of assignment of claims (see FAR Subpart 32.8, Assignment of Claims). Assignees shall be separately registered in the CCR database. Information provided to the Contractor's CCR record that indicates payments, including those made by EFT, to an ultimate recipient other than that Contractor will be considered to be incorrect information within the meaning of the "Suspension of payment" paragraph of the EFT clause of this contract.

(h) Offerors and Contractors may obtain information on registration and annual confirmation requirements via the internet at *http://www.ccr.gov* or by calling 1-888-227-2423, or 269-961-5757.
(End of clause)

14. DFARS 252.204-7003 CONTROL OF GOVERNMENT PERSONNEL WORK PRODUCT (APR 1992)

The Contractor's procedures for protecting against unauthorized disclosure of information shall not require Department of Defense employees or members of the Armed Forces to relinquish control of their work products, whether classified or not, to the Contractor.

15. DFARS 252.204-7004 ALTERNATE A (NOV 2003)

As prescribed in 204.1104, substitute the following paragraph (a) for paragraph (a) of the clause at FAR 52.204-7:

(a) *Definitions*. As used in this clause--

"Central Contractor Registration (CCR) database" means the primary Government repository for contractor information required for the conduct of business with the Government.

"Commercial and Government Entity (CAGE) code" means-

(1) A code assigned by the Defense Logistics Information Service (DLIS) to identify a commercial or Government entity; or

(2) A code assigned by a member of the North Atlantic Treaty Organization that DLIS records and maintains in the CAGE master file. This type of code is known as an "NCAGE code."

"Data Universal Numbering System (DUNS) number" means the 9-digit number assigned by Dun and Bradstreet, Inc. (D&B) to identify unique business entities.

"Data Universal Numbering System +4 (DUNS+4) number" means the DUNS number assigned by D&B plus a 4-character suffix that may be assigned by a business concern. (D&B has no affiliation with this 4-character suffix.) This 4-character suffix may be assigned at the discretion of the business concern to establish additional CCR records for identifying alternative Electronic Funds Transfer (EFT) accounts (see Subpart 32.11 of the Federal Acquisition Regulation) for the same parent concern.

"Registered in the CCR database" means that-

(1) The Contractor has entered all mandatory information, including the DUNS number or the

DUNS+4 number, into the CCR database;

(2) The Contractor's CAGE code is in the CCR database; and

(3) The Government has validated all mandatory data fields and has marked the records "Active."

16. *FAR 52.209-6 PROTECTING THE GOVERNMENTS INTEREST WHEN SUBCONTRACTING WITH CONTRACTORS DEBARRED, SUSPENDED, OR PROPOSED FOR DEBARMENT (JUL 1995)

(a) The Government suspends or debars Contractors to protect the Government's interests. The Contractor shall not enter into any subcontract in excess of $25,000 with a Contractor that is debarred, suspended, or proposed for debarment unless there is a compelling reason to do so.

(b) The Contractor shall require each proposed first-tier subcontractor, whose subcontract will exceed $25,000, to disclose to the Contractor, in writing, whether as of the time of award of the subcontract, the subcontractor, or its principals, is or is not debarred, suspended, or proposed for debarment by the Federal Government.

(c) A corporate office or a designee of the Contractor shall notify the Contracting Officer, in writing, before entering into a subcontract with a party that is debarred, suspended, or proposed for debarment (see FAR 9.404 for information on the List of Parties Excluded from Procurement Programs). The notice must include the following:

(1) The name of the subcontractor.

(2) The Contractor's knowledge of the reasons for the subcontractor being on the List of Parties Excluded from Procurement Programs.

(3) The compelling reason(s) for doing business with the subcontractor notwithstanding its inclusion on the List of Parties Excluded From Procurement Programs.

(4) The systems and procedures the Contractor has established to ensure that it is fully protecting the Government's interests when dealing with such subcontractor in view of the specific basis for the party's debarment, suspension, or proposed debarment.

17. DFARS 252.209-7004 SUBCONTRACTING WITH FIRMS THAT ARE OWNED OR CONTROLLED BY THE GOVERNMENT OF A TERRORIST COUNTRY (MAR 1998)

(a) Unless the Government determines that there is a compelling reason to do so, the Contractor shall not enter into any subcontract in excess of $25,000 with a firm, or a subsidiary of a firm, that is identified, on the List of Parties Excluded from Federal Procurement and Nonprocurement Programs, as being ineligible for the award of Defense contracts or subcontracts because it is owned or controlled by the government of a terrorist country.

(b) A corporate officer or a designee of the Contractor shall notify the Contracting Officer, in writing, before entering into a subcontract with a party that is identified, on the List of Parties Excluded from Federal Procurement and Nonprocurement Programs, as being ineligible for the award of Defense contracts or subcontracts because it is owned or controlled by the government of a terrorist country. The notice must include the name of the proposed subcontractor and the compelling reason(s) for doing business with the subcontractor notwithstanding its inclusion on the List of Parties Excluded From Federal Procurement and Nonprocurement Programs.

(End of clause)

18. *FAR 52.211-15 DEFENSE PRIORITY AND ALLOCATION REQUIREMENTS (SEP 1990) [<u>For Military Contract's Only</u>]

This is a rated order certified for national defense use, and the Contractor shall follow all the requirements of the Defense Priorities and Allocations System regulation (15 CFR 700).

19. FAR 52.211-18 VARIATION IN ESTIMATED QUANTITY (APR 1984)

If the quantity of a unit-priced item in this contract is an estimated quantity and the actual quantity of the unit-priced item varies more than 15 percent above or below the estimated quantity, an equitable adjustment in the contract price shall be made upon demand of either party. The equitable adjustment shall be based upon any increase or decrease in costs due solely to the variation above 115 percent or below 85 percent of the estimated quantity. If the quantity variation is such as to cause an increase in the time necessary for completion, the Contractor may request, in writing, an extension of time, to be received by the Contracting Officer within 10 days from the beginning of the delay, or within such further period as may be granted by the Contracting Officer before the date of final settlement of the contract. Upon the receipt of a written request for an extension, the Contracting Officer shall ascertain the facts and make an adjustment for extending the completion date as, in the judgement of the Contracting Officer, is justified.

20. *FAR 52.214-26 AUDIT AND RECORDS--SEALED BIDDING (OCT 1997)

(a) As used in this clause, "records" includes books, documents, accounting procedures and practices, and other data, regardless of whether such items are in written form, in the form of computer data, or in any other form.

(b) Cost or pricing data. If the Contractor has submitted cost or pricing data in connection with the pricing of any modification to this contract, the Contracting Officer or authorized representative of the Contracting Officer, in order to evaluate the accuracy, completeness, and currency of the cost or pricing data, shall have the right to examine and audit all of the Contractor's records, including computations and projections related to--

(1) The proposal for the modification;
(2) The discussions conducted on the proposal(s), including those related to negotiating;
(3) Pricing of the modification; or
(4 Performance of the modification.

(c) Comptroller General. In the case of pricing any modification, the Comptroller General of the United States, or an authorized representative, shall have the same rights as specified in paragraph (b) of this clause.

(d) Availability. The Contractor shall make available at its office at all reasonable times the materials described in paragraph (b) of this clause, for examination, audit, or reproduction, until 3 years after final payment under this contract, or for any other period specified in Subpart 4.7 of the Federal Acquisition Regulation (FAR). FAR Subpart 4.7, Contractor Records Retention, in effect on the date of this contract, is incorporated by reference in its entirety and made a part of this contract.

(1) If this contract is completely or partially terminated, the records relating to the work terminated shall be made available for 3 years after any resulting final termination settlement.

(2) Records pertaining to appeals under the Disputes clause or to litigation or the settlement of claims arising under or relating to the performance of this contract shall be made available until disposition of such appeals, litigation, or claims.

(e) The Contractor shall insert a clause containing all the provisions of this clause, including this paragraph (e), in all subcontracts expected to exceed the threshold in FAR 15.403-4(a)(1) for submission of cost or pricing data.

21. *FAR 52.214-27 PRICE REDUCTION FOR DEFECTIVE COST OR PRICING DATA—MODIFICATIONS--SEALED BIDDING (OCT 1997)

(a) This clause shall become operative only for any modification to this contract involving aggregate increases and/or decreases in costs, plus applicable profits, expected to exceed the threshold for submission of cost or pricing data at FAR 15.403-4(a)(1), except that this clause does not apply to any modification if an exception under FAR 15.403-1(b) applies.

(b) If any price, including profit, negotiated in connection with any modification under this clause, was increased by any significant amount because

(1) The Contractor or a subcontractor furnished cost or pricing data that were not complete, accurate, and current as certified in its Certificate of Current Cost or Pricing Data,

(2) a subcontractor or prospective subcontractor furnished the Contractor cost or pricing data that were not complete, accurate, and current as certified in the Contractor's Certificate of Current Cost or Pricing Data, or

(3) Any of these parties furnished data of any description that were not accurate, the price shall be reduced accordingly and the contract shall be modified to reflect the reduction. This right to a price reduction is limited to that resulting from defects in data relating to modifications for which this clause becomes operative under paragraph (a) of this clause.

(c) Any reduction in the contract price under paragraph (b) above due to defective data from a prospective subcontractor that was not subsequently awarded the subcontract shall be limited to the amount, plus applicable overhead and profit markup, by which

(1) the actual subcontract or

(2) the actual cost to the Contractor, if there was no subcontract, was less than the prospective subcontract cost estimate submitted by the Contractor; provided, that the actual subcontract price was not itself affected by defective cost or pricing data.

(d) (1) If the Contracting Officer determines under paragraph (b) of this clause that a price or cost reduction should be made, the Contractor agrees not to raise the following matters as a defense:

(i) The Contractor or subcontractor was a sole source supplier or otherwise was in a superior bargaining position and thus the price of the contract would not have been modified even if accurate, complete, and current cost or pricing data had been submitted.

(ii) The Contracting Officer should have known that the cost or pricing data in issue were defective even though the Contractor or subcontractor took no affirmative action to bring the character of the data to the attention of the Contracting Officer.

(iii) The contract was based on an agreement about the total cost of the contract and there was no agreement about the cost of each item procured under the contract.

(iv) The Contractor or subcontractor did not submit a Certificate of Current Cost or Pricing Data.

(2) (i) Except as prohibited by subdivision (d)(2)(ii) of this clause, an offset in an amount determined appropriate by the Contracting Officer based upon the facts shall be allowed against the amount of a contract price reduction if--

(A) The Contractor certifies to the Contracting Officer that, to the best of the Contractor's knowledge and belief, the Contractor is entitled to the offset in the amount requested; and

(B) The Contractor proves that the cost or pricing data were available before the date of agreement on the price of the contract (or price of the modification) and that the data were not submitted before such date.

(ii) An offset shall not be allowed if--

(A) The understated data was known by the Contractor to be understated when the Certificate of Current Cost or Pricing Data was signed; or

(B) The Government proves that the facts demonstrate that the contract price would not have increased in the amount to be offset even if the available data had been submitted before the date of agreement on price.

(e) If any reduction in the contract price under this clause reduces the price of items for which payment was made prior to the date of the modification reflecting the price reduction, the Contractor shall be liable to and shall pay the United States at the time such overpayment is repaid--

(1) Simple interest on the amount of such overpayment to be computed from the date(s) of overpayment to the Contractor to the date the Government is repaid by the Contractor at the applicable underpayment rate effective for each quarter prescribed by the Secretary of the Treasury under 26 U.S.C. 6621(a)(2); and

(2) A penalty equal to the amount of the overpayment, if the Contractor of subcontractor knowingly submitted cost or pricing data which were incomplete, inaccurate, or noncurrent.

22. *FAR 52.214-28 SUBCONTRACTOR COST OR PRICING DATA--MODIFICATIONS—SEALED BIDDING (OCT 1997)

(a) The requirements of paragraphs (b) and (c) of this clause shall--

(1) Become operative only for any modification to this contract involving aggregate increases and/or decreases in costs, plus applicable profits, expected to exceed the threshold for submission of cost or pricing data at FAR 15.403-4(a)(1); and

(2) Be limited to such modifications.

(b) Before awarding any subcontract expected to exceed the threshold for submission of cost or pricing data at FAR 15.403-4(a)(1), on the date of agreement on price or the date of award, whichever is later; or before pricing any subcontract modification involving aggregate increases and/or decreases in costs, plus applicable profits, expected to exceed the threshold for submission of cost or pricing data at FAR 15.403-4(a)(1), the Contractor shall require the subcontractor to submit cost or pricing data (actually or by specific identification in writing), unless an exception under FAR 15.403-1(b) applies.

(c) The Contractor shall require the subcontractor to certify in substantially the form prescribed in FAR subsection 15.406-2 that, to the best of its knowledge and belief, the data submitted under paragraph (b) above were accurate, complete, and current as of the date of agreement on the negotiated price of the subcontract or subcontract modification.

(d) The Contractor shall insert the substance of this clause, including this paragraph (d), in each subcontract that when entered into, exceeds the threshold for submission of cost or pricing data at FAR 15.403-4(a)(1).

(End of clause)

23. *FAR 52.219-4 NOTICE OF PRICE EVALUATION PREFERENCE FOR HUBZONE SMALL BUSINESS CONCERNS (JAN 1999)

(a) *Definition*. "HUBZone small business concern," as used in this clause, means a small business concern that appears on the List of Qualified HUBZone Small Business Concerns maintained by the Small Business Administration.

(b) *Evaluation preference*. (1) Offers will be evaluated by adding a factor of 10 percent to the price of all offers, except—

(i) Offers from HUBZone small business concerns that have not waived the evaluation preference;

(ii) Otherwise successful offers from small business concerns;

(iii) Otherwise successful offers of eligible products under the Trade Agreements Act when the dollar threshold for application of the Act is exceeded (see 25.402 of the Federal Acquisition Regulation (FAR)); and

(iv) Otherwise successful offers where application of the factor would be inconsistent with a Memorandum of Understanding or other international agreement with a foreign government.

(2) The factor of 10 percent shall be applied on a line item basis or to any group of items on which award may be made. Other evaluation factors described in the solicitation shall be applied before application of the factor.

(3) A concern that is both a HUBZone small business concern and a small disadvantaged business concern will receive the benefit of both the HUBZone small business price evaluation preference and the small disadvantaged business price evaluation adjustment (see FAR clause 52.219-23). Each applicable price evaluation preference or adjustment shall be calculated independently against an offeror's base offer. These individual preference amounts shall be added together to arrive at the total evaluated price for that offer.

(c) *Waiver of evaluation preference*. A HUBZone small business concern may elect to waive the evaluation preference, in which case the factor will be added to its offer for evaluation purposes. The agreements in paragraph

(d) of this clause do not apply if the offeror has waived the evaluation preference.

[ ] Offeror elects to waive the evaluation preference.

(d) *Agreement*. A HUBZone small business concern agrees that in the performance of the contract, in the case of a contract for—

(1) Services (except construction), at least 50 percent of the cost of personnel for contract performance will be spent for employees of the concern or employees of other HUBZone small business concerns;

(2) Supplies (other than procurement from a nonmanufacturer of such supplies), at least 50 percent of the cost of manufacturing, excluding the cost of materials, will be performed by the concern or other HUBZone small business concerns;

(3) General construction, at least 15 percent of the cost of the contract performance incurred for personnel will be will be spent on the concern's employees or the employees of other HUBZone small business concerns; or

(4) Construction by special trade contractors, at least 25 percent of the cost of the contract performance incurred for personnel will be spent on the concern's employees or the employees of other HUBZone small business concerns.

(e) A HUBZone joint venture agrees that in the performance of the contract, the applicable percentage specified in paragraph (d) of this clause will be performed by the HUBZone small business participant or participants.

(f) A HUBZone small business concern nonmanufacturer agrees to furnish in performing this contract only end items manufactured or produced by HUBZone small business manufacturer concerns. This paragraph does not apply in connection with construction or service contracts.

(End of clause)

24. *FAR 52.219-8 UTILIZATION OF SMALL BUSINESS CONCERNS (MAY 2004)

(a) It is the policy of the United States that small business concerns, veteran-owned small business concerns, service-disabled veteran-owned small business concerns, HUBZone small business concerns, small disadvantaged business concerns, and women-owned small business concerns shall have the maximum practicable opportunity to participate in performing contracts let by any Federal agency, including contracts and subcontracts for subsystems, assemblies, components, and related services for major systems. It is further the policy of the United States that its prime contractors establish procedures to ensure the timely payment of amounts due pursuant to the terms of their subcontracts with small business concerns, veteran-owned small business concerns, service-disabled veteran-owned small business concerns, HUBZone small business concerns, small disadvantaged business concerns, and women-owned small business concerns.

(b) The Contractor hereby agrees to carry out this policy in the awarding of subcontracts to the fullest extent consistent with efficient contract performance. The Contractor further agrees to cooperate in any studies or surveys as may be conducted by the United States Small Business Administration or the awarding agency of the United States as may be necessary to determine the extent of the Contractor ’s compliance with this clause.

(c) *Definitions*. As used in this contract—

“HUBZone small business concern” means a small business concern that appears on the List of Qualified HUBZone Small Business Concerns maintained by the Small Business Administration .

“Service-disabled veteran-owned small business concern ” —

(1) Means a small business concern—

(i) Not less than 51 percent of which is owned by one or more service-disabled veterans or, in the case of any publicly owned business, not less than 51 percent of the stock of which is owned by one or more service-disabled veterans; and

(ii) The management and daily business operations of which are controlled by one or more service-disabled veterans or, in the case of a service-disabled veteran with permanent and severe disability, the spouse or permanent caregiver of such veteran.

(2) Service-disabled veteran means a veteran, as defined in 38 U.S.C. 101(2), with a disability that is service-connected, as defined in 38 U.S.C. 101(16).

“Small business concern” means a small business as defined pursuant to Section 3 of the Small Business Act and relevant regulations promulgated pursuant thereto.

"Small disadvantaged business concern" means a small business concern that represents, as part of its offer that—

(1) It has received certification as a small disadvantaged business concern consistent with 13 CFR part 124, Subpart B;

(2) No material change in disadvantaged ownership and control has occurred since its certification;

(3) Where the concern is owned by one or more individuals, the net worth of each individual upon whom the certification is based does not exceed $750,000 after taking into account the applicable exclusions set forth at 13 CFR 124.104(c)(2); and

(4) It is identified, on the date of its representation, as a certified small disadvantaged business in the database maintained by the Small Business Administration (PRO-Net).

"Veteran-owned small business concern" means a small business concern—

(1) Not less than 51 percent of which is owned by one or more veterans (as defined at 38 U.S.C. 101(2)) or, in the case of any publicly owned business, not less than 51 percent of the stock of which is owned by one or more veterans; and

(2) The management and daily business operations of which are controlled by one or more veterans.

"Women-owned small business concern" means a small business concern—

(1) That is at least 51 percent owned by one or more women, or, in the case of any publicly owned business, at least 51 percent of the stock of which is owned by one or more women; and

(2) Whose management and daily business operations are controlled by one or more women.

(d) Contractors acting in good faith may rely on written representations by their subcontractors regarding their status as a small business concern, a veteran-owned small business concern, a service-disabled veteran-owned small business concern, a HUBZone small business concern, a small disadvantaged business concern, or a women-owned small business concern.

(End of clause)

25. *FAR 52.219-9 SMALL BUSINESS SUBCONTRACTING PLAN (JAN 2002) [When Contracting By Negotiations]

(a) This clause does not apply to small business concerns.

(b) *Definitions*. As used in this clause—

"Commercial item" means a product or service that satisfies the definition of commercial item in section 2.101 of the Federal Acquisition Regulation.

"Commercial plan" means a subcontracting plan (including goals) that covers the offeror's fiscal year and that applies to the entire production of commercial items sold by either the entire company or a portion thereof (*e.g.*, division, plant, or product line).

"Individual contract plan" means a subcontracting plan that covers the entire contract period (including option periods), applies to a specific contract, and has goals that are based on the offeror's planned subcontracting in support of the specific contract, except that indirect costs incurred for common or joint purposes may be allocated on a prorated basis to the contract.

"Master plan" means a subcontracting plan that contains all the required elements of an individual contract plan, except goals, and may be incorporated into individual contract plans, provided the master plan has been approved.

"Subcontract" means any agreement (other than one involving an employer-employee relationship) entered into by a Federal Government prime Contractor or subcontractor calling for supplies or services required for performance of the contract or subcontract.

(c) The offeror, upon request by the Contracting Officer, shall submit and negotiate a subcontracting plan, where applicable, that separately addresses subcontracting with small business, veteran-owned small business, service-disabled veteran-owned small business, HUBZone small business concerns, small disadvantaged business, and women-owned small business concerns. If the offeror is submitting an individual contract plan, the plan must separately address subcontracting with small business, veteran-owned small business, service-disabled veteran-owned small business, HUBZone small business, small disadvantaged business, and women-owned small business

concerns, with a separate part for the basic contract and separate parts for each option (if any). The plan shall be included in and made a part of the resultant contract. The subcontracting plan shall be negotiated within the time specified by the Contracting Officer. Failure to submit and negotiate the subcontracting plan shall make the offeror ineligible for award of a contract.

(d) The offeror's subcontracting plan shall include the following:

(1) Goals, expressed in terms of percentages of total planned subcontracting dollars, for the use of small business, veteran-owned small business, service-disabled veteran-owned small business, HUBZone small business, small disadvantaged business, and women-owned small business concerns as subcontractors. The offeror shall include all subcontracts that contribute to contract performance, and may include a proportionate share of products and services that are normally allocated as indirect costs.

(2) A statement of—

(i) Total dollars planned to be subcontracted for an individual contract plan; or the offeror's total projected sales, expressed in dollars, and the total value of projected subcontracts to support the sales for a commercial plan;

(ii) Total dollars planned to be subcontracted to small business concerns;

(iii) Total dollars planned to be subcontracted to veteran-owned small business concerns;

(iv) Total dollars planned to be subcontracted to service-disabled veteran-owned small business;

(v) Total dollars planned to be subcontracted to HUBZone small business concerns;

(vi) Total dollars planned to be subcontracted to small disadvantaged business concerns; and

(vii) Total dollars planned to be subcontracted to women-owned small business concerns.

(3) A description of the principal types of supplies and services to be subcontracted, and an identification of the types planned for subcontracting to—

(i) Small business concerns;

(ii) Veteran-owned small business concerns;

(iii) Service-disabled veteran-owned small business concerns;

(iv) HUBZone small business concerns;

(v) Small disadvantaged business concerns; and

(vi) Women-owned small business concerns.

(4) A description of the method used to develop the subcontracting goals in paragraph (d)(1) of this clause.

(5) A description of the method used to identify potential sources for solicitation purposes (*e.g.*, existing company source lists, the Procurement Marketing and Access Network (PRO-Net) of the Small Business Administration (SBA), veterans service organizations, the National Minority Purchasing Council Vendor Information Service, the Research and Information Division of the Minority Business Development Agency in the Department of Commerce, or small, HUBZone, small disadvantaged, and women-owned small business trade associations). A firm may rely on the information contained in PRO-Net as an accurate representation of a concern's size and ownership characteristics for the purposes of maintaining a small, veteran-owned small, service-disabled veteran-owned small, HUBZone small, small disadvantaged, and women-owned small business source list. Use of PRONet as its source list does not relieve a firm of its responsibilities (*e.g.*, outreach, assistance, counseling, or publicizing subcontracting opportunities) in this clause.

(6) A statement as to whether or not the offeror included indirect costs in establishing subcontracting goals, and a description of the method used to determine the proportionate share of indirect costs to be incurred with—

(i) Small business concerns;

(ii) Veteran-owned small business concerns;

(iii) Service-disabled veteran-owned small business concerns;

(iv) HUBZone small business concerns;

(v) Small disadvantaged business concerns; and

(vi) Women-owned small business concerns.

(7) The name of the individual employed by the offeror who will administer the offeror's subcontracting program, and a description of the duties of the individual.

(8) A description of the efforts the offeror will make to assure that small business, veteran-owned

small business, service-disabled veteran-owned small business, HUBZone small business, small disadvantaged business, and women-owned small business concerns have an equitable opportunity to compete for subcontracts.

(9) Assurances that the offeror will include the clause of this contract entitled "Utilization of Small Business Concerns" in all subcontracts that offer further subcontracting opportunities, and that the offeror will require all subcontractors (except small business concerns) that receive subcontracts in excess of $500,000 ($1,000,000 for construction of any public facility) to adopt a subcontracting plan that complies with the requirements of this clause.

(10) Assurances that the offeror will—

(i) Cooperate in any studies or surveys as may be required;

(ii) Submit periodic reports so that the Government can determine the extent of compliance by the offeror with the subcontracting plan;

(iii) Submit Standard Form (SF) 294, Subcontracting Report for Individual Contracts, and/or SF 295, Summary Subcontract Report, in accordance with paragraph (j) of this clause. The reports shall provide information on subcontract awards to small business concerns, veteran-owned small business concerns, service-disabled veteran-owned small business concerns, HUBZone small business concerns, small disadvantaged business concerns, women-owned small business concerns, and Historically Black Colleges and Universities and Minority Institutions. Reporting shall be in accordance with the instructions on the forms or as provided in agency regulations.

(iv) Ensure that its subcontractors agree to submit SF 294 and SF 295.

(11) A description of the types of records that will be maintained concerning procedures that have been adopted to comply with the requirements and goals in the plan, including establishing source lists; and a description of the offeror's efforts to locate small business, veteran-owned small business, service-disabled veteran-owned small business, HUBZone small business, small disadvantaged business, and women-owned small business concerns and award subcontracts to them. The records shall include at least the following (on a plant-wide or company-wide basis, unless otherwise indicated):

(i) Source lists (*e.g.*, PRO-Net), guides, and other data that identify small business, veteran-owned small business, service-disabled veteran-owned small business, HUBZone small business, small disadvantaged business, and women-owned small business concerns.

(ii) Organizations contacted in an attempt to locate sources that are small business, veteran-owned small business, service-disabled veteran-owned small business, HUBZone small business, small disadvantaged business, or women-owned small business concerns.

(iii) Records on each subcontract solicitation resulting in an award of more than $100,000, indicating—

(A) Whether small business concerns were solicited and, if not, why not;

(B) Whether veteran-owned small business concerns were solicited and, if not, why not;

(C) Whether service-disabled veteran-owned small business concerns were solicited and, if not, why not;

(D) Whether HUBZone small business concerns were solicited and, if not, why not;

(E) Whether small disadvantaged business concerns were solicited and, if not, why not;

(F) Whether women-owned small business concerns were solicited and, if not, why not; and

(G) If applicable, the reason award was not made to a small business concern.

(iv) Records of any outreach efforts to contact—

(A) Trade associations;

(B) Business development organizations;

(C) Conferences and trade fairs to locate small, HUBZone small, small disadvantaged, and women-owned small business sources; and

(D) Veterans service organizations.

(v) Records of internal guidance and encouragement provided to buyers through—

(A) Workshops, seminars, training, etc.; and

(B) Monitoring performance to evaluate compliance with the program's

requirements.

(vi) On a contract-by-contract basis, records to support award data submitted by the offeror to the Government, including the name, address, and business size of each subcontractor. Contractors having commercial plans need not comply with this requirement.

(e) In order to effectively implement this plan to the extent consistent with efficient contract performance, the Contractor shall perform the following functions:

(1) Assist small business, veteran-owned small business, service-disabled veteran-owned small business, HUBZone small business, small disadvantaged business, and women-owned small business concerns by arranging solicitations, time for the preparation of bids, quantities, specifications, and delivery schedules so as to facilitate the participation by such concerns. Where the Contractor's lists of potential small business, veteran-owned small business, service-disabled veteran-owned small business, HUBZone small business, small disadvantaged business, and women-owned small business subcontractors are excessively long, reasonable effort shall be made to give all such small business concerns an opportunity to compete over a period of time.

(2) Provide adequate and timely consideration of the potentialities of small business, veteran-owned small business, service-disabled veteran-owned small business, HUBZone small business, small disadvantaged business, and women-owned small business concerns in all "make-or-buy" decisions.

(3) Counsel and discuss subcontracting opportunities with representatives of small business, veteran-owned small business, service-disabled veteran-owned small business , HUBZone small business, small disadvantaged business, and women-owned small business firms.

(4) Provide notice to subcontractors concerning penalties and remedies for misrepresentations of business status as small, veteran-owned small business, HUBZone small, small disadvantaged, or women-owned small business for the purpose of obtaining a subcontract that is to be included as part or all of a goal contained in the Contractor's subcontracting plan.

(f) A master plan on a plant or division-wide basis that contains all the elements required by paragraph (d) of this clause, except goals, may be incorporated by reference as a part of the subcontracting plan required of the offeror by this clause; provided —

(1) The master plan has been approved;

(2) The offeror ensures that the master plan is updated as necessary and provides copies of the approved master plan, including evidence of its approval, to the Contracting Officer; and

(3) Goals and any deviations from the master plan deemed necessary by the Contracting Officer to satisfy the requirements of this contract are set forth in the individual subcontracting plan.

(g) A commercial plan is the preferred type of subcontracting plan for contractors furnishing commercial items. The commercial plan shall relate to the offeror's planned subcontracting generally, for both commercial and Government business, rather than solely to the Government contract. Commercial plans are also preferred for subcontractors that provide commercial items under a prime contract, whether or not the prime contractor is supplying a commercial item.

(h) Prior compliance of the offeror with other such subcontracting plans under previous contracts will be considered by the Contracting Officer in determining the responsibility of the offeror for award of the contract.

(i) The failure of the Contractor or subcontractor to comply in good faith with—

(1) The clause of this contract entitled "Utilization Of Small Business Concerns;" or

(2) An approved plan required by this clause, shall be a material breach of the contract.

(j) The Contractor shall submit the following reports:

(1) *Standard Form 294, Subcontracting Report for Individual Contracts.* This report shall be submitted to the Contracting Officer semiannually and at contract completion. The report covers subcontract award data related to this contract. This report is not required for commercial plans.

(2) *Standard Form 295, Summary Subcontract Report.* This report encompasses all of the contracts with the awarding agency. It must be submitted semi-annually for contracts with the Department of Defense and annually for contracts with civilian agencies. If the reporting activity is covered by a commercial plan, the reporting activity must report annually all subcontract awards under that plan. All reports submitted at the close of each fiscal year (both individual and commercial plans) shall include a breakout, in the Contractor's format, of subcontract awards, in whole dollars, to small disadvantaged business concerns by North American Industry Classification System (NAICS) Industry Subsector. For a commercial plan, the Contractor may obtain from each of its subcontractors a predominant NAICS Industry Subsector and report all awards to that subcontractor under its predominant NAICS Industry Subsector.

(End of clause)

26. *FAR 52.219-9 SMALL BUSINESS SUBCONTRACTING PLAN (JAN 2002) --ALTERNATE I (OCT 2001) [When Contracting By Sealed Bidding]

(a) This clause does not apply to small business concerns.

(b) *Definitions*. As used in this clause—

"Commercial item" means a product or service that satisfies the definition of commercial item in section 2.101 of the Federal Acquisition Regulation.

"Commercial plan" means a subcontracting plan (including goals) that covers the offeror's fiscal year and that applies to the entire production of commercial items sold by either the entire company or a portion thereof (*e.g.*, division, plant, or product line).

"Individual contract plan" means a subcontracting plan that covers the entire contract period (including option periods), applies to a specific contract, and has goals that are based on the offeror's planned subcontracting in support of the specific contract, except that indirect costs incurred for common or joint purposes may be allocated on a prorated basis to the contract.

"Master plan" means a subcontracting plan that contains all the required elements of an individual contract plan, except goals, and may be incorporated into individual contract plans, provided the master plan has been approved.

"Subcontract" means any agreement (other than one involving an employer-employee relationship) entered into by a Federal Government prime Contractor or subcontractor calling for supplies or services required for performance of the contract or subcontract.

(c) The apparent low bidder, upon request by the Contracting Officer, shall submit a subcontracting plan, where applicable, that separately addresses subcontracting with small business, veteran-owned small business, service-disabled veteran-owned small business, HUBZone small business, small disadvantaged business, and women-owned small business concerns. If the bidder is submitting an individual contract plan, the plan must separately address subcontracting with small business, veteran-owned small business, service-disabled veteran-owned small business, HUBZone small business, small disadvantaged business, and women-owned small business concerns, with a separate part for the basic contract and separate parts for each option (if any). The plan shall be included in and made a part of the resultant contract. The subcontracting plan shall be submitted within the time specified by the Contracting Officer. Failure to submit the subcontracting plan shall make the bidder ineligible for the award of a contract.

(d) The offeror's subcontracting plan shall include the following:

(1) Goals, expressed in terms of percentages of total planned subcontracting dollars, for the use of small business, veteran-owned small business, service-disabled veteran-owned small business, HUBZone small business, small disadvantaged business, and women-owned small business concerns as subcontractors. The offeror shall include all subcontracts that contribute to contract performance, and may include a proportionate share of products and services that are normally allocated as indirect costs.

(2) A statement of—

(i) Total dollars planned to be subcontracted for an individual contract plan; or the offeror's total projected sales, expressed in dollars, and the total value of projected subcontracts to support the sales for a commercial plan;

(ii) Total dollars planned to be subcontracted to small business concerns;

(iii) Total dollars planned to be subcontracted to veteran-owned small business concerns;

(iv) Total dollars planned to be subcontracted to service-disabled veteran-owned small business;

(v) Total dollars planned to be subcontracted to HUBZone small business concerns;

(vi) Total dollars planned to be subcontracted to small disadvantaged business concerns; and

(vii) Total dollars planned to be subcontracted to women-owned small business concerns.

(3) A description of the principal types of supplies and services to be subcontracted, and an identification of the types planned for subcontracting to—

(i) Small business concerns;

(ii) Veteran-owned small business concerns;

(iii) Service-disabled veteran-owned small business concerns;
(iv) HUBZone small business concerns;
(v) Small disadvantaged business concerns; and
(vi) Women-owned small business concerns.

(4) A description of the method used to develop the subcontracting goals in paragraph (d)(1) of this clause.

(5) A description of the method used to identify potential sources for solicitation purposes (*e.g.*, existing company source lists, the Procurement Marketing and Access Network (PRO-Net) of the Small Business Administration (SBA), veterans service organizations, the National Minority Purchasing Council Vendor Information Service, the Research and Information Division of the Minority Business Development Agency in the Department of Commerce, or small, HUBZone, small disadvantaged, and women-owned small business trade associations). A firm may rely on the information contained in PRO-Net as an accurate representation of a concern's size and ownership characteristics for the purposes of maintaining a small, veteran-owned small, service-disabled veteran-owned small, HUBZone small, small disadvantaged, and women-owned small business source list. Use of PRONet as its source list does not relieve a firm of its responsibilities (*e.g.*, outreach, assistance, counseling, or publicizing subcontracting opportunities) in this clause.

(6) A statement as to whether or not the offeror included indirect costs in establishing subcontracting goals, and a description of the method used to determine the proportionate share of indirect costs to be incurred with—

(i) Small business concerns;
(ii) Veteran-owned small business concerns;
(iii) Service-disabled veteran-owned small business concerns;
(iv) HUBZone small business concerns;
(v) Small disadvantaged business concerns; and
(vi) Women-owned small business concerns.

(7) The name of the individual employed by the offeror who will administer the offeror's subcontracting program, and a description of the duties of the individual.

(8) A description of the efforts the offeror will make to assure that small business, veteran-owned small business, service-disabled veteran-owned small business, HUBZone small business, small disadvantaged business, and women-owned small business concerns have an equitable opportunity to compete for subcontracts.

(9) Assurances that the offeror will include the clause of this contract entitled "Utilization of Small Business Concerns" in all subcontracts that offer further subcontracting opportunities, and that the offeror will require all subcontractors (except small business concerns) that receive subcontracts in excess of $500,000 ($1,000,000 for construction of any public facility) to adopt a subcontracting plan that complies with the requirements of this clause.

(10) Assurances that the offeror will—

(i) Cooperate in any studies or surveys as may be required;

(ii) Submit periodic reports so that the Government can determine the extent of compliance by the offeror with the subcontracting plan;

(iii) Submit Standard Form (SF) 294, Subcontracting Report for Individual Contracts, and/or SF 295, Summary Subcontract Report, in accordance with paragraph (j) of this clause. The reports shall provide information on subcontract awards to small business concerns, veteran-owned small business concerns, service-disabled veteran-owned small business concerns, HUBZone small business concerns, small disadvantaged business concerns, women-owned small business concerns, and Historically Black Colleges and Universities and Minority Institutions. Reporting shall be in accordance with the instructions on the forms or as provided in agency regulations.

(iv) Ensure that its subcontractors agree to submit SF 294 and SF 295.

(11) A description of the types of records that will be maintained concerning procedures that have been adopted to comply with the requirements and goals in the plan, including establishing source lists; and a description of the offeror's efforts to locate small business, veteran-owned small business, service-disabled veteran-owned small business, HUBZone small business, small disadvantaged business, and women-owned small business concerns and award subcontracts to them. The records shall include at least the following (on a plant-wide or company-wide basis, unless otherwise indicated):

(i) Source lists (*e.g.*, PRO-Net), guides, and other data that identify small business,

veteran-owned small business, service-disabled veteran-owned small business, HUBZone small business, small disadvantaged business, and women-owned small business concerns.

(ii) Organizations contacted in an attempt to locate sources that are small business, veteran-owned small business, service-disabled veteran-owned small business, HUBZone small business, small disadvantaged business, or women-owned small business concerns.

(iii) Records on each subcontract solicitation resulting in an award of more than $100,000, indicating—

(A) Whether small business concerns were solicited and, if not, why not;

(B) Whether veteran-owned small business concerns were solicited and, if not, why not;

(C) Whether service-disabled veteran-owned small business concerns were solicited and, if not, why not;

(D) Whether HUBZone small business concerns were solicited and, if not, why not;

(E) Whether small disadvantaged business concerns were solicited and, if not, why not;

(F) Whether women-owned small business concerns were solicited and, if not, why not; and

(G) If applicable, the reason award was not made to a small business concern.

(iv) Records of any outreach efforts to contact—

(A) Trade associations;

(B) Business development organizations;

(C) Conferences and trade fairs to locate small, HUBZone small, small disadvantaged, and women-owned small business sources; and

(D) Veterans service organizations.

(v) Records of internal guidance and encouragement provided to buyers through—

(A) Workshops, seminars, training, etc.; and

(B) Monitoring performance to evaluate compliance with the program's requirements.

(vi) On a contract-by-contract basis, records to support award data submitted by the offeror to the Government, including the name, address, and business size of each subcontractor. Contractors having commercial plans need not comply with this requirement.

(e) In order to effectively implement this plan to the extent consistent with efficient contract performance, the Contractor shall perform the following functions:

(1) Assist small business, veteran-owned small business, service-disabled veteran-owned small business, HUBZone small business, small disadvantaged business, and women-owned small business concerns by arranging solicitations, time for the preparation of bids, quantities, specifications, and delivery schedules so as to facilitate the participation by such concerns. Where the Contractor's lists of potential small business, veteran-owned small business, service-disabled veteran-owned small business, HUBZone small business, small disadvantaged business, and women-owned small business subcontractors are excessively long, reasonable effort shall be made to give all such small business concerns an opportunity to compete over a period of time.

(2) Provide adequate and timely consideration of the potentialities of small business, veteran-owned small business, service-disabled veteran-owned small business, HUBZone small business, small disadvantaged business, and women-owned small business concerns in all "make-or-buy" decisions.

(3) Counsel and discuss subcontracting opportunities with representatives of small business, veteran-owned small business, service-disabled veteran-owned small business , HUBZone small business, small disadvantaged business, and women-owned small business firms.

(4) Provide notice to subcontractors concerning penalties and remedies for misrepresentations of business status as small, veteran-owned small business, HUBZone small, small disadvantaged, or women-owned small business for the purpose of obtaining a subcontract that is to be included as part or all of a goal contained in the Contractor's subcontracting plan.

(f) A master plan on a plant or division-wide basis that contains all the elements required by paragraph (d) of this clause, except goals, may be incorporated by reference as a part of the subcontracting plan required of the offeror by this clause; provided —

(1) The master plan has been approved;

(2) The offeror ensures that the master plan is updated as necessary and provides copies of the approved master plan, including evidence of its approval, to the Contracting Officer; and

(3) Goals and any deviations from the master plan deemed necessary by the Contracting Officer to satisfy the requirements of this contract are set forth in the individual subcontracting plan.

(g) A commercial plan is the preferred type of subcontracting plan for contractors furnishing commercial items. The commercial plan shall relate to the offeror's planned subcontracting generally, for both commercial and Government business, rather than solely to the Government contract. Commercial plans are also preferred for subcontractors that provide commercial items under a prime contract, whether or not the prime contractor is supplying a commercial item.

(h) Prior compliance of the offeror with other such subcontracting plans under previous contracts will be considered by the Contracting Officer in determining the responsibility of the offeror for award of the contract.

(i) The failure of the Contractor or subcontractor to comply in good faith with—

(1) The clause of this contract entitled "Utilization Of Small Business Concerns;" or

(2) An approved plan required by this clause, shall be a material breach of the contract.

(j) The Contractor shall submit the following reports:

(1) *Standard Form 294, Subcontracting Report for Individual Contracts.* This report shall be submitted to the Contracting Officer semiannually and at contract completion. The report covers subcontract award data related to this contract. This report is not required for commercial plans.

(2) *Standard Form 295, Summary Subcontract Report.* This report encompasses all of the contracts with the awarding agency. It must be submitted semi-annually for contracts with the Department of Defense and annually for contracts with civilian agencies. If the reporting activity is covered by a commercial plan, the reporting activity must report annually all subcontract awards under that plan. All reports submitted at the close of each fiscal year (both individual and commercial plans) shall include a breakout, in the Contractor's format, of subcontract awards, in whole dollars, to small disadvantaged business concerns by North American Industry Classification System (NAICS) Industry Subsector. For a commercial plan, the Contractor may obtain from each of its subcontractors a predominant NAICS Industry Subsector and report all awards to that subcontractor under its predominant NAICS Industry Subsector.

(End of clause)

27. DFARS 252.219-7009 SECTION 8(a) DIRECT AWARD (MAR 2002) [When Competitive 8(a) Contracting Procedures are used]

(a) This contract is issued as a direct award between the contracting office and the 8(a) Contractor pursuant to the Partnership Agreement dated February 1, 2002, between the Small Business Administration (SBA) and the Department of Defense. Accordingly, the SBA, even if not identified in Section A of this contract, is the prime contractor and retains responsibility for 8(a) certification, for 8(a) eligibility determinations and related issues, and for providing counseling and assistance to the 8(a) Contractor under the 8(a) Program. The cognizant SBA district office is:

[To be completed by the Contracting Officer at the time of award]

(b) The contracting office is responsible for administering the contract and for taking any action on behalf of the Government under the terms and conditions of the contract; provided that the contracting office shall give advance notice to the SBA before it issues a final notice terminating performance, either in whole or in part, under

the contract. The contracting office also shall coordinate with the SBA prior to processing any novation agreement. The contracting office may assign contract administration functions to a contract administration office.

(c) The 8(a) Contractor agrees that--

(1) It will notify the Contracting Officer, simultaneous with its notification to the SBA (as required by SBA's 8(a) regulations at 13 CFR 124.308), when the owner or owners upon whom 8(a) eligibility is based plan to relinquish ownership or control of the concern. Consistent with Section 407 of Pub. L. 100-656, transfer of ownership or control shall result in termination of the contract for convenience, unless the SBA waives the requirement for termination prior to the actual relinquishing of ownership and control; and

(2) It will not subcontract the performance of any of the requirements of this contract without the prior written approval of the SBA and the Contracting Officer.

(End of clause)

28. *FAR 52.219-14 LIMITATIONS ON SUBCONTRACTING (DEC 1996) [<u>For Small Business Set Aside Only</u>]

(a) This clause does not apply to the unrestricted portion of a partial set-aside.

(b) By submission of an offer and execution of a contract, the Offeror/Contractor agrees that in performance of the contract in the case of a contract for--

(1) Services (except construction). At least 50 percent of the cost of contract performance incurred for personnel shall be expended for employees of the concern.

(2) Supplies (other than procurement from a nonmanufacturer of such supplies). The concern shall perform work for at least 50 percent of the cost of manufacturing the supplies, not including the cost of materials.

(3) General construction. The concern will perform at least 15 percent of the cost of the contract, not including the cost of materials, with its own employees.

(4) Construction by special trade contractors. The concern will perform at lest 25 percent of the cost of the contract, not including the cost of materials, with its own employees.

29. *FAR 52.219-16 LIQUIDATED DAMAGES-SUBCONTRACTING PLAN (JAN 1999)

(a) Failure to make a good faith effort to comply with the subcontracting plan, as used in this clause, means a willful or intentional failure to perform in accordance with the requirements of the subcontracting plan approved under the clause in this contract entitled ``Small Business Subcontracting Plan," or willful or intentional action to frustrate the plan.

(b) Performance shall be measured by applying the percentage goals to the total actual subcontracting dollars or, if a commercial plan is involved, to the pro rata share of actual subcontracting dollars attributable to Government contracts covered by the commercial plan., If, at contract completion, or in the case of a commercial plan, at the close of the fiscal year for which the plan is applicable, the Contractor has failed to meet its subcontracting goals and the Contracting Officer decides in accordance with paragraph (c) of this clause that the Contractor failed to make a good faith effort to comply with its subcontracting plan, established in accordance with the clause in this contract entitled ``Small Business Subcontracting Plan," the Contractor shall pay the Government liquidated damages in an amount stated. The amount of probable damages attributable to the Contractor's failure to comply shall be an amount equal to the actual dollar amount by which the Contractor failed to achieve each subcontract goal.

(c) Before the Contracting Officer makes a final decision that the Contractor has failed to make such good faith effort, the Contracting Officer shall give the Contractor written notice specifying the failure and permitting the Contractor to demonstrate what good faith efforts have been made and to discuss the matter. Failure

to respond to the notice may be taken as an admission that no valid explanation exists. If, after consideration of all the pertinent data, the Contracting Officer finds that the Contractor failed to make a good faith effort to comply with the subcontracting plan, the Contracting Officer shall issue a final decision to that effect and require that the Contractor pay the Government liquidated damages as provided in paragraph (b) of this clause.

(d) With respect to commercial plans, the Contracting Officer who approved the plan will perform the functions of the Contracting Officer under this clause on behalf of all agencies with contracts covered by a commercial plan.

(e) The Contractor shall have the right of appeal, under the clause in this contract entitled, Disputes, from many final decision of the Contracting Officer.

(f) Liquidated damages shall be in addition to any other remedies that the Government may have.

30. DFARS 252.219-7010 ALTERNATE A (JUN 1998) [When Competitive 8(a) Contracting Procedures are used]

As prescribed in 219.811-3(2), substitute the following paragraph (c) for paragraph (c) of the clause at FAR 52.219-18:

(c) Any award resulting from this solicitation will be made directly by the Contracting Officer to the successful 8(a) offeror selected through the evaluation criteria set forth in this solicitation.

31. FAR 52.219-18 NOTIFICATION OF COMPETITION LIMITED TO ELIGIBLE 8(A) CONCERNS (JUNE 2003) [When Competitive 8(a) Contracting Procedures are used]

(a) Offers are solicited only from small business concerns expressly certified by the Small Business Administration (SBA) for participation in the SBA's 8(a) Program and which meet the following criteria at the time of submission of offer--

(1) The Offeror is in conformance with the 8(a) support limitation set forth in its approved business plan; and

(2) The Offeror is in conformance with the Business Activity Targets set forth in its approved business plan or any remedial action directed by the SBA.

(b) By submission of its offer, the Offeror represents that it meets all of the criteria set forth in paragraph (a) of this clause.

(c) Any award resulting from this solicitation will be made to the Small Business Administration, which will subcontract performance to the successful 8(a) offeror selected through the evaluation criteria set forth in this solicitation.

(d) (1) Agreement. A small business concern submitting an offer in its own name agrees to furnish, in performing the contract, only end items manufactured or produced by small business concerns in the United States or its outlying areas. If this procurement is processed under simplified acquisition procedures and the total amount of this contract does not exceed $25,000, a small business concern may furnish the product of any domestic firm. This subparagraph does not apply in connection with construction or service contracts.

(2) The . . . . . [insert name of SBA's contractor] will notify the U.S. Army Corps of Engineers Contracting Officer in writing immediately upon entering an agreement (either oral or written) to transfer all or part of its stock or other ownership interest to any other party.

(End of clause)

32. FAR 52.219-27 NOTICE OF TOTAL SERVICE-DISABLED VETERAN-OWNED SMALL BUSINESS SET-ASIDE (MAY 2004)

[Applicable only to projects restricted to Service-disabled veteran-owned small business set- asides]

(a) *Definition*. "Service-disabled veteran-owned small business concern"-

(1) Means a small business concern-

(i) Not less than 51 percent of which is owned by one or more service-disabled veterans or, in the case of any publicly owned business, not less than 51 percent of the stock of which is owned by one or more service-disabled veterans; and

(ii) The management and daily business operations of which are controlled by one or more service-disabled veterans or, in the case of a service-disabled veteran with permanent and severe disability, the spouse or permanent caregiver of such veteran.

(2) "Service-disabled veteran" means a veteran, as defined in 38 U.S.C. 101(2), with a disability that is service-connected, as defined in 38 U.S.C. 101(16).

(b) *General*.

(1) Offers are solicited only from service-disabled veteran-owned small business concerns. Offers received from concerns that are not service-disabled veteran-owned small business concerns shall not be considered.

(2) Any award resulting from this solicitation will be made to a service-disabled veteran-owned small business concern.

(c) *Agreement*. A service-disabled veteran-owned small business concern agrees that in the performance of the contract, in the case of a contract for-

(1) Services (except construction), at least 50 percent of the cost of personnel for contract performance will be spent for employees of the concern or employees of other service-disabled veteran-owned small business concerns;

(2) Supplies (other than acquisition from a nonmanufacturer of the supplies), at least 50 percent of the cost of manufacturing, excluding the cost of materials, will be performed by the concern or other service-disabled veteran-owned small business concerns;

(3) General construction, at least 15 percent of the cost of the contract performance incurred for personnel will be spent on the concern's employees or the employees of other service-disabled veteran-owned small business concerns; or

(4) Construction by special trade contractors, at least 25 percent of the cost of the contract performance incurred for personnel will be spent on the concern's employees or the employees of other service-disabled veteran-owned small business concerns.

(d) A joint venture may be considered a service-disabled veteran owned small business concern if-

(1) At least one member of the joint venture is a service-disabled veteran-owned small business concern, and makes the following representations: That it is a service-disabled veteran-owned small business concern, and that it is a small business concern under the North American Industry Classification Systems (NAICS) code assigned to the procurement;

(2) Each other concern is small under the size standard corresponding to the NAICS code assigned to the procurement; and

(3) The joint venture meets the requirements of paragraph 7 of the explanation of Affiliates in 19.101 of the Federal Acquisition Regulation.

(4) The joint venture meets the requirements of 13 CFR 125.15(b)

(e) Any service-disabled veteran-owned small business concern (nonmanufacturer) must meet the requirements in 19.102(f) of the Federal Acquisition Regulation to receive a benefit under this program.
(End of clause)

33. DFARS 252.219-7003 SMALL, SMALL DISADVANTAGED AND WOMEN-OWNED SMALL BUSINESS SUBCONTRACTING PLAN (DOD CONTRACTS) (APR 1996)

This clause supplements the Federal Acquisition Regulation 52.219-9, Small, Small Disadvantaged and Women-Owned Small Business Subcontracting Plan, clause of this contract.

(a) Definitions.

"Historically black colleges and universities," as used in this clause, means institutions determined by the Secretary of Education to meet the requirements of 34 CFR Section 608.2. The term also means any nonprofit research institution that was an integral part of such a college or university before November 14, 1986.

"Minority institutions," as used in this clause, means institutions meeting the requirements of Section 1046(3) of the Higher Education Act of 1965 (20 U.S.C. 1135d-5(3)). The term also includes Hispanic-serving institutions as defined in Section 316(b)(1) of such Act (20 U.S.C. 1059c(b)(1).

(b) Except for company or division-wide commercial products subcontracting plans, the term "small disadvantaged business," when used in the FAR 52.219-9 clause, includes historically black colleges and universities and minority institutions in addition to small disadvantaged business concerns.

(c) Work under the contract or its subcontracts shall be credited toward meeting the small disadvantaged business concern goal required by paragraph (d) of the FAR 52.219-9 clause when:

(1) It is performed on Indian lands or in joint venture with an Indian tribe or a tribally-owned corporation, and

(2) It meets the requirements of 10 U.S.C. 2323a.

(d) Subcontracts awarded to workshops approved by the Committee for Purchase from People Who are Blind or Severely Disabled (41 U.S.C. 46-48), may be counted toward the Contractor's small business subcontracting goal.

(e) A mentor firm, under the Pilot Mentor-Protege Program established under Section 831 of Pub. L. 101-510, as amended, may count toward its small disadvantaged business goal, subcontracts awarded--

(1) Protege firms which are qualified organizations employing the severely handicapped; and

(2) Former protege firms that meet the criteria in Section 831(g)(4) of Pub. L. 101-510.

(f) The master plan approval referred to in paragraph (f) of the FAR 52.219-9 clause is approval by the Contractor's cognizant contract administration activity.

(g) In those subcontracting plans which specifically identify small, small disadvantaged, and women-owned businesses, the Contractor shall notify the Administrative Contracting Officer of any substitutions of firms that are not small, small disadvantaged, or women-owned small businesses for the firms listed in the subcontracting plan. Notifications shall be in writing and shall occur within a reasonable period of time after award of the subcontract. Contractor-specified formats shall be acceptable.

34. DFARS 252.219-7004 SMALL, SMALL DISADVANTAGED AND WOMEN-OWNED SMALL BUSINESS SUBCONTRACTING PLAN (TEST PROGRAM) (JUN 1997)

(a) Definition. "Subcontract," as used in this clause, means any agreement (other than one involving an employer-employee relationship) entered into by a Federal Government prime Contractor or subcontractor calling for supplies or services required for performance of the contract or subcontract.

(b) The Offeror's comprehensive small business subcontracting plan and its successors, which are authorized by and approved under the test program of Section 834 of Pub. L. 101-189, shall be included in and made a part of the resultant contract. Upon expulsion from the test program or expiration of the test program, the Contractor shall negotiate an individual subcontracting plan for all future contracts that meet the requirements of Section 211 of Publ. L. 95-507.

(c) The Contractor shall submit Standard Form 295, Summary Subcontract Report, in accordance with the instructions on the form, except--

(1) One copy of SF 295 and attachments shall be submitted to Director, Small and Disadvantaged Business Utilization, Office of the Deputy Under Secretary of Defense (International and Commercial Programs), 3061 Defense Pentagon, Room 2A338, Washington, DC 20301-3061; and

(2) Item 14, Remarks, shall be completed to include semi-annual cumulative--

(1) Small business, small disadvantaged business and women-owned small business goals; and

(2) Small business and small disadvantaged business goals, actual accomplishments, and percentages for each of the two designated industry categories.

(d) The failure of the Contractor or subcontractor to comply in good faith with (1) the clause of this contract entitled "Utilization of Small, Small Disadvantaged and Women-Owned Small Business Concerns," or (2) an approved plan required by this clause, shall be a material breach of the contract.

35. *FAR 52.222-3 CONVICT LABOR (JUNE 2003)

(a) Except as provided in paragraph (b) of this clause, the Contractor shall not employ in the performance of this contract any person undergoing a sentence of imprisonment imposed by any court of a State, the District of Columbia, Puerto Rico, the Northern Mariana Islands, American Samoa,
Guam, or the U.S. Virgin Islands.

(b) The Contractor is not prohibited from employing persons—

(1) On parole or probation to work at paid employment during the term of their sentence;

(2) Who have been pardoned or who have served their terms; or

(3) Confined for violation of the laws of any of the States, the District of Columbia, Puerto Rico, the Northern Mariana Islands, American Samoa, Guam, or the U.S. Virgin Islands who are authorized to work at paid employment in the community under the laws of such jurisdiction, if—

(i) The worker is paid or is in an approved work training program on a voluntary basis;

(ii) Representatives of local union central bodies or similar labor union organizations have been consulted;

(iii) Such paid employment will not result in the displacement of employed workers, or be applied in skills, crafts, or trades in which there is a surplus of available gainful labor in the locality, or impair existing contracts for services;

(iv) The rates of pay and other conditions of employment will not be less than those paid or provided for work of a similar nature in the locality in which the work is being performed; and

(v) The Attorney General of the United States has certified that the work-release laws or regulations of the jurisdiction involved are in conformity with the requirements of Executive Order 11755, as amended by Executive Orders 12608 and 12943. (End of clause)

36. *FAR 52.222-4 CONTRACT WORK HOURS AND SAFETY STANDARDS ACT—OVERTIME COMPENSATION (SEPT 2000)

(a) *Overtime requirements*. No Contractor or subcontractor employing laborers or mechanics (see Federal Acquisition Regulation 22.300) shall require or permit them to work over 40 hours in any workweek unless they are paid at least 1 and 1/2 times the basic rate of pay for each hour worked over 40 hours.

(b) *Violation; liability for unpaid wages; liquidated damages*. The responsible Contractor and subcontractor are liable for unpaid wages if they violate the terms in paragraph (a) of this clause. In addition, the Contractor and subcontractor are liable for liquidated damages payable to the Government. The Contracting Officer will assess liquidated damages at the rate of $10 per affected employee for each calendar day on which the employer required or permitted the employee to work in excess of the standard workweek of 40 hours without paying overtime wages required by the Contract Work Hours and Safety Standards Act.

(c) *Withholding for unpaid wages and liquidated damages*. The Contracting Officer will withhold from payments due under the contract sufficient funds required to satisfy any Contractor or subcontractor liabilities for unpaid wages and liquidated damages. If amounts withheld under the contract are insufficient to satisfy Contractor or subcontractor liabilities, the Contracting Officer will withhold payments from other Federal or Federally assisted contracts held by the same Contractor that are subject to the Contract Work Hours and Safety Standards Act.

(d) *Payrolls and basic records*. (1) The Contractor and its subcontractors shall maintain payrolls and basic payroll records for all laborers and mechanics working on the contract during the contract and shall make them available to the Government until 3 years after contract completion. The records shall contain the name and address of each employee, social security number, labor classifications, hourly rates of wages paid, daily and weekly number of hours worked, deductions made, and actual wages paid. The records need not duplicate those required for construction work by Department of Labor regulations at 29 CFR 5.5(a)(3) implementing the Davis-Bacon Act .

(2) The Contractor and its subcontractors shall allow authorized representatives of the Contracting Officer or the Department of Labor to inspect, copy, or transcribe records maintained under paragraph (d)(1) of this clause. The Contractor or subcontractor also shall allow authorized representatives of the Contracting Officer or Department of Labor to interview employees in the workplace during working hours.

(e) *Subcontracts*. The Contractor shall insert the provisions set forth in paragraphs (a) through (d) of this clause in subcontracts exceeding $100,000 and require subcontractors to include these provisions in any lower-tier subcontracts. The Contractor shall be responsible for compliance by any subcontractor or lower-tier subcontractor with the provisions set forth in paragraphs (a) through (d) of this clause.
(End of clause)

37. *FAR 52.222-6 DAVIS-BACON ACT (FEB 1995)

(a) All laborers and mechanics employed or working upon the site of the work will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act (29 CFR Part 3)), the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the Contractor and such laborers and mechanics. Contributions made or costs reasonably anticipated for bona fide fringe benefits under section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of paragraph (d) of this clause; also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs which cover the particular weekly period, are deemed to be constructively made or incurred during such period. Such laborers and mechanics shall be paid not less than the appropriate wage rate and fringe benefits in the wage determination for the classification of work actually performed, without regard to skill, except as provided in the clause entitled Apprentices and Trainees. Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein; provided, that the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classifications and wage rates conformed under paragraph (b) of this clause) and the Davis-Bacon poster (WH-1321) shall be posted at all times by the Contractor and its subcontractors at the site of the work in a prominent and accessible place where it can be easily seen by the workers.

(b) (1) The Contracting Officer shall require that any class of laborers or mechanics, which is not listed in the wage determination and which is to be employed under the contract shall be classified in conformance with the wage determination. The Contracting Officer shall approve an additional classification and wage rate and fringe benefits therefor only when all the following criteria have been met:

(i) The work to be performed by the classification requested is not performed by a classification in the wage determination.

(ii) The classification is utilized in the area by the construction industry.

(iii) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.

(2) If the Contractor and laborers and mechanics to be employed in the classification (if known), or their representatives, and the Contracting Officer agree on the classification and wage rate (including the amount designated for fringe benefits, where appropriate), a report of the action taken shall be sent by the Contracting Officer to the Administrator of the Wage and Hour Division, Employment Standards Administration, U.S. Department of Labor, Washington, DC 20210. The Administrator or an authorized representative will approve, modify, or disapprove every additional classification action within 30 days of receipt and so advise the Contracting Officer or will notify the Contracting Officer within the 30-day period that additional time is necessary.

(3) In the event the Contractor, the laborers or mechanics to be employed in the classification, or their representatives, and the Contracting Officer do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the Contracting Officer shall refer the questions, including the views of all interested parties and the recommendation of the Contracting Officer, to the Administrator of the Wage and Hour Division for determination. The Administrator, or an authorized

representative, will issue a determination within 30 days of receipt and so advise the Contracting Officer or will notify the Contracting Officer within the 30-day period that additional time is necessary.

(4) The wage rate (including fringe benefits, where appropriate) determined pursuant to subparagraphs (b)(2) and (b)(3) of this clause shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.

(c) Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the Contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.

(d) If the Contractor does not make payments to a trustee or other third person, the Contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program; provided, that the Secretary of Labor has found, upon the written request of the Contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the Contractor to set aside in a separate account assets for the meeting of obligations under the plan or program.

38. *FAR 52.222-7 WITHHOLDING OF FUNDS (FEB 1988)

The Contracting Officer shall, upon his or her own action or upon written request of an authorized representative of the Department of Labor, withhold or cause to be withheld from the Contractor under this contract or any other Federal contract with the same Prime Contractor, or any other Federally assisted contract subject to Davis-Bacon prevailing wage requirements, which is held by the same Prime Contractor, so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the Contractor or any subcontractor the full amount of wages required by the contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee, or helper, employed or working on the site of the work, all or part of the wages required by the contract, the Contracting Officer may, after written notice to the Contractor, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

39. *FAR 52.222-8 PAYROLLS AND BASIC RECORDS (FEB 1988)

(a) Payrolls and basic records relating thereto shall be maintained by the Contractor during the course of the work and preserved for a period of 3 years thereafter for all laborers and mechanics working at the site of the work. Such records shall contain the name, address, and social security number of each such worker, his or her correct classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in section 1(b)(2)(B) of the Davis-Bacon Act), daily and weekly number of hours worked, deductions made, and actual wages paid. Whenever the Secretary of Labor has found, under paragraph (d) of the clause entitled Davis-Bacon Act, that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in section 1(b)(2)(B) of the Davis-Bacon Act, the Contractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected and records which show the costs anticipated or the actual cost incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs.

(b) (1) The Contractor shall submit weekly for each week in which any contract work is performed a coy of all payrolls to the Contracting Officer. The payrolls submitted shall set out accurately and completely all of the information required to be maintained under paragraph (a) of this clause. This information may be submitted in any form desired. Optional Form WH-347 (Federal Stock Number 029-005-00014-1) is available for this purpose and may be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. The Prime Contractor is responsible for the submission of copies of payrolls by all subcontractors.

(2) Each payroll submitted shall be accompanied by a "Statement of Compliance," signed by the Contractor or subcontractor or his or her agent who pays or supervises the payment of the persons employed under the contract and shall certify--

(i) That the payroll for the payroll period contains the information required to be maintained under paragraph (a) of this clause and that such information is correct and complete;

(ii) That each laborer or mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in the Regulations, 29 CFR Part 3; and

(iii) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated into the contract.

(3) The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH-347 shall satisfy the requirement for submission of the "Statement of Compliance" required by subparagraph (b)(2) of this clause.

(4) The falsification of any of the certifications in this clause may subject the Contractor or subcontractor to civil or criminal prosecution under Section 1001 of Title 18 and Section 3729 of Title 31 of the United States Code.

(c) The Contractor or subcontractor shall make the records required under paragraph (a) of this clause available for inspection, copying, or transcription by the Contracting Officer or authorized representatives of the Contracting Officer or the Department of Labor. The Contractor of subcontractor shall permit the Contracting Officer or representatives of the Contracting Officer or the Department of Labor to interview employees during working hours on the job. If the Contractor or subcontractor fails to submit required records or to make them available, the Contracting Officer may, after written notice to the Contractor, take such action as may be necessary to cause the suspension of any further payment. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.

40. *FAR 52.222-9 APPRENTICES AND TRAINEES (FEB 1988)

(a) Apprentices. Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Bureau of Apprenticeship and Training, or with a State Apprenticeship Agency recognized by the Bureau, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Bureau of Apprenticeship and Training or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice. The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the Contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated in this paragraph, shall be paid not less than the applicable wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a Contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the Contractor's or subcontractor's registered program shall be observed. Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination. In the event the Bureau of Apprenticeship and Training, or a State Apprenticeship Agency

recognized by the Bureau, withdraws approval of an apprenticeship program, the Contractor will not longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(b) Trainees. Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration. The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration. Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed in the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate in the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate in the wage determination for the classification of work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate in the wage determination for the work actually performed. In the event the Employment and Training Administration withdraws approval of a training program, the Contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(c) Equal employment opportunity. The utilization of apprentices, trainees, and journeymen under this clause shall be inconformity with the equal employment opportunity requirements of Executive Order 11246, as amended, and 29 CFR Part 30.

41. *FAR 52.222-10 COMPLIANCE WITH COPELAND ACT REQUIREMENTS (FEB 1988)

The Contractor shall comply with the requirements of 29 CFR Part 3, which are hereby incorporated by reference in this contract.

42. *FAR 52.222-11 SUBCONTRACTS (LABOR STANDARDS) (FEB 1988)

(a) The Contractor or subcontractor shall insert in any subcontracts the clauses entitled Davis-Bacon Act, Contract Work Hours and Safety Standards Act--Overtime Compensation, Apprentices and Trainees, Payrolls and Basic Records, Compliance with Copeland Act Requirements, Withholding of Funds, Subcontracts (Labor Standards), Contract Termination--Debarment, Disputes Concerning Labor Standards, Compliance with Davis-Bacon and Related Act Regulations ,and Certification of Eligibility, and such other clauses as the Contracting Officer may, by appropriate instructions, require, and also a clause requiring subcontractors to include these clauses in any lower tier subcontracts. The Prime Contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with all the contract clauses cited in this paragraph.

(b) (1) Within 14 days after award of the contract, the Contractor shall deliver to the Contracting Officer a completed Statement and Acknowledgment Form (SF 1413) for each subcontract, including the subcontractor's signed and dated acknowledgment that the clauses set forth in paragraph (a) of this clause have been included in the subcontract.

(2) Within 14 days after the award of any subsequently awarded subcontract the Contractor shall deliver to the Contracting Officer an updated completed SF 1413 for such additional subcontract.

43. *FAR 52.222-12 CONTRACT TERMINATION--DEBARMENT (FEB 1988)

A breach of the contract clauses entitled Davis-Bacon Act, Contract Work Hours and Safety Standards Act--Overtime Compensation, Apprentices and Trainees, Payrolls and Basic Records, Compliance with Copeland Act Requirements, Subcontracts (Labor Standards), Compliance with Davis-Bacon and Related Act Regulations, or Certification of Eligibility may be grounds for termination of the contract, and for debarment as a Contractor and subcontractor as provided in 29 CFR 5.12.

44. *FAR 52.222-13 COMPLIANCE WITH DAVIS-BACON AND RELATED ACT REGULATIONS (FEB 1988)

All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 CFR Parts 1, 3, and 5 are hereby incorporated by reference in this contract.

45. *FAR 52.222-14 DISPUTES CONCERNING LABOR STANDARDS (FEB 1988)

The United States Department of Labor has set forth in 29 CFR Parts 5, 6, and 7 procedures for resolving disputes concerning labor standards requirements. Such disputes shall be resolved in accordance with those procedures and not the Disputes clause of this contract. Disputes within the meaning of this clause include disputes between the Contractor (or any of its subcontractors) and the contracting agency the U.S. Department of Labor, or the employees of their representatives.

46. *FAR 52.222-15 CERTIFICATION OF ELIGIBILITY (FEB 1988)

(a) By entering into this contract, the Contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the Contractor's firm is a person or firm ineligible to be awarded Government contracts by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(b) No part of this contract shall be subcontracted to any person or firm ineligible for award of a Government contract by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(c) The penalty for making false statements is prescribed in the U.S. Criminal Code, 18 U.S.C. 1001.

47. *FAR 52.222-26 EQUAL OPPORTUNITY (APR 2002)

(a) *Definition*. "United States," as used in this clause, means the 50 States, the District of Columbia, Puerto Rico, the Northern Mariana Islands, American Samoa, Guam, the U.S. Virgin Islands, and Wake Island.

(b) If, during any 12-month period (including the 12 months preceding the award of this contract), the Contractor has been or is awarded nonexempt Federal contracts and/or subcontracts that have an aggregate value in excess of $10,000, the Contractor shall comply with paragraphs (b)(1) through (b)(11) of this clause, except for work performed outside the United States by employees who were not recruited within the United States. Upon request, the Contractor shall provide information necessary to determine the applicability of this clause.

(1) The Contractor shall not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin. However, it shall not be a violation of this clause for the Contractor to extend a publicly announced preference in employment to Indians living on or near an Indian reservation, in connection with employment opportunities on or near an Indian reservation, as permitted by 41 CFR 60-1.5.

(2) The Contractor shall take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, color, religion, sex, or national origin. This shall include, but not be limited to—

(i) Employment;
(ii) Upgrading;
(iii) Demotion;

(iv) Transfer;
(v) Recruitment or recruitment advertising;
(vi) Layoff or termination;
(vii) Rates of pay or other forms of compensation; and
(viii) Selection for training, including apprenticeship.

(3) The Contractor shall post in conspicuous places available to employees and applicants for employment the notices to be provided by the Contracting Officer that explain this clause.

(4) The Contractor shall, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, or national origin.

(5) The Contractor shall send, to each labor union or representative of workers with which it has a collective bargaining agreement or other contract or understanding, the notice to be provided by the Contracting Officer advising the labor union or workers' representative of the Contractor's commitments under this clause, and post copies of the notice in conspicuous places available to employees and applicants for employment.

(6) The Contractor shall comply with Executive Order 11246, as amended, and the rules, regulations, and orders of the Secretary of Labor.

(7) The Contractor shall furnish to the contracting agency all information required by Executive Order 11246, as amended, and by the rules, regulations, and orders of the Secretary of Labor. The Contractor shall also file Standard Form 100 (EEO-1), or any successor form, as prescribed in 41 CFR part 60-1. Unless the Contractor has filed within the 12 months preceding the date of contract award, the Contractor shall, within 30 days after contract award, apply to either the regional Office of Federal Contract Compliance Programs (OFCCP) or the local office of the Equal Employment Opportunity Commission for the necessary forms.

(8) The Contractor shall permit access to its premises, during normal business hours, by the contracting agency or the OFCCP for the purpose of conducting on-site compliance evaluations and complaint investigations. The Contractor shall permit the Government to inspect and copy any books, accounts, records (including computerized records), and other material that may be relevant to the matter under investigation and pertinent to compliance with Executive Order 11246, as amended, and rules and regulations that implement the Executive Order.

(9) If the OFCCP determines that the Contractor is not in compliance with this clause or any rule, regulation, or order of the Secretary of Labor, this contract may be canceled, terminated, or suspended in whole or in part and the Contractor may be declared ineligible for further Government contracts, under the procedures authorized in Executive Order 11246, as amended. In addition, sanctions may be imposed and remedies invoked against the Contractor as provided in Executive Order 11246, as amended; in the rules, regulations, and orders of the Secretary of Labor; or as otherwise provided by law.

(10) The Contractor shall include the terms and conditions of paragraphs (b)(1) through (11) of this clause in every subcontract or purchase order that is not exempted by the rules, regulations, or orders of the Secretary of Labor issued under Executive Order 11246, as amended, so that these terms and conditions will be binding upon each subcontractor or vendor.

(11) The Contractor shall take such action with respect to any subcontract or purchase order as the Contracting Officer may direct as a means of enforcing these terms and conditions, including sanctions for noncompliance, provided, that if the Contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of any direction, the Contractor may request the United States to enter into the litigation to protect the interests of the United States.

(c) Notwithstanding any other clause in this contract, disputes relative to this clause will be governed by the procedures in 41 CFR 60-1.1.

(End of clause)

48. *FAR 52.222-27 AFFIRMATIVE ACTION COMPLIANCE REQUIREMENTS FOR CONSTRUCTION (FEB 1999)

(a) Definitions.

"Covered area," as used in this clause, means the geographical area described in the solicitation for this contract.

"Deputy Assistant Secretary," as used in this clause, means the Deputy Assistant Secretary for Federal Contract Compliance, U.S. Department of Labor, or a designee

"Employer's identification number," as used in this clause, means the Federal Social Security number used on the employer's quarterly Federal tax return, U.S. Treasury Department Form 941.

"Minority," as used in this clause, means--

(1) American Indian or Alaskan Native (all persons having origins in any of the original peoples of North America and maintaining identifiable tribal affiliations through membership and participation or community identification).

(2) Asian and Pacific Islander (all persons having origins in any of the original peoples of the Far East, Southeast Asia, the Indian Subcontinent, or the Pacific Islands);

(3) Black (all persons having origins in any of the black African racial groups not of Hispanic origin); and

(4) Hispanic (all persons of Mexican, Puerto Rican, Cuban, Central or South American, or other Spanish culture or origin, regardless of race).

(b) If the Contractor, or a subcontractor at any tier, subcontracts a portion of the work involving any construction trade each such subcontract in excess of $10,000 shall include this clause and the Notice containing the goals for minority and female participation stated in the solicitation for this contract.

(c) If the Contractor is participating in a Hometown Plan (41 CFR 60-4) approved by the U.S. Department of Labor in a covered area, either individually or through an association, its affirmative actin obligations on all work in the plan area (including goals) shall comply with the plan for those trades that have unions participating in the plan. Contractors must be able to demonstrate participation in, and compliance with, the provisions of the plan. Each Contractor or subcontractor participating in an approved plan is also required to comply with its obligations under the Equal Opportunity clause, and to make a good faith effort to achieve each goal under the plan in each trade in which it has employees. The overall good-faith performance by other Contractors or subcontractors toward a goal in an approved plan does not excuse any Contractor's or subcontractor's failure to make good-faith efforts to achieve the plan's goals.

(d) The Contractor shall implement the affirmative action procedures in subparagraphs (g)(1) through (16) of this clause. The goals stated in the solicitation for this contract are expressed as percentages of the total hours of employment and training of minority and female utilization that the Contractor should reasonably be able to achieve in each construction trade in which it has employees in the covered area. If the Contractor performs construction work in a geographical area located outside of the covered area, it shall apply the goals established for the geographical area where that work is actually performed. The Contractor is expected to make substantially uniform progress toward its goals in each craft.

(e) Neither the terms and conditions of any collective bargaining agreement, nor the failure by a union with which the Contractor has a collective bargaining agreement, to refer minorities or women shall excuse the Contractor's obligations under this clause, Executive Order 11246, as amended, or the regulations thereunder.

(f) In order for the nonworking training hours of apprentices and trainees to be counted in meeting the goals, apprentices and trainees must be employed by the Contractor during the training period, and the Contractor must have made a commitment to employ the apprentices and trainees at the completion of their training, subject to the availability of employment opportunities. Trainees must be trained pursuant to training programs approved by the U.S. Department of Labor.

(g) The Contractor shall take affirmative action to ensure equal employment opportunity. The evaluation of the Contractor's compliance with this clause shall be based upon its effort to achieve maximum results from its actions. The Contractor shall document these efforts fully and implement affirmative action steps at least as extensive as the following:

(1) Ensure a working environment free of harassment, intimidation, and coercion at all sites and in all facilities where the Contractor's employees are assigned to work. The Contractor, if possible, will assign two or more women to each construction project. The Contractor shall ensure that foremen, superintendents, and other onsite supervisory personnel are aware of and carry out the Contractor's obligation to maintain such a working environment, with specific attention to minority or female individuals working at these sites or facilities.

(2) Establish and maintain a current list of sources for minority and female recruitment. Provide written notification to minority and female recruitment sources and community organizations when the Contractor or its unions have employment opportunities available, and maintain a record of the organizations' responses.

(3) Establish and maintain a current file of the names, addresses, and telephone numbers of each minority and female off-the-street applicant, referrals of minorities or females from unions, recruitment sources, or community organizations, and the action taken with respect to each individual. If an individual was sent to the union hiring hall for referral and not referred back to the Contractor by the union or, if referred back, not employed by the Contractor, this shall be documented in the file, along with whatever additional actions the Contractor may have taken.

(4) Immediately notify the Deputy Assistant Secretary when the union or unions with which the Contractor has a collective bargaining agreement has not referred back to the Contractor a minority or woman sent by the Contractor, or when the Contractor has other information that the union referral process has impeded the Contractor's efforts to meet its obligations.

(5) Develop on-the-job training opportunities and/or participate in training programs for the area that expressly include minorities and women, including upgrading programs and apprenticeship and trainee programs relevant to the Contractor's employment needs, especially those programs funded or approved by the Department of Labor. The Contractor shall provide notice of these programs to the sources compiled under subparagraph (g)(2) of this clause.

(6) Disseminate the Contractor's equal employment policy by--

(i) Providing notice of the policy to unions and to training, recruitment, and outreach programs, and requesting their cooperation in assisting the Contractor in meeting its contract obligations;

(ii) Including the policy in any policy manual and in collective bargaining agreements;

(iii) Publicizing the policy in the company newspaper, annual report, etc.;

(iv) Reviewing the policy with all management personnel and with all minority and female employees at least once a year; and

(v) Posting the policy on bulletin boards accessible to employees at each location where construction work is performed.

(7) Review, at least annually, the Contractor's equal employment policy and affirmative action obligations with all employees having responsibility for hiring, assignment, layoff, termination, or other employment decisions. Conduct review of this policy with all on-site supervisory personnel before initiating construction work at a job site. A written record shall be made and maintained identifying the time and place of these meetings, persons attending, subject matter discussed, and disposition of the subject matter.

(8) Disseminate the Contractor's equal employment policy externally by including it in any advertising in the news media, specifically including minority and female news media. Provide written notification to, and discuss this policy with, other Contractors and subcontractors with which the Contractor does or anticipates doing business.

(9) Direct recruitment efforts, both oral and written, to minority, female, and community organizations, to schools with minority and female students, and to minority and female recruitment and training organizations serving the Contractor's recruitment area and employment needs. Not later than 1 month before the date for acceptance of applications for apprenticeship or training by any recruitment source, send written notification to organizations such as the above, describing the openings, screening procedures, and tests to be used in the selection process.

(10) Encourage present minority and female employees to recruit minority persons and women. Where reasonable, provide after-school, summer, and vacation employment to minority and female youth both on the site and in other areas of the Contractor's workforce.

(11) Validate all tests and other selection requirements where required under 41 CFR 60-3.

(12) Conduct, at least annually, an inventory and evaluation at least of all minority and female personnel for promotional opportunities. Encourage these employees to seek or to prepare for, through appropriate training, etc., opportunities for promotion.

(13) Ensure that seniority practices job classifications, work assignments, and other personnel practices do not have a discriminatory effect by continually monitoring all personnel and employment-related activities to ensure that the Contractor's obligations under this contract are being carried out.

(14) Ensure that all facilities and company activities are nonsegregated except that separate or single-user toilet and necessary changing facilities shall be provided to assure privacy between the sexes.

(15) Maintain a record of solicitations for subcontracts for minority and female construction contractors and suppliers, including circulation of solicitations to minority and female contractor associations and other business associations.

(16) Conduct a review, at lest annually, of all supervisors' adherence to and performance under the Contractor's equal employment policy and affirmative action obligations.

(h) The Contractor is encouraged to participate in voluntary associations that may assist in fulfilling one or more of the affirmative action obligations contained in subparagraphs (g)(1) through (16) of this clause. The efforts of a contractor association, joint contractor-union, contractor-community, or similar group of which the contractor is a member and participant may be asserted as fulfilling one or more of its obligations under subparagraphs (g)(1) through (16) of this clause, provided the Contractor--

(1) Actively participates in the group;

(2) Makes every effort to ensure that the group has a positive impact on the employment of minorities and women in the industry;

(3) Ensures that concrete benefits of the program are reflected in the Contractor's minority and female workforce participation;

(4) Makes a good-faith effort to meet its individual goals and timetables; and

(5) Can provide access to documentation that demonstrates the effectiveness of actions taken on behalf of the Contractor. The obligation to comply is the Contractor's, and failure of such a group to fulfill an obligation shall not be a defense for the Contractor's noncompliance.

(i) A single goal for minorities and a separate single goal for women shall be established. The Contractor is required to provide equal employment opportunity and to take affirmative action for all minority groups, both male and female, and all women, both minority and nonminority. Consequently, the Contractor may be in violation of Executive Order 11246, as amended, if a particular group is employed in a substantially disparate manner.

(j) The Contractor shall not use goals or affirmative action standards to discriminate against any person because of race, color, religion, sex, or national origin.

(k) The Contractor shall not enter into any subcontract with any person or firm debarred from Government contracts under Executive Order 11246, as amended.

(l) The Contractor shall carry out such sanctions and penalties for violation of this clause and of the Equal Opportunity clause, including suspension, termination, and cancellation of existing subcontracts, as may be imposed or ordered under Executive Order 11246, as amended, and its implementing regulations, by the OFCCP. Any failure to carry out these sanctions and penalties as ordered shall be a violation of this clause and Executive Order 11246, as amended.

(m) The Contractor in fulfilling its obligations under this clause shall implement affirmative action procedures at least as extensive as those prescribed in paragraph (g) of this clause, so as to achieve maximum results from its efforts to ensure equal employment opportunity. If the Contractor fails to comply with the requirements of Executive Order 11246, as amended, the implementing regulations, or this clause, the Deputy Assistant Secretary shall take action as prescribed in 41 CFR 60-4.8.

(n) The Contractor shall designate a responsible official to--

(1) Monitor all employment-related activity to ensure that the Contractor's equal employment policy is being carried out;

(2) Submit reports as may be required by the Government; and

(3) Keep records that shall at least include for each employee the name, address, telephone number, construction trade, union affiliation (if any), employee identification number, social security number, race, sex, status (e.g., mechanic, apprentice, trainee, helper, or laborer), dates of changes in status, hours worked per week in the indicated trade, rate of pay, and locations at which the work was performed. Records shall be maintained in an easily understandable and retrievable form; however, to the degree that existing records satisfy this requirement, separate records are not required to be maintained.

(o) Nothing contained herein shall be construed as a limitation upon the application of other laws that establish different standards of compliance or upon the requirements for the hiring of local or other area residents (e.g., those under the Public Works Employment Act of 1977 and the Community Development Block Grant Program).

49. *FAR 52.222-35 EQUAL OPPORTUNITY FOR SPECIAL DISABLED VETERANS, VETERANS OF THE VIETNAM ERA, AND OTHER ELIGIBLE VETERANS (DEC 2001)

(a) *Definitions*. As used in this clause—

"All employment openings" means all positions except executive and top management, those positions that will be filled from within the Contractor's organization, and positions lasting 3 days or less. This term includes full-time employment, temporary employment of more than 3 days duration, and part-time employment.

"Executive and top management" means any employee—

(1) Whose primary duty consists of the management of the enterprise in which the individual is employed or of a customarily recognized department or subdivision thereof;

(2) Who customarily and regularly directs the work of two or more other employees;

(3) Who has the authority to hire or fire other employees or whose suggestions and recommendations as to the hiring or firing and as to the advancement and promotion or any other change of status of other employees will be given particular weight;

(4) Who customarily and regularly exercises discretionary powers; and

(5) Who does not devote more than 20 percent or, in the case of an employee of a retail or service establishment, who does not devote more than 40 percent of total hours of work in the work week to activities that are not directly and closely related to the performance of the work described in paragraphs (1) through (4) of this definition. This paragraph (5) does not apply in the case of an employee who is in sole charge of an establishment or a physically separated branch establishment, or who owns at least a 20 percent interest in the enterprise in which the individual is employed.

"Other eligible veteran" means any other veteran who served on active duty during a war or in a campaign or expedition for which a campaign badge has been authorized.

"Positions that will be filled from within the Contractor's organization" means employment openings for which the Contractor will give no consideration to persons outside the Contractor's organization (including any affiliates, subsidiaries, and parent companies) and includes any openings the Contractor proposes to fill from regularly established "recall" lists. The exception does not apply to a particular opening once an employer decides to consider applicants outside of its organization.

"Qualified special disabled veteran" means a special disabled veteran who satisfies the requisite skill, experience, education, and other job-related requirements of the employment position such veteran holds or desires, and who, with or without reasonable accommodation, can perform the essential functions of such position.

"Special disabled veteran" means—

(1) A veteran who is entitled to compensation (or who but for the receipt of military retired pay would be entitled to compensation) under laws administered by the Department of Veterans Affairs for a disability—

(i) Rated at 30 percent or more; or

(ii) Rated at 10 or 20 percent in the case of a veteran who has been determined under 38 U.S.C. 3106 to have a serious employment handicap (*i.e*., a significant impairment of the veteran's ability to prepare for, obtain, or retain employment consistent with the veteran's abilities, aptitudes, and interests); or

(2) A person who was discharged or released from active duty because of a service-connected disability.

"Veteran of the Vietnam era" means a person who—

(1) Served on active duty for a period of more than 180 days and was discharged or released from active duty with other than a dishonorable discharge, if any part of such active duty occurred—

(i) In the Republic of Vietnam between February 28, 1961, and May 7, 1975; or

(ii) Between August 5, 1964, and May 7, 1975, in all other cases; or

(2) Was discharged or released from active duty for a service-connected disability if any part of the active duty was performed—

(i) In the Republic of Vietnam between February 28, 1961, and May 7, 1975; or

(ii) Between August 5, 1964, and May 7, 1975, in all other cases.

(b) *General*. (1) The Contractor shall not discriminate against the individual because the individual is a special disabled veteran, a veteran of the Vietnam era, or other eligible veteran, regarding any position for which the employee or applicant for employment is qualified. The Contractor shall take affirmative action to employ, advance in employment, and otherwise treat qualified special disabled veterans, veterans of the Vietnam era, and other

eligible veterans without discrimination based upon their disability or veterans' status in all employment practices such as—

(i) Recruitment, advertising, and job application procedures;

(ii) Hiring, upgrading, promotion, award of tenure, demotion, transfer, layoff, termination, right of return from layoff and rehiring;

(iii) Rate of pay or any other form of compensation and changes in compensation;

(iv) Job assignments, job classifications, organizational structures, position descriptions, lines of progression, and seniority lists;

(v) Leaves of absence, sick leave, or any other leave;

(vi) Fringe benefits available by virtue of employment, whether or not administered by the Contractor;

(vii) Selection and financial support for training, including apprenticeship, and on-the-job training under 38 U.S.C. 3687, professional meetings, conferences, and other related activities, and selection for leaves of absence to pursue training;

(viii) Activities sponsored by the Contractor including social or recreational programs; and

(ix) Any other term, condition, or privilege of employment.

(2) The Contractor shall comply with the rules, regulations, and relevant orders of the Secretary of Labor issued under the Vietnam Era Veterans' Readjustment Assistance Act of 1972 (the Act), as amended (38 U.S.C. 4211 and 4212).

(c) *Listing openings*. (1) The Contractor shall immediately list all employment openings that exist at the time of the execution of this contract and those which occur during the performance of this contract, including those not generated by this contract, and including those occurring at an establishment of the Contractor other than the one where the contract is being performed, but excluding those of independently operated corporate affiliates, at an appropriate local public employment service office of the State wherein the opening occurs. Listing employment openings with the U.S. Department of Labor's America's Job Bank shall satisfy the requirement to list jobs with the local employment service office.

(2) The Contractor shall make the listing of employment openings with the local employment service office at least concurrently with using any other recruitment source or effort and shall involve the normal obligations of placing a bona fide job order, including accepting referrals of veterans and nonveterans. This listing of employment openings does not require hiring any particular job applicant or hiring from any particular group of job applicants and is not intended to relieve the Contractor from any requirements of Executive orders or regulations concerning nondiscrimination in employment.

(3) Whenever the Contractor becomes contractually bound to the listing terms of this clause, it shall advise the State public employment agency in each State where it has establishments of the name and location of each hiring location in the State. As long as the Contractor is contractually bound to these terms and has so advised the State agency, it need not advise the State agency of subsequent contracts. The Contractor may advise the State agency when it is no longer bound by this contract clause.

(d) *Applicability*. This clause does not apply to the listing of employment openings that occur and are filled outside the 50 States, the District of Columbia, the Commonwealth of Puerto Rico, the Commonwealth of the Northern Mariana Islands, American Samoa, Guam, the Virgin Islands of the United States, and Wake Island.

(e) *Postings*. (1) The Contractor shall post employment notices in conspicuous places that are available to employees and applicants for employment.

(2) The employment notices shall—

(i) State the rights of applicants and employees as well as the Contractor's obligation under the law to take affirmative action to employ and advance in employment qualified employees and applicants who are special disabled veterans, veterans of the Vietnam era, and other eligible veterans; and

(ii) Be in a form prescribed by the Deputy Assistant Secretary for Federal Contract Compliance Programs, Department of Labor (Deputy Assistant Secretary of Labor), and provided by or through the Contracting Officer.

(3) The Contractor shall ensure that applicants or employees who are special disabled veterans are informed of the contents of the notice (e.g., the Contractor may have the notice read to a visually disabled veteran, or may lower the posted notice so that it can be read by a person in a wheelchair).

(4) The Contractor shall notify each labor union or representative of workers with which it has a collective bargaining agreement, or other contract understanding, that the Contractor is bound by the terms of the Act and is committed to take affirmative action to employ, and advance in employment, qualified special disabled veterans, veterans of the Vietnam era, and other eligible veterans.

(f) *Noncompliance*. If the Contractor does not comply with the requirements of this clause, the Government may take appropriate actions under the rules, regulations, and relevant orders of the Secretary of Labor issued pursuant to the Act.

(g) *Subcontracts*. The Contractor shall insert the terms of this clause in all subcontracts or purchase orders of $25,000 or more unless exempted by rules, regulations, or orders of the Secretary of Labor. The Contractor shall act as specified by the Deputy Assistant Secretary of Labor to enforce the terms, including action for noncompliance.

(End of clause)

50. *FAR 52.222-36 AFFIRMATIVE ACTION FOR WORKERS WITH DISABILITIES (JUN 1998)

(a) General.

(1) Regarding any position for which the employee or applicant for employment is qualified, the Contractor shall not discriminate against any employee or applicant because of physical or mental disability. The Contractor agrees to take affirmative action to employ, advance in employment, and otherwise treat qualified individuals with disabilities without discrimination based upon their physical or mental disability in all employment practices such as--

(i) Recruitment, advertising, and job application procedures;

(ii) Hiring, upgrading, promotion, award of tenure, demotion, transfer, layoff, termination, right of return from layoff, and rehiring;

(iii) Rates of pay or other forms of compensation and changes in compensation;

(iv) Job assignments, job classifications, orgizational structures, position descriptions, lines of progression, and senority lists;

(v) Leaves of absence, sick leave, or any other leave;

(vi) Fringe benefits available by virtue of employment, whether or not administered by the Contractor;

(vii) Selection and financial support for training, including apprenticeships, professional meetings, conferences, and other related activities, and selection for leaves of absence to pursue training;

(viii) Activities sponsored by the Contractor, including social or recreational programs; and

(ix) Any other term, condition, or priviledge of employment.

(2) The Contractor agrees to comply with the rules, regulations, and relevant orders of the Secretary of Labor (Secretary) issued under the Rehabilitation Act of 1973 (29 U.S.C. 793) (the Act), as amended.

(b) Postings.

(1) The Contractor agrees to post employment notices stating--

(i) The Contractor's obligation under the law to take affirmative action to employ and advance in employment qualified individuals with disabilities; and

(ii) The rights of applicants and employees.

(2) These notices shall be posted in conspicuous places that are available to employees and applicants for employment. The Contractor shall ensure that applicants and employees with disabilities are informed of the contents of the notice (e.g., the Contractor may have the notice read to visually disabled individual, or may lower the posted notice so that it might be read by a person in a wheelchair). The notices shall be in a form prescribed by the Deputy Assistant Secretary for Federal Contract Compliance of the U.S. Department of Labor (Deputy Assistant Secretary) and shall be provided by or through the Contracting Officer.

(3) The Contractor shall notify each labor union or representative of workers with which it has a collective bargaining agreement or other contract understanding, that the Contractor is bound by the terms of Section 503 of the Act and is committed to take affirmative action to employ, and advance in employment, qualified individuals with physical or mental disabilities.

(c) Noncompliance. If the Contractor does not comply with the requirements of this clause, appropriate actions may be taken under the rules, regulations, and relevant orders of the Secretary issued pursuant to the Act.

(d) Subcontracts. The Contractor shall include the terms of this clause in every subcontract or purchase order in excess of $10,000 unless exempted by rules, regulations, or orders of the Secretary. The Contractor shall act as specified by the Deputy Assistant Secretary to enforce the terms, including action for noncompliance.

51. *FAR 52.222-37 EMPLOYMENT REPORTS ON SPECIAL DISABLED VETERANS, VETERANS OF THE VIETNAM ERA, AND OTHER ELIGIBLE VETERANS (DEC 2001)

(a) Unless the Contractor is a State or local government agency, the Contractor shall report at least annually, as required by the Secretary of Labor, on—

(1) The number of special disabled veterans, the number of veterans of the Vietnam era, and other eligible veterans in the workforce of the Contractor by job category and hiring location; and

(2) The total number of new employees hired during the period covered by the report, and of the total, the number of special disabled veterans, the number of veterans of the Vietnam era, and the number of other eligible veterans; and

(3) The maximum number and the minimum number of employees of the Contractor during the period covered by the report.

(b) The Contractor shall report the above items by completing the Form VETS-100, entitled "Federal Contractor Veterans' Employment Report (VETS-100 Report)".

(c) The Contractor shall submit VETS-100 Reports no later than September 30 of each year beginning September 30, 1988.

(d) The employment activity report required by paragraph (a)(2) of this clause shall reflect total hires during the most recent 12-month period as of the ending date selected for the employment profile report required by paragraph (a)(1) of this clause. Contractors may select an ending date—

(1) As of the end of any pay period between July 1 andAugust 31 of the year the report is due; or

(2) As of December 31, if the Contractor has prior writtenapproval from the Equal Employment Opportunity Commission to do so for purposes of submitting the Employer Information Report EEO-1 (Standard Form 100).

(e) The Contractor shall base the count of veterans reported according to paragraph (a) of this clause on voluntary disclosure. Each Contractor subject to the reporting requirements at 38 U.S.C. 4212 shall invite all special disabled veterans, veterans of the Vietnam era, and other eligible veterans who wish to benefit under the affirmative action program at 38 U.S.C. 4212 to identify themselves to the Contractor. The invitation shall state that—

(1) The information is voluntarily provided;

(2) The information will be kept confidential;

(3) Disclosure or refusal to provide the information will not subject the applicant or employee to any adverse treatment; and

(4) The information will be used only in accordance with the regulations promulgated under 38 U.S.C. 4212.

(f) The Contractor shall insert the terms of this clause in all subcontracts or purchase orders of $25,000 or more unless exempted by rules, regulations, or orders of the Secretary of Labor.

(End of clause)

52. *FAR 52.222-38 COMPLIANCE WITH VETERANS' EMPLOYMENT REPORTING REQUIREMENTS (DEC 2001)

By submission of its offer, the offeror represents that, if it is subject to the reporting requirements of 38 U.S.C. 4212(d) (*i.e.*, if it has any contract containing Federal Acquisition Regulation clause 52.222-37, Employment Reports on Special Disabled Veterans, Veterans of the Vietnam Era, and Other Eligible Veterans), it has submitted the most recent VETS-100 Report required by that clause.

(End of provision)

53. *FAR 52.223-5 POLLUTION PREVENTION AND RIGHT-TO-KNOW INFORMATION (AUG 2003) [For Work on Federal Facilities]

(a) *Definitions*. As used in this clause—

"Priority chemical" means a chemical identified by the Interagency Environmental Leadership Workgroup or, alternatively, by an agency pursuant to Section 503 of Executive Order 13148 of April 21, 2000, Greening the Government through Leadership in Environmental Management.

"Toxic chemical" means a chemical or chemical category listed in 40 CFR 372.65.

(b) Executive Order 13148 requires Federal facilities to comply with the provisions of the Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA) (42 U.S.C. 11001-11050) and the Pollution Prevention Act of 1990 (PPA) (42 U.S.C. 13101-13109).

(c) The Contractor shall provide all information needed by the Federal facility to comply with the following:

(1) The emergency planning reporting requirements of Section 302 of EPCRA.
(2) The emergency notice requirements of Section 304 of EPCRA.
(3) The list of Material Safety Data Sheets, required by Section 311 of EPCRA.
(4) The emergency and hazardous chemical inventory forms of Section 312 of EPCRA.
(5) The toxic chemical release inventory of Section 313 of EPCRA, which includes the reduction and recycling information required by Section 6607 of PPA.
(6) The toxic chemical, priority chemical, and hazardous substance release and use reduction goals of Sections 502 and 503 of Executive Order 13148.

(End of clause)

54. *FAR 52.223-6 DRUG-FREE WORKPLACE (MAY 2001)

(a) Definitions. As used in this clause--

"Controlled substance" means a controlled substance in schedules I through V of section 202 of the Controlled Substances Act (21 U.S.C. 812) and as further defined in regulation at 21 CFR 1308.11 - 1308.15.

"Conviction" means a finding of guilt (including a plea of nolo contendere) or imposition of sentence, or both, by any judicial body charged with the responsibility to determine violations of the Federal or State criminal drug statutes.

"Criminal drug statute" means a Federal or non-Federal criminal statute involving the manufacture, distribution, dispensing, possession or use of any controlled substance.

"Drug-free workplace" means the site(s) for the performance of work done by the Contractor in connection with a specific contract where employees of the Contractor are prohibited from engaging in the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance.

"Employee" means an employee of a Contractor directly engaged in the performance of work under a Government contract. "Directly engaged" is defined to include all direct cost employees and any other Contractor employee who has other than a minimal impact or involvement in contract performance.

"Individual" means an offeror/contractor that has no more than one employee including the offeror/contractor.

(b) The Contractor, if other than an individual, shall--within 30 days after award (unless a longer period is agreed to in writing for contracts of 30 days or more performance duration), or as soon as possible for contracts of less than 30 days performance duration--

(1) Publish a statement notifying its employees that the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance is prohibited in the Contractor's workplace and specifying the actions that will be taken against employees for violations of such prohibition;

(2) Establish an ongoing drug-free awareness program to inform such employees about--

(i) The dangers of drug abuse in the workplace;

(ii) The Contractor's policy of maintaining a drug-free workplace;

(iii) Any available drug counseling, rehabilitation, and employee assistance programs; and

(iv) The penalties that may be imposed upon employees for drug abuse violations occurring in the workplace.

(3) Provide all employees engaged in performance of the contract with a copy of the statement required by subparagraph (b)(1) of this clause;

(4) Notify such employees in writing in the statement required by subparagraph (b)(1) of this clause that, as a condition of continued employment on this contract, the employee will--

(i) Abide by the terms of the statement; and

(ii) Notify the employer in writing of the employee's conviction under a criminal drug statute for a violation occurring in the workplace no later than 5 days after such conviction.

(5) Notify the Contracting Officer in writing within 10 days after receiving notice under subdivision (b)(4)(ii) of this clause, from an employee or otherwise receiving actual notice of such conviction. The notice shall include the position title of the employee;

(6) Within 30 days after receiving notice under subdivision (b)(4)(ii) of this clause of a conviction, take one of the following actions with respect to any employee who is convicted of a drug abuse violation occurring in the workplace:

(i) Taking appropriate personnel action against such employee, up to and including termination; or

(ii) Require such employee to satisfactorily participate in a drug abuse assistance or rehabilitation program approved for such purposes by a Federal, State, or local health, law enforcement, or other appropriate agency; and

(7) Make a good faith effort to maintain a drug-free workplace through implementation of subparagraphs (b)(1) through (b)(6) of this clause.

(c) The Contractor, if an individual, agrees by award of the contract or acceptance of a purchase order, not to engage in the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance while performing this contract.

(d) In addition to other remedies available to the Government, the Contractor's failure to comply with the requirements of paragraph (b) or (c) of this clause may, pursuant to FAR 23.560, render the Contractor subject to suspension of contract payments, termination of the contract for default, and suspension or debarment.

55. FAR 52.223-9 ESTIMATE OF PERCENTAGE OF RECOVERED MATERIAL CONTENT FOR EPA-DESIGNATED PRODUCTS (AUG 2000) [For Contracts exceeding $100,000. EPA Designated product (available at http://www.epa.gov/cpg/)]

(a) Definitions. As used in this clause—

"Postconsumer material" means a material or finished product that has served its intended use and has been discarded for disposal or recovery, having completed its life as a consumer item. Postconsumer material is a part of the broader category of "recovered material."

"Recovered material" means waste materials and by-products recovered or diverted from solid waste, but the term does not include those materials and by-products generated from, and commonly reused within, an original manufacturing process.

(b) The Contractor, on completion of this contract, shall—

(1) Estimate the percentage of the total recovered material used in contract performance, including, if applicable, the percentage of postconsumer material content; and

(2) Submit this estimate to the Contracting Officer.

(End of clause)

56. *FAR 52.223-14 TOXIC CHEMICAL RELEASE REPORTING (AUG 2003) [For Contracts Over $100,000]

(a) Unless otherwise exempt, the Contractor, as owner or operator of a facility used in the performance of this contract, shall file by July 1 for the prior calendar year an annual Toxic Chemical Release Inventory Form (Form R) as described in sections 313(a) and (g) of the Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA) (42 U.S.C. 11023(a) and (g)), and section 6607 of the Pollution Prevention Act of 1990 (PPA) (42 U.S.C. 13106). The Contractor shall file, for each facility subject to the Form R filing and reporting requirements, the annual Form R throughout the life of the contract.

(b) A Contractor-owned or -operated facility used in the performance of this contract is exempt from the requirement to file an annual Form R if—

(1) The facility does not manufacture, process, or otherwise use any toxic chemicals listed in 40 CFR 372.65;

(2) The facility does not have 10 or more full-time employees as specified in section 313(b)(1)(A) of EPCRA, 42 U.S.C. 11023(b)(1)(A);

(3) The facility does not meet the reporting thresholds of toxic chemicals established under section 313(f) of EPCRA, 42 U.S.C. 11023(f) (including the alternate thresholds at 40 CFR 372.27, provided an appropriate certification form has been filed with EPA);

(4) The facility does not fall within the following Standard Industrial Classification (SIC) codes or their corresponding North American Industry Classification System sectors:

(i) Major group code 10 (except 1011, 1081, and 1094.

(ii) Major group code 12 (except 1241).

(iii) Major group codes 20 through 39.

(iv) Industry code 4911, 4931, or 4939 (limited to facilities that combust coal and/or oil for the purpose of generating power for distribution in commerce).

(v) Industry code 4953 (limited to facilities regulated under the Resource Conservation and Recovery Act, Subtitle C (42 U.S.C. 6921, *et seq*.)), or 5169, or 5171, or 7389 (limited to facilities primarily engaged in solvent recovery services on a contract or fee basis); or

(5) The facility is not located in the United States or its outlying areas.

(c) If the Contractor has certified to an exemption in accordance with one or more of the criteria in paragraph (b) of this clause, and after award of the contract circumstances change so that any of its owned or operated facilities used in the performance of this contract is no longer exempt—

(1) The Contractor shall notify the Contracting Officer; and

(2) The Contractor, as owner or operator of a facility used in the performance of this contract that is no longer exempt, shall—

(i) Submit a Toxic Chemical Release Inventory Form (Form R) on or before July 1 for the prior calendar year during which the facility becomes eligible; and

(ii) Continue to file the annual Form R for the life of the contract for such facility.

(d) The Contracting Officer may terminate this contract or take other action as appropriate, if the Contractor fails to comply accurately and fully with the EPCRA and PPA toxic chemical release filing and reporting requirements.

(e) Except for acquisitions of commercial items as defined in FAR Part 2, the Contractor shall—

(1) For competitive subcontracts expected to exceed $100,000 (including all options), include a solicitation provision substantially the same as the provision at FAR 52.223-13, Certification of Toxic Chemical Release Reporting; and

(2) Include in any resultant subcontract exceeding $100,000 (including all options), the substance of this clause, except this paragraph (e).

(End of clause)

57. RESERVED

58. DFARS 252.223-7006 PROHIBITION ON STORAGE AND DISPOSAL OF TOXIC AND HAZARDOUS MATERIALS (APR 1993)

(a) Definitions. As used in this clause--

(1) "Storage" means a non-transitory, semi-permanent or permanent holding, placement, or leaving of material. It does not include a temporary accumulation of a limited quantity of a material used in or a waste generated or resulting from authorized activities, such as servicing, maintenance, or repair of Department of Defense (DoD) items, equipment, or facilities.

(2) "Toxic or hazardous materials" means:

(i) Materials referred to in section 101(14) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 (42 U.S.C. 9601(14)) and materials designated under section 102 of CERCLA (42 U.S.C. 9602) (40 CFR Part 302);

(ii) Materials that are of an explosive, flammable, or pyrotechnic nature; or

(iii) Materials otherwise identified by the Secretary of Defense as specified in DoD regulations.

(b) In accordance with 10 U.S.C. 2692, the Contractor is prohibited from storing or disposing of non-DoD-owned toxic or hazardous materials on a DoD installation, except to the extent authorized by a statutory exception to 10 U.S.C. 2692 or as authorized by the Secretary of Defense or his designee.

59. *FAR 52.225-9 BUY AMERICAN ACT—CONSTRUCTION MATERIALS (JUNE 2003) (<u>For Contracts less than $6.481 million</u>)

(a) *Definitions*. As used in this clause—

"Component" means an article, material, or supply incorporated directly into a construction material.

"Construction material" means an article, material, or supply brought to the construction site by the Contractor or a subcontractor for incorporation into the building or work. The term also includes an item brought to the site preassembled from articles, materials, or supplies. However, emergency life safety systems, such as emergency lighting, fire alarm, and audio evacuation systems, that are discrete systems incorporated into a public building or work and that are produced as complete systems, are evaluated as a single and distinct construction material regardless of when or how the individual parts or components of those systems are delivered to the construction site. Materials purchased directly by the Government are supplies, not construction material.

"Cost of components" means—

(1) For components purchased by the Contractor, the acquisition cost, including transportation costs to the place of incorporation into the construction material (whether or not such costs are paid to a domestic firm), and any applicable duty (whether or not a duty-free entry certificate is issued); or

(2) For components manufactured by the Contractor, all costs associated with the manufacture of the component, including transportation costs as described in paragraph (1) of this definition, plus allocable overhead costs, but excluding profit. Cost of components does not include any costs associated with the manufacture of the end product.

"Domestic construction material" means—

(1) An unmanufactured construction material mined or produced in the United States; or

(2) A construction material manufactured in the United States, if the cost of its components mined, produced, or manufactured in the United States exceeds 50 percent of the cost of all its components. Components of foreign origin of the same class or kind for which nonavailability determinations have been made are treated as domestic.

"Foreign construction material" means a construction material other than a domestic construction material.

"United States" means the 50 States and the District of Columbia, and outlying areas.

(b) *Domestic preference*. (1) This clause implements the Buy American Act (41 U.S.C. 10a - 10d) by providing a preference for domestic construction material. The Contractor shall use only domestic construction material in performing this contract, except as provided in paragraphs (b)(2) and (b)(3) of this clause.

(2) This requirement does not apply to the construction material or components listed by the Government as follows:

_____

[*Contracting Officer to list applicable excepted materials or indicate "none"*]

(3) The Contracting Officer may add other foreign construction material to the list in paragraph (b)(2) of this clause if the Government determines that—

(i) The cost of domestic construction material would be unreasonable. The cost of a particular domestic construction material subject to the requirements of the Buy American Act is unreasonable when the cost of such material exceeds the cost of foreign material by more than 6 percent;

(ii) The application of the restriction of the Buy American Act to a particular construction material would be impracticable or inconsistent with the public interest; or

(iii) The construction material is not mined, produced, or manufactured in the United States in sufficient and reasonably available commercial quantities of a satisfactory quality.

(c) *Request for determination of inapplicability of the BuyAmerican Act*. (1)(i) Any Contractor request to use foreign construction material in accordance with paragraph (b)(3) of this clause shall include adequate information for Government evaluation of the request, including—

(A) A description of the foreign and domestic construction materials;

(B) Unit of measure;

(C) Quantity;

(D) Price;

(E) Time of delivery or availability;

(F) Location of the construction project;

(G) Name and address of the proposed supplier; and

(H) A detailed justification of the reason for use of foreign construction materials cited in accordance with paragraph (b)(3) of this clause.

(ii) A request based on unreasonable cost shall include a reasonable survey of the market and a completed price comparison table in the format in paragraph (d) of this clause.

(iii) The price of construction material shall include all delivery costs to the construction site and any applicable duty (whether or not a duty-free certificate may be issued).

(iv) Any Contractor request for a determination submitted after contract award shall explain why the Contractor could not reasonably foresee the need for such determination and could not have requested the determination before contract award. If the Contractor does not submit a satisfactory explanation, the Contracting Officer need not make a determination.

(2) If the Government determines after contract award that an exception to the Buy American Act applies and the Contracting Officer and the Contractor negotiate adequate consideration, the Contracting Officer will modify the contract to allow use of the foreign construction material. However, when the basis for the exception is the unreasonable price of a domestic construction material, adequate consideration is not less than the differential established in paragraph (b)(3)(i) of this clause.

(3) Unless the Government determines that an exception to the Buy American Act applies, use of foreign construction material is noncompliant with the Buy American Act.

(d) *Data*. To permit evaluation of requests under paragraph (c) of this clause based on unreasonable cost, the Contractor shall include the following information and any applicable supporting data based on the survey of suppliers:

FOREIGN AND DOMESTIC CONSTRUCTION MATERIALS PRICE COMPARISON			
Construction Material Description	Unit of Measure	Quantity	Price (Dollars)*
Item 1:			
Foreign construction material	_____	_____	_____
Domestic construction material	_____	_____	_____
Item 2:			
Foreign construction material	_____	_____	_____
Domestic construction material	_____	_____	_____

[List *name, address, telephone number, and contact for suppliers surveyed. Attach copy of response; if oral, attach summary.] [Include other applicable supporting information.]*
[Include all delivery costs to the construction site and any applicable duty (whether or not a duty-free entry certificate is issued).]*

60. *FAR 52.225-10 NOTICE OF BUY AMERICAN ACT REQUIREMENT—CONSTRUCTION MATERIALS (MAY 2002) (Applicable with FAR 52.225-9)

(a) *Definitions*. "Construction material," "domestic construction material," and "foreign construction material," as used in this provision, are defined in the clause of this solicitation entitled "Buy American Act—Construction Materials" (Federal Acquisition Regulation (FAR) clause 52.225-9).

(b) *Requests for determinations of inapplicability*. An offeror requesting a determination regarding the inapplicability of the Buy American Act should submit the request to the Contracting Officer in time to allow a determination before submission of offers. The offeror shall include the information and applicable supporting data required by paragraphs (c) and (d) of the clause at FAR 52.225-9 in the request. If an offeror has not requested a determination regarding the inapplicability of the Buy American Act before submitting its offer, or has not received a response to a previous request, the offeror shall include the information and supporting data in the offer.

(c) *Evaluation of offers*. (1) The Government will evaluate an offer requesting exception to the requirements of the Buy American Act, based on claimed unreasonable cost of domestic construction material, by adding to the offered price the appropriate percentage of the cost of such foreign construction material, as specified in paragraph (b)(3)(i) of the clause at FAR 52.225-9.

(2) If evaluation results in a tie between an offeror that requested the substitution of foreign construction material based on unreasonable cost and an offeror that did not request an exception, the Contracting Officer will award to the offeror that did not request an exception based on unreasonable cost.

(d) *Alternate offers*. (1) When an offer includes foreign construction material not listed by the Government in this solicitation in paragraph (b)(2) of the clause at FAR 52.225-9, the offeror also may submit an alternate offer based on use of equivalent domestic construction material.

(2) If an alternate offer is submitted, the offeror shall submit a separate Standard Form 1442 for the alternate offer, and a separate price comparison table prepared in accordance with paragraphs (c) and (d) of the clause at FAR 52.225-9 for the offer that is based on the use of any foreign construction material for which the Government has not yet determined an exception applies.

(3) If the Government determines that a particular exception requested in accordance with paragraph (c) of the clause at FAR 52.225-9 does not apply, the Government will evaluate only those offers based on use of the equivalent domestic construction material, and the offeror shall be required to furnish such domestic construction material. An offer based on use of the foreign construction material for which an exception was requested—

(i) Will be rejected as nonresponsive if this acquisition is conducted by sealed bidding; or
(ii) May be accepted if revised during negotiations.

(End of provision)

61. *FAR 52.225-11 BUY AMERICAN ACT—CONSTRUCTION MATERIALS UNDER TRADE AGREEMENTS (JAN 2004) [For Contracts more than $6,481,000] ALTERNATE I (JAN 2004) [For Contracts between $6.481 and 7.304733 Million]

(a) *Definitions*. As used in this clause—

"Component" means an article, material, or supply incorporated directly into a construction material.

"Construction material" means an article, material, or supply brought to the construction site by the Contractor or subcontractor for incorporation into the building or work. The term also includes an item brought to the site preassembled from articles, materials, or supplies. However, emergency life safety systems, such as emergency lighting, fire alarm, and audio evacuation systems, that are discrete systems incorporated into a public building or work and that are produced as complete systems, are evaluated as a single and distinct construction material regardless of when or how the individual parts or components of those systems are delivered to the construction site. Materials purchased directly by the Government are supplies, not construction material.

"Cost of components" means—

(1) For components purchased by the Contractor, the acquisition cost, including transportation costs to the place of incorporation into the construction material (whether or not such costs are paid to a domestic firm), and any applicable duty (whether or not a duty-free entry certificate is issued); or

(2) For components manufactured by the Contractor, all costs associated with the manufacture of the component, including transportation costs as described in paragraph (1) of this definition, plus allocable overhead costs, but excluding profit. Cost of components does not include any costs associated with the manufacture of the end product.

"Designated country" means any of the following countries:

Aruba	Kiribati
Austria	Korea, Republic of
Bangladesh	Lesotho
Belgium	Liechtenstein
Benin	Luxembourg
Bhutan	Malawi
Botswana	Maldives
Burkina Faso	Mali
Burundi	Mozambique
Canada	Nepal
Cape Verde	Netherlands
Central African Republic	Niger
Chad	Norway
Comoros	Portugal
Denmark	Rwanda
Djibouti	Sao Tome and Principe
Equatorial Guinea	Sierra Leone
Finland	Singapore
France	Somalia
Gambia	Spain
Germany	Sweden
Greece	Switzerland
Guinea	Tanzania U.R.
Guinea-Bissau	Togo
Haiti	Tuvalu
Hong Kong	Uganda
Iceland	United Kingdom
Ireland	Vanuatu
Israel	Western Samoa
Italy	Yemen
Japan	

"Designated country construction material" means a construction material that—

(1) Is wholly the growth, product, or manufacture of a designated country; or

(2) In the case of a construction material that consists in whole or in part of materials from another country, has been substantially transformed in a designated country into a new and different construction material distinct from the materials from which it was transformed.

"Domestic construction material" means—

(1) An unmanufactured construction material mined or produced in the United States; or

(2) A construction material manufactured in the United States, if the cost of its components mined, produced, or manufactured in the United States exceeds 50 percent of the cost of all its components. Components of foreign origin of the same class or kind for which nonavailability determinations have been made are treated as domestic.

"Foreign construction material" means a construction material other than a domestic construction material.

"Free Trade Agreement country" means Canada, Chile, Mexico, or Singapore.

"Free Trade Agreement country construction material" means a construction material that—

(1) Is wholly the growth, product, or manufacture of a Free Trade Agreement (FTA) country; or

(2) In the case of a construction material that consists in whole or in part of materials from another country, has been substantially transformed in a FTA country into a new and different construction material distinct from the materials from which it was transformed.

"United States" means the 50 States and the District of Columbia, and outlying areas.

(b) *Construction materials*. (1) This clause implements the Buy American Act (41 U.S.C. 10a–10d) by providing a preference for domestic construction material. In addition, the Contracting Officer has determined that the Trade Agreements Act and Free Trade Agreements (FTAs) apply to this acquisition.
Therefore, the Buy American Act restrictions are waived for designated country and FTA country construction materials.

(2) The Contractor shall use only domestic, designated country, or FTA country construction material in performing this contract, except as provided in paragraphs (b)(3) and (b)(4) of this clause.

(3) The requirement in paragraph (b)(2) of this clause does not apply to the construction materials or components listed by the Government as follows:

_____

[*Contracting Officer to list applicable excepted materials or indicate "none"*]

(4) The Contracting Officer may add other foreign construction material to the list in paragraph (b)(3) of this clause if the Government determines that—

(i) The cost of domestic construction material would be unreasonable. The cost of a particular domestic construction material subject to the restrictions of the Buy American Act is unreasonable when the cost of such material exceeds the cost of foreign material by more than 6 percent;

(ii) The application of the restriction of the Buy American Act to a particular construction material would be impracticable or inconsistent with the public interest; or

(iii) The construction material is not mined, produced, or manufactured in the United States in sufficient and reasonably available commercial quantities of a satisfactory quality.

(c) *Request for determination of inapplicability of the Buy American Act*. (1)(i) Any Contractor request to use foreign construction material in accordance with paragraph (b)(4) of this clause shall include adequate information for Government evaluation of the request, including—

(A) A description of the foreign and domestic construction materials;

(B) Unit of measure;

(C) Quantity;

(D) Price;

(E) Time of delivery or availability;

(F) Location of the construction project;

(G) Name and address of the proposed supplier; and

(H) A detailed justification of the reason for use of foreign construction materials cited in accordance with paragraph (b)(3) of this clause.

(ii) A request based on unreasonable cost shall include a reasonable survey of the market

and a completed price comparison table in the format in paragraph (d) of this clause.

(iii) The price of construction material shall include all delivery costs to the construction site and any applicable duty (whether or not a duty-free certificate may be issued).

(iv) Any Contractor request for a determination submitted after contract award shall explain why the Contractor could not reasonably foresee the need for such determination and could not have requested the determination before contract award. If the Contractor does not submit a satisfactory explanation, the Contracting Officer need not make a determination.

(2) If the Government determines after contract award that an exception to the Buy American Act applies and the Contracting Officer and the Contractor negotiate adequate consideration, the Contracting Officer will modify the contract to allow use of the foreign construction material. However, when the basis for the exception is the unreasonable price of a domestic construction material, adequate consideration is not less than the differential established in paragraph (b)(4)(i) of this clause.

(3) Unless the Government determines that an exception to the Buy American Act applies, use of foreign construction material is noncompliant with the Buy American Act.

(d) *Data*. To permit evaluation of requests under paragraph (c) of this clause based on unreasonable cost, the Contractor shall include the following information and any applicable supporting data based on the survey of suppliers:

FOREIGN AND DOMESTIC CONSTRUCTION MATERIALS PRICE COMPARISON			
Construction Material Description	Unit of Measure	Quantity	Price (Dollars)*
Item 1:			
Foreign construction material	_____	_____	_____
Domestic construction material	_____	_____	_____
Item 2:			
Foreign construction material	_____	_____	_____
Domestic construction material	_____	_____	_____

[List *name, address, telephone number, and contact for suppliers surveyed. Attach copy of response; if oral, attach summary.]*
[Include other applicable supporting information.]
[Include all delivery costs to the construction site and any applicable duty (whether or not a duty-free entry certificate is issued).]*

(e) United States law will apply to resolve any claim of breach of this contract.

(End of clause)

Alternate I (Jan 2004). As prescribed in 25.1102(c)(3), delete the definitions of ''Free Trade Agreement country'' and ''Free Trade Agreement country construction material'' from the definitions in paragraph (a) of the basic clause, add the following definition of ''Chilean construction material'' to paragraph (a) of the basic clause, and substitute the following paragraphs (b)(1) and (b)(2) for paragraphs (b)(1) and (b)(2) of the basic clause:

"Chilean construction material" means a construction material that—

(1) Is wholly the growth, product, or manufacture of Chile; or

(2) In the case of a construction material that consists in whole or in part of materials from another country, has been substantially transformed in Chile into a new and different construction material distinct from the materials from which it was transformed.

(b) *Construction materials.* (1) This clause implements the Buy American Act (41 U.S.C. 10a–10d) by providing a preference for domestic construction material. In addition, the Contracting Officer has determined that

the Trade Agreements Act, the Chile Free Trade Agreement, and the Singapore Free Trade Agreement apply to this acquisition. Therefore, the Buy American Act restrictions are waived for designated country and Chilean construction materials.

(2) The Contractor shall use only domestic, designated country, or Chilean construction material in performing this contract, except as provided in paragraphs (b)(3) and (b)(4) of this clause.

62. *FAR 52.225-12 NOTICE OF BUY AMERICAN ACT REQUIREMENT—CONSTRUCTION MATERIALS UNDER TRADE AGREEMENTS (JAN 2004) [Applicable with FAR 52.225-11] ALTERNATE II (JAN 2004) [For Contracts Between 6.481 and 7.344733 Million]

(a) *Definitions.* "Construction material," "designated country construction material," "domestic construction material," "foreign construction material," and "FTA country construction material," as used in this provision, are defined in the clause of this solicitation entitled "Buy American Act—Construction Materials under Trade Agreements" (Federal Acquisition Regulation (FAR) clause 52.225-11).

(b) *Requests for determination of inapplicability*. An offeror requesting a determination regarding the inapplicability of the Buy American Act should submit the request to the Contracting Officer in time to allow a determination before submission of offers. The offeror shall include the information and applicable supporting data required by paragraphs (c) and (d) of FAR clause 52.225-11 in the request. If an offeror has not requested a determination regarding the inapplicability of the Buy American Act before submitting its offer, or has not received a response to a previous request, the offeror shall include the information and supporting data in the offer.

(c) *Evaluation of offers*. (1) The Government will evaluate an offer requesting exception to the requirements of the Buy American Act, based on claimed unreasonable cost of domestic construction materials, by adding to the offered price the appropriate percentage of the cost of such foreign construction material, as specified in paragraph (b)(4)(i) of FAR clause 52.225-11.

(2) If evaluation results in a tie between an offeror that requested the substitution of foreign construction material based on unreasonable cost and an offeror that did not request an exception, the Contracting Officer will award to the offeror that did not request an exception based on unreasonable cost.

(d) *Alternate offers*. (1) When an offer includes foreign construction material, other than designated country or FTA country construction material, that is not listed by the Government in this solicitation in paragraph (b)(3) of FAR clause 52.225-11, the offeror also may submit an alternate offer based on use of equivalent domestic, designated country, or FTA country construction material.

(2) If an alternate offer is submitted, the offeror shall submit a separate Standard Form 1442 for the alternate offer, and a separate price comparison table prepared in accordance with paragraphs (c) and (d) of FAR clause 52.225-11 for the offer that is based on the use of any foreign construction material for which the Government has not yet determined an exception applies.

(3) If the Government determines that a particular exception requested in accordance with paragraph (c) of FAR clause 52.225-11 does not apply, the Government will evaluate only those offers based on use of the equivalent domestic, designated country, or FTA country construction material, and the offeror shall be required to furnish such domestic, designated country, or FTA country construction material. An offer based on use of the foreign construction material for which an exception was requested—

(i) Will be rejected as nonresponsive if this acquisition is conducted by sealed bidding; or

(ii) May be accepted if revised during negotiations.

(End of provision)

ALTERNATE II (JAN 2004) **[For Contracts between 6.481 and 7.304733 Million]**
As prescribed in 25.1102(d)(3), substitute the following paragraphs (a) and (d) for paragraphs (a) and (d) of the basic provision:

(a) Definitions. *Chilean construction material, construction material, designated country construction material, domestic construction material*, and *foreign construction material*, as used in this provision, are defined in the clause of this solicitation entitled ''Buy American Act—Construction Materials Under Trade Agreements'' (Federal Acquisition Regulation (FAR) clause 52.225–11).

(d) *Alternate offers*. (1) When an offer includes foreign construction material, other than designated country or Chilean construction material, that is not listed by the Government in this solicitation in paragraph (b)(3) of FAR clause 52.225–11, the offeror also may submit an alternate offer based on use of equivalent domestic, designated country, or Chilean construction material.

(2) If an alternate offer is submitted, the offeror shall submit a separate Standard Form 1442 for the alternate offer, and a separate price comparison table prepared in accordance with paragraphs (c) and (d) of FAR clause 52.225-11 for the offer that is based on the use of any foreign construction material for which the Government has not yet determined an exception applies.

(3) If the Government determines that a particular exception requested in accordance with paragraph (c) of FAR clause 52.225–11 does not apply, the Government will evaluate only those offers based on use of the equivalent domestic, designated country, or Chilean construction material, and the offeror shall be required to furnish such domestic, designated country, or Chilean construction material. An offer based on use of the foreign construction material for which an exception was requested—

(i) Will be rejected as nonresponsive if this acquisition is conducted by sealed bidding; or
(ii) May be accepted if revised during negotiations.

63. *FAR 52.225-13 RESTRICTIONS ON CERTAIN FOREIGN PURCHASES (DEC 2003)

(a) Except as authorized by the Office of Foreign Assets Control (OFAC) in the Department of the Treasury, the Contractor shall not acquire, for use in the performance of this contract, any supplies or services if any proclamation, Executive order, or statute administered by OFAC, or if OFAC's implementing regulations at 31 CFR chapter V, would prohibit such a transaction by a person subject to the jurisdiction of the United States.

(b) Except as authorized by OFAC, most transactions involving Cuba, Iran, Libya, and Sudan are prohibited, as are most imports from North Korea, into the United States or its outlying areas. Lists of entities and individuals subject to economic sanctions are included in OFAC's List of Specially Designated Nationals and Blocked Persons at *http://www.epls.gov/TerList1.html*. More information about these restrictions, as well as updates, is available in the OFAC's regulations at 31 CFR chapter V and/or on OFAC's website at *http://www.treas.gov/ofac*.

(c) The Contractor shall insert this clause, including this paragraph (c), in all subcontracts.
(End of clause)

64. DFARS 252.226-7001 UTILIZATION OF INDIAN ORGANIZATIONS, INDIAN-OWNED ECONOMIC ENTERPRISES, AND NATIVE HAWAIIAN SMALL BUSINESS CONCERNS (OCT 2003)

(a) *Definitions.* As used in this clause--

"Indian" means any person who is a member of any Indian tribe, band, group, pueblo, or community that is recognized by the Federal Government as eligible for services from the Bureau of Indian Affairs (BIA) in accordance with 25 U.S.C. 1452(c) and any "Native" as defined in the Alaska Native Claims Settlement Act (43 U.S.C. 1601).

"Indian organization" means the governing body of any Indian tribe or entity established or recognized by the governing body of an Indian tribe for the purposes of 25 U.S.C. Chapter 17.

"Indian-owned economic enterprise" means any Indian-owned (as determined by the Secretary of the Interior) commercial, industrial, or business activity established or organized for the purpose of profit, provided that Indian ownership constitutes not less than 51 percent of the enterprise.

"Indian tribe" means any Indian tribe, band, group, pueblo, or community, including native villages and native groups (including corporations organized by Kenai, Juneau, Sitka, and Kodiak) as defined in the Alaska Native Claims Settlement Act, that is recognized by the Federal Government as eligible for services from BIA in accordance with 25 U.S.C. 1452(c).

"Interested party" means a contractor or an actual or prospective offeror whose direct economic interest

would be affected by the award of a subcontract or by the failure to award a subcontract.

"Native Hawaiian small business concern" means an entity that is-

(1) A small business concern as defined in Section 3 of the Small Business Act (15 U.S.C. 632) and relevant implementing regulations; and

(2) Owned and controlled by a Native Hawaiian as defined in 25 U.S.C. 4221(9).

(b) The Contractor shall use its best efforts to give Indian organizations, Indian-owned economic enterprises, and Native Hawaiian small business concerns the maximum practicable opportunity to participate in the subcontracts it awards, to the fullest extent consistent with efficient performance of the contract.

(c) The Contracting Officer and the Contractor, acting in good faith, may rely on the representation of an Indian organization, Indian-owned economic enterprise, or Native Hawaiian small business concern as to its eligibility, unless an interested party challenges its status or the Contracting Officer has independent reason to question that status.

(d) In the event of a challenge to the representation of a subcontractor, the Contracting Officer will refer the matter to-

(1) For matters relating to Indian organizations or Indian-owned economic enterprises:

U.S. Department of the Interior
Bureau of Indian Affairs
Attn: Chief, Division of Contracting and
Grants Administration
1849 C Street NW, MS-2626-MIB
Washington, DC 20240-4000.

The BIA will determine the eligibility and will notify the Contracting Officer.

(2) For matters relating to Native Hawaiian small business concerns:

Department of Hawaiian Home Lands
PO Box 1879
Honolulu, HI 96805.

The Department of Hawaiian Home Lands will determine the eligibility and will notify the Contracting Officer.

(e) No incentive payment will be made-

(1) While a challenge is pending; or

(2) If a subcontractor is determined to be an ineligible participant.

(f)(1) The Contractor, on its own behalf or on behalf of a subcontractor at any tier, may request an incentive payment in accordance with this clause.

(2) The incentive amount that may be requested is 5 percent of the estimated cost, target cost, or fixed price included in the subcontract at the time of award to the Indian organization, Indian-owned economic enterprise, or Native Hawaiian small business concern.

(3) In the case of a subcontract for commercial items, the Contractor may receive an incentive payment only if the subcontracted items are produced or manufactured in whole or in part by an Indian organization, Indian-owned economic enterprise, or Native Hawaiian small business concern.

(4) The Contractor has the burden of proving the amount claimed and shall assert its request for an incentive payment prior to completion of contract performance.

(5) The Contracting Officer, subject to the terms and conditions of the contract and the availability of funds, will authorize an incentive payment of 5 percent of the estimated cost, target cost, or fixed price included

in the subcontract awarded to the Indian organization, Indian-owned economic enterprise, or Native Hawaiian small business concern.

(6) If the Contractor requests and receives an incentive payment on behalf of a subcontractor, the Contractor is obligated to pay the subcontractor the incentive amount.

(g) The Contractor shall insert the substance of this clause, including this paragraph (g), in all subcontracts exceeding $500,000 for which further subcontracting opportunities may exist.

(End of clause)

65. *FAR 52.227-1 AUTHORIZATION AND CONSENT (JUL 1995)

(a) The Government authorizes and consents to all use and manufacture, in performing this contract or any subcontract at any tier, of any invention described in and covered by a United States patent

(1) embodied in the structure or composition of any article the delivery of which is accepted by the Government under this contract or

(2) used in machinery, tools, or methods whose use necessarily results from compliance by the Contractor or a subcontractor with

(i) specifications or written provisions forming a part of this contract or

(ii) specific written instructions given by the Contracting Officer directing the manner of performance. The entire liability to the Government for infringement of a patent of the United States shall be determined solely by the provisions of the indemnity clause, if any, included in this contract or any subcontract hereunder (including any lower-tier subcontract), and the Government assumes liability for all other infringement to the extent of the authorization and consent hereinabove granted.

(b) The Contractor agrees to include, and require inclusion of, this clause, suitably modified to identify the parties, in all subcontracts at any tier for supplies or services (including construction, architect-engineer services, and materials, supplies, models, samples, and design or testing services expected to exceed the simplified acquisition threshold) however, omission of this clause from any subcontract, including those at or below the simplified acquisition threshold, does not affect this authorization and consent.

66. *FAR 52.227-2 NOTICE AND ASSISTANCE REGARDING PATENT AND COPYRIGHT INFRINGEMENT (AUG 1996)

(a) The Contractor shall report to the Contracting Officer, promptly and in reasonable written detail, each notice or claim of patent or copy-right infringement based on the performance of this contract of which the Contractor has knowledge.

(b) In the event of any claim or suit against the Government on account of any alleged patent or copyright infringement arising out of the performance of this contract or out of the use of any supplies furnished or work or services performed under this contract, the Contractor shall furnish to the Government, when requested by the Contracting Officer, all evidence and information in possession of the Contractor pertaining to such suit or claim. Such evidence and information shall be furnished at the expense of the Government except where the Contractor has agreed to indemnify the Government.

(c) The Contractor agrees to include, and require inclusion of, this clause in all subcontracts at any tier for supplies or services (including construction and architect-engineer subcontracts and those for material, supplies, models, samples, or design or testing services) expected to exceed the simplified acquisition threshold at FAR 2.101.

67. *FAR 52.227-4 PATENT INDEMNITY--CONSTRUCTION CONTRACTS (APR 1984)

Except as otherwise provided, the Contractor agrees to indemnify the Government and its officers, agents, and employees against liability, including costs and expenses, for infringement upon any United States patent (except a patent issued upon an application that is now or may hereafter be withheld from issue pursuant to a

Secrecy Order under 35 U.S.C. 181) arising out of performing this contract or out of the use or disposal by or for the account of the Government of supplies furnished or work performed under this contract.

68. DFARS 252.227-7033 RIGHTS IN SHOP DRAWINGS (APR 1966)

(a) Shop drawings for construction means drawings, submitted to the Government by the Construction Contractor, subcontractor or any lower-tier subcontractor pursuant to a construction contract, showing in detail

(i) the proposed fabrication and assembly of structural elements and (ii) the installation (i.e., form, fit, and attachment details) of materials or equipment. The Government may duplicate, use, and disclose in any manner and for any purpose shop drawings delivered under this contract.

(b) This clause, including this paragraph (b), shall be included in all subcontracts hereunder at any tier.

69. FAR 52.228-1 BID GUARANTEE (SEP 1996) [NOTE: Not required for projects less than $100,000]

(a) Failure to furnish a bid guarantee in the proper form and amount, by the time set for opening of bids, may be cause for rejection of bids.

(b) The bidder shall furnish a bid guarantee in the form of a firm commitment, e.g., bid bond supported by good and sufficient surety or sureties acceptable to the Government, postal money order, certified check, cashier's check, irrevocable letter of credit, or, under Treasury Department regulations, certain bonds or notes of the United States. The Contracting Officer will return bid guarantees, other than bid bonds, (1) to unsuccessful bidders as soon as practicable after the opening of bids; and (2) to the successful bidder upon execution of contractual documents and bonds (including any necessary coinsurance or reinsurance agreements), as required by the bid as accepted.

(c) The amount of the bid guarantee shall be twenty (20%) of the bid price or Three Million Dollars ($3,000,000), whichever is less.

(d) If the successful bidder, upon acceptance of its bid by the Government within the period specified for acceptance, fails to execute all contractual documents or furnish executed bond(s) within 10 days after receipt of the forms by the bidder, the Contracting Officer may terminate the contract for default.

(e) In the event the contract is terminated for default, the bidder is liable for any cost of acquiring the work that exceeds the amount of its bid and the bid guarantee is available to offset the difference.

70. *FAR 52.228-2 ADDITIONAL BOND SECURITY (OCT 1997)

The Contractor shall promptly furnish additional security required to protect the Government and persons supplying labor or materials under this contract if--

(a) Any surety upon any bond, or issuing financial institution for other security, furnished with this contract becomes unacceptable to the Government;

(b) Any surety fails to furnish reports on its financial condition as required by the Government;

(c) The contract price is increased so that the penal sum of any bond becomes inadequate in the opinion of the Contracting Officer; or

(d) An irrevocable letter of credit (ILC) used as security will expire before the end of the period of required security. If the Contractor does not furnish an acceptable extension or replacement ILC, or other acceptable substitute, at least 30 days before an ILC's scheduled expiration, the Contracting Officer has the right to immediately draw on the ILC.

71. *FAR 52.228-5 INSURANCE--WORK ON A GOVERNMENT INSTALLATION (JAN 1997) [For Contracts Exceeding $100,000]

(a) The Contractor shall, at its own expense, provide and maintain during the entire performance of this contract, at least the kinds and minimum amounts of insurance required in the Schedule or elsewhere in the contract.

(b) Before commencing work under this contract, the Contractor shall notify the Contracting Officer in writing that the required insurance has been obtained. The policies evidencing required insurance shall contain an endorsement to the effect that any cancellation or any material change adversely affecting the Government's interest shall not be effective

(1) for such period as the laws of the State in which this contract is to be performed prescribe, or

(2) until 30 days after the insurer or the Contractor gives written notice to the Contracting Officer, whichever period is longer.

(c) The Contractor shall insert the substance of this clause, including this paragraph (c), in subcontracts under this contract that require work on a Government installation and shall require subcontractors to provide and maintain the insurance required in the Schedule or elsewhere in the contract. The Contractor shall maintain a copy of all subcontractors' proofs of required insurance, and shall make copies available to the Contracting Officer upon request.

72. *FAR 52.228-11 PLEDGES OF ASSETS (FEB 1992)

(a) Offerors shall obtain from each person acting as an individual surety on a bid guarantee, a performance bond, or a payment bond--

(1) Pledge of assets; and

(2) Standard Form 28, Affidavit of Individual Surety.

(b) Pledges of assets from each person acting as an individual surety shall be in the form of--

(1) Evidence of an escrow account containing cash, certificates of deposit, commercial or Government securities, or other assets described in FAR 28.203-2 (except see 28.203-2(b)(2) with respect to Government securities held in book entry form) and/or;

(2) A recorded lien on real estate. The offeror will be required to provide--

(i) Evidence of title in the form of a certificate of title prepared by a title insurance company approved by the United States Department of Justice. This title evidence must show fee simple title vested in the surety along with any concurrent owners; whether any real estate taxes are due and payable; and any recorded encumbrances against the property, including the lien filed in favor of the Government as required by FAR 28.203-3(d);

(ii) Evidence of the amount due under any encumbrance shown in the evidence of title;

(iii) A copy of the current real estate tax assessment of the property or a current appraisal dated no earlier than 6 months prior to the date of the bond, prepared by a professional appraiser who certifies that the appraisal has been conducted in accordance with the generally accepted appraisal standards as reflected in the Uniform Standards of Professional Appraisal Practice, as promulgated by the Appraisal Foundation.

73. *FAR 52.228-12 PROSPECTIVE SUBCONTRACTOR REQUESTS FOR BONDS (OCT 1995)

In accordance with Section 806(a)(3) of Public Law 102-190, as amended by Sections 2091 and 8105 of Pub. L. 103-355, upon the request of a prospective subcontractor or supplier offering to furnish labor or material for the performance of this contract for which a payment bond has been furnished to the Government pursuant to the Miller Act, the Contractor shall promptly provide a copy of such payment bond to the requestor.

74. FAR 52.228-13 ALTERNATIVE PAYMENT PROTECTIONS (JULY 2000) [Applicable only for

projects or delivery orders less than $100,000]

(a) The Contractor shall submit one of the following payment protections:

(1) A payment bond.

(2) An irrevocable letter of credit from a federally insured financial institution.

(b) The amount of the payment protection shall be 100 percent of the contract price.

(c) The submission of the payment protection is required within 10 days of contract award.

(d) The payment protection shall provide protection for the full contract performance period plus a one-year period.

(e) Except for escrow agreements and payment bonds, which provide their own protection procedures, the Contracting Officer is authorized to access funds under the payment protection when it has been alleged in writing by a supplier of labor or material that a nonpayment has occurred, and to withhold funds pending resolution by administrative or judicial proceedings or mutual agreement of the parties.

(f) When a tripartite escrow agreement is used, the Contractor shall utilize only suppliers of labor and material that signed the escrow agreement.

75. FAR 52.228-14 IRREVOCABLE LETTER OF CREDIT (DEC 1999)

(a) "Irrevocable letter of credit" (ILC), as used in this clause, means a written commitment by a federally insured financial institution to pay all or part of a stated amount of money, until the expiration date of the letter, upon presentation by the Government (the beneficiary) of a written demand therefor. Neither the financial institution nor the offeror/Contractor can revoke or condition the letter of credit.

(b) If the offeror intends to use an ILC in lieu of a bid bond, or to secure other types of bonds such as performance and payment bonds, the letter of credit and letter of confirmation formats in paragraphs (e) and (f) of this clause shall be used.

(c) The letter of credit shall be irrevocable, shall require presentation of no document other than a written demand and the ILC (including confirming letter, if any), shall be issued/confirmed by an acceptable federally insured financial institution as provided in paragraph (d) of this clause, and--

(1) If used as a bid guarantee, the ILC shall expire no earlier than 60 days after the close of the bid acceptance period;

(2) If used as an alternative to corporate or individual sureties as security for a performance or payment bond, the offeror/Contractor may submit an ILC to cover the entire period of performance or may submit an ILC with an initial expiration date estimated to cover the entire period for which financial security is required or may submit an ILC with an initial expiration that is a minimum period of one year from the date of issuance. The ILC shall provide that, unless the issuer provides the beneficiary written notice of non-renewal of least 60 days in advance of the current expiration date, the ILC is automatically extended without amendment for one year from the expiration date, or any future expiration date, until the period of required coverage is completed and the Contracting Officer provides the financial institution with a written statement waiving the right to payment. The period of required coverage shall be:

(i) For contracts subject to the Miller Act, the later of--

(A) One year following the expected date of final payment;

(B) For performance bonds only, until completion of any warranty period; or

(C) For payment bonds only, until resolution of all claims filed against the payment bond during the one-year period following final payment.

(ii) For contracts not subject to the Miller Act, the later of--

(A) 90 days following final payment; or

(B) For performance bonds only, until completion of any warranty period.

(d) Only federally insured financial institution rated investment grade or higher shall issue or confirm the ILC. The offeror/Contractor shall provide the Contracting Officer a credit rating that indicates the financial institution has the required rating(s) as of the date of issuance of the ILC. Unless the financial institution issuing the ILC had letter of credit business of at least $25 million in the past year, ILCs over $5 million must be confirmed by another acceptable financial institution that had letter of credit business of at least $25 million in the past year.

(e) The following format shall be used by the issuing financial institution to create an ILC:

[Issuing Financial Institution's Letterhead or Name and Address]

Issue Date----------

Irrevocable Letter of Credit No.----------
Account party's name----------
Account party's address----------
For Solicitation No.----------
(For reference only)

TO: [U.S. Government agency]
[U.S. Government agency's address]

1. We hereby establish this irrevocable and transferable Letter of Credit in your favor for one or more drawings up to United States $_____. This Letter of Credit is payable at [issuing financial institution's and, if any, confirming financial institution's] office at [issuing financial institution's address and, if any, confirming financial institution's address] and expires with our close of business on _____, or any automatically extended expiration date.

2. We hereby undertake to honor your or transferee's sight draft(s) drawn on issuing or, if any, the confirming financial institution, for all or any part of this credit if presented with this Letter of Credit and confirmation, if any, at the office specified in paragraph 1 of this Letter of Credit on or before the expiration date or any automatically extended expiration date.

3. [This paragraph is omitted if used as a bid guarantee, and subsequent paragraphs are renumbered.] It is a condition of this Letter of Credit that it is deemed to be automatically extended without amendment for one year from the expiration date hereof, or any future expiration date, unless at least 60 days prior to any expiration date, we notify you or the transferee by registered mail, or other receipted means of delivery, that we elect not to consider this Letter of Credit renewed for any such additional period. At the time we notify you, we also agree to notify the account party (and confirming financial institution, if any) by the same means of delivery.

4. This Letter of Credit is transferable. Transfers and assignments of proceeds are to be effected without charge to either the beneficiary or the transferee/assignee of proceeds. Such transfer or assignment shall be only at the written direction of the Government (the beneficiary) in a form satisfactory to the issuing financial institution and the confirming financial institution, if any.

5. This Letter of Credit is subject to the Uniform Customs and Practice (UCP) for Documentary Credits, 1993 Revision, International Chamber of Commerce Publication No. 500, and to the extent not inconsistent therewith, to the laws of _____ [state of confirming financial institution, if any, otherwise state of issuing financial institution].

6. If this credit expires during an interruption of business of this financial institution as described in Article 17 of the UCP, the financial institution specifically agrees to effect payment if this credit is drawn against within 30 days after the resumption of our business.

Sincerely,

[Issuing financial institution]

(f) The following format shall be used by the financial institution to confirm an ILC:

[Confirming Financial Institution's Letterhead or Name and Address]---

(Date) _____

Our Letter of Credit
Advice Number----------
Beneficiary:----------
[U.S. Government agency]

Issuing Financial Institution:----------
Issuing Financial Institution's LC No.:----------

Gentlemen:

1. We hereby confirm the above indicated Letter of Credit, the original of which is attached, issued by _____ [name of issuing financial institution] for drawings of up to United States dollars _____/U.S. $_____ and expiring with our close of business on _____ [the expiration date], or any automatically extended expiration date.

2. Draft(s) drawn under the Letter of Credit and this Confirmation are payable at our office located at _____.

3. We hereby undertake to honor sight draft(s) drawn under and presented with the Letter of Credit and this Confirmation at our offices as specified herein.

4. [This paragraph is omitted if used as a bid guarantee, and subsequent paragraphs are renumbered.] It is a condition of this confirmation that it be deemed automatically extended without amendment for one year from the expiration date hereof, or any automatically extended expiration date, unless:

(a) At least 60 days prior to any such expiration date, we shall notify the Contracting Officer, or the transferee and the issuing financial institution, by registered mail or other receipted means of delivery, that we elect not to consider this confirmation extended for any such additional period; or

(b) The issuing financial institution shall have exercised its right to notify you or the transferee, the account party, and ourselves, of its election not to extend the expiration date of the Letter of Credit.

5. This confirmation is subject to the Uniform Customs and Practice (UCP) for Documentary Credits, 1993 Revision, International Chamber of Commerce Publication No. 500, and to the extent not inconsistent therewith, to the laws of _____ [state of confirming financial institution].

6. If this confirmation expires during an interruption of business of this financial institution as described in Article 17 of the UCP, we specifically agree to effect payment if this credit is drawn against within 30 days after the resumption of our business.

Sincerely,

[Confirming financial institution]

(g) The following format shall be used by the Contracting Officer for a sight draft to draw on the Letter of Credit:

SIGHT DRAFT

[City, State]

(Date) _____

[Name and address of financial institution]
Pay to the order of----------
[Beneficiary Agency] _____

the sum of United States $ _____
This draft is drawn under----------
Irrevocable Letter of Credit No.----------

[Beneficiary Agency]
By: _____

76. FAR 52.228-15 PERFORMANCE AND PAYMENT BONDS (JULY 2000).

[This provision is Not Required for projects less than $100,000. See Clauses "Alternate Payment Protections" and "Inapplicable Provisions and Clauses".]

(a) *Definitions*. As used in this clause—

"Original contract price" means the award price of the contract; or, for requirements contracts, the price payable for the estimated total quantity; or, for indefinite-quantity contracts, the price payable for the specified minimum quantity. Original contract price does not include the price of any options, except those options exercised at the time of contract award.

(b) *Amount of required bonds*. Unless the resulting contract price is $100,000 or less, the successful offeror shall furnish performance and payment bonds to the Contracting Officer as follows:

(1) *Performance bonds (Standard Form 25).* The penal amount of performance bonds at the time of contract award shall be 100 percent of the original contract price.

(2) *Payment Bonds (Standard Form 25-A).* The penal amount of payment bonds at the time of contract award shall be 100 percent of the original contract price.

(3) *Additional bond protection*. (i) The Government may require additional performance and payment bond protection if the contract price is increased. The increase in protection generally will equal 100 percent of the increase in contract price.

(ii) The Government may secure the additional protection by directing the Contractor to increase the penal amount of the existing bond or to obtain an additional bond.

(c) *Furnishing executed bonds*. The Contractor shall furnish all executed bonds, including any necessary reinsurance agreements, to the Contracting Officer, within the time period specified in the Bid Guarantee provision of the solicitation, or otherwise specified by the Contracting Officer, but in any event, before starting work.

(d) *Surety or other security for bonds*. The bonds shall be in the form of firm commitment, supported by corporate sureties whose names appear on the list contained in Treasury Department Circular 570, individual sureties, or by other acceptable security such as postal money order, certified check, cashier's check, irrevocable letter of credit, or, in accordance with Treasury Department regulations, certain bonds or notes of the United States. Treasury Circular 570 is published in the Federal Register or may be obtained from the:

U.S. Department of Treasury
Financial Management Service
Surety Bond Branch
401 14th Street, NW, 2nd Floor, West Wing
Washington, DC 20227.

(e) *Notice of subcontractor waiver of protection (40 U.S.C. 270b(c).* Any waiver of the right to sue on the payment bond is void unless it is in writing, signed by the person whose right is waived, and executed after such person has first furnished labor or material for use in the performance of the contract.
(End of clause)

77. FAR 52.229-3 FEDERAL, STATE, AND LOCAL TAXES (APR 2003) [<u>For Contracts Exceeding $100,000</u>]

(a) As used in this clause--

"All applicable Federal, State, and local taxes and duties," means all taxes and duties, in effect on the contract date, that the taxing authority is imposing and collecting on the transactions or property covered by this contract.

"After-imposed Federal tax," as used in this clause, means any new or increased Federal excise tax or duty, or tax that was exempted or excluded on the contract date but whose exemption was later revoked or reduced during the contract period, on the transactions or property covered by this contract that the Contractor is required to pay or bear as the result of legislative, judicial, or administrative action taking effect after the contract date. It does not include social security tax or other employment taxes.

"After-relieved Federal tax," means any amount of Federal excise tax or duty, except social security or other employment taxes, that would otherwise have been payable on the transactions or property covered by this

contract, but which the Contractor is not required to pay or bear, or for which the Contractor obtains a refund or drawback, as the result of legislative, judicial, or administrative action taking effect after the contract date.

"Contract date," means the date set for bid opening or, if this is a negotiated contract or a modification, the effective date of this contract or modification.

"Local taxes" includes taxes imposed by a possession or territory of the United States, Puerto Rico, or the Northern Mariana Islands, if the contract is performed wholly or partly in any of those areas.

(b) The contract price includes all applicable Federal, State, and local taxes and duties.

(c) The contract price shall be increased by the amount of any after-imposed Federal tax, provided the Contractor warrants in writing that no amount for such newly imposed Federal excise tax or duty or rate increase was included in the contract price, as a contingency reserve or otherwise.

(d) The contract price shall be decreased by the amount of any after-relieved Federal tax.

(e) The contract price shall be decreased by the amount of any Federal excise tax or duty, except social security or other employment taxes, that the Contractor is required to pay or bear, or does not obtain a refund of, through the Contractor's fault, negligence, or failure to follow instructions of the Contracting Officer.

(f) No adjustment shall be made in the contract price under this clause unless the amount of the adjustment exceeds $250.

(g) The Contractor shall promptly notify the Contracting Officer of all matters relating to any Federal excise tax or duty that reasonably may be expected to result in either an increase or decrease in the contract price and shall take appropriate action as the Contracting Officer directs.

(h) The Government shall, without liability, furnish evidence appropriate to establish exemption from any Federal, State, or local tax when the Contractor requests such evidence and a reasonable basis exists to sustain the exemption.

78. RESERVED

79. DFARS 252.231-7000 SUPPLEMENTAL COST PRINCIPLES (DEC 1991)

When the allowability of costs under this contract is determined in accordance with part 31 of the Federal Acquisition Regulation (FAR) allowability shall also be determined in accordance with part 231 of the DoD FAR Supplement, in effect on the date of this contract.

80. *FAR 52.232-5 PAYMENTS UNDER FIXED-PRICE CONSTRUCTION CONTRACTS (SEPT 2002)

(a) Payment of Price. The Government shall pay the Contractor the contract price as provided in this contract.

(b) Progress Payments. The Government shall make progress payments monthly as the work proceeds, or at more frequent intervals as determined by the Contracting Officer, on estimates of work accomplished which meets the standards of quality established under the contract, as approved by the Contracting Officer.

(1) The Contractor's request for progress payments shall include the following substantiation:

(i) An itemization of the amounts requested, related to the various elements of work required by the contract covered by the payment requested.

(ii) A listing of the amount included for work performed by each subcontractor under the contract.

(iii) A listing of the total amount of each subcontract under the contract.

(iv) A listing of the amounts previously paid to each such subcontractor under the contract.

(v) Additional supporting data in a form and detail required by the Contracting Officer.

(2) In the preparation of estimates, the Contracting Officer may authorize material delivered on the site and preparatory work done to be taken into consideration. Material delivered to the Contractor at locations other than the site also may be taken into consideration if--

(i) Consideration is specifically authorized by this contract; and

(ii) The Contractor furnishes satisfactory evidence that it has acquired title to such material and that the material will be used to perform this contract.

(c) Contractor Certification. Along with each request for progress payments, the Contractor shall furnish the following certification, or payment shall not be made: (However, if the Contractor elects to delete paragraph (c)(4) from the certification, the certification is still acceptable.) I hereby certify, to the best of my knowledge and belief, that--

(1) The amounts requested are only for performance in accordance with the specifications, terms, and conditions of the contract;

(2) All payments due to subcontractors and suppliers from previous payments received under the contract have been made, and timely payments will be made from the proceeds of the payment covered by this certification, in accordance with subcontract agreements and the requirements of chapter 39 of Title 31, United States Code;

(3) This request for progress payments does not include any amounts which the prime contractor intends to withhold or retain from a subcontractor or supplier in accordance with the terms and conditions of the subcontract; and

(4) This certification is not to be construed as final acceptance of a subcontractor's performance.

(Name)

(Title)

(Date)

(d) Refund of Unearned Amounts. If the Contractor, after making a certified request for progress payments, discovers that a portion or all of such request constitutes a payment for performance by the Contractor that fails to conform to the specifications, terms, and conditions of this contract (hereinafter referred to as the "unearned amount"), the Contractor shall--

(1) Notify the Contracting Officer of such performance deficiency; and

(2) Be obligated to pay the Government an amount (computed by the Contracting Officer in the manner provided in paragraph (j) of this clause) equal to interest on the unearned amount from the 8th day after the date of receipt of the unearned amount until--

(i) The date the Contractor notifies the Contracting Officer that the performance deficiency has been corrected; or

(ii) The date the Contractor reduces the amount of any subsequent certified request for progress payments by an amount equal to the unearned amount.

(e) Retainage. If the Contracting Officer finds that satisfactory progress was achieved during any period for which a progress payment is to be made, the Contracting Officer shall authorize payment to be made in full. However, if satisfactory progress has not been made, the Contracting Officer may retain a maximum of 10 percent of the amount of the payment until satisfactory progress is achieved. When the work is substantially complete, the Contracting Officer may retain from previously withheld funds and future progress payments that amount the Contracting Officer considers adequate for protection of the Government and shall release to the Contractor all the remaining withheld funds. Also, on completion and acceptance of each separate building, public work, or other division of the contract, for which the price is stated separately in the contract, payment shall be made for the completed work without retention of a percentage.

(f) Title, Liability, and Reservation of Rights. All material and work covered by progress payments made shall, at the time of payment, become the sole property of the Government, but this shall not be construed as--

(1) Relieving the Contractor from the sole responsibility for al material and work upon which payments have been made or the restoration of any damaged work; or

(2) Waiving the right of the Government to require the fulfillment of all of the terms of the contract.

(g) Reimbursement for Bond Premiums. In making these progress payments, the Government shall, upon request, reimburse the Contractor for the amount of premiums paid for performance and payment bonds

(including coinsurance and reinsurance agreements, when applicable) after the Contractor has furnished evidence of full payment to the surety. The retainage provisions in paragraph (e) of this clause shall not apply to that portion of progress payments attributable to bond premiums.

(h) Final Payment. The Government shall pay the amount due the Contractor under this contract after--

(1) Completion and acceptance of all work;

(2) Presentation of a properly executed voucher; and

(3) Presentation of release of all claims against the Government arising by virtue of this contract, other than claims, in stated amounts, that the Contractor has specifically excepted from the operation of the release. A release may also be required of the assignee if the Contractor's claim to amounts payable under this contract has been assigned under the Assignment of Claims Act of 1940 (31 U.S.C. 3727 and 41 U.S.C. 15).

(i) Limitation Because of Undefinitized Work. Notwithstanding any provision of this contract, progress payments shall not exceed 80 percent on work accomplished on undefinitized contract actions. A "contract action" is any action resulting in a contract, as defined in FAR Subpart 2.1, including contract modifications for additional supplies or services, but not including contract modifications that are within the scope and under the terms of the contract, such as contract modifications issued pursuant to the Changes clause, or funding and other administrative changes.

(j) Interest Computation on Unearned Amounts. In accordance with 31 U.S.C. 3903(c)(1), the amount payable under subparagraph (d)(2) of this clause shall be--

(1) Computed at the rate of average bond equivalent rates of 91-day Treasury bills auctioned at the most recent auction of such bills prior to the date the Contractor receives the unearned amount; and

(2) Deducted from the next available payment to the Contractor.

81. RESERVED.

82. *FAR 52.232-17 INTEREST (JUN 1996)

(a) Except as otherwise provided in this contract under a Price Reduction for Defective Cost or Pricing Data clause or a Cost Accounting Standards clause, all amounts that become payable by the Contractor to the Government under this contract (net of any applicable tax credit under the Internal Revenue Code (26 U.S.C. 1481)) shall bear simple interest from the date due until paid unless paid within 30 days of becoming due. The interest rate shall be the interest rate established by the Secretary of the Treasury as provided in Section 12 of the Contract Disputes Act of 1978 (Public Law 95-563), which is applicable to the period in which the amount becomes due, as provided in paragraph (b) of this clause, and then at the rate applicable for each six-month period as fixed by the Secretary until the amount is paid.

(b) Amounts shall be due at the earliest of the following dates:

(1) The date fixed under this contract.

(2) The date of the first written demand for payment consistent with this contract, including any demand resulting from a default termination.

(3) The date the Government transmits to the Contractor a proposed supplemental agreement to confirm completed negotiations establishing the amount of debt.

(4) If this contract provides for revision of prices, the date of written notice to the Contractor stating the amount of refund payable in connection with a pricing proposal or a negotiated pricing agreement not confirmed by contract modification.

(c) The interest charge made under this clause may be reduced under the procedures prescribed in 32.614-2 of the Federal Acquisition Regulation in effect on the date of this contract.

83. *FAR 52.232-23 ASSIGNMENT OF CLAIMS (JAN 1986)

(a) The Contractor, under the Assignment of Claims Act, as amended, 31 U.S.C. 3727, 41 U.S.C. 15 (hereafter referred to as "the Act"), may assign its rights to be paid amounts due or to become due as a result of the

performance of this contract to a bank, trust company, or other financing institution, including any Federal lending agency. The assignee under such an assignment may thereafter further assign or reassign its right under the original assignment to any type of financing institution described in the preceding sentence.

(b) Any assignment or reassignment authorized under the Act and this clause shall cover all unpaid amounts payable under this contract, and shall not be made to more than one party, except that an assignment or reassignment may be made to one party as agent or trustee for two or more parties participating in the financing of this contract.

(c) The Contractor shall not furnish or disclose to any assignee under this contract any classified document (including this contract) or information related to work under this contract until the Contracting Officer authorizes such action in writing.

84. *FAR 52.232-27 PROMPT PAY FOR CONSTRUCTION CONTRACTS (OCT 2003)

Notwithstanding any other payment terms in this contract, the Government will make invoice payments under the terms and conditions specified in this clause. The Government considers payment as being made on the day a check is dated or the date of an electronic funds transfer. Definitions of pertinent terms are set forth in sections 2.101, 32.001, and 32.902 of the Federal Acquisition Regulation. All days referred to in this clause are calendar days, unless otherwise specified. (However, see paragraph (a)(3) concerning payments due on Saturdays, Sundays, and legal holidays.)

(a) *Invoice payments*—(1) *Types of invoice payments.* For purposes of this clause, there are several types of invoice payments that may occur under this contract, as follows:

(i) Progress payments, if provided for elsewhere in this contract, based on Contracting Officer approval of the estimated amount and value of work or services performed, including payments for reaching milestones in any project.

(A) The due date for making such payments is 14 days after the designated billing office receives a proper payment request. If the designated billing office fails to annotate the payment request with the actual date of receipt at the time of receipt, the payment due date is the 14th day after the date of the Contractor's payment request, provided the designated billing office receives a proper payment request and there is no disagreement over quantity, quality, or Contractor compliance with contract requirements.

(B) The due date for payment of any amounts retained by the Contracting Officer in accordance with the clause at 52.232–5, Payments Under Fixed-Price Construction Contracts, is as specified in the contract or, if not specified, 30 days after approval by the Contracting Officer for release to the Contractor.

(ii) Final payments based on completion and acceptance of all work and presentation of release of all claims against the Government arising by virtue of the contract, and payments for partial deliveries that have been accepted by the Government (*e.g.,* each separate building, public work, or other division of the contract for which the price is stated separately in the contract).

(A) The due date for making such payments is the later of the following two events:

(*1*) The 30th day after the designated billing office receives a proper invoice from the Contractor.

(*2*) The 30th day after Government acceptance of the work or services completed by the Contractor. For a final invoice when the payment amount is subject to contract settlement actions (*e.g.,* release of claims), acceptance is deemed to occur on the effective date of the contract settlement.

(B) If the designated billing office fails to annotate the invoice with the date of actual receipt at the time of receipt, the invoice payment due date is the 30th day after the date of the Contractor's invoice, provided the designated billing office receives a proper invoice and there is no disagreement over quantity, quality, or Contractor compliance with contract requirements.

(2) *Contractor's invoice.* The Contractor shall prepare and submit invoices to the designated billing office specified in the contract. A proper invoice must include the items listed in paragraphs (a)(2)(i) through (a)(2)(xi) of this clause. If the invoice does not comply with these requirements, the designated billing office must return it within 7 days after receipt, with the reasons why it is not a proper invoice. When computing any interest

penalty owed the Contractor, the Government will take into account if the Government notifies the Contractor of an improper invoice in an untimely manner.

(i) Name and address of the Contractor.

(ii) Invoice date and invoice number. (The Contractor should date invoices as close as possible to the date of mailing or transmission.)

(iii) Contract number or other authorization for work or services performed (including order number and contract line item number).

(iv) Description of work or services performed.

(v) Delivery and payment terms (*e.g.,* discount for prompt payment terms).

(vi) Name and address of Contractor official to whom payment is to be sent (must be the same as that in the contract or in a proper notice of assignment).

(vii) Name (where practicable), title, phone number, and mailing address of person to notify in the event of a defective invoice.

(viii) For payments described in paragraph (a)(1)(i) of this clause, substantiation of the amounts requested and certification in accordance with the requirements of the clause at 52.232–5, Payments Under Fixed-Price Construction Contracts.

(ix) Taxpayer Identification Number (TIN). The Contractor shall include its TIN on the invoice only if required elsewhere in this contract.

(x) Electronic funds transfer (EFT) banking information.

(A) The Contractor shall include EFTbanking information on the invoice only if required elsewhere in this contract.

(B) If EFT banking information is not required to be on the invoice, in order for the invoice to be a proper invoice, the Contractor shall have submitted correct EFT banking information in accordance with the applicable solicitation provision (*e.g.,* 52.232–38, Submission of Electronic Funds Transfer Information with Offer), contract clause (*e.g.,* 52.232–33, Payment by Electronic Funds Transfer—Central Contractor Registration, or 52.232–34, Payment by Electronic Funds Transfer—Other Than Central Contractor Registration), or applicable agency procedures.

(C) EFT banking information is not required if the Government waived the requirement to pay by EFT.

(xi) Any other information or documentation required by the contract.

(3) *Interest penalty.* The designated payment office will pay an interest penalty automatically, without request from the Contractor, if payment is not made by the due date and the conditions listed in paragraphs (a)(3)(i) through (a)(3)(iii) of this clause are met, if applicable. However, when the due date falls on a Saturday, Sunday, or legal holiday, the designated payment office may make payment on the following working day without incurring a late payment interest penalty.

(i) The designated billing office received a proper invoice.

(ii) The Government processed a receiving report or other Government documentation authorizing payment and there was no disagreement over quantity, quality, Contractor compliance with any contract term or condition, or requested progress payment amount.

(iii) In the case of a final invoice for any balance of funds due the Contractor for work or services performed, the amount was not subject to further contract settlement actions between the Government and the Contractor.

(4) *Computing penalty amount.* The Government will compute the interest penalty in accordance with the Office of Management and Budget prompt payment regulations at 5 CFR part 1315.

(i) For the sole purpose of computing an interest penalty that might be due the Contractor for payments described in paragraph (a)(1)(ii) of this clause, Government acceptance or approval is deemed to occur constructively on the 7th day after the Contractor has completed the work or services in accordance with the terms and conditions of the contract. If actual acceptance or approval occurs within the constructive acceptance or approval period, the Government will base the determination of an interest penalty on the actual date of acceptance or approval. Constructive acceptance or constructive approval requirements do not apply if there is a disagreement over quantity, quality, or Contractor compliance with a contract provision. These requirements also do not compel Government officials to accept work or services, approve Contractor estimates, perform contract administration functions, or make payment prior to fulfilling their responsibilities.

(ii) The prompt payment regulations at 5 CFR 1315.10(c) do not require the

Government to pay interest penalties if payment delays are due to disagreement between the Government and the Contractor over the payment amount or other issues involving contract compliance, or on amounts temporarily withheld or retained in accordance with the terms of the contract. The Government and the Contractor shall resolve claims involving disputes, and any interest that may be payable in accordance with the clause at FAR 52.233–1, Disputes.

(5) *Discounts for prompt payment.* The designated payment office will pay an interest penalty automatically, without request from the Contractor, if the Government takes a discount for prompt payment improperly. The Government will calculate the interest penalty in accordance with the prompt payment regulations at 5 CFR part 1315.

(6) *Additional interest penalty.* (i) The designated payment office will pay a penalty amount, calculated in accordance with the prompt payment regulations at 5 CFR part 1315 in addition to the interest penalty amount only if—

(A) The Government owes an interest penalty of $1 or more;

(B) The designated payment office does not pay the interest penalty within 10 days after the date the invoice amount is paid; and

(C) The Contractor makes a written demand to the designated payment office for additional penalty payment, in accordance with paragraph (a)(6)(ii) of this clause, postmarked not later than 40 days after the date the invoice amount is paid.

(ii)(A) The Contractor shall support written demands for additional penalty payments with the following data. The Government will not request any additional data. The Contractor shall—

(*1*) Specifically assert that late payment interest is due under a specific invoice, and request payment of all overdue late payment interest penalty and such additional penalty as may be required;

(*2*) Attach a copy of the invoice on which the unpaid late payment interest was due; and

(*3*) State that payment of the principal has been received, including the date of receipt.

(B) If there is no postmark or the postmark is illegible—

(1) The designated payment office that receives the demand will annotate it with the date of receipt provided the demand is received on or before the 40th day after payment was made; or

(*2*) If the designated payment office fails to make the required annotation, the Government will determine the demand's validity based on the date the Contractor has placed on the demand, provided such date is no later than the 40th day after payment was made.

(b) *Contract financing payments.* If this contract provides for contract financing, the Government will make contract financing payments in accordance with the applicable contract financing clause.

(c) *Subcontract clause requirements.* The Contractor shall include in each subcontract for property or services (including a material supplier) for the purpose of performing this contract the following:

(1) *Prompt payment for subcontractors.* A payment clause that obligates the Contractor to pay the subcontractor for satisfactory performance under its subcontract not later than 7 days from receipt of payment out of such amounts as are paid to the Contractor under this contract.

(2) *Interest for subcontractors.* An interest penalty clause that obligates the Contractor to pay to the subcontractor an interest penalty for each payment not made in accordance with the payment clause—

(i) For the period beginning on the day after the required payment date and ending on the date on which payment of the amount due is made; and

(ii) Computed at the rate of interest established by the Secretary of the Treasury, and published in the **Federal Register,** for interest payments under section 12 of the Contract Disputes Act of 1978 (41 U.S.C. 611) in effect at the time the Contractor accrues the obligation to pay an interest penalty.

(3) *Subcontractor clause flowdown.* A clause requiring each subcontractor to

(i) Include a payment clause and an interest penalty clause conforming to the standards set forth in paragraphs (c)(1) and (c)(2) of this clause in each of its subcontracts; and

(ii) Require each of its subcontractors to include such clauses in their subcontracts with each lower-tier subcontractor or supplier.

(d) *Subcontract clause interpretation.* The clauses required by paragraph (c) of this clause shall not be

construed to impair the right of the Contractor or a subcontractor at any tier to negotiate, and to include in their subcontract, provisions that—

(1) *Retainage permitted.* Permit the Contractor or a subcontractor to retain (without cause) a specified percentage of each progress payment otherwise due to a subcontractor for satisfactory performance under the subcontract without incurring any obligation to pay a late payment interest penalty, in accordance with terms and conditions agreed to by the parties to the subcontract, giving such recognition as the parties deem appropriate to the ability of a subcontractor to furnish a performance bond and a payment bond;

(2) *Withholding permitted.* Permit the Contractor or subcontractor to make a determination that part or all of the subcontractor's request for payment may be withheld in accordance with the subcontract agreement; and

(3) *Withholding requirements.* Permit such withholding without incurring any obligation to pay a late payment penalty if—

(i) A notice conforming to the standards of paragraph (g) of this clause previously has been furnished to the subcontractor; and

(ii) The Contractor furnishes to the Contracting Officer a copy of any notice issued by a Contractor pursuant to paragraph (d)(3)(i) of this clause.

(e) *Subcontractor withholding procedures.* If a Contractor, after making a request for payment to the Government but before making a payment to a subcontractor for the subcontractor's performance covered by the payment request, discovers that all or a portion of the payment otherwise due such subcontractor is subject to withholding from the subcontractor in accordance with the subcontract agreement, then the Contractor shall—

(1) *Subcontractor notice.* Furnish to the subcontractor a notice conforming to the standards of paragraph (g) of this clause as soon as practicable upon ascertaining the cause giving rise to a withholding, but prior to the due date for subcontractor payment;

(2) *Contracting Officer notice.* Furnish to the Contracting Officer, as soon as practicable, a copy of the notice furnished to the subcontractor pursuant to paragraph (e)(1) of this clause;

(3) *Subcontractor progress payment reduction.* Reduce the subcontractor's progress payment by an amount not to exceed the amount specified in the notice of withholding furnished under paragraph (e)(1) of this clause;

(4) *Subsequent subcontractor payment.* Pay the subcontractor as soon as practicable after the correction of the identified subcontract performance deficiency, and—

(i) Make such payment within—

(A) Seven days after correction of the identified subcontract performance deficiency (unless the funds therefor must be recovered from the Government because of a reduction under paragraph (e)(5)(i)) of this clause; or

(B) Seven days after the Contractor recovers such funds from the Government; or

(ii) Incur an obligation to pay a late payment interest penalty computed at the rate of interest established by the Secretary of the Treasury, and published in the **Federal Register**, for interest payments under section 12 of the Contracts Disputes Act of 1978 (41 U.S.C. 611) in effect at the time the Contractor accrues the obligation to pay an interest penalty;

(5) *Notice to Contracting Officer.* Notify the Contracting Officer upon—

(i) Reduction of the amount of any subsequent certified application for payment; or

(ii) Payment to the subcontractor of any withheld amounts of a progress payment, specifying—

(A) The amounts withheld under paragraph (e)(1) of this clause; and

(B) The dates that such withholding began and ended; and

(6) *Interest to Government.* Be obligated to pay to the Government an amount equal to interest on the withheld payments (computed in the manner provided in 31 U.S.C. 3903(c)(1)), from the 8th day after receipt of the withheld amounts from the Government until—

(i) The day the identified subcontractor performance deficiency is corrected; or

(ii) The date that any subsequent payment is reduced under paragraph (e)(5)(i) of this clause.

(f) *Third-party deficiency reports*—(1) *Withholding from subcontractor.* If a Contractor, after making payment to a first-tier subcontractor, receives from a supplier or subcontractor of the first-

tier subcontractor (hereafter referred to as a ''second-tier subcontractor'') a written notice in accordance with section 2 of the Act of August 24, 1935 (40 U.S.C. 270b, Miller Act), asserting a deficiency in such first-tier subcontractor's performance under the contract for which the Contractor may be ultimately liable, and the Contractor determines that all or a portion of future payments otherwise due such first-tier subcontractor is subject to withholding in accordance with the subcontract agreement, the Contractor may, without incurring an obligation to pay an interest penalty under paragraph (e)(6) of this clause—

(i) Furnish to the first-tier subcontractor a notice conforming to the standards of paragraph (g) of this clause as soon as practicable upon making such determination; and

(ii) Withhold from the first-tier subcontractor's next available progress payment or payments an amount not to exceed the amount specified in the notice of withholding furnished under paragraph (f)(1)(i) of this clause.

(2) *Subsequent payment or interest charge.* As soon as practicable, but not later than 7 days after receipt of satisfactory written notification that the identified subcontract performance deficiency has been corrected, the Contractor shall—

(i) Pay the amount withheld under paragraph (f)(1)(ii) of this clause to such first-tier subcontractor; or

(ii) Incur an obligation to pay a late payment interest penalty to such first-tier subcontractor computed at the rate of interest established by the Secretary of the Treasury, and published in the **Federal Register**, for interest payments under section 12 of the Contracts Disputes Act of 1978 (41 U.S.C. 611) in effect at the time the Contractor accrues the obligation to pay an interest penalty.

(g) *Written notice of subcontractor withholding.* The Contractor shall issue a written notice of any withholding to a subcontractor (with a copy furnished to the Contracting Officer), specifying—

(1) The amount to be withheld;

(2) The specific causes for the withholding under the terms of the subcontract; and

(3) The remedial actions to be taken by the subcontractor in order to receive payment of the amounts withheld.

(h) *Subcontractor payment entitlement.* The Contractor may not request payment from the Government of any amount withheld or retained in accordance with paragraph (d) of this clause until such time as the Contractor has determined and certified to the Contracting Officer that the subcontractor is entitled to the payment of such amount.

(i) *Prime-subcontractor disputes.* A dispute between the Contractor and subcontractor relating to the amount or entitlement of a subcontractor to a payment or a late payment interest penalty under a clause included in the subcontract pursuant to paragraph (c) of this clause does not constitute a dispute to which the Government is a party. The Government may not be interpleaded in any judicial or administrative proceeding involving such a dispute.

(j) *Preservation of prime-subcontractor rights.* Except as provided in paragraph (i) of this clause, this clause shall not limit or impair any contractual, administrative, or judicial remedies otherwise available to the Contractor or a subcontractor in the event of a dispute involving late payment or nonpayment by the Contractor or deficient subcontract performance or nonperformance by a subcontractor.

(k) *Non-recourse for prime contractor interest penalty.* The Contractor's obligation to pay an interest penalty to a subcontractor pursuant to the clauses included in a subcontract under paragraph (c) of this clause shall not be construed to be an obligation of the Government for such interest penalty. A cost-reimbursement claim may not include any amount for reimbursement of such interest penalty.

(l) *Overpayments*. If the Contractor becomes aware of a duplicate contract financing or invoice payment or that the Government has otherwise overpaid on a contract financing or invoice payment, the Contractor shall immediately notify the Contracting Officer and request instructions for disposition of the overpayment.
(End of clause)

85. *FAR 52.232-33 PAYMENT BY ELECTRONIC FUNDS TRANSFER –CENTRAL CONTRACTOR REGISTRATION (OCT 2003)

(a) *Method of payment*. (1) All payments by the Government under this contract shall be made by electronic funds transfer (EFT), except as provided in paragraph (a)(2) of this clause. As used in this clause, the term ''EFT'' refers to the funds transfer and may also include the payment information transfer.

(2) In the event the Government is unable to release one or more payments by EFT, the Contractor agrees to either—

(i) Accept payment by check or some other mutually agreeable method of payment; or

(ii) Request the Government to extend the payment due date until such time as the Government can make payment by EFT (but see paragraph (d) of this clause).

(b) *Contractor's EFT information*. The Government shall make payment to the Contractor using the EFT information contained in the Central Contractor Registration (CCR) database. In the event that the EFT information changes, the Contractor shall be responsible for providing the updated information to the CCR database.

(c) *Mechanisms for EFT payment*. The Government may make payment by EFT through either the Automated Clearing House (ACH) network, subject to the rules of the National Automated Clearing House Association, or the Fedwire Transfer System. The rules governing Federal payments through the ACH are contained in 31 CFR part 210.

(d) *Suspension of payment*. If the Contractor's EFT information in the CCR database is incorrect, then the Government need not make payment to the Contractor under this contract until correct EFT information is entered into the CCR database; and any invoice or contract financing request shall be deemed not to be a proper invoice for the purpose of prompt payment under this contract. The prompt payment terms of the contract regarding notice of an improper invoice and delays in accrual of interest penalties apply.

(e) *Contractor EFT arrangements*. If the Contractor has identified multiple payment receiving points (i.e., more than one remittance address and/or EFT information set) in the CCR database, and the Contractor has not notified the Government of the payment receiving point applicable to this contract, the Government shall make payment to the first payment receiving point (EFT information set or remittance address as applicable) listed in the CCR database.

(f) *Liability for uncompleted or erroneous transfers*. (1) If an uncompleted or erroneous transfer occurs because the Government used
the Contractor's EFT information incorrectly, the Government remains responsible for—

(i) Making a correct payment;

(ii) Paying any prompt payment penalty due; and

(iii) Recovering any erroneously directed funds.

(2) If an uncompleted or erroneous transfer occurs because the Contractor's EFT information was incorrect, or was revised within 30 days of Government release of the EFT payment transaction instruction to the Federal Reserve System, and—

(i) If the funds are no longer under the control of the payment office, the Government is deemed to have made payment and the Contractor is responsible for recovery of any erroneously directed funds; or

(ii) If the funds remain under the control of the payment office, the Government shall not make payment, and the provisions of paragraph (d) of this clause shall apply.

(g) *EFT and assignment of claims*. If the Contractor assigns the proceeds of this contract as provided for in the assignment of claims terms of this contract, the Contractor shall require as a condition of any such assignment, that the assignee shall register separately in the CCR database and shall be paid by EFT in accordance with the terms of this clause. Notwithstanding any other requirement of this contract, payment to an ultimate recipient other than the Contractor, or a financial institution properly recognized under an assignment of claims pursuant to Subpart 32.8, is not permitted. In all respects, the requirements of this clause shall apply to the assignee as if it were the Contractor. EFT information that shows the ultimate recipient of the transfer to be other than the Contractor, in the absence of a proper assignment of claims acceptable to the Government, is incorrect EFT information within the meaning of paragraph
(d) of this clause.

(h) *Liability for change of EFT information by financial agent.* The Government is not liable for errors resulting from changes to EFT information made by the Contractor's financial agent.

(i) *Payment information*. The payment or disbursing office shall forward to the Contractor available payment information that is suitable for transmission as of the date of release of the EFT instruction to the Federal Reserve System. The Government may request the Contractor to designate a desired format and method(s) for delivery of payment information from a list of formats and methods the payment office is capable of executing. However, the Government does not guarantee that any particular format or method of delivery is available at any

particular payment office and retains the latitude to use the format and delivery method most convenient to the Government. If the Government makes payment by check in accordance with paragraph (a) of this clause, the Government shall mail the payment information to the remittance address contained in the CCR database.
(End of Clause)

86. DFARS 252.232-7004 DOD PROGRESS PAYMENT RATES (OCT 2001)

(a) If the contractor is a small business concern, the Progress Payments clause of this contract is modified to change each mention of the progress payment rate and liquidation rate (excepting paragraph (k), *Limitations on Undefinitized Contract Actions*) to 90 percent.

(b) If the contractor is a small disadvantaged business concern, the Progress Payments clause of this contract is modified to change each mention of the progress payment rate and liquidation rate (excepting paragraph (k), *Limitations on Undefinitized Contract Actions*) to 95 percent.
(End of clause)

87. DFARS 252.232-7005 REIMBURSEMENT OF SUBCONTRACTOR ADVANCE PAYMENTS--DOD PILOT MENTOR-PROTEGE PROGRAM (SEP 2001)

(a) The Government will reimburse the Contractor for any advance payments made by the Contractor, as a mentor firm, to a protege firm, pursuant to an approved mentor-protege agreement, provided-

(1) The Contractor's subcontract with the protege firm includes a provision substantially the same as FAR 52.232-12, Advance Payments;

(2) The Contractor has administered the advance payments in accordance with the policies of FAR Subpart 32.4; and

(3) The Contractor agrees that any financial loss resulting from the failure or inability of the protege firm to repay any unliquidated advance payments is the sole financial responsibility of the Contractor.

(b) For a fixed price type contract, advance payments made to a protege firm shall be paid and administered as if they were 100 percent progress payments. The Contractor shall include as a separate attachment with each Standard Form (SF) 1443, Contractor's Request for Progress Payment, a request for reimbursement of advance payments made to a protege firm. The attachment shall provide a separate calculation of lines 14a through 14e of SF 1443 for each protege, reflecting the status of advance payments made to that protege.

(c) For cost reimbursable contracts, reimbursement of advance payments shall be made via public voucher. The Contractor shall show the amounts of advance payments made to each protege on the public voucher, in the form and detail directed by the cognizant contracting officer or contract auditor.
(End of clause)

88. *FAR 52.233-1 DISPUTES (JULY 2002)

(a) This contract is subject to the Contract Disputes Act of 1978, as amended (41 U.S.C. 601-613).

(b) Except as provided in the Act, all disputes arising under or relating to this contract shall be resolved under this clause.

(c) "Claim," as used in this clause, means a written demand or written assertion by one of the contracting parties seeking, as a matter of right, the payment of money in a sum certain, the adjustment or interpretation of contract terms, or other relief arising under or relating to this contract. However, a written demand or written assertion by the Contractor seeking the payment of money exceeding $100,000 is not a claim under the Act until certified. A voucher, invoice, or other routine request for payment that is not in dispute when submitted is not a claim under the Act. The submission may be converted to a claim under the Act, by complying with the submission and certification requirements of this clause, if it is disputed either as to liability or amount or is not acted upon in a reasonable time.

(d)(1) A claim by the Contractor shall be made in writing and, unless otherwise stated in this contract, submitted within 6 years after accrual of the claim to the Contracting Officer for a written decision. A claim by the Government against the Contractor shall be subject to a written decision by the Contracting Officer.

(2) (i) Contractors shall provide the certification specified in paragraph (d)(2)(iii) of this clause when submitting any claim exceeding $100,000.

(ii) The certification requirement does not apply to issues in controversy that have not been submitted as all or part of a claim.

(iii) The certification shall state as follows:

'I certify that the claim is made in good faith; that the supporting data are accurate and complete to the best of my knowledge and belief; that the amount requested accurately reflects the contract adjustment for which the Contractor believes the Government is liable; and that I am duly authorized to certify the claim on behalf of the Contractor.'

(3) The certification may be executed by any person duly authorized to bind the Contractor with respect to the claim.

(e) For Contractor claims of $100,000 or less, the Contracting Officer must, if requested in writing by the Contractor, render a decision within 60 days of the request. For Contractor-certified claims over $100,000, the Contracting Officer must, within 60 days, decide the claim or notify the Contractor of the date by which the decision will be made.

(f) The Contracting Officer's decision shall be final unless the Contractor appeals or files a suit as provided in the Act.

(g) If the claim by the Contractor is submitted to the Contracting Officer or a claim by the Government is presented to the Contractor, the parties, by mutual consent, may agree to use alternative dispute resolution (ADR). If the Contractor refuses an offer for ADR, the Contractor shall inform the Contracting Officer, in writing, of the Contractor's specific reasons for rejecting the offer.

(h) The Government shall pay interest on the amount found due and unpaid from (1) the date the Contracting Officer receives the claim (certified if required), or (2) the date that payment otherwise would be due, if that date is later, until the date of payment. With regard to claims having defective certifications, as defined in (FAR) 48 CFR 33.201, interest shall be paid from the date that the Contracting Officer initially receives the claim. Simple interest on claims shall be paid at the rate, fixed by the Secretary of the Treasury as provided in the Act, which is applicable to the period during which the Contracting Officer receives the claim and then at the rate applicable for each 6-month period as fixed by the Treasury Secretary during the pendency of the claim.

(i) The Contractor shall proceed diligently with performance of this contract, pending final resolution of any request for relief, claim, appeal, or action arising under the contract, and comply with any decision of the Contracting Officer.

89. *FAR 52.233-3 PROTEST AFTER AWARD (AUG 1996)

(a) Upon receipt of a notice of protest (as defined in FAR 33.101) or a determination that a protest is likely (see FAR 33.102(d)), the Contracting Officer may, by written order to the Contractor, direct the Contractor to stop performance of the work called for by this contract. The order shall be specifically identified as a stop-work order issued under this clause. Upon receipt of the order, the Contractor shall immediately comply with its terms and take all reasonable steps to minimize the incurrence of costs allocable to the work covered by the order during the period of work stoppage. Upon receipt of the final decision in the protest, the Contracting Officer shall either--

(1) Cancel the stop-work order; or

(2) Terminate the work covered by the order as provided in the Default, or the Termination for Convenience of the Government, clause of this contract.

(b) If a stop-work order issued under this clause is canceled either before or after a final decision in the protest, the Contractor shall resume work. The Contracting Officer shall make an equitable adjustment in the delivery schedule or contract price, or both, and the contract shall be modified, in writing, accordingly, if--

(1) The stop-work order results in an increase in the time required for, or in the Contractor's cost properly allocable to, the performance of any part of this contract; and

(2) The Contractor asserts its right to an adjustment within 30 days after the end of the period of work stoppage; provided, that if the Contracting Officer decides the facts justify the action, the Contracting Officer may receive and act upon a proposal at any time before final payment under this contract.

(c) If a stop-work order is not canceled and the work covered by the order is terminated for the convenience of the Government, the Contracting Officer shall allow reasonable costs resulting from the stop-work order in arriving at the termination settlement.

(d) If a stop-work order is not canceled and the work covered by the order is terminated for default, the Contracting Officer shall allow, by equitable adjustment or otherwise, reasonable costs resulting from the stop-work order.

(e) The Government's rights to terminate this contract at any time are not affected by action taken under this clause.

(f) If, as the result of the Contractor's intentional or negligent misstatement, misrepresentation, or miscertification, a protest related to this contract is sustained, and the Government pays costs, as provided in FAR 33.102(b)(2) or 33.104(h)(1), the Government may require the Contractor to reimburse the Government the amount of such costs. In addition to any other remedy available, and pursuant to the requirements of Subpart 32.6, the Government may collect this debt by offsetting the amount against any payment due the Contractor under any contract between the Contractor and the Government.

90. RESERVED

91. FAR 52.236-2 DIFFERING SITE CONDITIONS (APR 1984)

(a) The Contractor shall promptly, and before the conditions are disturbed, give a written notice to the Contracting Officer of

(1) subsurface or latent physical conditions at the site which differ materially from those indicated in this contract, or

(2) unknown physical conditions at the site, of an unusual nature, which differ materially from those ordinarily encountered and generally recognized as inhering in work of the character provided for in the contract.

(b) The Contracting Officer shall investigate the site conditions promptly after receiving the notice. If the conditions do materially so differ and cause an increase or decrease in the Contractor's cost of, or the time required for, performing any part of the work under this contract, whether or not changed as a result of the conditions, an equitable adjustment shall be made under this clause and the contract modified in writing accordingly.

(c) No request by the Contractor for an equitable adjustment to the contract under this clause shall be allowed, unless the Contractor has given the written notice required, provided, that the time prescribed in (a) above for giving written notice may be extended by the Contracting Officer.

(d) No request by the Contractor for an equitable adjustment to the contract for differing site conditions shall be allowed if made after final payment under this contract.

92. *FAR 52.236-3 SITE INVESTIGATION AND CONDITIONS AFFECTING THE WORK (APR 1984)

(a) The Contractor acknowledges that it has taken steps reasonably necessary to ascertain the nature and location of the work, and that it has investigated and satisfied itself as to the general and local conditions which can affect the work or its cost, including but not limited to

(1) conditions bearing upon transportation, disposal, handling, and storage of materials;

(2) the availability of labor, water, electric power, and roads;

(3) uncertainties of weather, river stages, tides, or similar physical conditions at the site;

(4) the conformation and conditions of the ground; and

(5) the character of equipment and facilities needed preliminary to and during work performance. The Contractor also acknowledges that it has satisfied itself as to the character, quality, and quantity of surface and subsurface materials or obstacles to be encountered insofar as this information is reasonably ascertainable from an inspection of the site, including all exploratory work done by the Government, as well as from the drawings and specifications made a part of this contract. Any failure of the Contractor to take the actions described and acknowledged in this paragraph will not relieve the Contractor from responsibility for estimating properly the difficulty and cost of successfully performing the work, or for proceeding to successfully perform the work without additional expense to the Government.

(b) The Government assumes no responsibility for any conclusions or interpretations made by the Contractor based on the information made available by the Government. Nor does the Government assume responsibility for any understanding reached or representation made concerning conditions which can affect the work by any of its officers or agents before the execution of this contract, unless that understanding or representation is expressly stated in this contract.

93. *FAR 52.236-5 MATERIAL AND WORKMANSHIP (APR 1984)

(a) All equipment, material, and articles incorporated into the work covered by this contract shall be new and of the most suitable grade for the purpose intended, unless otherwise specifically provided in this contract. References in the specifications to equipment, material, articles, or patented processes by trade name, make, or catalog number, shall be regarded as establishing a standard of quality and shall not be construed as limiting competition. The Contractor may, at its option, use any equipment, material, article, or process that, in the judgment of the Contracting Officer, is equal to that named in the specifications, unless otherwise specifically provided in this contract.

(b) The Contractor shall obtain the Contracting Officer's approval of the machinery and mechanical and other equipment to be incorporated into the work. When requesting approval, the Contractor shall furnish to the Contracting Officer the name of the manufacturer, the model number, and other information concerning the performance, capacity, nature, and rating of the machinery and mechanical and other equipment. When required by this contract or by the Contracting Officer, the Contractor shall also obtain the Contracting Officer's approval of the material or articles which the Contractor contemplates incorporating into the work. When requesting approval, the Contractor shall provide full information concerning the material or articles. When directed to do so, the Contractor shall submit samples for approval at the Contractor's expense, with all shipping charges prepaid. Machinery, equipment, material, and articles that do not have the required approval shall be installed or used at the risk of subsequent rejection.

(c) All work under this contract shall be performed in a skillful and workmanlike manner. The Contracting Officer may require, in writing, that the Contractor remove from the work any employee the Contracting Officer deems incompetent, careless, or otherwise objectionable.

94. RESERVED

95. *FAR 52.236-6 SUPERINTENDENCE BY THE CONTRACTOR (APR 1984)

At all times during performance of this contract and until the work is completed and accepted, the Contractor shall directly superintend the work or assign and have on the work site a competent superintendent who is satisfactory to the Contracting Officer and has authority to act for the Contractor.

96. FAR 52.236-7 PERMITS AND RESPONSIBILITIES (NOV 1991)

The Contractor shall, without additional expense to the Government, be responsible for obtaining any necessary licenses and permits, and for complying with any Federal, State, and municipal laws, codes, and regulations applicable to the performance of the work. The Contractor shall also be responsible for all damages to

persons or property that occur as a result of the Contractor's fault or negligence. The Contractor shall also be responsible for all materials delivered and work performed until completion and acceptance of the entire work, except for any completed unit of work which may have been accepted under the contract.

97. *FAR 52.236-8 OTHER CONTRACTS (APR 1984)

The Government may undertake or award other contracts for additional work at or near the site of the work under this contract. The Contractor shall fully cooperate with the other contractors and with Government employees and shall carefully adapt scheduling and performing the work under this contract to accommodate the additional work, heeding any direction that may be provided by the Contracting Officer. The Contractor shall not commit or permit any act that will interfere with the performance of work by any other contractor or by Government employees.

98. *FAR 52.236-9 PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES, AND IMPROVEMENTS (APR 1984)

(a) The Contractor shall preserve and protect all structures, equipment, and vegetation (such as trees, shrubs, and grass) on or adjacent to the work site, which are not to be removed and which do not unreasonably interfere with the work required under this contract. The Contractor shall only remove trees when specifically authorized to do so, and shall avoid damaging vegetation that will remain in place. If any limbs or branches of trees are broken during contract performance, or by the careless operation of equipment, or by workmen, the Contractor shall trim those limbs or branches with a clean cut and paint the cut with a tree-pruning compound as directed by the Contracting Officer.

(b) The Contractor shall protect from damage all existing improvements and utilities

(1) at or near the work site, and

(2) on adjacent property of a third party, the locations of which are made known to or should be known by the Contractor. The Contractor shall repair any damage to those facilities, including those that are the property of a third party, resulting from failure to comply with the requirements of this contract or failure to exercise reasonable care in performing the work. If the Contractor fails or refused to repair the damage promptly, the Contracting Officer may have the necessary work performed and charge the cost to the Contractor.

99. *FAR 52.236-10 OPERATIONS AND STORAGE AREAS (APR 1984)

(a) The Contractor shall confine all operations (including storage of materials) on Government premises to areas authorized or approved by the Contracting Officer. The Contractor shall hold and save the Government, its officers and agents, free and harmless from liability of any nature occasioned by the Contractor's performance.

(b) Temporary buildings (e.g., storage sheds, shops, offices) and utilities may be erected by the Contractor only with the approval of the Contracting Officer and shall be built with labor and materials furnished by the Contractor without expense to the Government. The temporary buildings and utilities shall remain the property of the Contractor and shall be removed by the Contractor at its expense upon completion of the work. With the written consent of the Contracting Officer, the buildings and utilities may be abandoned and need not be removed.

(c) The Contractor shall, under regulations prescribed by the Contracting Officer, use only established roadways, or use temporary roadways constructed by the Contractor when and as authorized by the Contracting Officer. When materials are transported in prosecuting the work, vehicles shall not be loaded beyond the loading capacity recommended by the manufacturer of the vehicle or prescribed by any Federal, State, or local law or regulation. When it is necessary to cross curbs or sidewalks, the Contractor shall protect them from damage. The Contractor shall repair or pay for the repair of any damaged curbs, sidewalks, or roads.

100.*FAR 52.236-11 USE AND POSSESSION PRIOR TO COMPLETION (APR 1984)

(a) The Government shall have the right to take possession of or use any completed or partially completed part of the work. Before taking possession of or using any work, the Contracting Officer shall furnish the Contractor a list of items of work remaining to be performed or corrected on those portions of the work that the Government intends to take possession of or use. However, failure of the Contracting Officer to list any item of work shall not relieve the Contractor of responsibility for complying with the terms of the contract. The Government's possession or use shall not be deemed an acceptance of any work under the contract.

(b) While the Government has such possession or use, the Contractor shall be relieved of the responsibility for the loss of or damage to the work resulting from the Government's possession or use, notwithstanding the terms of the clause in this contract entitled "Permits and Responsibilities." If prior possession or use by the Government delays the progress of the work or causes additional expense to the Contractor, an equitable adjustment shall be made in the contract price or the time of completion, and the contract shall be modified in writing accordingly.

101.*FAR 52.236-12 CLEANING UP (APR 1984)

The Contractor shall at all times keep the work area, including storage areas, free from accumulations of waste materials. Before completing the work, the Contractor shall remove from the work and premises any rubbish, tools, scaffolding, equipment, and materials that are not the property of the Government. Upon completing the work, the Contractor shall leave the work area in a clean, neat, and orderly condition satisfactory to the Contracting Officer.

102.*FAR 52.236-13 ACCIDENT PREVENTION-ALTERNATE I (NOV 1991)

(a) The Contractor shall provide and maintain work environments and procedures which will (1) safeguard the public and Government personnel, property, materials, supplies, and equipment exposed to Contractor operations and activities; (2) avoid interruptions of Government operations and delays in project completion dates; and (3) control costs in the performance of this contract.

(b) For these purposes on contracts for construction or dismantling, demolition, or removal of improvements, the Contractor shall--

(1) Provide appropriate safety barricades, signs, and signal lights;

(2) Comply with the standards issued by the Secretary of Labor at 29 CFR Part 1926 and 29 CFR Part 1910; and

(3) Ensure that any additional measures the Contracting Officer determines to be reasonably necessary for the purposes are taken.

(c) If this contract is for construction or dismantling, demolition or removal of improvements with any Department of Defense agency or component, the Contractor shall comply with all pertinent provisions of the latest version of U.S. Army Corps of engineers Safety and Health Requirements Manual, EM 385-1-1, in effect on the date of the solicitation.

(d) Whenever the Contracting Officer becomes aware of any noncompliance with these requirements or any condition which poses a serious or imminent danger to the health or safety of the public or Government personnel, the Contracting Officer shall notify the Contractor orally, with written confirmation, and request immediate initiation of corrective action. This notice, when delivered to the Contractor or the Contractor's representative at the work site, shall be deemed sufficient notice of the noncompliance and that corrective action is required. After receiving the notice, the Contractor shall immediately take corrective action. If the Contractor fails or refuses to promptly take corrective action, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. The Contractor shall not be entitled to any equitable adjustment of the contract price or extension of the performance schedule on any stop work order issued under this clause.

(e) The Contractor shall insert this clause, including this paragraph (e), with appropriate changes in the designation of the parties, in subcontractors.

(f) Before commencing the work, the Contractor shall--

(1) Submit a written proposed plan for implementing this clause. The plan shall include an analysis of the significant hazards to life, limb, and property inherent in contract work performance and a plan for controlling these hazards; and

(2) Meet with representatives of the Contracting Officer to discuss and develop a mutual understanding relative to administration of the overall safety program.

103.*FAR 52.236-14 AVAILABILITY AND USE OF UTILITY SERVICES (APR 1984)

(a) The Government shall make all reasonably required amounts of utilities available to the Contractor from existing outlets and supplies, as specified in the contract. Unless otherwise provided in the contract, the amount of each utility service consumed shall be charged to or paid for by the Contractor at prevailing rates charged to the Government or, where the utility is produced by the Government, at reasonable rates determined by the Contracting Officer. The Contractor shall carefully conserve any utilities furnished without charge.

(b) The Contractor, at its expense and in a workmanlike manner satisfactory to the Contracting Officer, shall install and maintain all necessary temporary connections and distribution lines, and all meters required to measure the amount of each utility used for the purpose of determining charges. Before final acceptance of the work by the Government, the Contractor shall remove all the temporary connections, distribution lines, meters, and associated paraphernalia.

104.FAR 52.236-15 SCHEDULES FOR CONSTRUCTION CONTRACTS (APR 1984)

(a) The Contractor shall, within five days after the work commences on the contract or another period of time determined by the Contracting Officer, prepare and submit to the Contracting Officer for approval three copies of a practicable schedule showing the order in which the Contractor proposes to perform the work, and the dates on which the Contractor contemplates starting and completing the several salient features of the work (including acquiring materials, plant, and equipment). The schedule shall be in the form of a progress chart of suitable scale to indicate appropriately the percentage of work scheduled for completion by any given date during the period. If the Contractor fails to submit a schedule within the time prescribed, the Contracting Officer may withhold approval of progress payments until the Contractor submits the required schedule.

(b) The Contractor shall enter the actual progress on the chart as directed by the Contracting Officer, and upon doing so shall immediately deliver three copies of the annotated schedule to the Contracting Officer. If, in the opinion of the Contracting Officer, the Contractor falls behind the approved schedule, the Contractor shall take steps necessary to improve its progress, including those that may be required by the Contracting Officer, without additional cost to the Government. In this circumstance, the Contracting Officer may require the Contractor to increase the number of shifts, overtime operations, days of work, and/or the amount of construction plant, and to submit for approval any supplementary schedule or schedules in chart form as the Contracting Officer deems necessary to demonstrate how the approved rate of progress will be regained.

(c) Failure of the Contractor to comply with the requirements of the Contracting Officer under this clause shall be grounds for a determination by the Contracting Officer that the Contractor is not prosecuting the work with sufficient diligence to ensure completion within the time specified in the contract. Upon making this determination, the Contracting Officer may terminate the Contractor's right to proceed with the work, or any separable part of it, in accordance with the default terms of this contract.

105.*FAR 52.236-17 LAYOUT OF WORK (APR 1984)

The Contractor shall lay out its work from Government-established base lines and bench marks indicated on the drawings, and shall be responsible for all measurements in connection with the layout. The Contractor shall

furnish, at its own expense, all stakes, templates, platforms, equipment, tools, materials, and labor required to lay out any part of the work. The Contractor shall be responsible for executing the work to the lines and grades that may be established or indicated by the Contracting Officer. The Contractor shall also be responsible for maintaining and preserving all stakes and other marks established by the Contracting Officer until authorized to remove them. If such marks are destroyed by the Contractor or through its negligence before their removal is authorized, the Contracting Officer may replace them and deduct the expense of the replacement from any amounts due or to become due to the Contractor.

106.FAR 52.236-21 SPECIFICATIONS AND DRAWINGS FOR CONSTRUCTION (FEB 1997)

(a) The Contractor shall keep on the work site a copy of the drawings and specifications and shall at all times give the Contracting Officer access thereto. Anything mentioned in the specifications and not shown on the drawings, or shown on the drawings and not mentioned in the specifications, shall be of like effect as if shown or mentioned in both. In case of difference between drawings and specifications, the specifications shall govern. In case of discrepancy in the figures, in the drawings, or in the specifications, the matter shall be promptly submitted to the Contracting Officer, who shall promptly make a determination in writing. Any adjustment by the Contractor without such a determination shall be at its own risk and expense. The Contracting Officer shall furnish from time to time such detailed drawings and other information as considered necessary, unless otherwise provided.

(b) Wherever in the specifications or upon the drawings the words "directed," "required," "ordered," "designated," "prescribed," or words of like import are used, it shall be understood that the "direction," "requirement," "order," "designation," or "prescription," of the Contracting Officer is intended and similarly the words "approved," "acceptable," "satisfactory," or words of like import shall mean "approved by," or "acceptable to," or "satisfactory to" the Contracting Officer, unless otherwise expressly stated.

(c) Where "as shown," "as indicated," "as detailed," or words of similar import are used, it shall be understood that the reference is made to the drawings accompanying this contract unless stated otherwise. The word "provided" as used herein shall be understood to mean "provide complete in place," that is "furnished and installed."

(d) Shop drawings means drawings, submitted to the Government by the Contractor, subcontractor, or any lower tier subcontractor pursuant to a construction contract, showing in detail

(1) the proposed fabrication and assembly of structural elements, and

(2) the installation (i.e., fit, and attachment details) of materials or equipment. It includes drawings, diagrams, layouts, schematics, descriptive literature, illustrations, schedules, performance and test data, and similar materials furnished by the Contractor to explain in detail specific portions of the work required by the contract. The Government may duplicate, use, and disclose in any manner and for any purpose shop drawings delivered under this contract.

(e) If this contract requires shop drawings, the Contractor shall coordinate all such drawings, and review them for accuracy, completeness, and compliance with contract requirements and shall indicate its approval thereon as evidence of such coordination and review. Shop drawings submitted to the Contracting Officer without evidence of the Contractor's approval may be returned for resubmission. The Contracting Officer will indicate an approval or disapproval of the shop drawings and if not approved as submitted shall indicate the Government's reasons therefor. Any work done before such approval shall be at the Contractor's risk. Approval by the Contracting Officer shall not relieve the Contractor from responsibility for any errors or omissions in such drawings, nor from responsibility for complying with the requirements of this contract, except with respect to variations described and approved in accordance with (f) below.

(f) If shop drawings show variations from the contract requirements, the Contractor shall describe such variations in writing, separate from the drawings, at the time of submission. If the Contracting Officer approves any such variation, the Contracting Officer shall issue an appropriate contract modification, except that, if the variation is minor or does not involve a change in price or in time of performance, a modification need not be issued.

(g) The Contractor shall submit to the Contracting Officer for approval four copies (unless otherwise indicated) of all shop drawings as called for under the various headings of these specifications. Three sets (unless otherwise indicated) of all shop drawings, will be retained by the Contracting Officer and one set will be returned to the Contractor.

107. *FAR 52.236-26 PRECONSTRUCTION CONFERENCE (FEB 1995)

If the Contracting Officer decides to conduct a preconstruction conference, the successful offeror will be notified and will be required to attend. The Contracting Officer's notification will include specific details regarding the date, time, and location of the conference, any need for attendance by subcontractors, and information regarding the items to be discussed.

108. DFARS 252.236-7000 MODIFICATION OF PROPOSALS - PRICE BREAKDOWN (DEC 1991)

(a) The Contractor shall furnish a price breakdown, itemized as required and within the time specified by the Contracting Officer, with any proposal for a contract modification.

(b) The price breakdown--

(1) Must include sufficient detail to permit an analysis of profit, and of all costs for--

(i) Material;

(ii) Labor,

(iii) Equipment;

(iv) Subcontracts; and

(2) Most cover all work involved in the modification, whether the work was deleted, added, or changed.

(c) The Contractor shall provide similar price breakdowns to support any amounts claimed for subcontracts.

(d) The Contractor's proposal shall include a justification for any time extension proposed.

109. DFARS 252.236-7008 CONTRACT PRICES - BIDDING SCHEDULES (DEC 1991)

(a) The Government's payment for the items listed in the Bidding Schedule shall constitute full compensation to the Contractor for--

(1) Furnishing all plant, labor, equipment, appliances, and materials; and

(2) Performing all operations required to complete the work in conformity with the drawings and specifications.

(b) The Contractor shall include in the prices for the items listed in the Bidding Schedule all costs for work in the specifications, whether or not specifically listed in the Bidding Schedule.

110. *FAR 52.242-13 BANKRUPTCY (JUL 1995)

In the event the Contractor enters into proceedings relating to bankruptcy, whether voluntary or involuntary, the Contractor agrees to furnish, by certified mail or electronic commerce method authorized by the contract, written notification of the bankruptcy to the Contracting Officer responsible for administering the contract. This notification shall be furnished within five days of the initiation of the proceedings relating to bankruptcy filing. This notification shall include the date on which the bankruptcy petition was filed, the identity of the court in which the bankruptcy petition was filed, and a listing of Government contract numbers and contracting offices for all Government contracts against which final payment has not been made. This obligation remains in effect until final payment under this contract.

111. *FAR 52.242-14 SUSPENSION OF WORK (APR 1984)

(a) The Contracting Officer may order the Contractor, in writing, to suspend, delay, or interrupt all or any part of the work of this contract for the period of time that the Contracting Officer determines appropriate for the convenience of the Government.

(b) If the performance of all or any part of the work is, for an unreasonable period of time, suspended, delayed, or interrupted (1) by an act of the Contracting Officer in the administration of this contract, or (2) by the Contracting Officer's failure to act within the time specified in this contract (or within a reasonable time if not specified), an adjustment shall be made for any increase in the cost of performance of this contract (excluding profit) necessarily caused by the unreasonable suspension, delay, or interruption, and the contract modified in writing accordingly. However, no adjustment shall be made under this clause for any suspension, delay, or interruption to the extent that performance would have been so suspended, delayed, or interrupted by any other cause, including the fault or negligence of the Contractor, or for which an equitable adjustment is provided for or excluded under any other term or condition of this contract.

(c) A claim under this clause shall not be allowed (1) for any costs incurred more than 20 days before the Contractor shall have notified the Contracting Officer in writing of the act or failure to act involved (but this requirement shall not apply as to a claim resulting from a suspension order), and (2) unless the claim, in an amount stated, is asserted in writing as soon as practicable after the termination of the suspension, delay, or interruption, but not later than the date of final payment under the contract.

112. FAR 52.243-4 CHANGES (AUG 1987)

(a) The Contracting Officer may, at any time, without notice to the sureties, if any, by written order designated or indicated to be a change order, make changes in the work within the general scope of the contract, including changes--

(1) In the specifications (including drawings and designs);
(2) In the method or manner of performance of the work;
(3) In the Government-furnished facilities, equipment, materials, services, or site; or
(4) Directing acceleration in the performance of the work.

(b) Any other written or oral order (which, as used in this paragraph (b), includes direction, instruction, interpretation, or determination) from the Contracting Officer that causes a change shall be treated as a change order under this clause; provided, that the Contractor gives the Contracting Officer written notice stating

(1) the date, circumstances, and source of the order and
(2) that the Contractor regards the order as a change order.

(c) Except as provided in this clause, no order, statement, or conduct of the Contracting Officer shall be treated as a change under this clause or entitle the Contractor to an equitable adjustment.

(d) If any change under this clause causes an increase or decrease in the Contractor's cost of, or the time required for, the performance of any part of the work under this contract, whether or not changed by any such order, the Contracting Officer shall make an equitable adjustment and modify the contract in writing. However, except for an adjustment based on defective specifications, no adjustment for any change under paragraph (b) of this clause shall be made for any costs incurred more than 20 days before the Contractor gives written notice as required. In the case of defective specifications for which the Government is responsible, the equitable adjustment shall include any increased cost reasonably incurred by the Contractor in attempting to comply with the defective specifications.

(e) The Contractor must assert its right to an adjustment under this clause within 30 days after

(1) receipt of a written change order under paragraph (a) of this clause or
(2) the furnishing of a written notice under paragraph (b) of this clause, by submitting to the Contracting Officer a written statement describing the general nature and amount of the proposal, unless this period is extended by the Government. The statement of proposal for adjustment may be included in the notice under paragraph (b) above.

(f) No proposal by the Contractor for an equitable adjustment shall be allowed if asserted after final payment under this contract.

113. DFARS 252.243-7001 PRICING OF CONTRACT MODIFICATIONS (DEC 1991)

When costs are a factor in any price adjustment under this contract, the contract cost principles and procedures in FAR Part 31 and DFARS Part 231, in effect on the date of this contract, apply.

114. DFARS 252.243-7002 REQUESTS FOR EQUITABLE ADJUSTMENT (MAR 1998)

(a) The amount of any request for equitable adjustment to contract terms shall accurately reflect the contract adjustment for which the Contractor believes the Government is liable. The request shall include only costs for performing the change, and shall not include any costs that already have been reimbursed or that have been separately claimed. All indirect costs included in the request shall be properly allocable to the change in accordance with applicable acquisition regulations.

(b)In accordance with 10 U.S.C. 2410(a), any request for equitable adjustment to contract terms that exceeds the simplified acquisition threshold shall bear, at the time of submission, the following certificate executed by an individual authorized to certify the request on behalf of the Contractor:
I certify that the request is made in good faith, and that the supporting data are accurate and complete to the best of may knowledge and belief.

(Official's Name)

(Title)

(c) The certification in paragraph (b) of this clause requires full disclosure of all relevant facts, including--

(1) Cost or pricing data if required in accordance with subsection 15.403-4 of the Federal Acquisition Regulation; and

(2) Information other than cost or pricing data, in accordance with subsection 15.403-3 of the FAR, including actual cost data and data to support any estimated costs, even if cost or pricing data are not required.

(d) The certification requirement in paragraph (b) of this clause does not apply to----

(1) Requests for routine contract payments; for example, requests for payment for accepted supplies and services, routine vouchers under a cost-reimbursement type contract, or progress payment invoices; or

(2) Final adjustment under an incentive provision of the contract.

(End of clause)

115. *FAR 52.244-2 SUBCONTRACTS (AUG 1998)

(a) Definitions. As used in this clause--

"Approved purchasing system" means a Contractor's purchasing system that has been reviewed and approved in accordance with Part 44 of the Federal Acquistion Regulation (FAR).

"Consent of subcontract" means the Contracting Officer's written consent for the Contractor to enter into a particular subcontract.

"Subcontract," means any contract, as defined in FAR Subpart 2.1, entered into by a subcontractor to furnish supplies or sevices for performance of the the prime contract or a subcontract. It includes, but is not limited to purchase orders, and changes and modifications to purchase orders.

(b) This clause does not apply to subcontracts for special test equipment when the contract contains the clause at FAR 52.245-18, Special Test Equipment.

(c) When this clause is included in a fixed-price type contract, consent to subcontract is required only on unpriced contract actions (including unpriced modification or unpriced delivery orders), and only if required in accordance with paragraph (d) or (e) of this clause.

(d) If the Contractor does not have an approved purchasing system, consent to subcontract is required for any subcontract that--

(1) Is of the cost-reimbursement, time-and-materials, or labor-hour type; or

(2) Is fixed-price and exceeds--

(i) For a contract awarded by the Department of Defense, the Coast Guard, or the National Aeronautics and Space Administration, the greater of the simplified theshold or 5 percent of the total estimated cost of the contract; or

(ii) For a contract awarded by a civilian agency other that the Coast Guard and the National Aeronautics and Space Administration, either the the simplified theshold or 5 percent of the total estimated cost of the contract.

(e) If the Contractor has an approved purchasing system, the Contractor nevertheless shall obtain the Contracting Officer's written consent before placing the following subcontracts:

_____
_____
_____

(f)(1) The Contractor shall notify the Contracting Officer reasonably in advance of placing any subcontract or modification thereof for which consent is required under paragraph (c), (d), or (e) of this clause, including the following information:

(i) A description of the supplies or services to be subcontracted.

(ii) Identification of the type of subcontract to be used.

(iii) Identification of the proposed subcontractor.

(iv) The proposed subcontract price.

(v) The subcontractor's current, complete, and accurate cost or pricing data and Certificate of Current Cost or Pricing Data, if required by other contract provisions.

(vi) The subcontractor's Disclosure Statement or Certificate relating to Cost Accounting Standards when such data are required by other provisions of this contract.

(vii) A negotiation memorandum reflecting--

(A) The principal elements of the subcontract price negotiations;

(B) The most significant considerations controlling establishment of initial or revised prices;

(C) The reason cost or pricing data were or were not required;

(D) The extent, if any, to which the Contractor did not rely on the subcontractor's cost or pricing data in determining the price objective and in negotiating the final price;

(E) The extent to which it was recognized in the negotiation that the subcontractor's cost or pricing data were not accurate, complete, or current; the action taken by the Contractor and subcontractor; and the effect of any such defective data on the total price negotiated;

(F) The reasons for any significant difference between the Contractor's price objective and the price negotiated; and

(G) A complete explanation of the incentive fee or profit plan when incentives are used. The explanation shall identify each critical performance element, management decisions used to quantify each incentive element, reasons for the incentives, and a summary of all trade-off possibilities considered.

(2) The Contractor is not required to notify the Contracting Officer in advance of entering into any subcontract for which consent is not required under paragraph (c), (d), or (e) of this clause.

(g) Unless the consent or approval specifically provides otherwise, neither consent by the Contracting Officer to any subcontract nor approval of the Contractor's purchasing system shall constitute a determination--

(1) Of the acceptability of any subcontract terms or conditions;

(2) Of the acceptability of any cost under this contract; or

(3) To relieve the Contractor of any responsibility for performing this contract.

(h) No subcontract or modification thereof placed under this contract shall provide for payment on a cost-plus-a-percentage-of-cost basis, and any fee payable under cost-reimbursement subcontracts shall not exceed the fee limitations in FAR 15.404-4(c)(4)(i).

(i) The Contractor shall give the Contracting Officer immediate written notice of any action or suit filed and prompt notice of any claim made against the Contractor by any subcontractor or vendor that, in the opinion of the Contractor, may result in litigation related in any way to this contract, with respect to which the Contractor may be entitled to reimbursement by the Government.

(j) The Government reserves the right to review the Contractor's purchasing system as set forth in FAR Subpart 44.3.

(k) Paragraphs (d) and (f) of this clause do not apply to the following subcontracts, which ere evaluated during negotiations:

_____

_____

_____

(End of clause)

116. FAR 52.244-6 SUBCONTRACTS FOR COMMERCIAL ITEMS (MAY 2004)

(a) *Definitions.* As used in this clause—

"Commercial item" has the meaning contained in the clause at 52.202-1, Definitions.

"Subcontract" includes a transfer of commercial items between divisions, subsidiaries, or affiliates of the Contractor or subcontractor at any tier.

(b) To the maximum extent practicable, the Contractor shall incorporate, and require its subcontractors at all tiers to incorporate, commercial items or nondevelopmental items as components of items to be supplied under this contract.

(c)(1) The Contractor shall insert the following clauses in subcontracts for commercial items:

(i) 52.219-8, Utilization of Small Business Concerns (May 2004) (15 U.S.C. 637(d)(2) and (3)), in all subcontracts that offer further subcontracting opportunities. If the subcontract (except subcontracts to small business concerns) exceeds $500,000 ($1,000,000 for construction of any public facility), the subcontractor must include 52.219-8 in lower tier subcontracts that offer subcontracting opportunities.

(ii) 52.222-26, Equal Opportunity (Apr 2002) (E.O. 11246).

(iii) 52.222-35, Equal Opportunity for Special Disabled Veterans, Veterans of the Vietnam Era, and Other Eligible Veterans (Dec 2001) (38 U.S.C. 4212(a));

(iv) 52.222-36, Affirmative Action for Workers with Disabilities (June 1998) (29 U.S.C. 793).

(v) 52.247-64, Preference for Privately Owned U.S.-Flag Commercial Vessels (APR 2003) (46 U.S.C. Appx 1241 and 10 U.S.C. 2631) (flow down required in accordance with paragraph (d) of FAR clause 52.247-64).

(2) While not required, the Contractor may flow down to subcontracts for commercial items a minimal number of additional clauses necessary to satisfy its contractual obligations.

(d) The Contractor shall include the terms of this clause, including this paragraph (d), in subcontracts awarded under this contract.

(End of clause)

117. *FAR 52.245-2 GOVERNMENT PROPERTY (FIXED-PRICE CONTRACTS) (MAY

2004) [<u>For Government Property over $100,000</u>]

(a) Government-furnished property.

(1) The Government shall deliver to the Contractor, for use in connection with and under the terms of this contract, the Government-furnished property described in the Schedule or specifications together with any related data and information that the Contractor may request and is reasonably required for the intended use of the property (hereinafter referred to as "Government-furnished property").

(2) The delivery or performance dates for this contract are based upon the expectation that Government-furnished property suitable for use (except for property furnished "as is") will be delivered to the Contractor at the times stated in the Schedule or, if not so stated, in sufficient time to enable the Contractor to meet the contract's delivery or performance dates.

(3) If Government-furnished property is received by the Contractor in a condition not suitable for the intended use, the Contractor shall, upon receipt of it, notify the Contracting Officer, detailing the facts, and, as directed by the Contracting Officer and at Government expense, either repair, modify, return, or otherwise dispose of the property. After completing the directed action and upon written request of the Contractor, the Contracting Officer shall make an equitable adjustment as provided in paragraph (h) of this clause.

(4) If Government-furnished property is not delivered to the Contractor by the required time, the Contracting Officer shall, upon the Contractor's timely written request, make a determination of the delay, if any, caused the Contractor and shall make an equitable adjustment in accordance with paragraph (h) of this clause.

(b) Changes in Government-furnished property.

(1) The Contracting Officer may, by written notice,

(i) decrease the Government-furnished property provided or to be provided under this contract, or

(ii) substitute other Government-furnished property for the property to be provided by the Government, or to be acquired by the Contractor for the Government, under this contract. The Contractor shall promptly take such action as the Contracting Officer may direct regarding the removal, shipment, or disposal of the property covered by such notice.

(2) Upon the Contractor's written request, the Contracting Officer shall make an equitable adjustment to the contract in accordance with paragraph (h) of this clause, if the Government has agreed in the Schedule to make the property available for performing this contract and there is any--

(i) Decrease or substitution in this property pursuant to subparagraph (b)(1) above; or

(ii) Withdrawal of authority to use this property, if provided under any other contract or lease.

(c) Title in Government property.

(1) The Government shall retain title to all Government-furnished property.

(2) All Government-furnished property and all property acquired by the Contractor, title to which vests in the Government under this paragraph (collectively referred to as "Government property"), are subject to the provisions of this clause. However, special tooling accountable to this contract is subject to the provisions of the Special Tooling clause and is not subject to the provisions of this clause. Title to Government property shall not be affected by its incorporation into or attachment to any property not owned by the Government, nor shall government property become a fixture or lose its identity as personal property by being attached to any real property.

(3) Title to each item of facilities and special test equipment acquired by the Contractor for the Government under this contract shall pass to and vest in the Government when its use in performing this contract commences or when the Government has paid for it, whichever is earlier, whether or not title previously vested in the Government.

(4) If this contract contains a provision directing the Contractor to purchase material for which the Government will reimburse the Contractor as a direct item of cost under this contract--

(i) Title to material purchased from a vendor shall pass to and vest in the Government upon the vendor's delivery of such material; and

(ii) Title to all other material shall pass to and vest in the Government upon--

(A) Issuance of the material for use in contract performance;

(B) Commencement of processing of the material or its use in contract performance; or

(C) Reimbursement of the cost of the material by the Government, whichever occurs first.

(d) Use of Government property. The Government property shall be used only for performing this contract, unless otherwise provided in this contract or approved by the Contracting Officer.

(e) Property Administration.

(1) The Contractor shall be responsible and accountable for all Government property provided under this contract and shall comply with Federal Acquisition Regulation (FAR) Subpart 45.5, as in effect on the date of this contract.

(2) The Contractor shall establish and maintain a program for the use, maintenance, repair, protection, and preservation of Government property in accordance with sound industrial practice and the applicable provisions of Subpart 45.5 of the FAR.

(3) If damage occurs to Government property, the risk of which has been assumed by the Government under this contract, the Government shall replace the items or the Contractor shall make such repairs as the Government directs. However, if the Contractor cannot effect such repairs within the time required, the Contractor shall dispose of the property as directed by the Contracting Officer. When any property for which the Government is responsible is replaced or repaired, the Contracting Officer shall make an equitable adjustment in accordance with paragraph (h) of this clause.

(4) The Contractor represents that the contract price does not include any amount for repairs or replacement for which the Government is responsible. Repair or replacement of property for which the Contractor is responsible shall be accomplished by the Contractor at its own expense.

(f) Access. The Government and all its designees shall have access at all reasonable times to the premises in which any Government property is located for the purpose of inspecting the Government property.

(g) Risk of loss. Unless otherwise provided in this contract, the Contractor assumes the risk of, and shall be responsible for, any loss or destruction of, or damage to, Government property upon its delivery to the Contractor or upon passage of title to the Government under paragraph (c) of this clause. However, the Contractor is not responsible for reasonable wear and tear to Government property or for Government property properly consumed in performing this contract.

(h) Equitable adjustment. When this clause specifies an equitable adjustment, it shall be made to any affected contract provision in accordance with the procedures of the Changes clause. When appropriate, the Contracting Officer may initiate an equitable adjustment in favor of the Government. The right to an equitable adjustment shall be the Contractor's exclusive remedy. The Government shall not be liable to suit for breach of contract for--

(1) Any delay in delivery of Government-furnished property;
(2) Delivery of Government-furnished property in a condition not suitable for its intended use;
(3) A decrease in or substitution of Government-furnished property; or
(4) Failure to repair or replace Government property for which the Government is responsible.

(i) *Government property disposal*. Except as provided in paragraphs (i)(1)(i), (i)(2), and (i)(8)(i) of this clause, the Contractor shall not dispose of Government property until authorized to do so by the Plant Clearance Officer.

(1) *Scrap (to which the Government has obtained title under paragraph (c) of this clause)*.—

(i) *Contractor with an approved scrap procedure*.—(A) The Contractor may dispose of scrap resulting from production or testing under this contract without Government approval. However, if the scrap requires demilitarization or is sensitive property, the Contractor shall submit the scrap on an inventory disposal schedule.

(B) For scrap from other than production or testing the Contractor may prepare scrap lists in lieu of inventory disposal schedules (provided such lists are consistent with the approved scrap procedures), except that inventory disposal schedules shall be submitted for scrap aircraft or aircraft parts and scrap that—

(1) Requires demilitarization;

(2) Is a classified item;
(3) Is generated from classified items;
(4) Contains hazardous materials or hazardous wastes;
(5) Contains precious metals; or
(6) Is dangerous to the public health, safety, or welfare.

(ii) *Contractor without an approved scrap procedure*. The Contractor shall submit an inventory disposal schedule for all scrap.

(2) *Pre-disposal requirements*. When the Contractor determines that a property item acquired or produced by the Contractor, to which the Government has obtained title under paragraph (c) of this clause, is no longer needed for performance of this contract, the Contractor, in the following order of priority:

(i) May purchase the property at the acquisition cost.

(ii) Shall make reasonable efforts to return unused property to the appropriate supplier at fair market value (less, if applicable, a reasonable restocking fee that is consistent with the supplier's customary practices).

(iii) Shall list, on Standard Form 1428, Inventory Disposal Schedule, property that was not purchased under paragraph (i)(2)(i) of this clause, could not be returned to a supplier, or could not be used in the performance of other Government contracts.

(3) *Inventory disposal schedules*.—(i) The Contractor shall use Standard Form 1428, Inventory Disposal Schedule, to identify—

(A) Government-furnished property that is no longer required for performance of this contract, provided the terms of another Government contract do not require the Government to furnish that property for performance of that contract; and

(B) Property acquired or produced by the Contractor, to which the Government has obtained title under paragraph (c) of this clause, that is no longer required for performance of that contract.

(ii) The Contractor may annotate inventory disposal schedules to identify property the Contractor wishes to purchase from the Government.

(iii) Unless the Plant Clearance Officer has agreed otherwise, or the contract requires electronic submission of inventory disposal schedules, the Contractor shall prepare separate inventory disposal schedules for—

(A) Special test equipment with commercial components;
(B) Special test equipment without commercial components;
(C) Printing equipment;
(D) Computers, components thereof, peripheral equipment, and related equipment;
(E) Precious Metals;
(F) Nonnuclear hazardous materials or hazardous wastes; or
(G) Nuclear materials or nuclear wastes.

(iv) Property with the same description, condition code, and reporting location may be grouped in a single line item. The Contractor shall describe special test equipment in sufficient detail to permit an understanding of the special test equipment's intended use.

(4) *Submission requirements*. The Contractor shall submit inventory disposal schedules to the Plant Clearance Officer no later than—

(i) Thirty days following the Contractor's determination that a Government property item is no longer required for performance of the contract;

(ii) Sixty days, or such longer period as may be approved by the Plant Clearance Officer, following completion of contract deliveries or performance; or

(iii) One hundred twenty days, or such longer period as may be approved by the Plant Clearance Officer, following contract termination in whole or in part.

(5) *Corrections*. The Plant Clearance Officer may require the Contractor to correct an inventory disposal schedule or may reject a schedule if the property identified on the schedule is not accountable under this contract or is not in the quantity or condition indicated.

(6) *Postsubmission adjustments*. The Contractor shall provide the Plant Clearance Officer at least 10 working days advance written notice of its intent to remove a property item from an approved inventory disposal schedule. Unless the Plant Clearance Officer objects to the intended schedule adjustment within the notice period, the Contractor may make the adjustment upon expiration of the notice period.

(7) *Storage*.—(i) The Contractor shall store the property identified on an inventory disposal schedule pending receipt of disposal instructions. The Government's failure to provide disposal instructions within 120 days following acceptance of an inventory disposal schedule might entitle the Contractor to an equitable adjustment for costs incurred to store such property on or after the 121st day.

(ii) The Contractor shall obtain the Plant Clearance Officer's approval to remove Government property from the premises at which the property is currently located prior to receipt of final disposition instructions. If approval is granted, any costs incurred by the Contractor to transport or store the property shall not increase the price or fee of any Government contract. The storage facility shall be appropriate for assuring the property's physical safety and suitability for use. Approval does not relieve the Contractor of any liability under this contract for such property.

(8) *Disposition instructions*.—(i) If the Government does not provide disposition instructions to the Contractor within 45 days following acceptance of a scrap list, the Contractor may dispose of the listed scrap in accordance with the Contractor's approved scrap procedures.

(ii) The Contractor shall prepare for shipment, deliver f.o.b. origin, or dispose of Government property as directed by the Plant Clearance Officer. The Contractor shall remove and destroy any markings identifying the property as Government property prior to disposing of the property.

(iii) The Contracting Officer may require the Contractor to demilitarize the property prior to shipment or disposal. Any equitable adjustment incident to the Contracting Officer's direction to demilitarize Government property shall be made in accordance with paragraph (h) of this clause.

(9) *Disposal proceeds*. The Contractor shall credit the net proceeds from the disposal of Government property to the price or cost of work covered by this contract or to the Government as the Contracting Officer directs.

(10) *Subcontractor inventory disposal schedules*. The Contractor shall require a subcontractor that is using property accountable under this contract at a subcontractor-managed site to submit inventory disposal schedules to the Contractor in sufficient time for the Contractor to comply with the requirements of paragraph (i)(4) of this clause.

(j) *Abandonment of Government property*.—(1) The Government will not abandon sensitive Government property without the Contractor's written consent.

(2) The Government, upon notice to the Contractor, may abandon any nonsensitive Government property in place at which time all obligations of the Government regarding such abandoned property shall cease.

(3) The Government has no obligation to restore or rehabilitate the Contractor's premises under any circumstances; however, if Government-furnished property is withdrawn or is unsuitable for the intended use, or if other Government property is substituted, then the equitable adjustment under paragraph (h) of this clause may properly include restoration or rehabilitation costs.

(k) Communications. All communications under this clause shall be in writing.

(l) Overseas contracts. If this contract is to be performed outside of the United States of America and its outlying areas, the words "Government" and "Government-furnished" (wherever they appear in this clause) shall be construed as "United States Government" and "United States Government-furnished," respectively.

118. *FAR 52.245-4 GOVERNMENT-FURNISHED PROPERTY (SHORT FORM) (JUNE 2003) [For Government Property $100,000 or Less]

(a) The Government shall delivery to the Contractor, at the time and locations stated in this contract, the Government-furnished property described in the Schedule or specifications. If that property, suitable for its intended use, is not delivered to the Contractor, the Contracting Officer shall equitably adjust affected provisions of this contract in accordance with the Changed clause when--

(1) The Contractor submits a timely written request for an equitable adjustment; and

(2) The facts warrant an equitable adjustment.

(b) Title to Government-furnished property shall remain in the Government. The Contractor shall use the Government-furnished property only in connection with this contract. The Contractor shall maintain adequate property control records in accordance with sound industrial practice and will make such records available for Government inspection at all reasonable times, unless the clause at Federal Acquisition Regulation 52.245-1, Property Records, is included in this contract.

(c) Upon delivery of Government-furnished property to the Contractor, the Contractor assumes the risk and responsibility for its loss or damage, except--

(1) For reasonable wear and tear;

(2) To the extent property is consumed in performing this contract; or

(3) As otherwise provided for by the provisions of this contract.

(d) Upon completing this contract, the Contractor shall follow the instructions of the Contracting Officer regarding the disposition of all Government-furnished property not consumed in performing this contract or previously delivered to the Government. The Contractor shall prepare for shipment, deliver f.o.b. origin, or dispose of the Government property, as may be directed or authorized by the Contracting Officer. The net proceeds of any such disposal shall be credited to the contract price or shall be paid to the Government as directed by the Contracting Officer.

(e) If this contract is to be performed outside the United States of America and its outlying areas, the words "Government" and "Government-furnished" (wherever they appear in this clause) shall be construed as "United States Government" and "United States Government-furnished," respectively.

119. *FAR 52.246-12 INSPECTION OF CONSTRUCTION (AUG 1996)

(a) Definition. "Work" includes, but is not limited to, materials, workmanship, and manufacture and fabrication of components.

(b) The Contractor shall maintain an adequate inspection system and perform such inspections as will ensure that the work performed under the contract conforms to contract requirements. The Contractor shall maintain complete inspection records and make them available to the Government. All work shall be conducted under the general direction of the Contracting Officer and is subject to Government inspection and test at all places and at all reasonable times before acceptance to ensure strict compliance with the terms of the contract.

(c) Government inspections and tests are for the sole benefit of the Government and do not--

(1) Relieve the Contractor of responsibility for providing adequate quality control measures;

(2) Relieve the Contractor of responsibility for damage to or loss of the material before acceptance;

(3) Constitute or imply acceptance; or

(4) Affect the continuing rights of the Government after acceptance of the completed work under paragraph (i) below.

(d) The presence or absence of a Government inspector does not relieve the Contractor from any contract requirement, nor is the inspector authorized to change any term or condition of the specification without the Contracting Officer's written authorization.

(e) The Contractor shall promptly furnish, at no increase in contract price, all facilities,labor, and material reasonably needed for performing such safe and convenient inspections and tests as may be required by the Contracting Officer. The Government may charge to the Contractor any additional cost of inspection or test when work is not ready at the time specified by the Contractor for inspection or test, or when prior rejection makes reinspection or retest necessary. The Government shall perform all inspections and tests in a manner that will not unnecessarily delay the work. Special, full size, and performance tests shall be performed as described in the contract.

(f) The Contractor shall, without charge, replace or correct work found by the Government not to conform to contract requirements, unless in the public interest the Government consents to accept the work with an appropriate adjustment in contract price. The Contractor shall promptly segregate and remove rejected material from the premises.

(g) If the Contractor does not promptly replace or correct rejected work, the Government may

(1) by contract or otherwise, replace or correct the work and charge the cost to the Contractor or

(2) Terminate for default the Contractor's right to proceed.

(h) If, before acceptance of the entire work, the Government decides to examine already completed work by removing it or tearing it out, the Contractor, on request, shall promptly furnish all necessary facilities, labor, and material. If the work is found to be defective or nonconforming in any material respect due to the fault of the Contractor or its subcontractors, the Contractor shall defray the expenses of the examination and of satisfactory reconstruction. However, if the work is found to meet contract requirements, the Contracting Officer shall make an equitable adjustment for the additional services involved in the examination and reconstruction, including, if completion of the work was thereby delayed, an extension of time.

(i) Unless otherwise specified in the contract, the Government shall accept, as promptly as practicable after completion and inspection, all work required by the contract or that portion of the work the Contracting Officer determines can be accepted separately. Acceptance shall be final and conclusive except for latent defects, fraud, gross mistakes amounting to fraud, or the Government's rights under any warranty or guarantee.

120. *FAR 52.246-21 WARRANTY OF CONSTRUCTION (MAR 1994)

(a) In addition to any other warranties in this contract, the Contractor warrants, except as provided in paragraph (i) of this clause, that work performed under this contract conforms to the contract requirements and is free of any defect in equipment, material, or design furnished, or workmanship performed by the Contractor or any subcontractor or supplier at any tier.

(b) This warranty shall continue for a period of 1 year from the date of final acceptance of the work. If the Government takes possession of any part of the work before final acceptance, this warranty shall continue for a period of 1 year from the date the Government takes possession.

(c) The Contractor shall remedy at the Contractor's expense any failure to conform, or any defect. In addition, the Contractor shall remedy at the Contractor's expense any damage to Government-owned or controlled real or personal property, when that damage is the result of--

(1) The Contractor's failure to conform to contract requirements; or
(2) Any defect of equipment, material, workmanship, or design furnished.

(d) The Contractor shall restore any work damaged in fulfilling the terms and conditions of this clause. The Contractor's warranty with respect to work repaired or replaced will run for 1 year from the date of repair or replacement.

(e) The Contracting Officer shall notify the Contractor, in writing, within a reasonable time after the discovery of any failure, defect, or damage.

(f) If the Contractor fails to remedy any failure, defect, or damage within a reasonable time after receipt of notice, the Government shall have the right to replace, repair, or otherwise remedy the failure, defect, or damage at the Contractor's expense.

(g) With respect to all warranties, express or implied, from subcontractors, manufacturers, or suppliers for work performed and materials furnished under this contract, the Contractor shall--

(1) Obtain all warranties that would be given in normal commercial practice;

(2) Require all warranties to be executed, in writing, for the benefit of the Government, if directed by the Contracting Officer; and

(3) Enforce all warranties for the benefit of the Government, if directed by the Contracting Officer.

(h) In the event the Contractor's warranty under paragraph (b) of this clause has expired, the Government may bring suit at its expense to enforce a subcontractor's, manufacturer's, or supplier's warranty.

(i) Unless a defect is caused by the negligence of the Contractor or subcontractor or supplier at any tier, the Contractor shall not be liable for the repair of any defects of material or design furnished by the Government nor for the repair of any damage that results from any defect in Government-furnished material or design.

(j) This warranty shall not limit the Government's rights under the Inspection and Acceptance clause of this contract with respect to latent defects, gross mistakes, or fraud.

121. DFARS 252.247-7023 TRANSPORTATION OF SUPPLIES BY SEA (MAR 2000)

(a) Definitions.

As used in this clause--

(1) "Components" means articles, materials, and supplies incorporated directly into end products at any level of manufacture, fabrication, or assembly by the Contractor or any subcontractor.

(2) 'Department of Defense" (DOD) means the Army, Navy, Air Force, Marine Corps, and defense agencies.

(3) "Foreign flag vessel" means any vessel that is not a U.S.-flag vessel.

(4) "Ocean transportation" means any transportation aboard a ship, vessel, boat, barge, or ferry through international waters.

(5) "Subcontractor" means a supplier, materialman, distributor, or vendor at any level below the prime Contractor whose contractual obligation to perform results from, or is conditioned upon, award of the prime contract and who is performing any part of the work or other requirement of the prime contract.

(6) "Supplies" means all property, except land and interests in lard, that is clearly identifiable for eventual use by or owned by the DoD at the time of transportation by sea.

(i) An item is clearly identifiable for eventual use by the DoD if, for example, the contract documentation contains a reference to a DoD contract number or a military destination.

(ii) "Supplies" includes (but is not limited to) public works; buildings and facilities; ships; floating equipment and vessels of every character, type, and description, with parts, subassemblies, accessories, and equipment; machine tools; material; equipment; stores of all kinds; end items; construction materials; and components of the foregoing.

(7) "U.S.-flag vessel" means a vessel of the United States or belonging to the United States, including any vessel registered or having national status under the laws of the United States.

(b) (1) The Contractor shall use U.S. -flag vessels when transporting any supplies by sea under this contract.

(2) A subcontractor transporting supplies by sea under this contract shall use U.S.-flag vessel if--

(i) This Contract is a construction contract; or

(ii) The supplies being transported are-

(A) Noncommercial items; or

(B) Commercial items that-

(1) The Contractor is reselling or distributing to the Government without adding value (generally, the Contractor does not add value to items that it subcontracts for f.o.b. destination shipment);

(2) Are shipped in direct support of U.S. military contingency operations, exercises, or forces deployed in humanitarian or peacekeeping operations; or

(3) Are commissary or exchange cargoes transported outside of the Defense Transportation System in accordance with 10 U.S.C. 2643.

(c) The Contractor and its subcontractors may request that the Contracting Officer authorize shipment in foreign-flag vessels, or designate available U.S.-flag vessels, if the Contractor or a subcontractor believes that--

(1) U.S.-flag vessels are not available for timely shipment;

(2) The freight charges are inordinately excessive or unreasonable; or

(3) Freight charges are higher that charges to private persons for transportation of like goods.

(d) The Contractor must submit any request for use of other than U.S.-flag vessels in writing to the Contracting Officer at least 45 days prior to the sailing date necessary to meet its delivery schedules. The Contracting Officer will process requests submitted after such date(s) as expeditiously as possible, but the Contracting Officer's failure to grant approvals to meet the shipper's sailing date will not of itself constitute a compensable delay under this or any other clause of this contract. Requests shall contain at a minimum--

(1) Type, weight, and cube of cargo;

(2) Required shipping date:

(3) Special handling and discharge requirements;

(4) Loading and discharge points;

(5) Name of shipper and consignee;

(6) Prime contract number, and

(7) A documented description of efforts made to secure U.S.-flag vessels, including points of contact (with names and telephone numbers) with at least two U.S.-flag carriers contacted. Copies of telephone notes, telegraphic and facsimile message or letters will be sufficient for this purpose.

(e) The Contractor shall, within 30 days after each shipment covered by this clause, provide the Contracting Officer and the Division of National Cargo, Office of Market Development, Maritime Administration, U.S. Department of Transportation, Washington, DC 20590, one copy of the rated on board vessel operating carrier's ocean bill of lading, which shall contain the following information--

(1) Prime contract number;

(2) Name of vessel;

(3) Vessel flag of registry;

(4) Date of loading;

(5) Port of loading;

(6) Port of final discharge;

(7) Description of commodity;

(8) Gross weight in pounds and cubic feet if available;

(9) Total ocean freight in U.S. dollars; and

(10) Name of the steamship company.

(f) The Contractor agrees to provide with its final invoice under this contract a representation that to the best of its knowledge and belief--

(1) No ocean transportation was used in the performance of this contract;

(2) Ocean transportation was used and only U.S.-flag vessels were used for all ocean shipments under the contract;

(3) Ocean transportation was used, and the Contractor had the written consent of the Contracting Officer for all non-U.S.-flag ocean transportation; or

(4) Ocean transportation was used and some or all of the shipments were made on non-U.S.-flag vessels without the written consent of the Contracting Officer. The Contractor shall describe these shipments in the following format;

ITEM DESCRIPTION	CONTRACT LINE ITEMS	QUANTITY
TOTAL		

(g) If the final invoice does not include the required representation, the Government will reject and return it to the Contractor as an improper invoice for the purposes of the Prompt Payment clause of this contract. In the event there has been unauthorized use of non-U.S.-flag vessels in the performance of this contract, the Contracting Officer is entitled to equitably adjust the contract, based on the unauthorized use.

(h) The Contractor shall include this clause, including this paragraph (h) in all subcontracts under this contract that-

(1) Exceed the simplified acquistion threshold in Part 2 of the Federal Acquisition Regulation; and

(2) Are for a type of supplies described in paragraph (b) (2) of this clause.

122. DFARS 252.247-7024 NOTIFICATION OF TRANSPORTATION OF SUPPLIES BY SEA (MAR 2000)

(a) The Contractor has indicated by the response to the solicitation provision, Representation of Extent of Transportation by Sea, that it did not anticipate transporting by sea any supplies. If, however, after the award of this contract, the Contractor learns that supplies, as defined in the Transportation of Supplies by Sea clause of this contract, will be transported by sea, the Contractor--

(1) Shall notify the Contracting Officer of that fact; and

(2) Hereby agrees to comply with all the terms and conditions of the Transportation of Supplies by Sea clause of this contract.

(b) (1) The Contractor shall use U.S. -flag vessels when transporting any supplies by sea under this contract.

(2) A subcontractor transporting supplies by sea under this contract shall use U.S.-flag vessel if--

(i) This Contract is a construction contract; or

(ii) The supplies being transported are-

(A) Noncommercial items; or

(B) Commercial items that-

(1) The Contractor is reselling or distributing to the Government without adding value (generally, the Contractor does not add value to items that it subcontracts for f.o.b. destination shipment);

(2) Are shipped in direct support of U.S. military contingency operations, exercises, or forces deployed in humanitarian or peacekeeping operations; or

(3) Are commissary or exchange cargoes transported outside of the Defense Transportation System in accordance with 10 U.S.C. 2643.

123. FAR 52.248-3 VALUE ENGINEERING--CONSTRUCTION (FEB 2000) (ALERNATE I (APR 1984)

(a) General. The Contractor is encouraged to develop, prepare, and submit value engineering change proposals (VECP's) voluntarily. The Contractor shall share in any instant contract savings realized from accepted VECP's, in accordance with paragraph (f) of this clause.

(b) Definitions. "Collateral costs," as used in this clause, means agency costs of operation, maintenance, logistic support, or Government-furnished property.

"Collateral savings," as used in this clause, means those measurable net reductions resulting from a VECP in the agency's overall projected collateral costs, exclusive of acquisition savings, whether or not the acquisition cost changes.

"Contractor's development and implementation costs," as used in this clause, means those costs the Contractor incurs on a VECP specifically in developing, testing, preparing, and submitting the VECP, as well as those costs the Contractor incurs to make the contractual changes required by Government acceptance of a VECP.

"Government costs," as used in this clause, means those agency costs that result directly from developing and implementing the VECP, such as any net increases in the cost of testing, operations, maintenance, and logistic support. The term does not include the normal administrative costs of processing the VECP.

"Instant contract savings," as used in this clause, means the estimated reduction in Contractor cost of performance resulting from acceptance of the VECP, minus allowable Contractor's development and implementation costs, including subcontractors' development and implementation costs (see paragraph (h) of this clause).

"Value engineering change proposal (VECP)" means a proposal that--

(1) Requires a change to this, the instant contract, to implement; and

(2) Results in reducing the contract price or estimated cost without impairing essential functions or characteristics; provided, that it does not involve a change--

(i) In deliverable end item quantities only; or

(ii) To the contract type only.

(c) VECP preparation. As a minimum, the Contractor shall include in each VECP the information described in paragraphs (c) (1) through (7) of this clause. If the proposed change is affected by contractually required configuration management or similar procedures, the instructions in those procedures relating to format, identification, and priority assignment shall govern VECP preparation. The VECP shall include the following:

(1) A description of the difference between the existing contract requirement and that proposed, the comparative advantages and disadvantages of each, a justification when an item's function or characteristics are being altered, and the effect of the change on the end item's performance.

(2) A list and analysis of the contract requirements that must be changed if the VECP is accepted, including any suggested specification revisions.

(3) A separate, detailed cost estimate for

(i) the affected portions of the existing contract requirement and

(ii) the VECP. The cost reduction associated with the VECP shall take into account the Contractor's allowable development and implementation costs, including any amount attributable to subcontracts under paragraph (h) of this clause.

(4) A description and estimate of costs the Government may incur in implementing the VECP, such as test and evaluation and operating and support costs.

(5) A prediction of any effects the proposed change would have on collateral costs to the agency.

(6) A statement of the time by which a contract modification accepting the VECP must be issued in order to achieve the maximum cost reduction, noting any effect on the contract completion time or delivery schedule.

(7) Identification of any previous submissions of the VECP, including the dates submitted, the agencies and contract numbers involved, and previous Government actions, if known.

(d) Submission. The Contractor shall submit VECP's to the Resident Engineer at the worksite, with a copy to the Contracting Officer.

(e) Government action.

(1) The Contracting Officer will notify the Contractor of the status of the VECP within 45 calendar days after the contracting office receives it. If additional time is required, the Contracting Officer will notify the Contractor within the 45-day period and provide the reason for the delay and the expected date of the decision. The Government will process VECP's expeditiously; however, it will not be liable for any delay in acting upon a VECP.

(2) If the VECP is not accepted, the Contracting Officer will notify the Contractor in writing, explaining the reasons for rejection. The Contractor may withdraw any VECP, in whole or in part, at any time

before it is accepted by the Government. The Contracting Officer may require that the Contractor provide written notification before undertaking significant expenditures for VECP effort.

(3) Any VECP may be accepted, in whole or in part, by the Contracting Officer's award of a modification to this contract citing this clause. The Contracting Officer may accept the VECP, even though an agreement on price reduction has not been reached, by issuing the Contractor a notice to proceed with the change. Until a notice to proceed is issued or a contract modification applied a VECP to this contract, the Contractor shall perform in accordance with the existing contract. The decision to accept or reject all or part of any VECP is a unilateral decision made solely at the discretion of the Contracting Officer.

(f) Sharing.

(1) Rates. The Government's share of savings is determined by subtracting Government costs from instant contract savings and multiplying the result by

(i) 45 percent for fixed-price contracts or

(ii) 75 percent for cost-reimbursement contracts.

(2) Payment. Payment of any share due the Contractor for use of a VECP on this contract shall be authorized by a modification to this contract to--

(i) Accept the VECP;

(ii) Reduce the contract price or estimated cost by the amount of instant contract savings; and

(iii) Provide the Contractor's share of savings by adding the amount calculated to the contract price or fee.

(g) Deleted.

(h) Subcontracts. The Contractor shall include an appropriate value engineering clause in any subcontract of $50,000 or more and may include one in subcontracts of lesser value. In computing any adjustment in this contract's price under paragraph (f) of this clause, the Contractor's allowable development and implementation costs clearly resulting from a VECP accepted by the Government under this contract, but shall exclude any value engineering incentive payments to a subcontractor. The Contractor may choose any arrangement for subcontractor value engineering incentive payments; provided, that these payments shall not reduce the Government's share of the savings resulting from the VECP.

(i) Data. The Contractor may restrict the Government's right to use any part of a VECP or the supporting data by marking the following legend on the affected parts:

"These data, furnished under the Value Engineering--Construction clause of contract - _____, shall not be disclosed outside the Government or duplicated, used, or disclosed, in whole or in part, for any purpose other than to evaluate a value engineering change proposal submitted under the clause. This restriction does not limit the Government's right to use information contained in these data if it has been obtained or is otherwise available from the Contractor or from another source without limitations."

If a VECP is accepted, the Contractor hereby grants the Government unlimited rights in the VECP and supporting data, except that, with respect to data qualifying and submitted as limited rights technical data, the Government shall have the rights specified in the contract modification implementing the VECP and shall appropriately mark the data. (The terms "unlimited rights" and "limited rights" are defined in Part 27 of the Federal Acquisition Regulation.)

(End of Clause)

124. *FAR 52.249-1 TERMINATION FOR CONVENIENCE OF THE GOVERNMENT (FIXED-PRICE) (SHORT FORM) (APR 1984) [For Contracts $100,000 or Less]

The Contracting Officer, by written notice, may terminate this contract, in whole or in part, when it is in the Government's interest. If this contract is terminated, the rights, duties, and obligations of the parties, including compensation to the Contractor, shall be in accordance with Part 49 of the Federal Acquisition Regulation in effect on the date of this contract.

125. *FAR 52.249-2 TERMINATION FOR CONVENIENCE OF THE GOVERNMENT (FIXED-PRICE) (MAY 2004) ALTERNATE I (SEP 1996) [For Contracts Over $100,000]

(a) The Government may terminate performance of work under this contract in whole or, from time to time, in part if the Contracting Officer determines that a termination is in the Government's interest. The Contracting Officer shall terminate by delivering to the Contractor a Notice of Termination specifying the extent of termination and the effective date.

(b) After receipt of a Notice of Termination, and except as directed by the Contracting Officer, the Contractor shall immediately proceed with the following obligations, regardless of any delay in determining or adjusting any amounts due under this clause:

(1) Stop work as specified in the notice.

(2) Place no further subcontracts or orders (referred to as subcontracts in this clause) for materials, services, or facilities, except as necessary to complete the continued portion of the contract.

(3) Terminate all subcontracts to the extent they relate to the work terminated.

(4) Assign to the Government, as directed by the Contracting Officer, all right, title, and interest of the Contractor under the subcontracts terminated, in which case the Government shall have the right to settle or to pay any termination settlement proposal arising out of those terminations.

(5) With approval or ratification to the extent required by the Contracting Officer, settle all outstanding liabilities and termination settlement proposals arising from the termination of subcontracts; the approval or ratification will be final for purposes of this clause.

(6) As directed by the Contracting Officer, transfer title and deliver to the Government

(i) the fabricated or unfabricated parts, work in process, completed work, supplies, and other material produced or acquired for the work terminated, and

(ii) the completed or partially completed plans, drawings, information, and other property that, if the contract had been completed, would be required to be furnished to the Government.

(7) Complete performance of the work not terminated.

(8) Take any action that may be necessary, or that the Contracting Officer may direct, for the protection and preservation of the property related to this contract that is in the possession of the Contractor and in which the Government has or may acquire an interest.

(9) Use its best efforts to sell, as directed or authorized by the Contracting Officer, any property of the types referred to in subparagraph (b) (6) of this clause; provided, however, that the Contractor

(i) is not required to extend credit to any purchaser and

(ii) may acquire the property under the conditions prescribed by, and at prices approved by, the Contracting Officer. The proceeds of any transfer or disposition will be applied to reduce any payments to be made by the Government under this contract, credited to the price or cost of the work, or paid in any other manner directed by the Contracting Officer.

(c) The Contractor shall submit complete termination inventory schedules no later than 120 days from the effective date of termination, unless extended in writing by the Contracting Officer upon written request of the Contractor within this 120-day period.

(d) After expiration of the plant clearance period as defined in Subpart 49.001 of the Federal Acquisition Regulation, the Contractor may submit to the Contracting Officer a list, certified as to quantity and quality, of termination inventory not previously disposed of, excluding items authorized for disposition by the Contracting Officer. The Contractor may request the Government to remove those items or enter into an agreement for their storage. Within 15 days, the Government will accept title to those items and remove them or enter into a storage agreement. The Contracting Officer may verify the list upon removal of the items, or if stored, within 45 days from submission of the list, and shall correct the list, as necessary, before final settlement.

(e) After termination, the Contractor shall submit a final termination settlement proposal to the Contracting Officer in the form and with the certification prescribed by the Contracting Officer. The Contractor shall submit the proposal promptly, but no later than 1 year from the effective date of termination, unless extended in writing by the Contracting Officer upon written request of the Contractor within this 1 year period. However, if the Contracting Officer determines that the facts justify it, a termination settlement proposal may be received and acted on after 1 year or any extension. If the Contractor fails to submit the proposal within the time allowed, the Contracting Officer may determine, on the basis of information available, the amount, if any, due the Contractor because of the termination and shall pay the amount determined.

(f) Subject to paragraph (e) of this clause, the Contractor and the Contracting Officer may agree upon the whole or any part of the amount to be paid because of the termination. The amount may include a reasonable allowance for profit on work done. However, the agreed amount, whether under this paragraph (f) or paragraph (g) of this clause, exclusive of costs shown in subparagraph (g)(3) of this clause, may not exceed the total contract price as reduced by (1) the amount of payments previously made and (2) the contract price of work not terminated. The contract shall be amended, and the Contractor paid the agreed amount. Paragraph (f) of this clause shall not limit, restrict, or affect the amount that may be agreed upon to be paid under this paragraph.

(g) If the Contractor and the Contracting Officer fail to agree on the whole amount to be paid the Contractor because of the termination of work, the Contracting Officer shall pay the Contractor the amounts determined as follows, but without duplication of any amounts agreed upon under paragraph (f) of this clause:

(1) For contract work performed before the effective date of the termination, the total (without duplication of any items) of--

(i) The cost of this work;

(ii) The cost of settling and paying termination settlement proposals under terminated subcontracts that are properly chargeable to the terminated portion of the contract if not included in subdivision (g)(1)(i) of this clause; and

(iii) A sum, as profit on subdivision (g)(1)(i) of this clause, determined by the Contracting Officer under 49.202 of the Federal Acquisition Regulation, in effect on the date of this contract, to be fair and reasonable; however, if it appears that the Contractor would have sustained a loss on the entire contract had it been completed, the Contracting Officer shall allow no profit under this subdivision (iii) and shall reduce the settlement to reflect the indicated rate of loss.

(2) The reasonable costs of settlement of the work terminated, including--

(i) Accounting, legal, clerical, and other expenses reasonably necessary for the preparation of termination settlement proposals and supporting data;

(ii) The termination and settlement of subcontracts (excluding the amounts of such settlements); and

(iii) Storage, transportation, and other costs incurred, reasonably necessary for the preservation, protection, or disposition of the termination inventory.

(h) Except for normal spoilage, and except to the extent that the Government expressly assumed the risk of loss, the Contracting Officer shall exclude from the amounts payable to the Contractor under paragraph (g) of this clause, the fair value, as determined by the Contracting Officer, of property that is destroyed, lost, stolen, or damaged so as to become undeliverable to the Government or to a buyer.

(i) The cost principles and procedures of Part 31 of the Federal Acquisition Regulation, in effect on the date of this contract, shall govern all costs claimed, agreed to, or determined under this clause.

(j) The Contractor shall have the right of appeal, under the Disputes clause, from any determination made by the Contracting Officer under paragraph (e), (g), or (l) of this clause, except that if the Contractor failed to submit the termination settlement proposal within the time provided in paragraph (e) or (l), respectively, and failed to request a time extension, there is no right of appeal.

(k) In arriving at the amount due the Contractor under this clause, there shall be deducted--

(1) All unliquidated advance or other payments to the Contractor under the terminated portion of this contract;

(2) Any claim which the Government has against the Contractor under this contract; and

(3) The agreed price for, or the proceeds of sale of, materials, supplies, or other things acquired by the Contractor or sold under the provisions of this clause and not recovered by or credited to the Government.

(l) If the termination is partial, the Contractor may file a proposal with the Contracting Officer for an equitable adjustment of the price(s) of the continued portion of the contract. The Contracting Officer shall make any equitable adjustment agreed upon. Any proposal by the Contractor for an equitable adjustment under this clause shall be requested within 90 days from the effective date of termination unless extended in writing by the Contracting Officer.

(m) (1) The Government may, under the terms and conditions it prescribes, make partial payments and payments against costs incurred by the Contractor for the terminated portion of the contract, if the Contracting Officer believes the total of these payments will not exceed the amount to which the Contractor will be entitled.

(2) If the total payments exceed the amount finally determined to be due, the Contractor shall repay the excess to the Government upon demand, together with interest computed at the rate established by the Secretary of the Treasury under 50 U.S.C. App. 1215(b)(2). Interest shall be computed for the period from the date the excess payment is received by the Contractor to the date the excess is repaid. Interest shall not be charged on any excess payment due to a reduction in the Contractor's termination settlement proposal because of retention or other disposition of termination inventory until 10 days after the date of the retention or disposition, or a later date determined by the Contracting Officer because of the circumstances.

(n) Unless otherwise provided in this contract or by statute, the Contractor shall maintain all records and documents relating to the terminated portion of this contract for 3 years after final settlement. This includes all books and other evidence bearing on the Contractor's costs and expenses under this contract. The Contractor shall make these records and documents available to the Government, at the Contractor's office, at all reasonable times, without any direct charge. If approved by the Contracting Officer, photographs, microphotographs, or other authentic reproductions may be maintained instead of original records and documents.

126. *FAR 52.249-10 DEFAULT (FIXED-PRICE CONSTRUCTION) (APR 1984)

(a) If the Contractor refuses or fails to prosecute the work or any separable part, with the diligence that will insure its completion within the time specified in this contract including any extension, or fails to complete the work within this time, the Government may, by written notice to the Contractor, terminate the right to proceed with the work (or the separable part of the work) that has been delayed. In this event, the Government may take over the work and complete it by contract or otherwise, and may take possession of and use any materials, appliances, and plant on the work site necessary for completing the work. The Contractor and its sureties shall be liable for any damage to the Government resulting from the Contractor's refusal or failure to complete the work within the specified time, whether or not the Contractor's right to proceed with the work is terminated. This liability includes any increased costs incurred by the Government in completing the work.

(b) The Contractor's right to proceed shall not be terminated nor the Contractor charged with damages under this clause, if-

(1) The delay in completing the work arises from unforeseeable causes beyond the control and without the fault or negligence of the Contractor. Examples of such causes include

(i) acts of God or of the public enemy,

(ii) acts of the Government in either its sovereign or contractual capacity,

(iii) acts of another Contractor in the performance of a contract with the Government,

(iv) fires,

(v) floods,

(vi) epidemics,

(vii) quarantine restrictions,

(viii) strikes,

(ix) freight embargoes,

(x) unusually severe weather, or

(xi) delays of subcontractors or suppliers at any tier arising from unforeseeable causes beyond the control and without the fault or negligence of both the Contractor and the subcontractors or suppliers; and

(2) The Contractor, within 10 days from the beginning of any delay (unless extended by the Contracting Officer), notifies the Contracting Officer in writing of the causes of delay. The Contracting Officer shall ascertain the facts and the extent of delay. If, in the judgment of the Contracting Officer, the findings of fact warrant such action, the time for completing the work shall be extended. The findings of the Contracting Officer shall be final and conclusive on the parties, but subject to appeal under the Disputes clause.

(c) If, after termination of the Contractor's right to proceed, it is determined that the Contractor was not in default, or that the delay was excusable, the rights and obligation s of the parties will be the same as if the termination had been issued for the convenience of the Government.

(d) The rights and remedies of the Government in this clause are in addition to any other rights and remedies provided by law or under this contract.

127. ENVIRONMENTAL LITIGATION (1974 NOV OCE)

(a) If the performance of all or any part of the work is suspended, delayed, or interrupted due to an order of a court of competent jurisdiction as a result of environmental litigation, as defined below, the Contracting Officer, at the request of the Contractor, shall determine whether the order is due in any part to the acts or omissions of the Contractor or a Subcontractor at any tier not required by the terms of this contract. If it is determined that the order is not due in any part to acts or omissions of the Contractor or a Subcontractor at any tier other than as required by the terms of this contract, such suspension, delay, or interruption shall be considered as if ordered by the Contracting Officer in the administration of this contract under the terms of the "Suspension of Work" clause of this contract. The period of such suspension, delay, or interruption shall be considered unreasonable, and an adjustment shall be made for any increase in the cost of performance of this contract (excluding profit) as provided in that clause, subject to all the provisions thereof.

(b) The term "environmental litigation," as used herein, means a lawsuit alleging that the work will have an adverse effect on the environment or that the Government has not duly considered, either substantively or procedurally, the effect of the work on the environment.

128. EFARS 52.249-5000 BASIS FOR SETTLEMENT OF PROPOSALS

Actual costs will be used to determine equipment cost for a settlement proposal submitted on the total cost basis under FAR 49.206-2(b). In evaluating a termination settlement proposal using the total cost basis, the following principles will be applied to determine allowable equipment costs:

(1) Actual costs for each piece of equipment, or groups of similar serial or series equipment, need not be available in the contractor's accounting records to determine total actual equipment costs.

(2) If equipment costs have been allocated to a contract using predetermined rates, those charges will be adjusted to actual costs.

(3) Recorded job costs adjusted for unallowable and unallocable expenses will be used to determine equipment operating expenses.

(4) Ownership costs (depreciation) will be determined using the contractor's depreciation schedule (subject to the provisions of FAR 31.205-11).

(5) License, taxes, storage and insurance costs are normally recovered as an indirect expense and unless the contractor charges these costs directly to contracts, they will be recovered through the indirect expense rate.

129. INAPPLICABLE PROVISIONS AND CLAUSES (Local Provision). [Applicable only for projects or delivery orders less than $100,000]

This provision applies only to delivery orders and projects less than $100,000.

Pursuant to Pub. L. 103-355, the following provisions and clauses, as noted below, are inapplicable to this contract:

(a) FAR 28.102-3, Miller Act requirements;
(b) Not Used;
(c) FAR 52.203-5, Covenant Against Contingent Fees;
(d) FAR 52.203-6, Restrictions on Subcontractor Sales to the Government;
(e) FAR 52.203-7, Anti-Kickback Procedures;
(f) FAR 52.222-4, Contract Work Hours and Safety Standards Act-Overtime Compensation; and
(g) FAR 52.223-6, Drug-Free Workplace, except for individuals.

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SECTION 00800

SPECIAL CONTRACT REQUIREMENTS
5/00, Rev 8/03

PART 1 GENERAL

Attachments:
Project Sign Details OD15-9A12
General Wage Decision No. ND030005 dated 6/18/2004
Appendix A - Contract Document Distribution List

1.1 COMMENCEMENT, PROSECUTION, AND COMPLETION OF WORK (APR 1984)

The Contractor shall commence work under this contract within ten (10) calendar days after the date of receipt by him of Notice to Proceed, prosecute said work diligently, and complete the entire work ready for use not later than 450 calendar days after receipt of Notice to Proceed. The time stated for completion shall include final cleanup of the premises. (FAR 52.211-10)

1.1.1 Start Work

Evidence that the Contractor has started procurement of materials, preparation and submission of shop drawings, preparation of subcontracts, and other preparatory work will satisfy the requirement that work commence within ten (10) calendar days after receipt of Notice to Proceed. Therefore, work need not be commenced at the construction site within ten (10) calendar days.

1.2 LIQUIDATED DAMAGES-CONSTRUCTION (SEPT 2000)

(a) If the Contractor fails to complete the work within the time specified in the contract, the Contractor shall pay liquidated damages to the Government in the amount of $800 for each calendar day of delay until the work is completed or accepted.

(b) If the Government terminates the Contractor's right to proceed, liquidated damages will continue to accrue until the work is completed. These liquidated damages are in addition to excess costs of repurchase under the Termination clause. (FAR 52.211-12)

1.3 EXCEPTION TO COMPLETION TIME AND LIQUIDATED DAMAGES

In case the Contracting Officer determines that seeding, sodding, and/or planting and/or the specified maintenance thereof is not feasible during the construction period, such work will be excepted from the completion time and liquidated damages. This work shall be accomplished during the first seeding, sodding, and/or planting period and the specified maintenance period following the completion date.

1.4 COMPUTING COMPLETION DATES FOR NON-WORK PERIOD

No work will be required at the construction site during the period 15 November 2004 through 15 April 2005 inclusive. The days in this period

have been included in computing the calendar days for completion of the work. The Contractor may perform work at the site during all or any part of this period upon giving prior written notice to the Contracting Officer. Working during this non-work period shall require approval by the Contracting Officer. No time extensions will be granted for delays during this period.

1.5 CONTRACT DRAWINGS AND SPECIFICATIONS

1.5.1 SETS FURNISHED

The contractor shall be responsible for making copies of specifications including amendments. The bid drawings as amended shall be utilized in the performance of the work until CD-ROM containing the contract drawings (i.e., bid drawings that have been posted with all amendment changes) are mailed to the Contractor. See paragraph below for contract drawing reproduction and distribution requirements. The work shall conform to the contract drawings, set out in the drawing index, all of which form a part of these specifications. The work shall also conform to the standard details bound or referenced herein.

1.5.2 DRAWING REPRODUCTION AND DISTRIBUTION

The Contractor shall reproduce multiple legible hard copy sets (half-size English unless directed otherwise) of contract drawings from Government provided CD-ROM containing read-only cal file drawings. Within 14 calendar days after receipt of CD-ROM containing read-only cal drawing files, the Contractor shall provide legible hard copy drawing sets to the addressees contained in the Contract Document Distribution List for Project in Appendix A to this specification. The Government will process no progress payments prior to receipt of the legible contract drawings. After receipt and distribution of the legible hard copy drawing sets, the Government will provide the Contractor with a CD-ROM containing editable CAD file drawings (format defined in Section 01040 AS-BUILT DRAWINGS). The Contractor shall prepare as-built drawings as defined in Section 01040 AS-BUILT DRAWINGS.

1.5.3 NOTIFICATION OF DISCREPANCIES

The Contractor shall check all CD-ROM drawing files furnished him immediately upon their receipt and shall promptly notify the Contracting Officer of any discrepancies. Dimensions marked on drawings shall be followed in lieu of scale measurements. Enlarged plans and details shall govern where the same work is shown at smaller scales. All scales shown are based on a standard drawing size of 28" x 40" . If any other size drawings are furnished or plotted the contractor shall adjust the scales accordingly. The Contractor shall also advise his sub-contractors of the above. The Contractor shall compare all drawings and verify the figures before laying out the work and will be responsible for any errors which might have been avoided thereby.

1.5.4 OMISSIONS

Omissions from the drawings or specifications or the misdescription of details of work which are manifestly necessary to carry out the intent of the drawings and specifications, or which are customarily performed, shall not relieve the Contractor from performing such omitted or misdescribed details of the work but they shall be performed as if fully and correctly

set forth and described in the drawings and specifications.

1.6 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Equipment Room Drawings; G-AO.

1.7 PHYSICAL DATA (APR 1984)

Data and information furnished or referred to below is for the Contractors' information. The Government shall not be responsible for any interpretation of or conclusion drawn from the data or information by the Contractor.

a. The indications of physical conditions on the drawings and in the specifications are the result of site investigations by surveys etc.. The data shown graphically and by symbol for each respective boring represents the actual geologic features observed and logged at the location given on the drawings. While the borings are representative of subsurface conditions at their respective locations and for their respective vertical reaches, local minor variations characteristic of the subsurface materials of this region could occur.

b. Weather conditions shall have been investigated by the Contractor to satisfy himself as to the hazards likely to arise therefrom. Complete weather records and reports may be obtained from the local U.S. Weather Bureau.

c. Transportation facilities shall have been investigated by the Contractor to satisfy himself as to the existence of access highways and railroad facilities. (FAR 52.236-4)

1.8 PAYMENT

1.8.1 PROMPT PAYMENT ACT

Pay requests authorized in CONTRACT CLAUSES clause: "Payments Under Fixed-Price Construction Contracts", will be paid pursuant to the clause, "Prompt Payment for Construction Contracts". Pay requests will be submitted on ENG Form 93 and 93a, "Payment Estimate-Contract Performance" and "Continuation". All information and substantiation required by the identified contract clauses will be submitted with the ENG Form 93, and the required certification will be included on the last page of the ENG Form 93a, signed by an authorized contractor official and dated when signed. The designated billing office is the Office of the Area Engineer.

1.8.2 PAYMENTS FOR MODIFICATIONS

Payments may be made for cost bearing change orders within the scope of the contract only to the extent funds are authorized in the order on a two-part modification. Contractor pricing proposed must be submitted at the

earliest possible time after the change order is issued, or at a specific time as directed by the Contracting Officer. At the discretion of the Contracting Officer, any and all payments may be withheld on the modification until the Contractor has submitted a qualifying price proposal, in as much detail as required by the Contracting Officer, and the final price has been agreed.

1.8.3 PAYMENT FOR MATERIALS DELIVERED OFFSITE (MAR 1995)

a. Pursuant to FAR clause 52.232-5, Payments Under Fixed Priced Construction Contracts, materials delivered to the contractor at locations other than the site of the work may be taken into consideration in making payments if included in payment estimates and if all the conditions of the General Provisions are fulfilled. Payment for items delivered to locations other than the work site will be limited to: (1) materials required by the technical provisions; or (2) materials that have been fabricated to the point where they are identifiable to an item of work required under this contract.

b. Such payment will be made only after receipt of paid or receipted invoices or invoices with canceled check showing title to the items in the prime contractor and including the value of material and labor incorporated into the item. Payment for materials delivered off-site includes petroleum products. (List additional items for which payments will be made for off-site delivery.) (EFAR 52.232-5000)

1.9 AVAILABILITY OF UTILITY SERVICES

All reasonably required amounts of domestic water and electricity will be made available to the Contractor by the Government from existing system outlets and supplies. The Contractor shall, at his own expense, make all temporary connections and install distribution lines. The Contractor shall furnish to the Contracting Officer a complete system layout drawing showing type of materials to be used and method of installation for all temporary electrical systems. Meters shall be installed by the Contractor to determine the amount of water and electricity used by him, and such utilities will be paid for by or charged to the Contractor. All temporary lines shall be maintained by the Contractor in a workmanlike manner satisfactory to the Contracting Officer and shall be removed by the Contractor in like manner prior to final acceptance of the construction. Normal quantities of electricity and water used to make final tests of completely installed systems will be furnished by the Government.

1.10 UTILITY SERVICE INTERRUPTIONS

The Contractor shall submit written notification not less than 15 calendar days in advance of each interruption of each utility and communication service to or within existing buildings and facilities being used by others. No single outage will exceed 4 hours unless approved in writing. The time and duration of all outages will be coordinated and approved with the Using Agency by the Contracting Officer.

1.11 DIGGING PERMITS AND ROAD CLOSINGS

The Contractor shall allow 14 calendar days from date of written application to receive permission to dig and to close roads. Roads shall only be closed one lane at a time and vehicular traffic shall be allowed to pass through the construction area. Work on or near roadways shall be

flagged in accordance with the safety requirements in Safety and Health Requirements Manual EM 385-1-1, which forms a part of these specifications. Work located along the alert force route shall not cause blockage and the Contractor shall maintain unobstructed access for alert force traffic at all times.

1.12 TIME EXTENSIONS FOR UNUSUALLY SEVERE WEATHER

a. This clause specifies the procedure for the determination of time extensions for unusually severe weather in accordance with the contract clause entitled "Default: (Fixed-Price Construction)." In order for the Contracting Officer to award a time extension under this clause, the following conditions must be satisfied:

(1) The weather experienced at the project site during the contract period must be found to be unusually severe, that is, more severe than the adverse weather anticipated for the project location during any given month.

(2) The unusually severe weather must actually cause a delay to the completion of the project. The delay must be beyond the control and without the fault or negligence of the contractor.

b. The following schedule of monthly anticipated adverse weather delays is based on National Oceanic and Atmospheric Administration (NOAA) or similar data for the project location and will constitute the base line for monthly weather time evaluations. The contractor's progress schedule must reflect these anticipated adverse weather delays in all weather dependent activities.

MONTHLY ANTICIPATED ADVERSE WEATHER DELAY
WORK DAYS BASED ON (5) DAY WORK WEEK

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
(23)	(18)	(12)	(4)	(5)	(7)	(6)	(5)	(5)	(3)	(12)	(20)

c. Upon acknowledgment of the Notice to Proceed (NTP) and continuing throughout the contract, the contractor will record on the daily CQC report, the occurrence of adverse weather and resultant impact to normally scheduled work. Actual adverse weather delay days must prevent work on critical activities for 50 percent or more of the contractor's scheduled work day. The number of actual adverse weather delay days shall include days impacted by actual adverse weather (even if adverse weather occurred in previous month), be calculated chronologically from the first to the last day of each month, and be recorded as full days. If the number of actual adverse weather delay days exceeds the number of days anticipated in paragraph b. above, the contracting officer will convert any qualifying delays to calendar days, giving full consideration for equivalent fair weather work days, and issue a modification in accordance with the contract clause entitled "Default (Fixed Price Construction)". (ER 415-1-15)

1.13 INSURANCE REQUIRED

In accordance with CONTRACT CLAUSES clause: "Insurance Work on a Government Installation," the Contractor shall procure the following minimum insurance:

Type Amount

Workmen's Compensation and Employer's Liability Insurance	$100,000
General Liability Insurance	$500,000 per occurrence
Automobile Liability Insurance	
Bodily injury	$200,000 per person and $500,000 per occurrence
Property damage	$ 20,000 per occurrence

(Coverages per FAR 28.307-2)

1.14 SECURITY REQUIREMENTS

1.14.1 Contractor's Employee Identification

The Contractor shall be responsible for furnishing to each employee and for requiring each employee engaged on the work to display such identification as may be approved and directed by the Contracting Officer. All prescribed identification shall immediately be delivered to the Contracting Officer, for cancellation upon release of any employees. When the contract involves work in restricted security areas, only employees who are U.S. citizens will be permitted to enter. Proof of U.S. citizenship is required prior to entry. When required by the Contracting Officer, the Contractor shall obtain and submit fingerprints of all persons employed or to be employed on the project. (Based on FAR 52.204-2)

1.14.2 ENTRY REQUIREMENTS

All Base access by Contractor personnel shall be made via the South Gate, except from 1 December 2003 to 1 April 2004, which will require use of the Magic City Gate (located approximately 1 mile North of South Gate). Vehicles are subject to search at the base gate, with anticipated delays expected to be 5 to 15 minutes (the larger the vehicle, the longer the delay).

1.14.3 IDENTIFICATION OF EMPLOYEES

The Contractor shall furnish a list of employees needing on-base access to the Corps of Engineers, Minot Project Office. This list shall be submitted on stationery with the company's letterhead and be signed by a supervisory member of that company.

The base will furnish Identification Forms 391. Employees without a badge and identification in their possession will be denied access to the base and work areas and may be detained. Personnel desiring base access will be required to present a base issued ID Form 391 prior to entering the gate.

1.14.4 IDENTIFICATION CREDENTIALS

All Contractor personnel, except those not under the Contractor's direct control, such as: concrete trucks and material deliveries, shall obtain an Application for Civilian Identification Card (Air Force Form 354) from the Corps of Engineers, Minot Project Office. After completion of Air Force Form 354, personnel shall proceed to the Base Pass and ID Section in Building 2248 during normal business hours and present the completed form. Up to 10 days may elapse before the pass is issued. In addition, private vehicles requiring access to the base shall display a vehicle sticker, which shall also be obtained after presentation of vehicle registration and

proof of insurance. The Contractor shall notify the Security Police, through the Contracting Officer, of all losses of badges within 48 hours after the loss by name, address, and badge number. Badges issued shall be recovered from employees upon termination of employment from the project and shall be turned over to the Security Police through the Contracting Officer. The badge shall not be worn or displayed off the military base. Badges are valid for no more than 1 year. If the contract period is over 1 year, badges will have to be revalidated using the above procedure.

1.14.4.1 Subcontractor Personnel

Subcontractor personnel identification credentials will vary, according to the duration of the Contract. Those subcontractor personnel requiring access to Minot AFB for 30 days or more will be given an AF Form 354 for issuance of a pass, as stated in paragraph IDENTIFICATION CREDENTIALS above. Subcontractors with contracts of 29 days or less shall provide a list of their employees' complete names, social security numbers, and driver's license numbers. This list will be forwarded to the Security Police through the Contracting Officer no later than 24 hours prior to the visit. Changes to the list, such as additions or deletions, may be made by calling 244-5571 (Minot Project Office) not later than 8 hours prior to the visit. This list shall be submitted on stationery with the company's letterhead and be signed by a supervisory member of that company.

1.14.4.2 Vendors and Delivery Vehicles

Vendors and delivery vehicles, such as concrete trucks and material deliveries, shall provide a letter and list of their employees (drivers) as stated in paragraph above. When time does not permit, the Contractor may call 723-3096 and provide the Law Enforcement Superintendent or his staff NCO with the name of the delivery vehicle driver, name of company, and approximately what time, date, and number of vehicles requiring entry to the base. A callback number shall be given for verification.

a. Not Used

b. Unscheduled Deliveries
To provide base access for unscheduled material deliveries such as long distance carriers, the Contractor shall submit a letter to the Contracting Officer designating up to four Contractor employees who are authorized to verify deliveries. A telephone number at which the designated personnel can be contacted shall also be included in the letter. Upon arrival of all unscheduled shipments, one of the designated Contractor personnel will be required to go to the gate where the shipment is held and physically verify that the shipment is for the Contractor. At that time, the driver of the unscheduled delivery vehicle will be issued a temporary visitor pass and will be escorted to the project site by the Contractor’s verification representative.

1.14.4.3 Commercial Vehicles

Commercial and company vehicles will be allowed access to the base, provided company emblems are attached to the sides of the vehicles and operators present identification credentials described in paragraph Identification Credentials above.

1.14.5 Contractor Employees Requiring Access to Automated Information Systems (AIS)

All Contractor (and subcontractor) employees (U.S. citizens and Non- U.S. citizens) working under this contract (to include grants, cooperative agreements and task orders) who require access to Automated Information Systems (AIS), (stand alone computers, network computers/systems, e-mail) shall, at a minimum, be designated into an ADP-III position (non-sensitive) in accordance with DoD 5220-22-R, Industrial Security Regulation (http://www.deskbook.osd.mil/htmlfiles/DBY_dod-7-Careers.asp).

The investigative requirements for an ADP-III position are a favorable National Agency Check (NAC), SF-85P, Public Trust Position. SF-85P is available at: http://www.gsa.gov/Portal/home.jsp

Under "Key Information", click on "Federal Forms",
Click on "U.S. Government Forms (GSA, Standard and Optional)"
Click on "Standard (SF) Forms"
Click on "SF 85P Questionnaire for Public Trust Positions"
SF 85P is available in either Screen-Fillable FormNet Version or Adobe Acrobat version.

Proof of a favorable NAC shall be submitted to USACE, Omaha District Security Officer, ATTN: CENWO-SL, 106 S. 15th St, Omaha, NE 68102-1618, within three (3) working days after award of any contract or task order, and shall be submitted prior to the individual being permitted access to an AIS.

a. Contractors who have a commercial or government entity (CAGE) Code and Facility Security Clearance should submit forms through their Facility Security Office, who shall forward results of the NAC to the Omaha District Security Officer (address above).

b. For those contractors who do not have a CAGE Code or Facility Security Clearance, the SF 85-P and 2 copies of the FD-258 (Fingerprint Cards) shall be completed and submitted to the Omaha District Security Officer (address above.) These must be mailed or hand-delivered, as original signatures are required. Fingerprint cards are available upon request and may be taken to any local law enforcement center for completion. For those in the Omaha, Nebraska area, fingerprint cards may be completed by contacting the Omaha District Human Resources Office, (402) 221-4072.

In accordance with Engineering Regulation, ER 380-1-18 (http://www.usace.army.mil/inet/usace-docs/eng-regs/er.htm), Section 4, foreign nationals who work on Corps of Engineers' contracts or task orders shall be approved by the HQUSACE Foreign Disclosure Officer or higher before beginning work on the contract/task order. This regulation includes subcontractor employees. (NOTE: exceptions to the above requirement include foreign nationals who perform janitorial and/or ground maintenance services.) The Contractor shall submit to the Omaha District Contracting Office, ATTN: (CENWO-CT) the names of all foreign nationals proposed for performance under this contract/task order, along with documentation to verify that he/she was legally admitted into the United States and has authority to work and/or go to school in the US. Such documentation may include a US passport, Certificate of US citizenship (INS Form N-560 or N-561), Certificate of Naturalization (INS Form N-550 or N-570), foreign passport with I-551 stamp or attached INS Form I-94 indicating employment authorization, Alien Registration Receipt Card with photograph (INS Form I-151 or I-551), Temporary Resident Card (INS Form

I-688), Employment Authorization Card (INS Form I-688A), Reentry Permit (INS Form I-327), Refugee Travel Document (INS Form I-571), Employment Authorization Document issued by the INS which contains a photograph (INS Form I-688B). INS forms are available at http://www.immigration.gov/graphics/formsfee/index.htm.

Compliance with this provision is mandatory (only if AIS access is required). Offeror should check the appropriate box below and return with offer or quote to Contracting Office.

[ ] HAVE FAVORABLE SF-85P(s)*
[ ] SF85-P(s) TO BE INITIATED UPON AWARD
[ ] SF85-P(s) PAPERWORK IN PROGRESS
[ ] DO NOT INTEND TO COMPLY

*Must be accomplished for each employee who will be accessing Government AIS under this action.

(End of Provision)(PIL 2003-06, 19 Feb 03)

1.15 CONTRACTOR QUALITY CONTROL (CQC)

See Section 01451A Contractor Quality Control.

1.16 NONDOMESTIC CONSTRUCTION MATERIALS

The List of nondomestic construction materials or their components included in the list set forth in paragraph 25.104 of the Federal Acquisition Regulation does not apply to the requirements of the contract clause entitled "Buy American Act Construction Materials".

1.17 NOTICE OF PRIORITY RATING FOR NATIONAL DEFENSE USE (SEP 1990)

Any contract awarded as a result of this solicitation will be a DO rated order certified for national defense use under the Defense Priorities and Allocations System (DPAS) (15 CFR 700), and the Contractor will be required to follow all of the requirements of this regulation. (FAR 52.211-14)

1.18 DAILY WORK SCHEDULES AND WEEKLY COORDINATION MEETINGS

In order to closely coordinate work under this contract, the Contractor shall prepare a written agenda/meeting minutes and attend a weekly coordination meeting with the Contracting Officer and Using Service at which time the Contractor shall submit for coordination and approval, his proposed daily work schedule for the next two week period. The Contractor shall provide a copy of modifications (MODs), Serial Letters, Requests for Information (RFIs)and any other information that is needed in the minutes of the meeting. Required temporary utility services, time and duration of interruptions, and protection of adjoining areas shall be included with the Contractor's proposed 2-week work schedule. At this meeting, the Contractor shall also submit his schedule of proposed dates and times of all preparatory inspections to be performed during the next 2 weeks. The items of work listed on the proposed 2-week schedule are to be keyed to the NAS by activity number and description for each activity anticipated to be performed during the next 2-week period. Coordination action by the Contracting Officer relative to these schedules will be accomplished during these weekly meetings. Daily reports shall be completed and given to the

Contracting Officer or Representative within 24 hours of work

1.19 EQUIPMENT OWNERSHIP AND OPERATING EXPENSE SCHEDULE (MAR 1995)

a. This statement shall become operative only for negotiated contracts where cost or pricing data is requested, and for modifications to sealed bid or negotiated contracts where cost or pricing data is requested. This clause does not apply to terminations. See 52.249-5000, Basis for settlement of proposals and FAR Part 49.

b. Allowable cost for construction and marine plant and equipment in sound workable condition owned or controlled and furnished by a Contractor or subcontractor at any tier shall be based on actual cost data for each piece of equipment or groups of similar serial and series for which the Government can determine both ownership and operating costs from the Contractor's accounting records. When both ownership and operating costs cannot be determined for any piece of equipment or groups of similar serial or series of equipment from the Contractor's accounting records, costs for that equipment shall be based upon the applicable provisions of EP 1110-1-8, "Construction Equipment Ownership and Operating Expense

Schedule," Region IV. Copies of each regional schedule may be obtained through the following Internet site: http://www.usace.army.mil/inet/usace-docs/eng-pamphlets/ep.htm. Working conditions shall be considered to be average for determining equipment rates using the schedule unless specified otherwise by the Contracting Officer. For equipment not included in the schedule, rates for comparable pieces of equipment may be developed using the formula provided in the schedule. For forward pricing, the Schedule in effect at the time of negotiations shall apply. For retrospective pricing, the Schedule in effect at the time the work was performed shall apply.

c. Equipment rental costs are allowable, subject to the provisions of FAR 31.105(d)(ii) and FAR 31.205-36. Rates for equipment rented from an organization under common control, lease-purchase arrangements, and sale-leaseback arrangements will be determined using the schedule, except that actual rates will be used for equipment leased from an organization under common control that has an established practice of leasing the same or similar equipment to unaffiliated lessees.

d. When actual equipment costs are proposed and the total amount of the pricing action exceeds the small purchase threshold, the contracting officer shall request the contractor to submit either certified cost or pricing data, or partial/limited data as appropriate. The data shall be submitted on Standard Form 1411, Contract Pricing Proposal Cover Sheet. (EFARS 52.231-5000)

1.20 AS-BUILT DRAWINGS

See SECTION 01040 - AS-BUILT DRAWINGS

1.21 SIGN

On commencement of work on this project, the Contractor shall furnish and erect the temporary sign in the location selected by the Contracting Officer near the project site. The Contractor shall maintain the sign in good condition through the project construction period. Upon completion of the project the Contractor shall remove the sign from the premises. The project sign shall conform to to the requirements shown on the drawings. A

decal of the "Engineer Castle" and the U. S. Air Force emblem will be furnished the Contractor upon request.

1.22 EQUIPMENT ROOM DRAWINGS

Prior to construction, the Contractor shall prepare and submit room plans for all mechanical, electrical, and communication rooms or similar areas. The plans shall be consolidated for all trades, shall be to scale, and shall show all pertinent structural features. In addition, other items such as doors, windows, and cabinets required for installation and which will affect the available space, will be shown. All mechanical and electrical equipment and accessories shall be shown to scale in plan and elevation and/or section in their installed positions. All duct work and piping shall be shown.

1.23 CONTRACTOR FURNISHED EQUIPMENT DATA

See Section 01200 Warranty of Construction for Contractor Furnished Equipment Data to be submitted as part of the Warranty Equipment Booklet.

1.24 TIME EXTENSIONS (SEPT 2000)

Time extensions for contract changes will depend upon the extent, if any, by which the changes cause delay in the completion of the various elements of construction. The change order granting the time extension may provide that the contract completion date will be extended only for those specific elements related to the changed work and that the remaining contract completion dates for all other portions of the work will not be altered. The change order also may provide an equitable readjustment of liquidated damages under the new completion schedule. (FAR 52.211-13)

1.25 PERFORMANCE OF WORK BY CONTRACTOR (APR 1984)

The Contractor shall perform on the site, and with its own organization, work equivalent to at least twenty (20) percent of the total amount of work to be performed under the contract. This percentage may be reduced by a supplemental agreement to this contract if, during performing the work, the Contractor requests a reduction and the Contracting Officer determines that the reduction would be to the advantage of the Government. (FAR 52.236-1)

1.26 PARTNERING

a. The Government intends to encourage the formation of a cohesive partnership with the Contractor. This partnership will be structured to draw on the strengths of each organization to identify and achieve reciprocal goals. The objective is effective contract performance in achieving completion within budget, on schedule and in accordance with plans and specifications. This partnership between the Contractor and the Government will be voluntary and its implementation will not be part of the contract requirements nor will it result in a change to contract price or terms.

b. It is anticipated that immediately after the preconstruction conference, the appropriate Contractor's key personnel and Government key personnel will attend a 2-3 hours informal team building workshop at the Area or Resident Office (as directed). Costs of the facilitator and facilities for the workshops will be shared equally by the participants.

1.27 PROFIT

a. Weighted guidelines method of determining profit shall be used on any equitable adjustment change order or modification issued under this contract. The profit factors shall be as follows:

Factor	Rate	Weight	Value
Degree of Risk	20	See Item	
Relative difficulty of work	15	b. below	
Size of Job	15		
Period of performance	15		
Contractor's investment	5		
Assistance by Government	5		
Subcontracting	25		
	100		

b. Based on the circumstances of each procurement action, each of the above factors shall be weighted from .03 to .12 as indicated below. The value shall be obtained by multiplying the rate by the weight. The value column when totaled indicates the fair and reasonable profit percentage under the circumstances of the particular procurement.

(1) Degree of Risk. Where the work involves no risk or the degree of risk is very small, the weighting should be .03; as the degree of risk increases, the weighting should be increased up to a maximum of .12. Lump sum items will have, generally, a higher weighted value than the unit price items for which quantities are provided. Other things to consider: the portion of the work to be done by subcontractors, nature of work, where work is to be performed, reasonableness of negotiated costs, amount of labor included in costs, and whether the negotiation is before or after performance of work.

(2) Relative Difficulty of Work. If the work is most difficult and complex, the weighting should be .12 and should be proportionately reduced to .03 on the simplest of jobs. This factor is tied in to some extent with the degree of risk. Some things to consider: the nature of the work, by whom it is to be done, where, and what is the time schedule.

(3) Size of Job. All work not in excess of $100,000 shall be weighted at .12. Work estimated between $100,000 and $5,000,000 shall be proportionately weighted from .12 to .05.

(4) Periods of Performance. Jobs in excess of 24 months are to be weighted at .12. Jobs of lesser duration are to be proportionately weighted to a minimum of .03 for jobs not to exceed 30 days. No weight where additional time not required.

(5) Contractor's Investment. To be weighted from .03 to .12 on the basis of below average, average, and above average. Things to consider: amount of subcontracting, mobilization payment item, Government furnished property, equipment and facilities, and expediting assistance.

(6) Assistance by Government. To be weighted from .12 to .03 on the basis of average to above average. Things to consider: use of Government-owned property, equipment and facilities, and expediting assistance.

(7) Subcontracting. To be weighted inversely proportional to the amount of subcontracting. Where 80 percent or more of the work is to be subcontracted, the weighting is to be .03 and such weighting proportionately increased to .12 where all the work is performed by the Contractor's own forces.

1.28 LABOR CONDITIONS APPLICABLE TO TEMPORARY FACILITIES

It is the position of the Department of Defense that the Davis-Bacon Act, 40 U.S.C. 276a is applicable to temporary facilities such as batch plants, sandpits, rock quarries, and similar operations, located off the immediate site of the construction but set up exclusively to furnish required materials for a construction project on the site of the work. Clause "Payrolls and Basic Records" of the CONTRACT CLAUSES is applicable to such operations.

1.29 DRAWING SCALES

All scales shown are based on a standard drawing size of 28" x 40". If any other size drawings are furnished or plotted, the contractor shall adjust the scales accordingly. The Contractor shall also advise his sub-contractors of the above.

1.30 WAGE RATE APPLICATION

1.30.1 Building Schedule

Applicable to all work required within 5 feet outside the building lines.

1.31 (FAR 52.222-23) NOTICE OF REQUIREMENT FOR AFFIRMATIVE ACTION TO ENSURE EQUAL EMPLOYMENT OPPORTUNITY FOR CONSTRUCTION (FEB 1999)

(a) The offeror's attention is called to the Equal Opportunity clause and the Affirmative Action Compliance Requirements for Construction clause of this solicitation.

(b) The goals for minority and female participation, expressed in percentage terms for the Contractor's aggregate workforce in each trade on all construction work in the covered area, are as follows:

Goals for Minority Participation for Each Trade	Goals for Female Participation for Each Trade
**********	**********
4.4	6.9

These goals are applicable to all the Contractor's construction work performed in the covered area. If the Contractor performs construction work in a geographical area located outside of the covered area, the Contractor shall apply the goals established for the geographical area

where the work is actually performed. Goals are published periodically in the Federal Register in notice form, and these notices may be obtained from any Office of Federal Contract Compliance Programs Office.

(c) The Contractor's compliance with Executive Order 11246, as amended, and the regulations in 41 CFR 60-4 shall be based on (1) its implementation of the Equal Opportunity clause, (2) specific affirmative action obligations required by the clause entitled "Affirmative Action Compliance Requirements for Construction," and (3) its efforts to meet the goals. The hours of minority and female employment and training must be substantially uniform throughout the length of the contract, and in each trade. The Contractor shall make a good faith effort to employ minorities and women evenly on each of its projects. The transfer of minority or female employees or trainees from Contractor to Contractor, or from project to project, for the sole purpose of meeting the Contractor's goals shall be a violation of the contract, Executive Order 11246, as amended, and the regulations in 41 CFR 60-4. Compliance with the goals will be measured against the total work hours performed.

(d) The Contractor shall provide written notification to the Deputy Assistant Secretary for Federal Contract Compliance, U.S. Department of Labor, within 10 working days following award of any construction subcontract in excess of $10,000 at any tier for construction work under the contract resulting from this solicitation. The notification shall list the -

(1) Name, address, and telephone number of the subcontractor;

(2) Employer identification number of the subcontractor;

(3) Estimated dollar amount of the subcontract;

(4) Estimated starting and completion dates of the subcontract; and

(5) Geographical area in which the subcontract is to be performed.

(e) As used in this Notice, and in any contract resulting from this solicitation, the "covered area" is Minot EA-152, which Ward county is a part of.

1.32 FEDERAL HOLIDAYS

The following Federal legal holidays are observed by this installation:

New Year's Day	1 January
Martin Luther King's Birthday	Third Monday in January
President's Day	Third Monday in February
Memorial Day	Last Monday in May
Independence Day	4 July
Labor Day	First Monday in September
Columbus Day	Second Monday in October
Veterans Day	11 November
Thanksgiving Day	Fourth Thursday in November
Christmas Day	25 December

If a wage determination applies the number of holidays specified on it, it has priority over this clause.

1.33 BASE HOURS

Base operation hours are 7:00 a.m. to 4:30 p.m. daily (Monday through Friday), excluding federal holidays. Access to the base during other times must be requested in writing from the Contracting Officer and will be granted only for extenuating circumstances.

PART 2 NOT USED

PART 3 NOT USED

3.1 APPENDIX A- CONTRACT DOCUMENT DISTRIBUTION LIST

Appendix A - Contract Document Distribution List

Addressee	No. of Sets
HQ ACC/CECW Attn: James Spoto 129 Andrews Street, Suite 315 Langley AFB, VA 23665-2769	2
5 CES/CECP Attn: W. Fried 320 Peacekeeper Place Minot AFB, ND 58705-4978	5
SLL/Leo A. Daly Attn: D. Young 730 Second Avenue South, Suite 1100 Minneapolis, MN 55402-2454	1
Black Hills Area Office US Army Corps of Engineers 2100 South Seventh, Suite L-17 Rapid City, SD 57701	2
Grand Forks Resident Office US Army Corps of Engineers P.O. Box 247 Emerado, ND 58228	2
Minot Project Office US Army Corps of Engineers c/o Base Post Office Minot, ND 58704	2

-- End of Section --

General Decision Number: ND030005 06/18/2004 ND5

Superseded General Decision Number: ND020005

State: North Dakota

Construction Type: Building

County: Ward County in North Dakota.

Building Projects (does not include single family homes and apartments up to and including 4 stories)

Modification Number	Publication Date
0	06/13/2003
1	10/31/2003
2	02/27/2004
3	03/05/2004
4	06/04/2004
5	06/18/2004

BRND0002-002 08/01/2002

	Rates	Fringes
Bricklayer	$ 22.05	5.00

CARP1176-003 05/01/1999

	Rates	Fringes
Carpenter CARPENTER(Including formwork, drywall hanging, drywall finishing, & cabinet installation; excluding metal building erection, heat and frost insulation, soft flooring & gypcrete flooring)	$ 14.26	5.80

ELEC0714-005 07/01/2003

WARD COUNTY:

	Rates	Fringes
Electrician ELECTRICIANS(including low voltage wiring for telephones, computers, doorbells, alarms, & HVAC controls)	$ 21.20	6.92+11%

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* PLUM0300-009 05/31/2004

	Rates	Fringes
Plumber PLUMBERS(incl HVAC piping)	$ 19.75	7.95

SHEE0010-034 10/01/2003

	Rates	Fringes
Sheet Metal Worker SHEET METAL WORKERS(HVAC only)	$ 16.37	8.53

SUND2000-001 03/23/2000

	Rates	Fringes
Heat and Frost Insulator	$ 8.00	.66
Laborers:		
Mason Tender	$ 9.88	
Unskilled	$ 8.70	

Painter		
PAINTERS (including paper hanging excluding drywall finishing)	$ 12.05	
Power equipment operators:		
Crane	$ 15.55	5.10
Skid Steer	$ 9.64	
Tile Setter	$ 11.50	.22

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

In the listing above, the "SU" designation means that rates listed under the identifier do not reflect collectively bargained wage and fringe benefit rates. Other designations indicate unions whose rates have been determined to be prevailing.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

* an existing published wage determination
* a survey underlying a wage determination
* a Wage and Hour Division letter setting forth a position on a wage determination matter
* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations

Wage and Hour Division

U.S. Department of Labor

200 Constitution Avenue, N.W.

Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator

U.S. Department of Labor

200 Constitution Avenue, N.W.

Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board

U.S. Department of Labor

200 Constitution Avenue, N.W.

Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

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END OF GENERAL DECISION

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SECTION 01040

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05/04

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-- End of Section Table of Contents --

SECTION 01040

AS-BUILT DRAWINGS
05/04

PART 1 GENERAL

1.1 DEFINITIONS

The definitions listed below form a part of this specification.

1.1.1 Red-Line Drawings

Contract drawings marked-up to show actual work performed to include necessary sketches, modification drawings, shop drawings and notes. Green ink is used to indicate work deleted from the contract. Red ink is used for additions and deviations from the contract.

1.1.2 As-Built Drawings

Professional finished bond paper drawings and Electronic CADD files developed from the original contract drawings that include all of the information from the redline drawings and suitable for half-size reproduction.

1.1.3 Black-Line Drawings

Paper drawings reproduced from electronic CADD files or high quality reproducible drawings.

1.1.4 Full-Size Drawings

28 inches x 40 inches nominal size drawings with all details visually readable.

1.1.5 Modification Circle

A circle with a horizontal line through the center. The top half will contain the letter "P" with the bottom half containing the Modification number. The lettering standard will be 1/8-inch (AutoCAD) Romans.shx.

1.1.6 Electronic CADD Files

Electronic CADD files are files saved on CD-ROM in accordance with appropriate CADD standard. The CADD standard will include level on/off status, special characters, line wieghts, font, and size requirements.

1.2 GENERAL REQUIREMENTS

The work includes creation of bond paper drawings and electronic CADD files on AutoCADD 2002 for as-built drawings to accurately depict existing conditions of the project. As-Built Drawings will become the permanent record drawings of the construction. The Contractor is responsible for development of electronic CADD files in accordance with Minot CADD Standards specified below. Omaha District AutoCADD Standards will be made available to the successful bidder. AutoCADD Standard utilize the National

CAD standards with Omaha District refinements concerning file names, layers, colors, line widths, details and symbols. See requirements in this section for a summary of Omaha District file format and font requirements. The Contractor shall be responsible for furnishing the required CAD software. The Omaha District will furnish a CD of CAD (read-write) contract drawing files in the software language specified in paragraph Procedure below. This is the software language required by the Using Service. These drawing files shall be used to prepare required As-Built drawings. The As-Built drawings shall include all major features of the work and all details to the same level as the original contract set of drawings. All changes from the contract drawings, including but not limited to all deviations, additional information, and modifications to the contract shall be shown on the as-builts. Where contract drawings or specifications allow for options, only the option selected and actually constructed shall be shown on the As-Built Drawings. Systems designed or enhanced by the Contractor such as HVAC control system, fire alarm system fire sprinkler system, irrigation sprinkler system, and letters of clarification, shall be accurately and neatly recorded on the As-Built Drawings using the same symbols, terminology, and general quality as the original set of contract drawings. All sheets affected by a change shall be revised. The transmittal requirements for the As-built Drawings shall be shown as events on the Contractor prepared project schedule.

1.3 PAYMENT

In accordance with the clause "Payment Under Fixed - Price Construction Contracts", which provides for progress payments on estimates of work accomplished (which meets the standards of quality established under the contract), $(250 x number of sheets) will be withheld from payment for the creation of As-Built drawings until the final as-built drawings are delivered to the Contracting Officer (including any necessary revisions and subject to the approval of the Contracting Officer).

The Government will assign the Contractor a performance rating (CCASS for Corps of Engineers projects) upon completion of the project. The timeliness of satisfactory As-Built drawing submittals will be an important factor in determining the assigned rating. An unsatisfactory performance of As-Built drawings creation will be given to the Contractor if the Contractor demonstrates an unwillingness to work with the Government on As-Built drawing creation or the Contractor fails to submit satisfactory Final As-Built drawings within 60 calendar days of turning the completed project over to the Using Service. If satisfactory As-Built drawings are not received within 120 days of turning the project over to the Government, the Government will utilze the funds withheld to complete the As-Builts.

1.4 TRANSMITTAL OF AS-BUILT DRAWINGS

1.4.1 Preliminary As-Built Drawings

The Contractor shall produce Preliminary As-Built Drawings indicating as-built conditions on AutoCADD (Version 2002) with "clouding". The Contractor shall contact Jim Janicek at (402)221-4519 before beginning As-Built preparation. As-Built preparation process is provided in paragraph As-Built Preparation below. Preliminary drawings shall consist of 15 percent of total project drawings. These drawings shall be sheets used for the construction of this project (exludes Cover Sheet, Vicinity Map, Location Plan and Indexes). The As-Built CADD files which include all changes up to the time Preliminary Drawings shall be sent as stated below. The Contractor shall draw attention to all drawing changes by "clouding"

the affected area. This "clouding" shall be accomplished on layer 63 of the drawing file. The Preliminary Drawings shall consist of one (1) set of CADD files on a CD-ROM and one (1) full-size set of the Black-Line Drawings. One (1) set of CADD files on a CD-ROM shall be submitted to the Omaha District Office (ATTN: CENWO-ED-DI, Jim Janicek). In conjunction with this submission, one (1) full-size set of the Black-Line Drawings shall be submitted to the COR. Both documents shall be submitted three (3)weeks prior to the final acceptance inspection unless otherwise directed by the COR. The COR will notify the Contractor in writing of approval / disapproval. The Contractor shall not submit the Final Drawings until he receives the COR's letter approving the Preliminary Drawings.

1.4.2 Final As-Built Drawings

The Contractor shall produce Final As-Built Drawings in AutoCADD (Version 2002) without "clouding". The As-Built preparation process is provided in paragraph As-Built Preparation below. The Final Drawings shall include all changes. The Final Drawings in the form of a CD-ROM shall be submitted to the COR and Omaha District Office (CENWO-ED-DI) no earlier than the day of acceptance of the project and no later than thirty (30) days after the date on the acceptance letter for the Preliminary Drawing unless otherwise directed by the COR. (Note: Final drawings shall not be forwarded to the customer. Corps of Engineers, Omaha District COR will forward to the customer after Quality Review.) Contractor shall submit one (1) set of CADD files on a CD-ROM to the Omaha District Office (ATTN: CENWO-ED-DI, Jim Janicek). Contractor shall send the following documents to the COR:

a) One (1) set of CADD files on CD-ROM (folder name containing as-built files shall be designated "AS-BUILTS" on each CD-ROM). Both CD case and CD-ROM shall contain the name of the project, location, specification number, and contract number, and words "As-Built Record Set"). The folder shall contain drawings, indexes and X-REF files related to all as-builts.

b) One (1) full-size set of bond paperAs-Built Drawings, along with All red-lined hard copy drawings prepared by the Contractor during construction.

COR will forward one (1) full-size set of drawings along with CD-ROM to the customer.

1.4.3 As-Built Preparation

Both preliminary and final electronic as-built drawings shall be produced in accordance with the following process for AutoCADD drawings:

1.4.3.1 Not Used

1.4.3.2 For AutoCADD (*DWG) Files

a. Drawing Sheet: Minot Air Force Base's drafting shop uses an architectural 28x40 standard drawing sheet. All sheets received by drafting will be plotted on a minimum of 4 mil. double mat erasable film using MAFB's standard title block.

Our prototype.dwg is set up with the dimension styles, and a basic layering scheme. All personnel both government and contractors shall use this prototype as the basis for starting all drawings The prototype.dwt is an

Acad template the that can be copied into the ACAD 2002 template directory.

b. File Naming: All drawings will use the following naming convention AS A MINIMUM:

1)The first two positions will be the sheets reference number, i.e. "A1".

2)The next two positions will distinguish whether the item is new (NW) or existing (EX).

3)The remainder of the name will be a short description of the sheet, i.e. a proposed electrical floor plan could be "E2NWELPL".

4)Revised sheets will be annotated with an R1 the R stands for revised the number stands for the number of revisions for that sheet (E2R4NWELPL). All sheets will be retained in the project directory until the project is constructed.

c. Layering Convention: Layers should be kept simple, other people will be working with this drawing also. All new item layers will be prefixed with "nw-" conversely all existing layers will be prefixed with "ex-". The remainder of the name will be a short descriptor, i.e. all new walls would be placed on a layer named "nw-walls".

d. Scale/Paper Space Model Space: All drawings will be done at FULL scale in model space. The sheet will be located in paper space with all title blocks filled. The finished drawing will be plotted at 1=1. The scale will be set by zooming to the correct scale factor in each model space viewport. For example if you are plotting at 1/8" =1'-0" you would zoom the view port at 1/96 xp to get the proper scale. The only things that will be in paper space will be the title sheet, text pertaining to the title sheet, titles, and any general notes. No drawings under any circumstance will be altered from their real world size using the scale command. Drawings such as riser diagrams, one line drawings, schematics, isometrics, and pictorial representations are the only drawings that do not have to be to scale.

e. Text: Will follow general drafting practices. General notes or leader notes text will be 1/8" or 3/32". Titles should be 1/4" or 3/16". Regardless which is chosen, it should remain consistent throughout the project. Text in the title sheet should be 1/8". Notes will all be consistent on each sheet throughout the entire project. The only text styles to be used are archquik.shx for notes, dimensioning and leaders. Archstyl.shx will be used for view titles.

f. Symbols: All graphic symbols for all trades will be taken from the most current release of AIA 's "Architectural Graphic Standards"

g. Line Weight: All items in the drawing database will follow general drafting guidelines. For example, all new items will be shown with thick lines, by contrast existing and demolition will be designated with thin lines. MAFB's drafting shop utilizes AutoCAD's color numbers to accomplish this. Only under special circumstances will an object in AutoCAD be edited to give it width. Whenever possible you will use the following standard.

Architectural/Civil Color Usage

COLOR/NUMBER	LINE WEIGHT	PURPOSE

red -1	.18	dimensions, hatching
yellow -2	.25	existing /demolition walls
green -3	.35	text
cyan -4	.35	existing discipline i.e. elec, mech
blue -5	.65	new
magenta -6	.8	new, cut lines, bubble lines
white -7	.25	general purpose
dark gray -8	.25/80% screen	special purpose, lines can be difficult to see when reproduced.
light gray -9	.13	special purpose, lines can be difficult to see when reproduced.
peach -11	.50	new

Mechanical/Electrical Color Usage

COLOR/NUMBER	LINE WEIGHT	PURPOSE
red-10	.18	dimension, hatching
orange-30	.5	new
yellow-50	.25	existing/demolition walls
green-90	.35	text
cyan-130	.35	existing discipline i.e. elec, Mech
blue-170	.65	new
magenta-220	.8	new, cut lines bubble lines
white-7	.25	general purpose

Plots

The following information is how we had our plots set up in both the 650c and the 750c hp- plotters. Using the pcp file or pc2(acad14) we establish the color scheme for the first 15 pens. Then in the plotter we set the pen widths for those colors.

COLORS ACAD PCP FILE	or	PEN SETTINGS PC2 FILE	PLOTTER PEN SETTINGS PALLET A
Color0=0			pen 0=0 .35
Color1=1		red .18	pen 1=1 .18
Color2=2		yellow .25	pen 2=1 .25
Color3=3		green .35	pen 3=1 .35
Color4=4		cyan .35	pen 4=1 .35
Color5=5		blue .65	pen 5=1 .65
Color6=6		magenta .8	pen 6=1 .80
Color7=7		white .25	pen 7=1 .25
Color8=8		dark gray .25	pen 8=8 .25
Color9=9		light gray .13	pen 9=1 .13
Color10=19		color? .35	pen 10=19 .35
Color11=11		peach .50	pen 11=1 .35
Color12=7		white .35	pen 12=35 .35
Color13=7		white .35	pen 13=68 .35
Color14=7		white .35	pen 14=100 .35
Color15=7		white .35	pen 15=110 .35

All other pens are set to pen 7 with the width at .35

We now use software setup on the plotters and have the pc3 file set the line weights for our plots. The pc3 flie is set to match our old plotter settings.

h. NOTES: 1: XREF DRAWINGS

1) Arch. Floor plan will be x-ref into mechanical and electrical

drawings during the design phase of the project. During the Asbuilt update the x-ref plans will be bound to the separate drawings. A copy of the mechanical, electrical and architectural plans will be put into the Asbuilt facility drawing.

2) When x-refing a drawing, remember to freeze the layers you don't want showing.

When x-refing arch plans into a mechanical or electrical drawing remember to change the colors on the x-ref layers to red. You can accomplish this by using the filter in the layer command, selecting all and changing the color to red.

1.5 PROCEDURE

Upon award of this contract, one (1) CD-ROM containing the contract drawings (read-write CADD files) and CADD standards in AutoCADD (Version 2002) format, for use in the preparation of As-Built Drawings by the Contractor, will be forwarded to the Resident Engineer. This CD-ROM will then be furnished to the Contractor after signed receipt to the Resident Engineer. The Contractor shall utilize this CD-ROM to create a set of electronic Cadd files and full-size Red-Line Drawings to fully indicate As-Built conditions. The Red-Line Drawings shall be maintained at the site, in a current condition until the completion of the work and shall be available for review by the COR at all times. All as-built conditions shall be on the Red-Line Drawings within two (2) days after the work activity is completed or shall be entered on the deficiency tracking system (see Section 01451A, CONTRACTOR QUALITY CONTROL). The Contractor shall not convert electronic drawing files from one software language to another (i.e. Microstation to AutoCADD or AutoCADD to Microstation).

1.6 TITLE BLOCKS

The contract number and the specification number (if available) shall be shown on all sheets. "RECORD DRAWING" shall be added below the title block on all sheets. All modifications to the contract shall be posted in ascending order. The top line of the revision box shall state "REVISED TO SHOW AS-BUILT CONDITIONS" and dated. All modifications to all plans, sections, or details, shall have a modification number placed in the revision box under column entitled "Symbol". The statement "GENERAL REVISIONS" may be used when applicable. The date to be added in the revision box for modifications is found in Block 3 of Form SF-30. Cover Sheet will have Contract Award Set changed to As-Built Record Set with month & year completed. Month and year completed will also go in the date box in the title block. There will be no separate dates.

1.7 PROCEDURES FOR POSTING MODIFICATION CHANGES TO DRAWINGS

Follow directions in the modification for posting descriptive changes.
A Modification Circle shall be place at the location of each deletion.
The highest modification number on the sheet should be shown in the modification circle in the "DATE" and "DRAWING CODE" boxes of the title block.
For all new details or sections that are added to a drawing, place a Modification Circle by the detail or section title.

For changes to a drawing, place a Modification Circle by the

title of the affected plan, section or detail titles (each location).
For changes to schedules on drawings, a Modification Circle shall be placed either by the schedule heading or by the change in the schedule.
The Modification Circle size shall be 1/2-inch diameter unless the area where circle is to be placed is crowded. Use smaller size circle for crowded areas.

1.8 WORD ABBREVIATIONS

Abbreviations shown on the abbreviation sheet shall be used to describe all work items. Additional word abbreviations, not found on the abbreviation sheet but necessary to describe the work, shall be properly identified and incorporated with the other standard word abbreviations.

1.9 LEGEND SHEETS

Symbols, which conflict with those on the original contract legend sheet, shall not be used. Additional symbols, necessary to depict any additional work items, shall be properly identified and added to the legend sheet or supplemental legend. Those projects that do not have legend sheets may use supplemental legends on each sheet where symbol is shown.

1.10 CONTRACTOR SHOP DRAWINGS

Contractor shop drawings,which supersede data on the contract plans and/or additional drawings, prepared by the Contractor, shall be incorporated into the As-Built Drawings. Design plans prepared by Contractor shall include the designer's name on the As-Built Drawings.

1.11 INDEXING OF DRAWINGS

If drawings are added to the portfolio of drawings to depict as-built conditions, the index of drawings shall be revised accordingly.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.1 GENERAL

As-Built drawings shall include as-built information to the same level of detail as shown on the original details, unless otherwise specified. The Contractor shall provide any additional full-size drawings as required to display all the details.

3.2 SITE WORK

3.2.1 Utilities

All utilities shall be shown whether active, inactive, shown on the original contract drawings, or found on-site. The type of utility, location, general direction, size, material make-up and depth shall be shown. The location and description of any utility line or other installations of any kind known to exist within the construction area shall be shown. The location shall include dimensions to permanent features.

3.2.2 Structures

Structures above and below ground shall be shown. The size, material make-up, location, height, and/or depth shall be shown. Manholes shall show rim elevation and invert elevations as applicable. Power poles shall show electrical equipment and voltage rating.

3.2.3 Grades

Grade or alignment of roads, structures, or utilities shall be corrected if any changes were made from the contract drawings. Elevations shall be corrected if changes were made in site grading.

3.3 STRUCTURAL

3.3.1 Steel/Concrete

Shop drawings that deviate from the contract drawings shall be incorporated in the As-Built Drawings.

3.4 MECHANICAL

3.4.1 Ductwork

Ductwork shall be shown to reflect actual installation and duct size. Ductwork routing changes shall be shown.

3.4.2 Plumbing

Piping and fixtures shall be shown to reflect the type of material, size and the route or location.

3.5 ELECTRICAL

3.5.1 PANELS

All contract drawing panel schedules shall be revised to show as-built conditions. Home-run circuit designation on electrical drawings shall accurately correspond to the as-built panel schedules.

3.5.2 Controls

All control diagrams in contract drawings shall be revised to reflect as-built conditions, and setpoints.

-- End of Section --

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DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01200

WARRANTY OF CONSTRUCTION

5/00; Rev 02/02

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-- End of Section Table of Contents --

SECTION 01200

WARRANTY OF CONSTRUCTION
5/00; Rev 02/02

PART 1 GENERAL

1.1 WARRANTY OF CONSTRUCTION

(a) Foremost and in addition to any other warranties in this contract, the Contractor warrants, except as provided in paragraph (i) of this clause, that work performed under this contract conforms to the contract requirements and is free of any defect in equipment, material, design furnished, or workmanship performed by the Contractor or any subcontractor or supplier at any tier.

(b) This warranty shall continue for a period of 1 year from the date of final acceptance of the work. If the Government takes possession of any part of the work before final acceptance, this warranty shall continue for a period of 1 year from the date the Government takes possession.

(c) The Contractor shall remedy at the Contractor's expense any failure to conform, or any defect. In addition, the Contractor shall remedy at the Contractor's expense any damage to Government-owned or controlled real or personal property, when that damage is the result of--

(1) The Contractor's failure to conform to contract requirements; or

(2) Any defect of equipment, material, workmanship, or design furnished by the Contractor.

(d) The Contractor shall restore any work damaged in fulfilling the terms and conditions of this clause.

(e) The Contractor's warranty with respect to work restored, repaired or replaced will run for 1 year from the date of restoration, repair or replacement. This provision applies equally to all items restored, repaired, or replaced under paragraph (c) and (d) above.

(f) The Government will notify the Contractor, in writing, within a reasonable time after the discovery of any failure, defect, or damage. Repair work necessary to correct a warranty condition which arises to threaten the health or safety of personnel, the physical safety of property or equipment, or which impairs operations, habitability of living spaces, etc., will be performed by the Contractor on an immediate basis as directed verbally by the Government. Written verification will follow verbal instruction.

(g) If the Contractor fails to remedy any failure, defect, or damage within a reasonable time after receipt of verbal or written notice, the Government shall have the right to replace, repair, or otherwise remedy the failure, defect, or damage at the Contractor's expense.

(h) With respect to all warranties, express or implied, from subcontractors, manufacturers, or suppliers for work performed and materials furnished under this contract, the Contractor shall--

(1) Obtain all warranties that would be given in normal commercial practice;

(2) Require all warranties to be executed, in writing, for the benefit of the Government, if directed by the Contracting Officer; and

(3) Enforce all warranties for the benefit of the Government, if directed by the Contracting Officer.

(i) In the event the Contractor's warranty under paragraph (b) of this clause has expired, the Government may bring suit at its expense to enforce a subcontractor's, manufacturer's, or supplier's warranty.

(j) Unless a defect is caused by the negligence of the Contractor or subcontractor or supplier at any tier, the Contractor shall not be liable for the repair of any defects of material or design furnished by the Government nor for the repair of any damage that results from any defect in Government-furnished material or design.

(k) This warranty shall not limit the Government's rights under the Inspection and Acceptance clause of this contract with respect to latent defects, gross mistakes, or fraud.

1.2 ADDITIONAL WARRANTY REQUIREMENTS

1.2.1 Performance Bond

(a) It is understood that the Contractor's Performance Bond will remain effective for one (1) year from the date of acceptance.

(b) If either the Contractor or his representative doesn't diligently pursue warranty work to completion, the contractor and surety will be liable for all costs. The Government, at its option, will either have the work performed by others or require the surety to have it done. Both direct and administrative costs will be reimbursable to the Government.

1.2.2 Pre-Warranty Conference

(a) Prior to contract completion and at a time designated by the Contracting Officer or his authorized representative, the Contractor shall meet with the Contracting Officer or his authorized representative to develop a mutual understanding with respect to the requirements of the Paragraph: WARRANTY OF CONSTRUCTION. Communication procedures for Contractor notification of warranty defects, priorities with respect to the type of defect and other details deemed necessary by the Contracting Officer or his authorized representative for the execution of the construction warranty shall be established/reviewed at this meeting.

(b) In connection with these requirements and at the time of the

Contractor's quality control completion inspection, the Contractor will furnish the name, telephone number and address of the service representative which is authorized to initiate and pursue warranty work action on behalf of the Contractor and surety. This single point of contact will be located within the local service area of the warranted construction, will be continuously available, and will be responsive to Government inquiry on warranty work action and status. This requirement does not relieve the Contractor of any Contractual responsibilities in connection with the paragraph: WARRANTY OF CONSTRUCTION.

(c) Local service area is defined as the area in which the contractor or his representative can meet the response times as described in paragraph 1.2.4 and in any event shall not exceed 200 miles radius of the construction site.

1.2.3 Equipment Warranty Identification

The Contractor shall provide warranty identification tags on all mechanical and electrical equipment installed under this contract. Tags and installation shall be in accordance with the requirements of Paragraph: EQUIPMENT WARRANTY IDENTIFICATION TAGS.

1.2.4 Warranty Service Calls

The Contractor or his local service representative will respond to the site, to a call within the time periods as follows: Four (4) hours for Heating, Air Conditioning, Refrigeration, Air Supply and Distribution, Critical Electrical service Systems and Food Service Equipment and Twenty-Four (24) hours For All Other Systems.

1.2.5 Equipment Warranty Booklet

At or before 30 days prior to final inspection and acceptance of the work, the Contractor shall submit the data mentioned as follows:

The Contractor shall provided a Booklet, which consists of a listing of all equipment items (see paragraphs a. and b. below) which are specified to be guaranteed along with the warranty papers for each piece of equipment. Three (3) legible bound copies of the booklet shall be submitted for approval and shall be indexed alphabetically by equipment type. For each specific guaranteed item, the name, address, and telephone number shall be shown on the list for the subcontractor who installed equipment, equipment supplier or distributor, and equipment manufacturer. Completion date of the guarantee period shall correspond to the applicable specification requirements for each guaranteed item. The names of service representatives that will make warranty calls along with the day, night, weekend and holiday contacts for response to a call within the time period specified shall also be identified.

a. For Equipment in Place: The equipment list shall show unit retail value and nameplate data including model number, size, manufacturer, etc. This would include capital equipment and other nonexpendable supplies of a movable nature that are not affixed as an integral part of the facility and may be removed without destroying or reducing the usefulness of the facility. Some examples are spare parts, special tools, manufacturing equipment, maintenance equipment, instruments, installed under this contract.

b. For Installed Building Equipment: The equipment list shall show unit retail value and nameplate data including model number, size, manufacturer, etc. This would include items of equipment and furnishings (including material for installation thereof), which are required to make the facility usable and are affixed as a permanent part of the structure. Some examples are plumbing fixtures, laboratory counters and cabinets, kitchen equipment, mechanical equipment, electrical equipment, and fire protection systems installed under this contract.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330SUBMITTAL PROCEDURES:

SD-11 Closeout Submittals

Equipment Warranty Booklet

1.4 EQUIPMENT WARRANTY IDENTIFICATIONS TAGS

1.4.1 GENERAL REQUIREMENTS

The Contractor shall provide warranty identification tags on all Contractor and government furnished equipment which is Contractor installed.

1.4.1.1 Tags and Information

The tags and information shall be similar in format and size to the exhibits provided by this specification, and shall be suitable for interior and exterior locations, resistant to solvents, abrasion, and to fading caused by sunlight, precipitation, etc. These tags shall have a permanent pressure- sensitive adhesive back, and shall be installed in a position that is easily (or most easily) noticeable. If the equipment surface is not suitable for adhesive back, Contractor shall submit his alternative to the Contracting Officer's Authorized Representative for review and approval. Contractor furnished equipment that has differing warranties on its components will have each component tagged.

1.4.1.2 Tags for Warranted Equipment

The tag for his equipment shall be similar to the following:

```
+-------------------------------------------+
|            EQUIPMENT WARRANTY             |
|                                           |
|      CONTRACTOR FURNISHED EQUIPMENT       |
|                                           |
|                                           |
| MFG----------------MODEL NO.-----------  |
|                                           |
| SERIAL NO.------------------------------- |
|                                           |
| CONTRACT NO.----------------------------- |
|                                           |
| CONTRACTOR NAME-------------------------- |
|                                           |
```

```
| CONTRACTOR ADDRESS---------------------- |
|                                          |
| CONTRACTOR TELEPHONE-------------------- |
|                                          |
| CONTRACTOR WARRANTY EXPIRES------------- |
|                                          |
| IN CASE OF WARRANTY ACTION FIRST CONTACT |
|                                          |
|     [DEH] [BCE] AT [TELEPHONE NUMBER]    |
|                                          |
+------------------------------------------+
```

```
+-------------------------------------------------+
|                                                 |
|                EQUIPMENT WARRANTY               |
|                                                 |
|          GOVERNMENT FURNISHED EQUIPMENT         |
|                                                 |
|  MFG _________________  MODEL NO._______________ |
|                                                 |
|  SERIAL NO. ___________________________________ |
|                                                 |
|  CONTRACT NO. _________________________________ |
|                                                 |
|  DATE EQUIP PLACED IN SERVICE _________________ |
|                                                 |
+-------------------------------------------------+
```

1.4.1.3 Exclusion to Providing Tags

If the manufacturer's name (MFG), model number and serial number are on the manufacturer's equipment data plate and this data plate is easily found and fully legible, this information need not be duplicated on the equipment warranty tag. The Contractor's warranty expiration date and the final manufacturer's warranty expiration date will be determined as specified by the Paragraph "WARRANTY OF CONSTRUCTION".

1.4.2 EXECUTION

The Contractor will complete the required information on each tag and install these tags on the equipment by the time of and as a condition of final acceptance of the equipment. The Contractor shall be responsible for scheduling acceptance inspection with the Contracting Officer (verbal and written notification required). If this inspection is delayed by the Contractor, the Contractor shall, at his own expense, update the in-service and warranty expiration dates on these tags.

1.4.3 Equipment Warranty Tag Replacement

Under the terms of this contract, the Contractor's warranty with respect to work repaired or replaced shall run for one year from the date of repair or replacement. Such activity shall include a data warranty identification tag on the repaired or replaced equipment. The tag shall be furnished and installed by the Contractor, and shall be similar to the original tag, except that it should include the scope of repair and that the contractor's warranty expiration date will be one year from the date of acceptance of the repair or replacement. In the case of repair, the repair only will be covered by the extended warranty. In the case of replacement of a

component, the component only will be covered by the extended warranty. In these cases, the original tags will not be removed, but an additional tag will be installed for the repair or component replacement.

PART 2 NOT USED

PART 3 NOT USED

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SECTION 01320A

PROJECT SCHEDULE
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PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of the specification to the extent referenced. The publications are referenced in the text by basic designation only.

U.S. ARMY CORPS OF ENGINEERS (USACE)

ER 1-1-11	(1995) Progress, Schedules, and Network Analysis Systems

1.2 QUALIFICATIONS

The Contractor shall designate an authorized representative who shall be responsible for the preparation of all required project schedule reports.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

Pursuant to the Contract Clause, SCHEDULE FOR CONSTRUCTION CONTRACTS, a Project Schedule as described below shall be prepared. The scheduling of construction shall be the responsibility of the Contractor. Contractor management personnel shall actively participate in its development. Subcontractors and suppliers working on the project shall also contribute in developing and maintaining an accurate Project Schedule. The approved Project Schedule shall be used to measure the progress of the work, to aid in evaluating time extensions, and to provide the basis of all progress payments. The scheduler shall be a direct employee of the prime contractor and have a minimum of 2 years experience in scheduling.

3.2 BASIS FOR PAYMENT

The schedule shall be the basis for measuring Contractor progress. Lack of an approved schedule or scheduling personnel will result in an inability of the Contracting Officer to evaluate Contractor's progress for the purposes of payment. Failure of the Contractor to provide all information, as specified below, shall result in the disapproval of the entire Project Schedule submission and the inability of the Contracting Officer to evaluate Contractor progress for payment purposes. In the case where Project Schedule revisions have been directed by the Contracting Officer and those revisions have not been included in the Project Schedule, the Contracting Officer may hold retainage up to the maximum allowed by contract, each payment period, until revisions to the Project Schedule have been made.

3.3 PROJECT SCHEDULE

The computer software system utilized by the Contractor to produce the Project Schedule shall be capable of providing all requirements of this specification. Failure of the Contractor to meet the requirements of this specification shall result in the disapproval of the schedule. Manual methods used to produce any required information shall require approval by the Contracting Officer.

3.3.1 Use of the Critical Path Method

The Critical Path Method (CPM) of network calculation shall be used to generate the Project Schedule. The Contractor shall provide the Project Schedule in the Precedence Diagram Method (PDM).

3.3.2 Level of Detail Required

The Project Schedule shall include an appropriate level of detail. Failure to develop or update the Project Schedule or provide data to the Contracting Officer at the appropriate level of detail, as specified by the Contracting Officer, shall result in the disapproval of the schedule. The Contracting Officer will use, but is not limited to, the following conditions to determine the appropriate level of detail to be used in the Project Schedule:

3.3.2.1 Activity Durations

Contractor submissions shall follow the direction of the Contracting Officer regarding reasonable activity durations. Reasonable durations are those that allow the progress of activities to be accurately determined between payment periods (usually less than 2 percent of all non-procurement activities' Original Durations are greater than 20 days).

3.3.2.2 Procurement Activities

Tasks related to the procurement of long lead materials or equipment shall be included as separate activities in the project schedule. Long lead materials and equipment are those materials that have a procurement cycle of over 90 days. Examples of procurement process activities include, but are not limited to: submittals, approvals, procurement, fabrication, and delivery.

3.3.2.3 Critical Activities

The following activities shall be listed as separate line activities on the Contractor's project schedule:

a. Submission and approval of mechanical/electrical layout drawings.

b. Submission and approval of O & M manuals.

c. Submission and approval of as-built drawings.

d. Submission and approval of 1354 data and installed equipment lists.

e. Submission and approval of testing and air balance (TAB).

f. Submission of TAB specialist design review report.

g. Submission and approval of fire protection specialist.

h. Submission and approval of testing and balancing of HVAC plus commissioning plans and data.

i. Air and water balance dates.

j. HVAC commissioning dates.

k. Controls testing plan.

l. Controls testing.

m. Performance Verification testing.

n. Other systems testing, if required.

o. Prefinal inspection.

p. Correction of punchlist from prefinal inspection.

q. Final inspection.

3.3.2.4 Government Activities

Government and other agency activities that could impact progress shall be shown. These activities include, but are not limited to: approvals, inspections, utility tie-in, Government Furnished Equipment (GFE) and Notice to Proceed (NTP) for phasing requirements.

3.3.2.5 Responsibility

All activities shall be identified in the project schedule by the party responsible to perform the work. Responsibility includes, but is not limited to, the subcontracting firm, contractor work force, or government agency performing a given task. Activities shall not belong to more than one responsible party. The responsible party for each activity shall be identified by the Responsibility Code.

3.3.2.6 Work Areas

All activities shall be identified in the project schedule by the work area in which the activity occurs. Activities shall not be allowed to cover more than one work area. The work area of each activity shall be identified by the Work Area Code.

3.3.2.7 Modification or Claim Number

Any activity that is added or changed by contract modification or used to justify claimed time shall be identified by a mod or claim code that changed the activity. Activities shall not belong to more than one modification or claim item. The modification or claim number of each activity shall be identified by the Mod or Claim Number. Whenever possible, changes shall be added to the schedule by adding new activities. Existing activities shall not normally be changed to reflect modifications.

3.3.2.8 Bid Item

All activities shall be identified in the project schedule by the Bid Item

to which the activity belongs. An activity shall not contain work in more than one bid item. The bid item for each appropriate activity shall be identified by the Bid Item Code.

3.3.2.9 Phase of Work

All activities shall be identified in the project schedule by the phases of work in which the activity occurs. Activities shall not contain work in more than one phase of work. The project phase of each activity shall be by the unique Phase of Work Code.

3.3.2.10 Category of Work

All Activities shall be identified in the project schedule according to the category of work which best describes the activity. Category of work refers, but is not limited, to the procurement chain of activities including such items as submittals approvals, procurement, fabrication, delivery, installation, start-up, and testing. The category of work for each activity shall be identified by the Category of Work Code.

3.3.2.11 Feature of Work

All activities shall be identified in the project schedule according to the feature of work to which the activity belongs. Feature of work refers, but is not limited to, a work breakdown structure for the project. The feature of work for each activity shall be identified by the Feature of Work Code.

3.3.3 Scheduled Project Completion

The schedule interval shall extend from NTP to the contract completion date.

3.3.3.1 Project Start Date

The schedule shall start no earlier than the date on which the NTP was acknowledged. The Contractor shall include as the first activity in the project schedule an activity called "Start Project". The "Start Project" activity shall have an "ES" constraint date equal to the date that the NTP was acknowledged, and a zero day duration.

3.3.3.2 Constraint of Last Activity

Completion of the last activity in the schedule shall be constrained by the contract completion date. Calculation on project updates shall be such that if the early finish of the last activity falls after the contract completion date, then the float calculation shall reflect a negative float on the critical path. The Contractor shall include as the last activity in the project schedule an activity called "End Project". The "End Project" activity shall have an "LF" constraint date equal to the completion date for the project, and a zero day duration.

3.3.3.3 Early Project Completion

In the event the project schedule shows completion of the project prior to the contract completion date, the Contractor shall identify those activities that have been accelerated and/or those activities that are scheduled in parallel to support the Contractor's "early" completion. Contractor shall specifically address each of the activities noted in the narrative report at every project schedule update period to assist the

Contracting Officer in evaluating the Contractor's ability to actually complete prior to the contract period.

3.3.4 Interim Completion Dates

Contractually specified interim completion dates shall also be constrained to show negative float if the early finish date of the last activity in that phase falls after the interim completion date.

3.3.4.1 Start Phase

The Contractor shall include as the first activity for a project phase an activity called "Start Phase X" where "X" refers to the phase of work. The "Start Phase X" activity shall have an "ES" constraint date equal to the date on which the NTP was acknowledged, and a zero day duration.

3.3.4.2 End Phase

The Contractor shall include as the last activity in a project phase an activity called "End Phase X" where "X" refers to the phase of work. The "End Phase X" activity shall have an "LF" constraint date equal to the completion date for the project, and a zero day duration.

3.3.4.3 Phase X

The Contractor shall include a hammock type activity for each project phase called "Phase X" where "X" refers to the phase of work. The "Phase X" activity shall be logically tied to the earliest and latest activities in the phase.

3.3.5 Default Progress Data Disallowed

Actual Start and Finish dates shall not be automatically updated by default mechanisms that may be included in CPM scheduling software systems. Actual Start and Finish dates on the CPM schedule shall match those dates provided from Contractor Quality Control Reports. Failure of the Contractor to document the Actual Start and Finish dates on the Daily Quality Control report for every in-progress or completed activity, and failure to ensure that the data contained on the Daily Quality Control reports is the sole basis for schedule updating shall result in the disapproval of the Contractor's schedule and the inability of the Contracting Officer to evaluate Contractor progress for payment purposes. Updating of the percent complete and the remaining duration of any activity shall be independent functions. Program features which calculate one of these parameters from the other shall be disabled.

3.3.6 Out-of-Sequence Progress

Activities that have posted progress without all preceding logic being satisfied (Out-of-Sequence Progress) will be allowed only on a case-by-case approval of the Contracting Officer. The Contractor shall propose logic corrections to eliminate all out of sequence progress or justify not changing the sequencing for approval prior to submitting an updated project schedule.

3.3.7 Negative Lags

Lag durations contained in the project schedule shall not have a negative value.

3.4 PROJECT SCHEDULE SUBMISSIONS

The Contractor shall provide the submissions as described below. The data disk, reports, and network diagrams required for each submission are contained in paragraph SUBMISSION REQUIREMENTS.

3.4.1 Preliminary Project Schedule Submission

The Preliminary Project Schedule, defining the Contractor's planned operations for the first 60 calendar days shall be submitted for approval within 20 calendar days after the NTP is acknowledged. The approved preliminary schedule shall be used for payment purposes not to exceed 60 calendar days after NTP.

3.4.2 Initial Project Schedule Submission

The Initial Project Schedule shall be submitted for approval within 40 calendar days after NTP. The schedule shall provide a reasonable sequence of activities which represent work through the entire project and shall be at a reasonable level of detail.

3.4.3 Monthly Schedule Updates

Based on the result of progress meetings, specified in "Monthly Progress Meetings," the Contractor shall submit monthly schedule updates. These submissions shall enable the Contracting Officer to assess Contractor's progress. If the Contractor fails or refuses to furnish the information and project schedule data, which in the judgement of the Contracting Officer or authorized representative is necessary for verifying the Contractor's progress, the Contractor shall be deemed not to have provided an estimate upon which progress payment may be made.

3.4.4 Standard Activity Coding Dictionary

The Contractor shall use the activity coding structure defined in the Standard Data Exchange Format (SDEF) in ER 1-1-11, Appendix A. This exact structure is mandatory, even if some fields are not used.

3.5 SUBMISSION REQUIREMENTS

The following items shall be submitted by the Contractor for the preliminary submission, initial submission, and every monthly project schedule update throughout the life of the project:

3.5.1 Data Disks

Two data disks containing the project schedule shall be provided. Data on the disks shall adhere to the SDEF format specified in ER 1-1-11, Appendix A.

3.5.1.1 File Medium

Required data shall be submitted on 3.5 disks, formatted to hold 1.44 MB of data or CD-ROM, compatible with Microsoft Windows 2000 operating systems, unless otherwise approved by the Contracting Officer.

3.5.1.2 Disk Label

A permanent exterior label shall be affixed to each disk submitted. The label shall indicate the type of schedule (Preliminary, Initial, Update, or Change), full contract number, project name, project location, data date, name and telephone number or person responsible for the schedule.

3.5.1.3 File Name

Each file submitted shall have a name related to either the schedule data date, project name, or contract number. The Contractor shall develop a naming convention that will ensure that the names of the files submitted are unique. The Contractor shall submit the file naming convention to the Contracting Officer for approval.

3.5.2 Narrative Report

A Narrative Report shall be provided with the preliminary, initial, and each update of the project schedule. This report shall be provided as the basis of the Contractor's progress payment request. The Narrative Report shall include: a description of activities along the 2 most critical paths, a description of current and anticipated problem areas or delaying factors and their impact, and an explanation of corrective actions taken or required to be taken. The narrative report is expected to relay to the Government, the Contractor's thorough analysis of the schedule output and its plans to compensate for any problems, either current or potential, which are revealed through that analysis.

3.5.3 Approved Changes Verification

Only project schedule changes that have been previously approved by the Contracting Officer shall be included in the schedule submission. The Narrative Report shall specifically reference, on an activity by activity basis, all changes made since the previous period and relate each change to documented, approved schedule changes.

3.5.4 Schedule Reports

The format for each activity for the schedule reports listed below shall contain: Activity Numbers, Activity Description, Original Duration, Remaining Duration, Early Start Date, Early Finish Date, Late Start Date, Late Finish Date, Total Float. Actual Start and Actual Finish Dates shall be printed for those activities in progress or completed.

3.5.4.1 Activity Report

A list of all activities sorted according to activity number.

3.5.4.2 Logic Report

A list of Preceding and Succeeding activities for every activity in ascending order by activity number. Preceeding and succeeding activities shall include all information listed above in paragraph Schedule Reports. A blank line shall be left between each activity grouping.

3.5.4.3 Total Float Report

A list of all incomplete activities sorted in ascending order of total float. Activities which have the same amount of total float shall be

listed in ascending order of Early Start Dates. Completed activities shall not be shown on this report.

3.5.4.4 Earnings Report

A compilation of the Contractor's Total Earnings on the project from the NTP until the most recent Monthly Progress Meeting. This report shall reflect the Earnings of specific activities based on the agreements made in the field and approved between the Contractor and Contracting Officer at the most recent Monthly Progress Meeting. Provided that the Contractor has provided a complete schedule update, this report shall serve as the basis of determining Contractor Payment. Activities shall be grouped by bid item and sorted by activity numbers. This report shall: sum all activities in a bid item and provide a bid item percent; and complete and sum all bid items to provide a total project percent complete. The printed report shall contain, for each activity: the Activity Number, Activity Description, Original Budgeted Amount, Total Quantity, Quantity to Date, Percent Complete (based on cost), and Earnings to Date.

3.5.5 Network Diagram

The network diagram shall be required on the initial schedule submission and on monthly schedule update submissions. The network diagram shall depict and display the order and interdependence of activities and the sequence in which the work is to be accomplished. The Contracting Officer will use, but is not limited to, the following conditions to review compliance with this paragraph:

3.5.5.1 Continuous Flow

Diagrams shall show a continuous flow from left to right with no arrows from right to left. The activity number, description, duration, and estimated earned value shall be shown on the diagram.

3.5.5.2 Project Milestone Dates

Dates shall be shown on the diagram for start of project, any contract required interim completion dates, and contract completion dates.

3.5.5.3 Critical Path

The critical path shall be clearly shown.

3.5.5.4 Banding

Activities shall be grouped to assist in the understanding of the activity sequence. Typically, this flow will group activities by category of work, work area and/or responsibility.

3.5.5.5 S-Curves

Earnings curves showing projected early and late earnings and earnings to date.

3.6 PERIODIC PROGRESS MEETINGS

Progress meetings to discuss payment shall include a monthly onsite meeting or other regular intervals mutually agreed to at the preconstruction conference. During this meeting the Contractor shall describe, on an

activity by activity basis, all proposed revisions and adjustments to the project schedule required to reflect the current status of the project. The Contracting Officer will approve activity progress, proposed revisions, and adjustments as appropriate.

3.6.1 Meeting Attendance

The Contractor's Project Manager and Scheduler shall attend the regular progress meeting.

3.6.2 Update Submission Following Progress Meeting

A complete update of the project schedule containing all approved progress, revisions, and adjustments, based on the regular progress meeting, shall be submitted not later than 4 working days after the monthly progress meeting.

3.6.3 Progress Meeting Contents

Update information, including Actual Start Dates, Actual Finish Dates, Remaining Durations, and Cost-to-Date shall be subject to the approval of the Contracting Officer. As a minimum, the Contractor shall address the following items on an activity by activity basis during each progress meeting.

3.6.3.1 Start and Finish Dates

The Actual Start and Actual Finish dates for each activity currently in-progress or completed.

3.6.3.2 Time Completion

The estimated Remaining Duration for each activity in-progress. Time-based progress calculations shall be based on Remaining Duration for each activity.

3.6.3.3 Cost Completion

The earnings for each activity started. Payment will be based on earnings for each in-progress or completed activity. Payment for individual activities will not be made for work that contains quality defects. A portion of the overall project amount may be retained based on delays of activities.

3.6.3.4 Logic Changes

All logic changes pertaining to NTP on change orders, change orders to be incorporated into the schedule, contractor proposed changes in work sequence, corrections to schedule logic for out-of-sequence progress, lag durations, and other changes that have been made pursuant to contract provisions shall be specifically identified and discussed.

3.6.3.5 Other Changes

Other changes required due to delays in completion of any activity or group of activities include: 1) delays beyond the Contractor's control, such as strikes and unusual weather. 2) delays encountered due to submittals, Government Activities, deliveries or work stoppages which make re-planning the work necessary. 3) Changes required to correct a schedule which does not represent the actual or planned prosecution and progress of the work.

3.7 REQUESTS FOR TIME EXTENSIONS

In the event the Contractor requests an extension of the contract completion date, or any interim milestone date, the Contractor shall furnish the following for a determination as to whether or not the Contractor is entitled to an extension of time under the provisions of the contract: justification, project schedule data, and supporting evidence as the Contracting Officer may deem necessary. Submission of proof of delay, based on revised activity logic, duration, and costs (updated to the specific date that the delay occurred) is obligatory to any approvals.

3.7.1 Justification of Delay

The project schedule shall clearly display that the Contractor has used, in full, all the float time available for the work involved with this request. The Contracting Officer's determination as to the number of allowable days of contract extension shall be based upon the project schedule updates in effect for the time period in question, and other factual information. Actual delays that are found to be caused by the Contractor's own actions, which result in the extension of the schedule, will not be a cause for a time extension to the contract completion date.

3.7.2 Submission Requirements

The Contractor shall submit a justification for each request for a change in the contract completion date of under 2 weeks based upon the most recent schedule update at the time of the NTP or constructive direction issued for the change. Such a request shall be in accordance with the requirements of other appropriate Contract Clauses and shall include, as a minimum:

a. A list of affected activities, with their associated project schedule activity number.

b. A brief explanation of the causes of the change.

c. An analysis of the overall impact of the changes proposed.

d. A sub-network of the affected area.

Activities impacted in each justification for change shall be identified by a unique activity code contained in the required data file.

3.7.3 Additional Submission Requirements

For any requested time extension of over 2 weeks, the Contracting Officer may request an interim update with revised activities for a specific change request. The Contractor shall provide this disk within 4 days of the Contracting Officer's request.

3.8 DIRECTED CHANGES

If the NTP is issued for changes prior to settlement of price and/or time, the Contractor shall submit proposed schedule revisions to the Contracting Officer within 2 weeks of the NTP being issued. The proposed revisions to the schedule will be approved by the Contracting Officer prior to inclusion of those changes within the project schedule. If the Contractor fails to submit the proposed revisions, the Contracting Officer may furnish the Contractor with suggested revisions to the project schedule. The

Contractor shall include these revisions in the project schedule until revisions are submitted, and final changes and impacts have been negotiated. If the Contractor has any objections to the revisions furnished by the Contracting Officer, the Contractor shall advise the Contracting Officer within 2 weeks of receipt of the revisions. Regardless of the objections, the Contractor shall continue to update the schedule with the Contracting Officer's revisions until a mutual agreement in the revisions is reached. If the Contractor fails to submit alternative revisions within 2 weeks of receipt of the Contracting Officer's proposed revisions, the Contractor will be deemed to have concurred with the Contracting Officer's proposed revisions. The proposed revisions will then be the basis for an equitable adjustment for performance of the work.

3.9 OWNERSHIP OF FLOAT

Float available in the schedule, at any time, shall not be considered for the exclusive use of either the Government or the Contractor.

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DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01330

SUBMITTAL PROCEDURES

09/01; Omaha Update 02/04

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SECTION 01330

SUBMITTAL PROCEDURES
09/01; Omaha Update 02/04

PART 1 GENERAL

Attachments: Submittal Register
ENG Form 4025, Transmittal Form

1.1 CONTRACTOR RESPONSIBILITIES

The Contractor is responsible for total management of his work including scheduling, control, and certification of all submittals. The submittal management system provided in these specifications is intended to be a complete system for the Contractor to use to control the quality of materials, equipment and workmanship provided by manufacturers, fabricators, suppliers and subcontractors. The Contractor shall review each submittal for contract compliance. Submittals that comply will be forwarded to the Government. Submittals that do not conform will be returned to the originator to be corrected. The Submittal Register (ENG Form 4288) will be utilized to log and monitor all submittal activities. No construction or installation activities shall be performed prior to required approvals of applicable submittals. The Contractor shall perform a check to assure that all materials and/or equipment have been tested, submitted and approved during the preparatory phase of quality control inspections.

1.2 SUBMITTAL IDENTIFICATION (SD)

Submittals required are identified by SD numbers and titles as follows:

SD-01 Preconstruction Submittals

Tabular lists showing location, features, or other pertinent information regarding products, materials, equipment, or components to be used in the work.

In addition, the following items are included:

Work plan
Quality control plan
Permits

SD-02 Shop Drawings

Submittals which graphically show relationship of various components of the work, schematic diagrams of systems, details of fabrication, layouts of particular elements, connections, and other relational aspects of the work.

SD-03 Product Data

Catalog cuts, illustrations, schedules, diagrams, performance charts,

instructions and brochures illustrating size, physical appearance and other characteristics of materials or equipment for some portion of the work.

Samples of warranty language when the contract requires extended product warranties.

SD-04 Samples

Samples, including both fabricated and unfabricated physical examples of materials, products, and units of work as complete units or as portions of units of work.

Physical examples of materials, equipment or workmanship that illustrate functional and aesthetic characteristics of a material or product and establish standards by which the work can be judged. Color samples from the manufacturer's standard line (or custom color samples if specified) to be used in selecting or approving colors for the project.

Field samples and mock-ups constructed on the project site establish standards by which the ensuring work can be judged. Includes assemblies or portions of assemblies which are to be incorporated into the project and those which will be removed at conclusion of the work.

SD-05 Design Data

Calculations, mix designs, analyses or other data pertaining to a part of work.

SD-06 Test Reports

Report signed by authorized official of testing laboratory that a material, product or system identical to the material, product or system to be provided has been tested in accordance with specified requirements. (Testing must have been within three years of date of contract award for the project.)

Report which includes findings of a test required to be performed by the contractor on an actual portion of the work or prototype prepared for the project before shipment to job site.

Report which includes finding of a test made at the job site or on sample taken from the job site, on portion of work during or after installation.

Investigation reports

Daily checklists

Final acceptance test and operational test procedure

SD-07 Certificates

A document, required of the Contractor, or through the Contractor, from a supplier, installer, manufacturer, or other lower tier Contractor, the purpose of which is to confirm the quality or orderly progression of a portion of the work by documenting procedures, acceptability of methods or personnel, qualifications, or other verifications of quality.

Statement signed by an official authorized to certify on behalf of the manufacturer of a product, system or material, attesting that the product,

system or material meets specified requirements. The statement must be dated after the award of the contract, must state the Contractor's name and address, must name the project and location, and must list the specific requirements which are being certified.

Confined space entry permits.

SD-08 Manufacturer's Instructions

Preprinted material describing installation of a product, system or material, including special notices and material safety data sheets, if any, concerning impedances, hazards, and safety precautions.

SD-09 Manufacturer's Field Reports

Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.

Factory test reports.

SD-10 Operation and Maintenance Data

Data intended to be incorporated in operations and maintenance manuals.

SD-11 Closeout Submittals

Documentation to record compliance with technical or administrative requirements or to establish an administrative mechanism.

In addition, the following items are included:

As-built drawings

Special warranties

Posted operating instructions

Training plan

1.3 SUBMITTAL CLASSIFICATION

Submittals are classified as follows:

1.3.1 Government Approved

Governmental approval is required for extensions of design, critical materials, deviations, equipment whose compatibility with the entire system must be checked, and other items as designated by the Contracting Officer. Within the terms of the Contract Clause entitled "Specifications and Drawings for Construction," they are considered to be "shop drawings." All submittals noted in the technical specifications and Submittal Register as "G-DO", "G-AE" or "G-AO" are subject to Government Approval.

1.3.2 Information Only (FIO)

All submittals not requiring Government approval will be for information

only. They are not considered to be "shop drawings" within the terms of the Contract Clause referred to above. The Contracting Officer has the option to review any submittal.

1.3.3 Administrative Submittals

The submittal items listed below are not be included on the Submittal Register (as discussed below). Unless directed otherwise by the Contracting Officer, the following administrative submittals shall be submitted to the Area or Resident (as directed) Office, for acceptance, via a Serial Letter: Quality Control Plans (Section 01451A CONTRACTOR QUALITY CONTROL), Accident Prevention Plans (Section 01400 SPECIAL SAFETY REQUIREMENTS, Environmental Protection Plans (Section 01355A ENVIRONMENTAL PROTECTION) and other submittals as directed by the Contracting Officer. Format for the Serial Letter shall be as directed by the Area or Resident Office.

1.4 APPROVED SUBMITTALS

The Contracting Officer's approval of submittals shall not be construed as a complete check, but will indicate only that the general method of construction, materials, detailing and other information are satisfactory. Approval will not relieve the Contractor of the responsibility for any error which may exist, as the Contractor under the Contractor Quality Control (CQC) requirements of this contract is responsible for dimensions, the design of adequate connections and details, and the satisfactory construction of all work. After submittals have been approved by the Contracting Officer, no resubmittal for the purpose of substituting materials or equipment will be considered unless accompanied by an explanation of why a substitution is necessary.

1.5 DISAPPROVED SUBMITTALS

The Contractor shall make all corrections required by the Contracting Officer and promptly furnish a corrected submittal in the form and number of copies specified for the initial submittal. If the Contractor considers any correction indicated on the submittals to constitute a change to the contract, a notice in accordance with the Contract Clause "Changes" shall be given promptly to the Contracting Officer.

1.6 WITHHOLDING OF PAYMENT

Payment for materials incorporated in the work will not be made if required approvals have not been obtained.

1.7 GENERAL

The Contractor shall make submittals as required by the specifications. The Contracting Officer may request submittals in addition to those specified when deemed necessary to adequately describe the work covered in the respective sections. Units of weights and measures used on all

submittals shall be the same as those used in the contract drawings. Each submittal shall be complete and in sufficient detail to allow ready determination of compliance with contract requirements. Prior to submittal, all items shall be checked and approved by the Contractor's Quality Control (CQC) System Manager and each item shall be stamped, signed, and dated by the CQC System Manager indicating action taken. Proposed deviations from the contract requirements shall be clearly identified. Submittals shall include items such as: Contractor's, manufacturer's, or fabricator's drawings; descriptive literature including (but not limited to) catalog cuts, diagrams, operating charts or curves; test reports; test cylinders; samples; O&M manuals (including parts list); certifications; warranties; and other such required submittals. Submittals requiring Government approval shall be scheduled and made prior to the acquisition of the material or equipment covered thereby. Samples remaining upon completion of the work shall be picked up and disposed of in accordance with manufacturer's Material Safety Data Sheets (MSDS) and in compliance with existing laws and regulations.

1.8 SUBMITTAL REGISTER AND ENG FORM 4288 (RMS) SUBMITTAL REGISTER

At the end of this section is a submittal register (submittal form) showing items of equipment and materials for which submittals are required by the specifications; this list may not be all inclusive and additional submittals may be required. The attached submittal register identifies only the submittal section, type of submittal, description of item submitted, paragraph number related to submittal item (section submittal paragraph if none listed), submittal classification (G), and submittal reviewer identifier (DO, AE or AO). Any submittal without a submittal classification and submittal reviewer identifier is considered to be For Information Only (FIO).

The Government will utilize the Submittal Register information - columns (c) thru (f) of the Submittal Forms furnished with this solicitation - to feed the Government Resident Management System (RMS) Software used for tracking construction submittals. The Submittal Register generated by RMS is referred to as ENG Form 4288 (RMS). The Contractor shall maintain an ENG Form 4288 (RMS) for the project in accordance with the attached ENG Form 4288 (RMS) Instructions. The Contractor will be furnished one (1) set of ENG Forms 4288 (RMS) at the preconstruction conference. The Contractor shall complete the appropriate columns as indicated on the attached ENG Form 4288 (RMS) Instructions and return to the Contracting Officer for approval within 20 calendar days after the preconstruction conference. The ENG Form 4288 (RMS)will become a part of the contract after approval. The TRANSMITTAL NUMBER shall be left blank for use later to record the respective transmittal number corresponding to those listed on the transmittal form entitled: "TRANSMITTAL OF SHOP DRAWINGS, EQUIPMENT DATA, MATERIAL SAMPLES, OR MANUFACTURER'S CERTIFICATES OF COMPLIANCE" (ENG Form 4025). The approved ENG Form 4288 (RMS) will become the scheduling document and will be used to control submittals throughout the life of the contract. The ENG Form 4288 (RMS) and the progress schedules shall be coordinated.

1.9 SCHEDULING

Submittals covering component items forming a system or items that are interrelated shall be scheduled to be coordinated and submitted

concurrently. Certifications to be submitted with the pertinent drawings shall be so scheduled. Adequate time (a minimum of 20 calendar days exclusive of mailing time) shall be allowed and shown on the register for review and approval. No delay damages or time extensions will be allowed for time lost in late submittals. An additional 20 calendar days shall be allowed and shown on the register for review and approval of submittals for refrigeration and HVAC control systems.

1.10 TRANSMITTAL FORM (ENG FORM 4025)

The sample transmittal form (ENG Form 4025) attached to this section shall be used for submitting both Goverment approved and information only submittals in accordance with the instructions on the reverse side of the form. These forms will be furnished to the Contractor. This form shall be properly completed by filling out all the heading blank spaces and identifying each item submitted. Special care shall be exercised to ensure proper listing of the specification paragraph and/or sheet number of the contract drawings pertinent to the data submitted for each item.

1.11 SUBMITTAL PROCEDURES

Submittals shall be made as follows:

1.11.1 Procedures

1.11.1.1 "G-DO" or "G-AE" Submittals

All items listed as "G-DO" or "G-AE" submittals in the various sections or on the Submittal Register shall be mailed directly to the addressee shown below as directed. For each submittal, a completed information copy of the attached transmittal form shall also be mailed to the Area Engineer, Resident Engineer and Project Engineer.

An additional copy of "G-D0", "G-AE" or "G-AO" submittals related to fire protection/detection systems shall be submitted concurrently to the Base Civil Engineering Office or DPW office. The mailing address for these submittals shall be obtained at the preconstruction conference.

Technical Reviewer

Mailing Address of Architect-Engineer (AE) Firm

Each required submittal which is in the form of a drawing shall be submitted as seven (7) prints of the drawing. Drawing prints shall be either blue or black line permanent-type prints on a white background or blueprint and shall be sufficiently clear and suitable for making legible copies.

All catalog and descriptive data shall be submitted in seven (7) copies. Catalog cuts and other descriptive data which have more than one model, size, or type or which shows optional equipment shall be clearly marked to show the model, size, or type and all optional equipment which is proposed for approval. Submittals on component items forming a system or that are

interrelated shall be submitted at one time as a single submittal in order to demonstrate that the items have been properly coordinated and will function as a unit.

1.11.1.2 "G-AO" and FIO Submittals

Except as noted below, data for all items listed as "G-AO" Submittals in the various sections shall be submitted in five (5) copies to the Area Engineer using the transmittal form. Items not to be submitted in multiples, such as samples and test cylinders, shall be submitted to the Area or Resident Engineer (as directed) accompanied by five (5) copies of the transmittal form.

Except as noted below, data for all items listed as FIO Submittals in the various sections shall be submitted in five (5) copies to the Area Engineer using the transmittal form. Items not to be submitted in multiples, such as samples and test cylinders, shall be submitted to the Area or Resident Engineer (as directed) accompanied by five (5) copies of the transmittal form. The Government has the option to review any FIO submittal.

1.11.1.3 Certificates of Compliance

Each certificate shall be signed by an official authorized to certify in behalf of the manufacturing company and shall contain the name and address of the Contractor, the project name and location, and the quantity and date or dates of shipment or delivery to which the certificates apply. Copies of laboratory test reports submitted with certificates shall contain the name and address of the testing laboratory and the date or dates of the tests to which the report applies. Certification shall not be construed as relieving the Contractor from furnishing satisfactory material, if, after tests are performed on selected samples, the material is found not to meet the specific requirements.

1.11.1.4 Purchase Orders

Copies of purchase orders shall be furnished to the Contracting Officer when the Contractor requests assistance for expediting deliveries of equipment or materials, or when requested by the Contracting Officer for the purpose of quality assurance review. Each purchase order issued by the Contractor or his subcontractors for materials and equipment to be incorporated into the project shall (1) be clearly identified with the applicable DA contract number, (2) carry an identifying number, (3) be in sufficient detail to identify the material being purchased, (4) indicate a definite delivery date, and (5) display the DMS priority rating, if applicable.

1.11.1.5 Operation and Maintenance Instructions and/or Manuals

Where required by various technical sections, operations and maintenance instructions and/or manuals with parts lists included shall be provided by the Contractor in quintuplicate, unless otherwise specified, and shall be assembled in three-ring binders with index and tabbed section divider and having a cover indicating the contents by equipment or system name and project title and shall be submitted for approval to the Contracting Officer 90 days prior to final tests of mechanical and electrical systems, unless otherwise specified. Each operation and maintenance manual shall contain a copy of all warranties and a list of local service representatives required by Section 01200 Warranty of Construction. If field testing requires these copies to be revised, they shall be updated

and resubmitted for approval within 10 calendar days after completion of tests. The Operations and Maintenance Instructions and/or Manuals shall be shown as a separate activity on the Contractor prepared construction schedule bar chart or network analysis system. In additon, one reproducible unfolded copy of all wiring and control diagrams and approved system layout drawings shall be submitted with the O&M Manuals.

1.11.1.6 Interior/Exterior Finish Sample and Data

All submittals regarding color boards (Section 09915 COLOR SCHEDULE) for interior finish samples and data shall be submitted concurrently and all submittals for exterior finish samples and data shall be submitted concurrently. These color boards are in addition to the samples required under the specfic technical specifications listed as "samples".

1.11.2 Deviations

For submittals which include proposed deviations requested by the Contractor, the column "variation" of ENG Form 4025 shall be checked. The Contractor shall set forth in writing the reason for any deviations and annotate such deviations on the submittal. The Government reserves the right to rescind inadvertent approval of submittals containing unnoted deviations.

1.12 CONTROL OF SUBMITTALS

The Contractor shall carefully control his procurement operations to ensure that each individual submittal is made on or before the Contractor scheduled submittal date shown on the approved "Submittal Register."

1.13 FINAL COPY OF GOVERNMENT APPROVED SUBMITTALS

Upon completion of review of submittals requiring Government approval, the submittals will be identified as having received approval by being so stamped and dated.

1.13.1 "G-AE" or "G-DO" Submittals

The drawing print and five (5) sets of all catalog data and descriptive literature and drawing prints will be retained by the Contracting Officer and two (2) sets of catalog data and descriptive literature and drawing prints will be returned to the Contractor.

1.13.2 "G-AO" Submittals

Two (2) copies of "G-AO" submittals for approval will be returned to the Contractor except for samples, test cylinders, and O&M manuals for which two (2) copies of the transmittal form only will be returned to the Contractor.

1.14 INFORMATION ONLY SUBMITTALS

Normally submittals for information only will not be returned. Review by the Contracting Officer is not required on information only submittals. The Government reserves the right to require the Contractor to resubmit any item found not to comply with the contract. This does not relieve the Contractor from the obligation to furnish material conforming to the plans and specifications; will not prevent the Contracting Officer from requiring

removal and replacement of nonconforming material incorporated in the work; and does not relieve the Contractor of the requirement to furnish samples for testing by the Government laboratory or for check testing by the Government in those instances where the technical specifications so prescribe.

1.15 STAMPS

Stamps used by the Contractor on the submittal data to certify that the submittal meets contract requirements shall be similar to the following. The stamp shall be affixed and filled out on the back of each ENG Form 4025.

CONTRACTOR

(Firm Name)

_____ Approved

_____ Approved with corrections as noted on submittal data and/or attached sheets(s).

SIGNATURE: _____

TITLE: _____

DATE: _____

INSTRUCTIONS
ENG FORM 4288 (RMS)

1. The Contractor shall utilize the ENG Form 4288 (RMS) generated by the Government Resident Management System (RMS) software for tracking construction submittals. The Government will furnish the Contractor a hard copy of the ENG Form 4288 (RMS) at the preconstruction conference. Listed below are the items included on the ENG Form 4288 (RMS) and parties responsible for completing the information required on the ENG Form 4288 (RMS) submittal register. The subparagraph headings below do not correspond to the Submittal Register column headings included in this solicitation.

a. Activity Number: will be provided by the Contractor from his Network Analysis, if required, and when a network analysis is accepted.

b1. Transmittal Number: will be provided by the Contractor on ENG Form 4025 for each transmittal at the time of submission of items to the Government.

b2. Item Number: will be provided by the Government on the ENG From 4288 (RMS) Submittal Register to be given to the Contractor at the Preconstruction Conference.

c. Specification Paragraph Number: will be provided by the Government from the Submittal Register from column entitled "Specification Paragraph Number".

d. Description of Submittal: will be provided by the Government from the Submittal Register from column entitled "Description of Item Submitted".

e. Type of Submittal: will be provided by the Government from the Submittal Register from column entitled "Type of Submittal" or "Description of Item Submitted".

f. Classification: will be provided by the Government from the Submittal Register from column entitled "Classification". Classification will be GA (Government Approval) or FIO (For Information Only).

g. Reviewer - Office/Name: will be provided by the Government from the Submittal Register from column entitled "Classification" or "Reviewer".

h. Contractor Schedule Dates: the Contractor will provide schedule dates for

"Submit Needed By" (Date the Contractor expects to submit an item. It is the Contractors responsibility to calculate the lead time needed for the government approval. Note if resubmittal is required it is the Contractors responsibility to make all adjustments necessary to meet the contract completion date.)

"Approval Needed By" (date the Contractor can receive approval and still obtain the material by need date.), and

"Material Needed By" (date that the material is needed at the site. If there is a network analysis it should reflect that date on the analysis.)

i. Contractor Action: Includes the following items: "Code" and "Submit to the Corps". These items will be completed by the Contractor. The action

codes will be one of the following:

A - Approved as submitted.
B - Approved, except as noted.
G - Other (specify)

j. Government Action: This item includes a Government Action "Code" and "Date" and is reserved for Government use. The Government reserves the right to review any submittal for contract compliance. Receipt of an Action Code "F - Receipt Acknowledged" or failure of the Contractor to receive an Action Code by the Government, does not mean that the submittal is in compliance with the contract requirements. When used by the Government, the action code will be one of the following:

A - Approved as submitted.
B - Approved except as noted on drawings.
C - Approved, except as noted on drawings. Refer to attached ____ sheet resubmission required.
D - Will be returned by separate correspondence.
E - Disapproved (See Attached).
F - Receipt Acknowledged.
Fx - Receipt acknowledged, does not comply as noted with contract requirements.
G - Other (specify).

2. Reviewer Abbreviation code will be as follows;

G-DO, G-AE or G-AO - Government Approved
For Information Only - Any submittal without a Government Approved abbreviation code.

INSTRUCTIONS
ENG FORM 4025

1. DATE at the top of form will be the date submitted to the Government which is to be completed by the Contractor.

2. TRANSMITTAL NO. Each new transmittal (i.e. G-AE, G-AO or FIO) shall be numbered consecutively for each specification section in the space provided in "Transmittal No.". This number will be the identifying symbol for each submittal. Example: "15400A-001", "15895A-001" "15895A-002", "16415A-001", etc. For each new submittal or for a resubmittal, the appropriate box must be marked. Resubmittals or supplemental submittals must be designated by their original sequential number followed by an ".1", ".2", etc. for each sequential resubmittal. Example: "15895A-001.1" (previous submittal No. 15895A-001). This will clearly annotate the resubmittal or supplemental submittals as related to the previous submittal.

3. TO: Box will contain the name and address of the office which will review the submittal (as designated by the Contracting Officer).

4. FROM: Box will be the name and address of the Contractor. Contractor is to complete this box.

5. CONTRACT NO. box will contain the Contractors construction contract number (e.g., W9128F-XX-C-XXXX).

6. CHECK ONE box

a. CHECK ONE box (for transmittal/ retransmittal) will be completed by the Contractor with one box marked. If a resubmittal is provided last transmittal number will be added.

b. CHECK ONE box will be completed by the Contractor with one box marked for the submittal type.

7. SPECIFICATION SECTION NO. box will be completed by the Contractor. The number will be the five digit number found in the specifications. No more than one section will be covered with each transmittal. **No more than one section will be covered with each transmittal.**

8. PROJECT TITLE AND LOCATION box will be completed by the Contractor.

9. Column a, will be completed by the Contractor and will contain a different number for each item submitted in that transmittal. **The item numbers will match the item numbers provided by the Government on the ENG Form 4288 (RMS) Submittal Register. Additional items shall only be submitted if requested by or coordinated with the Contracting Officer's Representative as necessary.**

10. Column b, will be completed by the Contractor. The description of each item on this form will match the descriptions provided on the ENG Form 4288 (RMS) Submittal Register. The Contractor shall submit each submittal register item all at once on one transmittal if possible. If a submittal register item can not be submitted all at once Contractor should note that in the remarks box.

11. Column c, will be completed by the Contractor. The information will be

the appropriate submittal description number as described in this Section or shown on the submittal register (e.g. SD-01, SD-02, etc.).

12. Column d, will be completed by the Contractor. The number of copies will be determined by the Contractor after review of submittal register for the classification of the item and after review of paragraph: SUBMITTAL PROCEDURES of this Section.

13. Column e, will be completed by the Contractor. The Contractor shall state all applicable paragraph numbers.

14. Column f, will be completed by the Contractor. The Contractor shall state all applicable drawing sheet numbers.

15. Column g, will be completed by the Contractor. **Any transmittal without a Contractor action code may be returned by the Government without Government action. The Contractor QC must demonstrate that a review has been conducted by the Contractor.** The action codes will be one of the following:

A - Approved as submitted.
B - Approved, except as noted.
G - Other (specify)

16. Column h, will be completely by the Contractor. A check shall be placed in this column when a submittal is not in accordance with the plans and specifications also, a written statement to that effect shall be included in the space provided for "Remarks".

17. Column i, is reserved for Government use and may or may not be provided. When used by the Government, the action code will be one of the following:

A - Approved as submitted.
B - Approved except as noted on drawings.
C - Approved, except as noted on drawings. Refer to attached ____ sheet resubmission required.
D - Will be returned by separate correspondence.
E - Disapproved (See Attached).
F - Receipt Acknowledged.
Fx - Receipt acknowledged, does not comply as noted with contract requirements.
G - Other (specify).

18. REMARKS box: **Provide any information related to Variations. Also, provide any and all remarks that explain any deviations in descriptions, item numbers, additional or supplemental submittal items, etc. It is imperative to clearly communicate what is included on the transmittal and these pertinent 'remarks' can facilitate the review of the transmittal.**

19. Contractor Quality Control Manager must provide name and sign all Eng Form 4025 certifying conformance. **In the space for the name and signature, also include a phone number where the CQC Manager may be reached.**

20. Section II will be completed by the Government. Contractor is not to write in this space.

See reverse side of ENG Form 4025 for additional instructions.

-- End of Section --

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION
ADAL Fitness Center, Minot AFB, ND

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		00800	SD-02 Shop Drawings															
			Equipment Room Drawings	1.22	G AO													
		01200	SD-11 Closeout Submittals															
			Equipment Warranty Booklet	1.2.5														
		01400	SD-07 Certificates															
			Qualifications		G AO													
		02300	SD-01 Preconstruction Submittals															
			Dewatering Work Plan	1.6	G AO													
			SD-03 Product Data															
			Utilization of Excavated Materials	3.9	G AO													
			Rock Excavation	1.5.2														
			Opening of any Excavation or	3.4														
			Borrow Pit															
			SD-06 Test Reports															
			Testing	3.17														
			Borrow Site Testing	2.1														
			SD-07 Certificates															
			Testing	3.17														
		02510A	SD-03 Product Data															
			Installation	3.1														
			Satisfactory Installation	3.4														
			SD-06 Test Reports															
			Bacteriological Disinfection	3.3														
		02531	SD-02 Shop Drawings															
			Precast concrete manhole	2.3.1														
			Metal items	2.3.4														

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION
ADAL Fitness Center, Minot AFB, ND

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAG# RAPH	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY				MAILED TO CONTR/	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION	DATE RCD FRM APPR AUTH	
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		02531	Frames, covers, and gratings	2.3.4.1														
			SD-03 Product Data															
			Pipeline materials	2.1														
			SD-07 Certificates															
			Portland Cement	2.2.2														
		02552A	SD-02 Shop Drawings															
			Heat Distribution System	1.3.1	G	AO												
			SD-03 Product Data															
			Expansion Loops and Bends	2.4	G	AE												
			Cathodic Protection Installation	3.4.7	G	AO												
			Interruption of Existing Service	3.1.2	G	AO												
			Work Plan	1.5.1	G	AO												
			Quality Assurance Plan	1.5.1														
			UHDS Manufacturer's	3.4.4														
			Representative Reports															
			Connecting to Existing Work	3.1.4	G	AO												
			SD-06 Test Reports															
			Thermal Performance Testing	3.8	G	AO												
			Operational Test	3.5.2.3	G	AO												
			Tests	3.5	G	AO												
			SD-07 Certificates															
			Manufacturer	1.5.1	G	AO												
			Manufacturer's Representative	1.5.2	G	AO												
			UHDS Design	1.4.2	G	AO												
			Certificate of Compliance	3.4.4	G	AO												
			Testing Firm	1.5.4														

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		02552A	Welding	3.3														
			SD-10 Operation and Maintenance															
			Data															
			Heat Distribution System	1.3.1	G AO													
		02556A	SD-02 Shop Drawings															
			Pipe, Fittings, and Associated	2.1														
			Materials															
			SD-03 Product Data															
			Materials and Equipment	1.3.2	G AO													
			Connections to Existing Lines	3.10														
			Jointing Polyethylene Piping	1.3.1	G AO													
			Connection and Abandonment	3.10.2	G AO													
			Plan															
			SD-06 Test Reports															
			Pressure and Leak Tests	3.12.2	G AO													
		02560	SD-02 Shop Drawings															
			Detail Drawings	1.3.1	G AO													
			SD-03 Product Data															
			Piping and Fittings	2.5														
			Valves	2.6														
			Insulation	2.9.2														
			Expansion Joints	2.11														
			SD-10 Operation and Maintenance															
			Data															
			Valve Manholes and Accessories	3.5														
			Data Package 2	3.5.1														

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		02564	SD-03 Product Data															
			Plant, Equipment, and Tools	1.9														
			SD-06 Test Reports															
			Initial Tests	2.5	G	AO												
			SD-07 Certificates															
			Asphalt Cement Binder	2.1.3	G	AO												
			SD-08 Manufacturer’s Instructions															
			Manufacturer's Recommendations	1.7	G	AO												
			SD-09 Manufacturer’s Field															
			Reports															
			Job Mix Formula	2.1.1	G	AO												
			Contractor Quality Control	1.6	G	AO												
			Contractor Quality Control	3.2.1	G	AO												
			Acceptability of Work	3.2.2	G	AO												
			Acceptability of Work	3.4.4	G	AO												
		02630	SD-03 Product Data															
			Placing Pipe	3.3														
			SD-04 Samples															
			Pipe for Culverts and Storm	2.1														
			Drains															
		02754A	SD-03 Product Data															
			Equipment	1.6	G	AO												
			Paving	3.4	G	AO												
			Mixture Proportions	2.11	G	AO												
		02763A	SD-03 Product Data															
			Equipment	1.5	G	AO												

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		02763A	SD-06 Test Reports															
			Sampling and Testing	2.4	G	AO												
		02821A	SD-07 Certificates															
			Chain Link Fence	2.1.1	G	AO												
		02921A	SD-03 Product Data															
			Equipment	3.1.3	G	AO												
			Surface Erosion Control Material	2.8	G	AO												
			Chemical Treatment Material	1.4.3	G	AO												
			Delivery	1.4.1	G	AO												
			Finished Grade and Topsoil	3.2.1	G	AO												
			Topsoil	2.2	G	AO												
			Quantity Check	3.5	G	AO												
			Seed Establishment Period	3.9	G	AO												
			Maintenance Record	3.9.3.5	G	AO												
			Application of Pesticide	3.6	G	AO												
			SD-04 Samples															
			Delivered Topsoil	1.4.1.1	G	AO												
			Soil Amendments	2.3	G	AO												
			Mulch	2.4	G	AO												
			SD-06 Test Reports															
			Equipment Calibration	3.1.3	G	AO												
			Soil Test	3.1.4	G	AO												
			SD-07 Certificates															
			Seed	2.1	G	AO												
			Topsoil	2.2	G	AO												
			pH Adjuster	2.3.1	G	AO												

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		02921A	Fertilizer	2.3.2	G	AO												
			Soil Conditioner	2.3.4	G	AO												
			Mulch	2.4	G	AO												
			Asphalt Adhesive	2.5	G	AO												
			Pesticide	2.7	G	AO												
		03100A	SD-03 Product Data															
			Form Materials	2.1														
			Form Releasing Agents	2.1.5														
		03200A	SD-02 Shop Drawings															
			Reinforcement	3.1	G	AE												
			SD-07 Certificates															
			Reinforcing Steel	2.1														
		03300	SD-03 Product Data															
			Mixture Proportions	1.6	G	AE												
			SD-06 Test Reports															
			Testing and Inspection for	3.12	G	AO												
			Contractor Quality Control															
			SD-07 Certificates															
			Qualifications	1.4														
		04200	SD-02 Shop Drawings															
			Structural Masonry	1.5	G	AE												
			SD-03 Product Data															
			Clay or Shale Brick	2.2	G	AE												
			Insulation	2.13	G	AE												
			Flashing	2.16	G	AE												
			Cold Weather Installation	3.1.2														

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		04200	SD-04 Samples															
			Concrete Masonry Units (CMU)	2.3														
			Cast Stone Items	2.5	G	AE												
			Clay or Shale Brick	2.2	G	AE												
			Anchors, Ties, and Bar Positioners	2.9														
			Expansion-Joint Materials	2.15														
			Joint Reinforcement	2.10														
			Insulation	2.13	G	AO												
			Portable Panel	1.3	G	AE												
			SD-05 Design Data															
			Pre-mixed Mortar	2.7.4	G	AE												
			Unit Strength Method	1.5.2	G	AE												
			SD-06 Test Reports															
			Efflorescence Test	3.24.3														
			Field Testing of Mortar	3.24.1														
			Field Testing of Grout	3.24.2														
			Prism tests	3.24.4														
			Masonry Cement	2.7.3														
			Fire-rated CMU	2.3.3														
			Special Inspection	1.5.1														
			SD-07 Certificates															
			Clay or Shale Brick	2.2														
			Cast Stone Items	2.5														
			Concrete Masonry Units (CMU)	2.3														
			Control Joint Keys	2.12														

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		04200	Anchors, Ties, and Bar	2.9														
			Positioners															
			Expansion-Joint Materials	2.15														
			Joint Reinforcement	2.10														
			Reinforcing Steel Bars and Rods	2.11														
			Masonry Cement	2.7.3														
			Insulation	2.13														
			Precast Concrete Items	2.4														
			Admixtures for Masonry Mortar	2.7.1														
			Admixtures for Grout	2.8.1														
			SD-08 Manufacturer's Instructions															
			Masonry Cement	2.7.3														
		05090A	SD-03 Product Data															
			Welding Procedure Qualifications	1.5	G	AE												
			Welder, Welding Operator, and	1.6														
			Tacker Qualification															
			Inspector Qualification	1.7														
			Previous Qualifications	1.5.1														
			Prequalified Procedures	1.5.2														
			SD-06 Test Reports															
			Quality Control	3.2														
		05120	SD-02 Shop Drawings															
			Erection Plan	1.5.2.1	G	AE												
			Fabrication drawings	1.5.1	G	AE												
			SD-03 Product Data															
			Shop primer	2.4														

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		05120	Load indicator bolts	2.2.3														
			SD-06 Test Reports															
			Class B coating	2.4														
			Bolts, nuts, and washers	2.2														
			SD-07 Certificates															
			Steel	2.1														
			Bolts, nuts, and washers	2.2														
			Shop primer	2.4														
			Welding electrodes and rods	2.3.1														
			Nonshrink grout	2.3.2														
			Welding procedures and	1.5.2.2														
			qualifications															
		05210A	SD-02 Shop Drawings															
			Steel Joists	1.3	G	AE												
			SD-07 Certificates															
			Steel Joists	1.3														
		05310	SD-02 Shop Drawings															
			Fabrication Drawings	1.3.5	G	AE												
			SD-03 Product Data															
			Deck Units	2.3.1	G	AE												
			Sound Absorbing Material	2.1.3														
			Accessories	2.2														
			SD-05 Design Data															
			Deck Units	2.3.1	G	AE												
			SD-07 Certificates															
			Deck Units	2.3.1														

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		05310	Accessories	2.2														
			Qualification of Welders	1.3.3														
			Wind Storm Resistance	1.3.4.1														
		05400	SD-02 Shop Drawings															
			Framing Components	1.5.1														
			SD-03 Product Data															
			studs,joists	2.1														
			SD-05 Design Data															
			Metal framing calculations	1.5.2	G	AE												
			SD-07 Certificates															
			Welds	3.1.1														
		05500A	SD-02 Shop Drawings															
			Miscellaneous Metal Items	1.6	G	AO												
			SD-04 Samples															
			Miscellaneous Metal Items	1.6														
		06100A	SD-02 Shop Drawings															
			Nailers and Nailing Strips	3.2.2	G	AO												
			SD-07 Certificates															
			Grading and Marking	2.1.1														
			Insulation	2.3														
		06200A	SD-02 Shop Drawings															
			Finish Carpentry	2.1	G	AE												
			SD-04 Samples															
			Moldings and Interior Trim	2.1.2	G	AE												
		06410A	SD-02 Shop Drawings															
			Shop Drawings	1.7	G	AE												

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		06410A	Installation	3.1	G	AO												
			SD-03 Product Data															
			Wood Materials	2.1														
			Wood Finishes	2.9														
			SD-04 Samples															
			Plastic Laminates	2.3	G	AE												
			Cabinet Hardware	2.6	G	AE												
			Wood Veneer	2.1.2.1	G	AE												
			SD-07 Certificates															
			Quality Assurance	1.4	G	AO												
			Laminate Clad Casework	3.1	G	AO												
		06650	SD-02 Shop Drawings															
			Shop Drawings	2.3	G	AE												
			Installation	3.2	G	AO												
			SD-03 Product Data															
			Solid polymer material	2.1														
			Qualifications	1.6														
			Fabrications	2.3														
			SD-04 Samples															
			Material	2.1	G	AE												
			Transaction Top and Vanity Tops	2.3.5	G	AO												
			SD-06 Test Reports															
			Solid polymer material	2.1														
			SD-07 Certificates															
			Fabrications	2.3														
			Qualifications	1.6														

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		06650	SD-10 Operation and Maintenance															
			Data															
			Clean-up	3.3														
		07131	SD-03 Product Data															
			Elastomeric waterproofing sheet	2.1	G	AE												
			material															
			Primers, adhesives, and mastics	2.1														
			SD-06 Test Reports															
			Elastomeric waterproofing sheet	2.1														
			material															
		07220	SD-02 Shop Drawings															
			Tapered roof insulation	2.1.4	G	AE												
			SD-03 Product Data															
			Fasteners	2.4														
			Asphalt	2.3.2	G	AO												
			Insulation	2.1	G	AE												
			SD-06 Test Reports															
			Flame spread and smoke	1.4.1														
			developed ratings															
			SD-07 Certificates															
			qualifications	1.3														
			SD-08 Manufacturer's Instructions															
			fasteners	2.4														
			insulation	2.1														
		07410	SD-02 Shop Drawings															
			Materials	2.1	G	AE												

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		07410	SD-03 Product Data															
			Materials	2.1	G	AE												
			Insulation	2.4.1														
			SD-04 Samples															
			Materials	2.1	G	AE												
			SD-06 Test Reports															
			System Performance	1.5														
			Requirements															
		07410N	SD-02 Shop Drawings															
			Panels	2.1	G	AE												
			Fasteners	2.1.4	G	AE												
			Supports	2.1.4	G	AE												
			Flashing	3.1.1	G	AE												
			Closures	3.1.1	G	AE												
			SD-03 Product Data															
			Panels	2.1	G	AE												
			Accessories	2.1.3														
			Fasteners	2.1.4														
			warranty	1.7														
			SD-04 Samples															
			Panels	2.1	G	AE												
			SD-06 Test Reports															
			Formability test	1.3.3														
			Accelerated Weathering, Chalking	1.3.4														
			Resistance and Color Change															
			Specular gloss	1.3.5														

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		07410N	Salt spray test	1.3.6														
			Abrasion resistance test	1.3.8														
			Humidity test	1.3.9														
			Wind uplift	1.3.2														
			SD-07 Certificates															
			Qualification of installer	1.5.2														
		07416A	SD-02 Shop Drawings															
			Structural Standing Seam Metal	1.2.1	G	AE												
			Roof (SSSMR) System															
			SD-03 Product Data															
			Design Analysis	1.2	G	AE												
			Qualifications	1.2.2														
			Qualifications	1.2.3														
			Quality Assurance Plan	1.9														
			SD-04 Samples															
			Accessories	2.3														
			Roof Panels	2.1														
			Factory Color Finish	2.6														
			Fasteners	2.4														
			Insulation	2.7	G	AE.												
			Gaskets and Insulating	2.9														
			Compounds															
			Sealant	2.8														
			Concealed Anchor Clips	2.2	G	AE.												
			Subpurlins	2.5	G	AE.												
			EPDM Rubber Boots	2.11	G	AE.												

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		07416A	SD-06 Test Reports															
			Uplift Resistance	1.4	G	AE												
			SD-07 Certificates															
			Structural Standing Seam Metal	1.2.1														
			Roof (SSSMR) System															
		07511	SD-03 Product Data															
			Asphalt	2.2.1	G	AO												
			Felts	2.2.2	G	AO												
			Fasteners	2.2.7														
			Primer	2.2.3														
			Asphalt roof cement	2.2.4														
			Walkway Materials	2.2.8														
			Inspection	3.5														
			Cants	2.2.5														
			Warranty	1.7	G	AO												
			SD-06 Test Reports															
			Samples of built-up roofing	3.4.2														
			SD-07 Certificates															
			Bill of lading	1.4.1														
			Qualifications of applicator	1.3.1														
			SD-11 Closeout Submittals															
			Information card	3.6														
		07600	SD-02 Shop Drawings															
			Downspouts	3.1.11	G	AE												
			Flashing for roof drains	3.1.12														
			Base flashing	3.1.9														

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		07600	Counterflashing	3.1.10														
			Flashing at roof penetrations	3.1.14														
			Scuppers	3.1.13	G	AE												
			Copings	3.1.16	G	AE												
			SD-11 Closeout Submittals															
			Quality Control Plan	3.5														
		07840	SD-02 Shop Drawings															
			Firestopping Materials	2.1														
			SD-07 Certificates															
			Firestopping Materials	2.1														
			Installer Qualifications	1.5														
			Inspection	3.3														
		07920	SD-03 Product Data															
			Sealants	2.1														
			Primers	2.2														
			Bond breakers	2.3														
			Backstops	2.4														
			SD-04 Samples															
			Color Selection	2.1	G	AE												
			SD-07 Certificates															
			Sealant	3.3.6														
		08110	SD-02 Shop Drawings															
			Doors	2.1	G	G												
			Doors	2.1	G	G												
			Frames	2.5	G	G												
			Frames	2.5	G	G												

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		08110	Accessories	2.4	G	AE												
			SD-03 Product Data															
			Doors	2.1	G	AE												
			Frames	2.5	G	AE												
			Accessories	2.4	G	AE												
		08120	SD-02 Shop Drawings															
			Doors and frames	2.1	G	AE												
			SD-03 Product Data															
			Doors and Frames	2.1	G	AE												
			SD-07 Certificates															
			Aluminum Door System Design	1.2.1	G	AE												
			SD-08 Manufacturer's Instructions															
			Doors and frames	2.1														
		08210	SD-02 Shop Drawings															
			Doors	2.1	G	AE												
			SD-03 Product Data															
			Doors	2.1	G	AE												
			Accessories	2.2														
			Water-resistant sealer	2.3.6														
			warranty	1.4														
			Fire resistance rating	2.1.2	G	AE												
			SD-04 Samples															
			Doors	2.1														
			Door finish colors	2.3.5.2	G	AE												
			SD-06 Test Reports															
			Split resistance	2.4														

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		08210	Cycle-slam	2.4														
			Hinge loading resistance	2.4														
		08330A	SD-02 Shop Drawings															
			Approved Detail Drawings	3.1														
			[ ], [ ]															
			Installation	3.1														
			SD-03 Product Data															
			Overhead Rolling Doors	2.1														
			[ ], [ ]															
			SD-06 Test Reports															
			Tests	3.3														
			[ ], [ ]															
			SD-04 Samples															
			Overhead Rolling Doors	2.1														
			[ ], [ ]															
			SD-07 Certificates															
			Fire Doors	2.2														
			[ ], [ ]															
			SD-10 Operation and Maintenance															
			Data															
			Operation and Maintenance	1.6														
			Manuals															
			[ ], [ ]															
		08331A	SD-02 Shop Drawings															
			Approved Detail Drawings	3.1	G	AE												
			SD-03 Product Data															

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		08331A	Rolling Counter Doors	1.3	G	AE												
			Rolling Counter Doors	2.5	G	AE												
			Installation	3.1														
			Cleaning	3.2														
			SD-04 Samples															
			Rolling Counter Doors	1.3														
			Rolling Counter Doors	2.5														
			SD-06 Test Reports															
			Tests	3.3														
			SD-10 Operation and Maintenance															
			Data															
			Operation	2.4	G	AO												
		08710	SD-02 Shop Drawings															
			Hardware schedule	1.3	G	AE												
			Keying system	2.3.5	G	AO												
			SD-03 Product Data															
			Hardware items	2.3	G	AE												
			SD-08 Manufacturer's Instructions															
			Installation	3.1														
			SD-10 Operation and Maintenance															
			Data															
			Hardware Schedule	1.3	G	AE												
			SD-11 Closeout Submittals															
			Key bitting	1.4	G	AO												
		08800	SD-02 Shop Drawings															
			Glass Setting	3.2	G	AE												

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		08800	SD-03 Product Data															
			Insulating Glass	1.7.1	G	AE												
			Glazing Accessories	1.4														
			SD-04 Samples															
			Insulating Glass	1.7.1	G	AE												
			Glazing Compound	2.3.1														
			Tape	2.3.4														
			Sealants	2.3.2														
			SD-07 Certificates															
			Insulating Glass	1.7.1														
			Glazing Accessories	1.4														
			SD-08 Manufacturer's Instructions															
			Setting and sealing materials	2.3														
			Glass setting	3.2														
		08900	SD-02 Shop Drawings															
			Glazed curtain wall system	1.6	G	AE												
			SD-03 Product Data															
			Glazed curtain wall system	1.6	G	AE												
			SD-05 Design Data															
			Calculations	1.4														
			SD-07 Certificates															
			Glazed Curtain Wall System	1.6	G	AE												
			SD-08 Manufacturer's Instructions															
			Glazed curtain wall system	1.6														
			Insulating glass	2.1.6														
		09100N	SD-02 Shop Drawings															

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		09100N	Metal support systems	2.1	G AO													
		09250	SD-03 Product Data															
			Cementitious backer units	2.1.5														
			Water-Resistant Gypsum Backing Board	2.1.2														
			Glass Mat Covered or Reinforced Gypsum Sheathing	2.1.3														
			Impact Resistant Gypsum Board	2.1.4														
			Accessories	2.1.9														
			SD-07 Certificates															
			Asbestos Free Materials	2.1	G AO													
		09310	SD-03 Product Data															
			Tile	2.1	G AE													
			Setting-Bed	2.2	G AE													
			Mortar, Grout, and Adhesive	2.4	G AE													
			Cove Base Movement Profile	2.1.4.1	G AE													
			Cove Base Movement Profile	3.5	G AE													
			Floor Edge Protection and Transition	2.1.4.2	G AE													
			Floor Edge Protection and Transition	3.6	G AE													
			SD-04 Samples															
			Tile	2.1	G AE													
			Cove Base Movement Profile	2.1.4.1	G AE													
			Cove Base Movement Profile	3.5	G AE													

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		09310	Floor Edge Protection and	2.1.4.2	G	AE												
			Transition															
			Floor Edge Protection and	3.6	G	AE												
			Transition															
			Solid Polymer (Solid Surfacing)	2.5	G	AE												
			Thresholds															
			SD-07 Certificates															
			Tile	2.1														
			Mortar, Grout, and Adhesive	2.4														
		09510	SD-02 Shop Drawings															
			Approved Detail Drawings	1.3	G	AE												
			SD-03 Product Data															
			Acoustical Units	2.1	G	AE												
			Suspension System	2.2	G	AE												
			SD-04 Samples															
			Acoustical Units	2.1	G	AE												
			SD-07 Certificates															
			Acoustical Units	2.1														
		09620A	SD-02 Shop Drawings															
			Sheet Vinyl Composition Flooring	2.1	G	AE												
			SD-03 Product Data															
			Installation	3.3	G	AE												
			SD-04 Samples															
			Flooring	1.3	G	AE												
			SD-07 Certificates															
			Materials	1.4														

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		09641N	SD-02 Shop Drawings															
			Hardwood strip flooring	2.1	G	AE												
			Floor Sleeves and Covers	2.2.11	G	AE												
			SD-03 Product Data															
			Hardwood strip flooring	2.1	G	AE												
			Floor Sleeves and Covers	2.2.11	G	AE												
			SD-04 Samples															
			Strip flooring	2.2.1	G	AE												
			Molded-rubber base	2.2.2	G	AE												
			Pads	2.2.3	G	AE												
			Engineered Sleepers	2.2.5														
			SD-08 Manufacturer's Instructions															
			system	2.1														
			Adhesive	3.2.1														
			SD-10 Operation and Maintenance															
			Data															
			strip flooring	2.2.1	G	AO												
		09650	SD-02 Shop Drawings															
			Resilient Flooring and	2.10	G	AE												
			Accessories															
			SD-03 Product Data															
			Resilient Flooring and	2.10	G	AE												
			Accessories															
			Adhesives	2.6														
			SD-04 Samples															

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		09650	Resilient Flooring and	2.10	G	AE												
			Accessories															
			SD-06 Test Reports															
			Moisture, Alkalinity and Bond	3.3	G	AO												
			Tests															
			SD-08 Manufacturer's Instructions															
			Surface Preparation	3.2														
			Installation	3.1														
			SD-10 Operation and Maintenance															
			Data															
			Resilient Flooring and	2.10	G	AO												
			Accessories															
		09680	SD-02 Shop Drawings															
			Installation	3.4	G	AE												
			Molding	2.4	G	AE												
			SD-03 Product Data															
			Carpet	2.1	G	AE												
			Surface Preparation	3.1	G	AO												
			Installation	3.4	G	AO												
			Regulatory Requirements	1.3	G	AO												
			SD-04 Samples															
			Carpet	2.1	G	AE												
			Molding	2.4	G	AE												
			SD-06 Test Reports															
			Moisture and Alkalinity Tests	3.2	G	AO												
			SD-07 Certificates															

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		09680	Carpet	2.1														
			Regulatory Requirements	1.3														
			SD-10 Operation and Maintenance															
			Data															
			Carpet	2.1	G	AO												
			Cleaning and Protection	3.5	G	AO												
		09900	SD-02 Shop Drawings															
			Piping identification	3.10														
			stencil	3.10														
			SD-03 Product Data															
			Coating	2.1	G	AE												
			Manufacturer's Technical Data	2.1														
			Sheets															
			SD-04 Samples															
			Color	1.9	G	AE												
			SD-07 Certificates															
			Applicator's qualifications	1.3														
			Qualification Testing	1.4.1.2	G	AO												
			SD-08 Manufacturer’s Instructions															
			Application instructions	3.2.1														
			Mixing	3.6.2														
			Manufacturer's Material Safety	1.7.2														
			Data Sheets															
			SD-10 Operation and Maintenance															
			Data															
			Coatings:	2.1	G	RE												

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		09915	SD-04 Samples															
			Color Schedule	2.2	G	AE												
		10100A	SD-03 Product Data															
			Visual Display Boards	1.2	G	AE												
			SD-04 Samples															
			Aluminum	2.2.2	G	AE												
			Flexible Dry-Erase Surface	2.2.1														
			SD-07 Certificates															
			Visual Display Boards	1.2														
		10153	SD-02 Shop Drawings															
			Installation	3.1	G	AE												
			SD-03 Product Data															
			Toilet Partition System	1.3	G	AE												
			Shower Seats	2.3	G	AE												
			SD-04 Samples															
			Colors and Finishes	2.5	G	AE												
		10201N	SD-02 Shop Drawings															
			Wall louvers	2.2	G	AE												
			SD-03 Product Data															
			Wall Louvers	2.2	G	AE												
			SD-04 Samples															
			Wall louvers	2.2	G	AE												
		10260	SD-02 Shop Drawings															
			Corner Guards	2.2	G	AE												
			SD-03 Product Data															
			Corner Guards	2.2	G	AE												

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		10260	SD-04 Samples															
			Finish	2.3	G	AE												
		10270A	SD-02 Shop Drawings															
			Raised Floor System	2.4	G	AE												
			SD-03 Product Data															
			Raised Floor System	2.4	G	AE												
			SD-04 Samples															
			Raised Floor System	2.4	G	AE												
			SD-06 Test Reports															
			Tests	2.6														
			SD-07 Certificates															
			Raised Floor System	2.4														
		10430	SD-02 Shop Drawings															
			Approved Detail Drawings	3.1	G	AE												
			SD-03 Product Data															
			Dimensional Building Letters	2.1	G	AE												
			Installation	3.1	G	AE												
			SD-04 Samples															
			Dimensional Building Letters	2.1	G	AE												
			SD-10 Operation and Maintenance															
			Data															
			Protection and Cleaning	3.1.2	G	AO												
		10440	SD-02 Shop Drawings															
			Detail Drawings	3.1	G	AE												
			SD-03 Product Data															
			Installation	3.1	G	AE												

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		10440	SD-04 Samples															
			Interior Signage	1.3	G	AE												
			SD-10 Operation and Maintenance															
			Data															
			Approved Manufacturer's	3.1	G	AE												
			Instructions															
			Protection and Cleaning	3.1.2	G	AE												
		10505N	SD-02 Shop Drawings															
			Types	2.1	G	AE												
			Location	2.1	G	AE												
			Installation	3.1														
			Numbering system	3.2														
			SD-03 Product Data															
			Material	2.2														
			Finish	2.2.3														
			components	2.3														
			Assembly	3.1														
			SD-04 Samples															
			Color chips	1.5.1	G	AE												
		10510	SD-02 Shop Drawings															
			Types	2.1	G	AE												
			Location	2.1	G	AE												
			Numbering System	3.2														
			SD-03 Product Data															
			Material	2.2														
			Finish	2.2.5.1														

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		10510	Assembly and installation	3.1														
			SD-04 Samples															
			Finish Samples	1.5.2	G	AE												
		10650A	SD-02 Shop Drawings															
			Operable Partitions	2.2	G	AE												
			SD-03 Product Data															
			Operable Partitions	2.2	G	AE												
			SD-04 Samples															
			Operable Partitions	2.2	G	AE												
			SD-07 Certificates															
			Materials	2.1	G	AO												
			Operable Partitions	2.2	G	AO												
			SD-10 Operation and Maintenance															
			Data															
			Operable Partitions	2.2														
		10800	SD-03 Product Data															
			Finishes	2.1.2	G	AE												
			Accessory Items	2.2	G	AE												
			SD-04 Samples															
			Finishes	2.1.2	G	AE												
			Accessory Items	2.2	G	AO												
			SD-07 Certificates															
			Accessory Items	2.2														
			SD-10 Operation and Maintenance															
			Data															
			Electric Hand Dryer	2.2.11	G	AO												

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		10800	Electric Hair Dryer	2.2.12	G AO													
		11401N	SD-03 Product Data															
			Kitchen equipment	2.1														
			SD-08 Manufacturer's Instructions															
			Kitchen equipment	2.1														
			Exhaust hood															
			SD-10 Operation and Maintenance															
			Data															
			Kitchen equipment	2.1														
		11480	SD-02 Shop Drawings															
			Shop Drawings	3.2														
			SD-03 Product Data															
			Product Data	3.1														
			SD-10 Operation and Maintenance															
			Data															
			Operation and Maintenance	3.3														
		12490A	SD-02 Shop Drawings															
			Approved Detail Drawings	3.2	G AE													
			SD-03 Product Data															
			Window Treatments	2.1	G AE													
			Window Treatments	3.2	G AE													
			Hardware	1.3														
			SD-04 Samples															
			Window Treatments	2.1														
			Window Treatments	3.2														
		13080	SD-02 Shop Drawings															

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		13080	Bracing	3.1	G	AE												
			Equipment Requirements	1.4	G	AE												
			SD-03 Product Data															
			Bracing	3.1	G	AE												
			Equipment Requirements	1.4	G	AE												
		13110A	SD-02 Shop Drawings															
			Drawings	1.3.7	G	AE												
			Contractor's Modifications	1.3.2	G	AE												
			SD-03 Product Data															
			Equipment		G	AE												
			Spare Parts	3.8														
			SD-06 Test Reports															
			Tests and Measurements	3.4	G	AO												
			Contractor's Modifications	1.3.2	G	AO												
			SD-07 Certificates															
			Cathodic Protection System															
			Services of 'Corrosion Expert'	1.3.1														
			SD-10 Operation and Maintenance															
			Data															
			Cathodic Protection System		G	AO												
			Training Course	3.5	G	AO												
		13851A	SD-02 Shop Drawings															
			Fire Alarm Reporting System	1.4.1	G	AE												
			SD-03 Product Data															
			Storage Batteries	2.2	G	AE												
			Voltage Drop	1.4.4	G	AE												

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		13851A	Special Tools and Spare Parts	2.7.4	G	AO												
			Technical Data and Computer	1.5	G	AE												
			Software															
			Training	3.5	G	AO												
			Testing	3.4	G	AE												
			SD-06 Test Reports															
			Testing	3.4	G	AE												
			SD-07 Certificates															
			Equipment	1.4.1	G	AE												
			Qualifications	1.3.7	G	AE												
			SD-10 Operation and Maintenance															
			Data															
			Technical Data and Computer	1.5	G	AO												
			Software															
		13920A	SD-02 Shop Drawings															
			Installation Requirements	3.3	G	AO												
			As-Built Drawings	3.6.6														
			SD-03 Product Data															
			Fire Pump Installation Related	3.1														
			Submittals															
			Installation Requirements	3.3	G	AE												
			Spare Parts	1.3														
			Preliminary Test	3.6.1														
			Field Tests	3.6	G	AO												
			Fire Protection Specialist	1.8	G	AO												
			Manufacturer's Representative	1.9	G	AO												

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		13920A	Field Training	3.8	G AO													
			Final Acceptance Test	3.6.2														
			SD-06 Test Reports															
			Preliminary Test	3.6.1	G AO													
			Final Acceptance Test	3.6.2	G AO													
			SD-07 Certificates															
			Fire Protection Specialist	1.8	G AO													
			SD-10 Operation and Maintenance															
			Data															
			Fire Pumps	3.6.1														
		13930A	SD-02 Shop Drawings															
			Shop Drawings	1.12	G AE													
			As-Built Drawings	3.11														
			SD-03 Product Data															
			Fire Protection Related Submittals	3.1														
			Sway Bracing	3.4.1	G AE													
			Materials and Equipment	2.3	G AE													
			Hydraulic Calculations	1.7	G AE													
			Spare Parts	1.11														
			Preliminary Tests	3.10	G AO													
			Final Acceptance Test	3.11	G AO													
			On-site Training	3.12	G AO													
			Fire Protection Specialist	1.8	G AO													
			Sprinkler System Installer	1.9	G AO													
			SD-06 Test Reports															
			Preliminary Test Report	3.11	G AO													

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		13930A	Final Acceptance Test Report	3.11	G AO													
			SD-07 Certificates															
			Inspection by Fire Protection	3.3	G AO													
			Specialist															
			SD-10 Operation and Maintenance															
			Data															
			Operating and Maintenance	3.12														
			Instructions															
		15070A	SD-02 Shop Drawings															
			Coupling and Bracing	3.1	G AE													
			Equipment Requirements	1.3	G AE													
			Contractor Designed Bracing	1.2.4	G AE													
			SD-03 Product Data															
			Coupling and Bracing	3.1	G AE													
			Equipment Requirements	1.3	G AE													
			Contractor Designed Bracing	1.2.4	G AE													
		15080A	SD-02 Shop Drawings															
			Mica Plates	3.2.2.4	G AO													
			SD-03 Product Data															
			General Materials	2.1	G AE													
		15182	SD-02 Shop Drawings															
			Refrigerant Piping System	2.3	G AO													
			SD-03 Product Data															
			Refrigerant Piping System	2.3														
			Spare Parts	1.5.3														
			Refrigerant Piping Tests	3.3	G AO													

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		15182	Demonstrations	3.4	G	AO												
			Verification of Dimensions	1.5.1														
			SD-06 Test Reports															
			Refrigerant Piping Tests	3.3														
			SD-07 Certificates															
			Service Organization	2.1	G	AO												
			SD-10 Operation and Maintenance															
			Data															
			Maintenance	1.6	G	AO												
			Operation and Maintenance	3.4	G	AO												
			Manuals															
		15190A	SD-02 Shop Drawings															
			Gas Piping System	3.2	G	AO												
			SD-03 Product Data															
			Welding	1.3.1	G	AO												
			SD-06 Test Reports															
			Testing	3.16	G	AO												
			Pressure Tests	3.16.1	G	AO												
			Test With Gas	3.16.2	G	AO												
		15400A	SD-02 Shop Drawings															
			Plumbing System	3.7.1	G	AO												
			Electrical Work	1.4	G	AO												
			SD-03 Product Data															
			Welding	1.5.1														
			Plumbing Fixture Schedule	3.8	G	AE												
			Vibration-Absorbing Features	3.4	G	AO												

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		15400A	Plumbing System	3.7.1														
			SD-06 Test Reports															
			Tests, Flushing and Disinfection	3.7														
			Test of Backflow Prevention	3.7.1.1	G AO													
			Assemblies															
			SD-07 Certificates															
			Materials and Equipment	1.3														
			Bolts	2.1.1														
			SD-10 Operation and Maintenance															
			Data															
			Plumbing System	3.7.1	G AO													
		15556A	SD-02 Shop Drawings															
			Heating System	2.16	G AO													
			SD-03 Product Data															
			Equipment	2.1	G AE													
			Spare Parts	3.19														
			Welding	3.3														
			Framed Instructions	3.18														
			SD-06 Test Reports															
			Testing and Cleaning	3.15	G AO													
			Water Treatment Testing	3.15.4	G AO													
			SD-07 Certificates															
			Bolts	2.2.11														
			SD-10 Operation and Maintenance															
			Data															
			Heating System	2.16	G AO													

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		15700A	SD-02 Shop Drawings															
			Drawings	1.5.2	G AO													
			SD-03 Product Data															
			Unitary Equipment	2.6	G AE													
			Spare Parts Data	3.6														
			Posted Instructions	3.5														
			Verification of Dimensions	1.5.1														
			System Performance Tests	3.4														
			Demonstrations	3.5	G AO													
			SD-06 Test Reports															
			Refrigerant Tests, Charging, and	3.3	G AO													
			Start-Up															
			System Performance Tests	3.4	G AO													
			SD-07 Certificates															
			Unitary Equipment	2.6														
			Service Organization	2.1														
			SD-10 Operation and Maintenance															
			Data															
			Operation Manuals	3.5	G AO													
			Maintenance Manuals	3.5	G AO													
		15895	SD-02 Shop Drawings															
			Drawings	3.1.6	G AO													
			Installation	3.1	G AO													
			SD-03 Product Data															
			Components and Equipment	2.1	G AE													
			Test Procedures	3.3	G AO													

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		15895	Diagrams	3.1	G	AO												
			Manufacturer's Experience	2.1														
			Performance Tests	3.6	G	AO												
			Field Training	3.8	G	AO												
			SD-06 Test Reports															
			Performance Tests	3.6	G	AO												
			Testing, Adjusting, and Balancing	3.5	G	AO												
			SD-10 Operation and Maintenance															
			Data															
			Operating and Maintenance	3.8	G	AO												
			Instructions															
		15951A	SD-02 Shop Drawings															
			HVAC Control System	3.1.1	G	AE												
			SD-03 Product Data															
			Service Organizations	1.7.2	G	AO												
			Equipment Compliance Booklet	1.6	G	AO												
			Commissioning Procedures	3.4	G	AO												
			Performance Verification Test	1.6	G	AO												
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			Training	3.6	G	AO												
			SD-06 Test Reports															
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			Performance Verification Test	3.5.3	G	AO												
			SD-10 Operation and Maintenance															
			Data															
			Operation Manual	1.5	G	AO												

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CONTRACT NO.

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CONTRACTOR

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		15951A	Maintenance and Repair Manual	1.6	G	AO												
		15990A	SD-02 Shop Drawings															
			TAB Schematic Drawings and	3.3	G	AO												
			Report Forms															
			SD-03 Product Data															
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			TAB Procedures	3.5.1	G	AO												
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			Systems Readiness Check	3.5.2	G	AO												
			TAB Execution	3.5.1	G	AO												
			TAB Verification	3.5.4	G	AO												
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			Design Review Report	3.1	G	AO												
			Systems Readiness Check	3.5.2	G	AO												
			TAB Report	3.5.3	G	AO												
			TAB Verification Report	3.5.4	G	AO												
			SD-07 Certificates															
			Ductwork Leak Testing	3.4	G	AO												
			TAB Firm	1.5.1	G	AO												
			TAB Specialist	1.5.2	G	AO												
		15995A	SD-03 Product Data															
			Commissioning Team	3.1	G	AO												
			Tests	3.2	G	AO												
			Pre-Commissioning Checks	3.2.1	G	AO												
			SD-06 Test Reports															
			Test Reports	3.2	G	AO												

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		16070A	SD-02 Shop Drawings															
			Lighting Fixtures in Buildings	3.1	G	AO												
			SD-03 Product Data															
			Lighting Fixtures in Buildings	3.1	G	AO												
			Contractor Designed Bracing	1.3.3	G	AO												
		16120A	SD-03 Product Data															
			Installation Instructions	2.2	G	AO												
			SD-06 Test Reports															
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			Verifications															
		16261N	SD-02 Shop Drawings															
			Schematic diagrams	1.5.1	G	AE												
			Interconnecting diagrams	1.5.2	G	AE												
			Installation drawings	1.5.3	G	AE												
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		16261N	VFD Factory Test Plan	2.5.1	G	AO												
			Factory test results	1.5.6														
			SD-10 Operation and Maintenance															
			Data															
			Variable frequency drives	2.1														
		16375A	SD-02 Shop Drawings															
			Electrical Distribution System	3.11.3	G	AE												
			As-Built Drawings	3.2.1	G	AO												
			SD-03 Product Data															
			Fault Current Analysis	2.17.4	G	AE												
			Protective Device	2.17	G	AE												
			Coordination Study	2.17.5	G	AE												
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			Material and Equipment	2.1	G	AO												
			General Installation Requirements	3.1	G	AO												
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			Operating Tests	3.11.8	G	RE												
			Cable Installation	3.2.1.4	G	AO												
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			Material and Equipment	2.1	G	AO												
			Cable Joints	3.3	G	AO												
			Cable Installer Qualifications	3.2.1.5	G	AO												
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		16375A	Electrical Distribution System	3.11.3	G	AO												
		16415A	SD-02 Shop Drawings															
			Interior Electrical Equipment	3.1	G	AE												
			SD-03 Product Data															
			Fault Current and Protective	2.23.4.1	G	AE												
			Device Coordination Study															
			Manufacturer's Catalog	3.1	G	AE												
			Material, Equipment, and Fixture	3.1	G	AE												
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			Installation Procedures	3.1	G	AO												
			As-Built Drawings	1.2.6	G	AO												
			Onsite Tests	3.22.2	G	AO												
			SD-06 Test Reports															
			Factory Test Reports	3.1	G	AO												
			Field Test Plan	3.1	G	AO												
			Field Test Reports	3.20	G	AO												
			SD-07 Certificates															
			Materials and Equipment	1.4	G	AO												
		16710A	SD-02 Shop Drawings															
			Premises Distribution System	1.7	G	AE												
			Installation	3.1	G	AE												
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		16710A	Test Plan	3.6	G	AE												
			Qualifications	1.5	G	AE												
			SD-06 Test Reports															
			Test Reports	3.6	G	AE												
			SD-07 Certificates															
			Premises Distribution System	1.7	G	AE												
			Materials and Equipment	2.1	G	AE												
			Installers	1.5.1	G	AE												

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TRANSMITTAL OF SHOP DRAWINGS, EQUIPMENT DATA, MATERIAL SAMPLES, OR MANUFACTURER'S CERTIFICATES OF COMPLIANCE *(Read instructions on the reverse side prior to initiating this form)*	DATE	TRANSMITTAL NO.

SECTION I - REQUEST FOR APPROVAL OF THE FOLLOWING ITEMS *(This section will be initiated by the contractor)*

TO:	FROM:	CONTRACT NO.	CHECK ONE: ☐ THIS IS A NEW TRANSMITTAL ☐ THIS IS A RESUBMITTAL OF TRANSMITTAL _____
SPECIFICATION SEC. NO. *(Cover only one section with each transmittal)*	PROJECT TITLE AND LOCATION		CHECK ONE: THIS TRANSMITTAL IS FOR ☐ FIO ☐ GOV'T. APPROVAL

ITEM NO. *a.*	DESCRIPTION OF ITEM SUBMITTED *(Type size, model number/etc.)* *b.*	MFG OR CONTR. CAT., CURVE DRAWING OR BROCHURE NO. *(See instruction no. 8)* *c.*	NO. OF COPIES *d.*	CONTRACT REFERENCE DOCUMENT		FOR CONTRACTOR USE CODE *g.*	VARIATION *(See instruction No. 6)* *h.*	FOR CE USE CODE *i.*
				SPEC. PARA. NO. *e.*	DRAWING SHEET NO. *f.*			

REMARKS

I certify that the above submitted items have been reviewed in detail and are correct and in strict conformance with the contract drawings and specifications except as other wise stated.

_____

NAME AND SIGNATURE OF CONTRACTOR

SECTION II - APPROVAL ACTION

ENCLOSURES RETURNED *(List by Item No.)*	NAME, TITLE AND SIGNATURE OF APPROVING AUTHORITY	DATE

INSTRUCTIONS

1. Section I will be initiated by the Contractor in the required number of copies.

2. Each transmittal shall be numbered consecutively in the space provided for "Transmittal No.". This number, in addition to the contract number, will form a serial number for identifying each submittal. For new submittals or resubmittals mark the appropriate box; on resubmittals, insert transmittal number of last submission as well as the new submittal number.

3. The "Item No." will be the same "Item No." as indicated on ENG FORM 4288-R for each entry on this form.

4. Submittals requiring expeditious handling will be submitted on a separate form.

5. Separate transmittal form will be used for submittals under separate sections of the specifications.

6. A check shall be placed in the "Variation" column when a submittal is not in accordance with the plans and specifications--also, a written statement to that effect shall be included in the space provided for "Remarks".

7. Form is self-transmittal, letter of transmittal is not required.

8. When a sample of material or Manufacturer's Certificate of Compliance is transmitted, indicate "Sample" or "Certificate" in column c, Section I.

9. U.S. Army Corps of Engineers approving authority will assign action codes as indicated below in space provided in Section I, column i to each item submitted. In addition they will ensure enclosures are indicated and attached to the form prior to return to the contractor. The Contractor will assign action codes as indicated below in Section I, column g, to each item submitted.

THE FOLLOWING ACTION CODES ARE GIVEN TO ITEMS SUBMITTED

A	--	Approved as submitted.	E	--	Disapproved (See attached).
B	--	Approved, except as noted on drawings.	F	--	Receipt acknowledged.
C	--	Approved, except as noted on drawings. Refer to attached sheet resubmission required.	FX	--	Receipt acknowledged, does not comply as noted with contract requirements.
D	--	Will be returned by separate correspondence.	G	--	Other (*Specify)*

10. Approval of items does not relieve the contractor from complying with all the requirements of the contact plans and specifications.

(Reverse of ENG Form 4025-R)

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DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01400

SPECIAL SAFETY REQUIREMENTS

05/00 Rev 04/04

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-- End of Section Table of Contents --

SECTION 01400

SPECIAL SAFETY REQUIREMENTS
05/00 Rev 04/04

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1926	Safety and Health Regulations for Construction

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2003) Safety and Health Requirements Manual

1.2 SUMMARY

1.2.1 General

This section provides guidelines for preparation of accident prevention plans, and to implement the accident prevention clause (this specification) and EM 385-1-1, Safety and Health Requirements Manual. The U.S. Army Corps of Engineers Safety and Health Requirements Manual, EM 385-1-1 is available from U.S. Government bookstores operated by the Government Printing Office and a copy is included on the CD-ROM issued with this solicitation. Changes to EM 385-1-1 applicable to this contract include only those revisions posted at the following website (all revisions up to the time this solicitation is issued): http://www.hq.usace.army.mil/soh/hqusace_soh.htm ("Changes to EM"). U.S. Government bookstores are located in most major cities including Milwaukee, Chicago, Kansas City, Denver, and Pueblo, Colorado.

1.2.2 Description of Work

Work consists of demolition of large gym, and construction of a new multipurpose gymnasium; reconfigure and renovate the existing small gym, update finishes, and replace lighting in the current facility.

1.3 PRECONSTRUCTION CONFERENCE

See Contract Clause "PRECONSTRUCTION CONFERENCE". A preconstruction conference will be scheduled prior to beginning of site work. Requirements relative to planning and administration of the overall safety program will be discussed.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330SUBMITTAL PROCEDURES:

Administrative Submittals

Accident Prevention Plan;

The written site-specific Accident Prevention Plan.

SD-07 Certificates

Qualifications; G-AO.

A written report providing evidence of qualifications for personnel, facilities and equipment assigned to the work.

1.5 ACCIDENT PREVENTION PLAN

The Contractor shall submit, prior to the start of on site construction activity, a proposed accident prevention plan which shall be the accident prevention policy to be followed by all of the Contractor's and subcontractor's personnel and supervisory staff during performance of the work.

1.5.1 Requirements

The proposed plan shall be developed after a careful analysis of the work involved and shall be tailored specifically to the conditions of this project. The Contractor's accident prevention plan shall contain, as a minimum, the following general information or procedures for the activity indicated. The Contractor shall submit his plan for review and acceptance prior to commencing work.

1.5.1.1 Responsible Individual(s)

The Contractor shall designate an onsite employee as the individual responsible for insuring the accident prevention plan is implemented and enforced.

1.5.1.2 Subcontractor Supervision

Explain procedures to assure that subcontractor(s) fully comply with the accident prevention plan.

1.5.1.3 Indoctrination of New Employees

The plan shall include provisions for advising workers of the purpose of the accident prevention plan, specific hazards on the job and precautions to be taken, emergency procedures, information concerning tool box safety meetings, required protective equipment, cleanup rules and location of company safety rules (posting or handout).

1.5.1.4 Tool Box Safety Meetings

Hold weekly "Tool Box" safety meetings. Timely safety subjects shall be determined by a responsible individual. Employees will be informed of time, location, who will conduct, and subject. Identify procedures for including subcontractors. The Contractor shall provide a copy of the Weekly Tool Box Meeting and Monthly Supervisor's Safety Meeting to the Contracting Officer.

1.5.1.5 Fire Prevention and Protection

Identify source of fire protection. Insure adequate fire extinguishers, water barrels, or other fire-fighting equipment is located on site. Explain prevention activities to include storage areas and special hazards such as welding and use of flammable liquids, and other special hazards.

1.5.1.6 Housekeeping

Daily cleanup of all debris and waste materials is required. Adequate disposal containers should be placed strategically around the site. Debris shall be removed on a regular basis. Explain procedures that include use of barrels, dumpsters, trash chutes, etc.

1.5.1.7 Mechanical Equipment Inspection

All mechanical equipment (trucks, cranes, forklifts, backhoes, graders, etc.) shall be inspected prior to use and at fixed intervals throughout the life of the contract. Explain how inspections will be accomplished (frequency, by whom, and records to be kept).

1.5.1.8 First Aid and Medical Facilities

First aid facilities shall be made available on the job site. Arrangements for emergency medical attention shall be made prior to start of work. All emergency numbers (doctor, hospital, ambulance, fire department) shall be posted at the project superintendent's office.

1.5.1.9 Sanitation

Include provisions for toilet facilities, drinking water and washing facilities. A sufficient number of toilet facilities as specified in EM 385-1-1 shall be provided unless permission is granted to use existing facilities (portable chemical are authorized). Insure safe drinking water and individual cups are available. For the projects where corrosive or toxic materials are used, separate washing facilities are required.

1.5.1.10 Safety Promotions

The Contractor shall promote accident prevention. Identify method (posters, awards etc.).

1.5.1.11 Accident Reporting

All accidents (employee injuries, vehicle, building, or equipment damage etc.) regardless of their severity, shall be reported to the onsite government representative or to the area engineer, who in turn will advise the Contractor of forms to be submitted and timeframes.

1.5.1.12 Job Hazard Analysis

When job situations change and it is necessary to alter safety requirements, a Job Hazard Analysis will be accomplished, documented, and added as an addendum to the Accident Prevention Plan. Each Job Hazard Analysis shall include, but not be limited to, a description of the work, probable hazards related to that work and positive precautionary measures to be taken to reduce or eliminate each hazard. An example of changing situations may be new subcontractors performing work such as earth moving, trenching, concrete work, roofing, electrical, masonry etc. The onsite government representative will determine the format and amount of detail required of the written plan.

1.6 RADIOLOGICAL EQUIPMENT

In addition to any applicable Nuclear Regulatory Commission, state, local, or other federal licenses or permits, and in accordance with requirements of EM 385-1-1, Safety and Health Requirement Manual, the Contractor is required to obtain a service permit to use, store, operate, or handle a radiation producing machine or radioactive materials on a Department of Defense (DOD) Installation. The service permit shall be obtained from the appropriate U.S. Army or U.S. Air Force Command through the Contracting Officer's representative. The Contractor should notify the Contracting Officer during the prework conference if a radiation producing device will be utilized on a DOD Installation in order to determine the permit application requirements, and allow a lead time of 45 days for obtaining a permit.

1.7 AIRFIELD SAFETY PRECAUTIONS (DEC 1991)

1.7.1 Definitions

As used in this clause-

a. "Landing areas" means:

(1) The primary surfaces, comprising the surface of the runway, runway shoulders, and lateral safety zones. The length of each primary surface is the same as the runway length. The width of each primary surface is 2,000 feet (1,000 feet on each side of the runway centerline);

(2) The "clear zone" beyond the ends of each runway, i.e., the extension of the primary surface for a distance of 1,000 feet beyond each end of each runway.

(3) All taxiways, plus the lateral clearance zones along each side for the length of the taxiways (the outer edge of each lateral clearance zone is laterally 250 feet from the far or opposite edge of the taxiway, e.g., a 75-foot-wide taxiway would have a combined width of taxiway and lateral clearance zones of 425 feet); and

(4) All aircraft parking aprons, plus the area 125 feet in width extending beyond each edge all around the aprons.

b. "Safety precaution areas" means those portions of approach-departure clearance zones and transitional zones where placement of objects incident to contract performance might result in vertical projections at or above the approach-departure clearance, or the

transitional surface.

(1) The "approach-departure clearance surface" is an extension of the primary surface and the clear zone at each end of each runway, for a distance of 50,000 feet, first along an inclined (glide angle) and then along a horizontal plane, both flaring symmetrically about the runway centerline extended.

(a) The inclined plane (glide angle) begins in the clear zone 200 feet past the end of the runway (and primary surface) at the same elevation as the end of the runway. It continues upward at a slope of 50:1 (1 foot vertically for each 50 feet horizontally) to an elevation of 500 feet above the established airfield elevation. At that point the plane become horizontal, continuing at that same uniform elevation to a point 50,000 feet longitudinally from the beginning of the inclined plane (glide angle) and ending there.

(b) The width of the surface at the beginning of the inclined plane (glide angle) is the same as the width of the clear zone. It then flares uniformly, reaching the maximum width of 16,000 feet at the end.

(2) The "approach-departure clearance zone" is the ground area under the approach-departure clearance surface.

(3) The "transitional surface" is a sideways extension of all primary surfaces, clear zones, and approach-departure clearance surfaces along inclined planes.

(a) The inclined plane in each case begins at the edge of the surface.

(b) The slope of the incline plane is 7:1 (1 foot vertically for each 7 feet horizontally). It continues to the point of intersection with the-

(i) Inner horizontal surface (which is the horizontal plane 500 feet above the established airfield elevation); or

(ii) Outer horizontal surface (which is the horizontal plane 500 feet above the established airfield elevation), whichever is applicable.

(4) The "transitional zone" is the ground area under the transitional surface. (It adjoins the primary surface, clear zone, and approach-departure clearance zone.)

1.7.2 General

a. The Contractor shall comply with the requirements of this clause while-

(1) Operating all ground equipment (mobile or stationary);

(2) Placing all materials; and

(3) Performing all work, upon and around all airfields.

b. The requirements of this clause are in addition to any other safety requirements of this contract.

1.7.3 The Contractor shall

a. Report to the Contracting Officer before initiating any work;

b. Notify the Contracting Officer of proposed changes to locations and operations;

c. Not permit either its equipment or personnel to use any runway for purposes other than aircraft operation without permission of the Contracting Officer, unless the runway is-

(1) Closed by order of the Contracting Officer; and

(2) Marked as provided in paragraph 1.7.4 b. of this clause;

d. Keep all paved surfaces, such as runways, taxiways, and hardstands, clean at all times and, specifically, free from small stones which might damage aircraft propellers or jet aircraft;

e. Operate mobile equipment according to the safety provisions of this clause, while actually performing work on the airfield. At all other times, the Contractor shall remove all mobile equipment to locations-

(1) Approved by the Contracting Officer;

(2) At a distance of at least 750 feet from the runway centerline, plus any additional distance, and

(3) Necessary to ensure compliance with the other provisions of this clause; and

f. Not open a trench unless material is on hand and ready for placing in the trench. As soon as practicable after material has been placed and work approved, the Contractor shall backfill and compact trenches as required by the contract. Meanwhile, all hazardous conditions shall be marked and lighted in accordance with the other provisions of this clause.

1.7.4 Landing Areas

The Contractor shall:

a. Place nothing upon the landing areas without the authorization of the Contracting Officer;

b. Outline those landing areas hazardous to aircraft, using (unless otherwise authorized by the Contracting Officer) red flags by day, and electric, battery-operated low-intensity red flasher lights by night;

c. Obtain, at an airfield where flying is controlled, additional permission from the control tower operator every time before entering any land area, unless the landing area is marked as hazardous in accordance with paragraph 1.7.4 b. of this clause;

d. Identify all vehicles it operates in landing areas by means of a flag on a staff attached to, and flying above, the vehicle. The flag shall be three feet square, and consist of a checkered pattern of international orange and white squares of 1 foot on each side (except that the flag may vary up to ten percent from each of these dimensions);

e. Mark all other equipment and materials in the landing areas, using the same marking devices as in paragraph 1.7.4 b. of this clause; and

f. Perform work so as to leave that portion of the landing area which is available to aircraft free from hazards, holes, piles of material, and projecting shoulders that might damage an airplane tire.

1.7.5 Safety Precaution Areas

The Contractor shall:

a. Place nothing upon the safety precaution areas without authorization of the Contracting Officer.

b. Mark all equipment and materials in safety precaution areas, using (unless otherwise authorized by the Contracting Officer) red flags by day, and electric, battery-operated, low-intensity red flasher lights by night.

c. Provide all objects placed in safety precaution areas with a red light or red lantern at night, if the objects project above the approach-departure clearance surface or above the transitional surface. (DFAR 252.236-7005)

1.8 EXCAVATION AND TRENCHING

The standards for excavation and trenching are outlined in 29 CFR 1926, Subpart P. These standards shall be followed in addition to those outlined in EM 385-1-1.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

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SECTION 01420

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03/04

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SECTION 01420

SOURCES FOR REFERENCE PUBLICATIONS
03/04

PART 1 GENERAL

1.1 REFERENCES

Various publications are referenced in other sections of the specifications to establish requirements for the work. These references are identified in each section by document number, date and title. The document number used in the citation is the number assigned by the standards producing organization, (e.g. ASTM B 564 Nickel Alloy Forgings). However, when the standards producing organization has not assigned a number to a document, an identifying number has been assigned for reference purposes.

1.2 ORDERING INFORMATION

The addresses of the standards publishing organizations whose documents are referenced in other sections of these specifications are listed below, and if the source of the publications is different from the address of the sponsoring organization, that information is also provided. Documents listed in the specifications with numbers which were not assigned by the standards producing organization should be ordered from the source by title rather than by number.

ACI INTERNATIONAL (ACI)
P.O. Box 9094
Farmington Hills, MI 48333-9094
Ph: 248-848-3700
Fax: 248-848-3701
E-mail: bkstore@concrete.org
Internet: http://www.aci-int.org

AIR-CONDITIONING AND REFRIGERATION INSTITUTE (ARI)
4100 North Fairfax Drive, Suite 200
Arlington, VA 22203
Ph: 703-524-8800
Fax: 703-528-3816
E-mail: ari@ari.org
Internet: http://www.ari.org

AIR CONDITIONING CONTRACTORS OF AMERICA (ACCA)
2800 Shirlington Road, Suite 300
Arlington, VA 22206
Ph: 703-575-4477
Fax: 703-575-4449
E-mail: info@acca.org
Internet: http://www.acca.org

AIR DIFFUSION COUNCIL (ADC)
1000 East Woodfield Road, Suite 102
Shaumburg, IL 60173-5921

Ph: 847-706-6750
Fax: 847-706-6751
E-mail: info@flexibleduct.org
Internet: http://www.flexibleduct.org

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30 West University Drive
Arlington Heights, IL 60004-1893
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Fax: 847-253-0088
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Internet: http://www.amca.org

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1200 G Street, NW, Suite 500
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Fax: 202-393-5453
Internet: http://www.atis.org

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Internet: http://www.aluminum.org

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Internet: http://www.aamanet.org

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Fax: 202-624-5806
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Internet: http://www.aashto.org

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Internet: http://www.aatcc.org

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Irving, TX 75039-5423
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Internet: http://www.concrete-pipe.org

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American Wood Council
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Internet: http://www.aga.org

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Internet: http://www.agma.org

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c/o Composite Panel Association

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Internet: http://www.aitc-glulam.org

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Note --- ANSI documents beginning with the letter "S" can be ordered from:

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Internet: http://www.asnt.org

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Internet: http://www.asce.org

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Fax: 706-278-8835
Internet: http://www.carpet-rug.com

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Chattanooga, TN 37421
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St. Charles, IL 60174
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Internet: http://www.cisca.org

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Ph: 404-639-3311
Internet: http://www.cdc.gov

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Morrow, GA 30260
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Fax: 703-907-7501
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SECTION 01451A

CONTRACTOR QUALITY CONTROL
1/03; Omaha Revision 1/04

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D 3740	(2001) Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
ASTM E 329	(2002) Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction

1.2 PAYMENT

Separate payment will not be made for providing and maintaining an effective Quality Control program, and all costs associated therewith shall be included in the applicable unit prices or lump-sum prices contained in the Bidding Schedule.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330SUBMITTAL PROCEDURES:

Administrative Submittals

Contractor Quality Control Plan;

The written site-specific Contractor Quality Control Plan as specified herein.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

The Contractor is responsible for quality control and shall establish and maintain an effective quality control system in compliance with the Contract Clause titled "Inspection of Construction." The quality control system shall consist of plans, procedures, and organization necessary to produce an end product which complies with the contract requirements. The system shall cover all design-construction and construction operations, both onsite and offsite, and shall be keyed to the proposed construction sequence.

The site project superintendent will be held responsible for the quality of work on the job. The site project superintendent is subject to removal by the Contracting Officer for non-compliance with either the established quality control system or quality requirements specified in this contract. The site project superintendent in this context shall be the highest-level manager responsible for the overall construction activities at the site, including quality and production. The site project superintendent shall maintain a physical presence at the site at all times, except as otherwise acceptable to the Contracting Officer.

3.2 QUALITY CONTROL PLAN

The Contractor shall furnish for review by the Government, not later than 10 days after receipt of notice to proceed, the Contractor Quality Control (CQC) Plan proposed to implement the requirements of the Contract Clause titled "Inspection of Construction." The plan shall identify personnel, procedures, control, instructions, tests, records, and forms to be used. The Government will consider an interim plan for the first 30 days of operation. will be permitted to begin only after acceptance of the CQC Plan or acceptance of an interim plan applicable to the particular feature of work to be started. Work outside of the features of work included in an accepted interim plan will not be permitted to begin until acceptance of a CQC Plan or another interim plan containing the additional features of work to be started.

3.2.1 Content of the CQC Plan

The CQC Plan shall include, as a minimum, the following to cover all operations, both onsite and offsite, including work by :

a. A description of the quality control organization, including a chart showing lines of authority and acknowledgment that the CQC staff shall implement the three phase control system for all aspects of the work specified. The staff shall include a CQC System Manager who shall report to the Project Manager or someone higher in the Contractor's organization. Project Manager in this context shall mean the individual with responsibility for the overall management of the project, including quality and production.

b. The name, qualifications (in resume format), duties, responsibilities, and authorities of each person assigned a CQC

function.

c. A copy of the letter to the CQC System Manager signed by an authorized official of the firm which describes the responsibilities and delegates sufficient authorities to adequately perform the functions of the CQC System Manager, including authority to stop work which is not in compliance with the contract. The CQC System Manager shall issue letters of direction to all other various quality control representatives outlining duties, authorities, and responsibilities. Copies of these letters shall also be furnished to the Government.

d. Procedures for scheduling, reviewing, certifying, and managing submittals, including those of . These procedures shall be in accordance with Section 01330 SUBMITTAL PROCEDURES.

e. Control, verification, and acceptance testing procedures for each specific test to include the test name, specification paragraph requiring test, feature of work to be tested, test frequency, and person responsible for each test. (Laboratory facilities approved by the Contracting Officer shall be used.)

f. Procedures for tracking preparatory, initial, and follow-up control phases and control, verification, and acceptance tests including documentation.

g. Procedures for tracking deficiencies from identification through acceptable corrective action. These procedures shall establish verification that identified deficiencies have been corrected.

h. Reporting procedures, including proposed reporting formats.

i. A list of the definable features of work. A definable feature of work is a task which is separate and distinct from other tasks, has separate control requirements, and may be identified by different trades or disciplines, or it may be work by the same trade in a different environment. Although each section of the specifications may generally be considered as a definable feature of work, there are frequently more than one definable features under a particular section. This list will be agreed upon during the coordination meeting.

3.2.2 Acceptance of Plan

Acceptance of the Contractor's plan is required prior to the start of . Acceptance is conditional and will be predicated on satisfactory performance during the . The Government reserves the right to require the Contractor to make changes in his CQC Plan and operations including removal of personnel, as necessary, to obtain the quality specified.

3.2.3 Notification of Changes

After acceptance of the CQC Plan, the Contractor shall notify the Contracting Officer in writing of any proposed change. Proposed changes are subject to acceptance by the Contracting Officer.

3.3 COORDINATION MEETING

After the and prior to acceptance by the Government of the CQC Plan, the Contractor shall meet with the Contracting Officer or Authorized Representative and discuss the Contractor's quality control system. The CQC Plan shall be submitted for review a minimum of 10 calendar days prior to the Coordination Meeting. During the meeting, a mutual understanding of the system details shall be developed, including the forms for recording the CQC , control activities, testing, administration of the system for both onsite and offsite work, and the interrelationship of Contractor's Management and control with the Government's Quality Assurance. Minutes of the meeting shall be prepared by the Government and signed by both the Contractor and the Contracting Officer. The minutes shall become a part of the contract file. There may be occasions when subsequent conferences will be called by either party to reconfirm mutual understandings and/or address deficiencies in the CQC system or procedures which may require corrective action by the Contractor.

3.4 QUALITY CONTROL ORGANIZATION

3.4.1 Personnel Requirements

The requirements for the CQC organization are a and sufficient number of additional qualified personnel to ensure safety and contract compliance. Personnel identified in the technical provisions as requiring specialized skills to assure the required work is being performed properly will also be included as part of the CQC organization. The Contractor's CQC staff shall maintain a presence at the site at all times during progress of the work and have complete authority and responsibility to take any action necessary to ensure contract compliance. The CQC staff shall be subject to acceptance by the Contracting Officer. The Contractor shall provide adequate office space, filing systems and other resources as necessary to maintain an effective and fully functional CQC organization. Complete records of all letters, material submittals, shop drawing submittals, schedules and all other project documentation shall be promptly furnished to the CQC organization by the Contractor. The CQC organization shall be responsible to maintain these documents and records at the site at all times, except as otherwise acceptable to the Contracting Officer.

3.4.2 CQC System Manager

The Contractor shall identify as CQC System Manager an individual within the onsite work organization who shall be responsible for overall management of CQC and have the authority to act in all CQC matters for the Contractor. The CQC System Manager shall be a construction person with a minimum of 5 years in related work. This CQC System Manager shall be on the site at all times during construction and shall be employed by the prime Contractor. The CQC System Manager shall be assigned no other duties. An alternate for the CQC System Manager shall be identified in the plan to serve in the event of the System Manager's absence. The requirements for the alternate shall be the same as for the designated CQC System Manager.

3.4.3 CQC Personnel

A staff shall be maintained under the direction of the CQC system manager

to perform all QC activities. The staff must be of sufficient size to ensure adequate QC coverage of all work phases, work shifts, and work crews involved in the construction. These personnel may perform other duties, but must be fully qualified by experience and technical training to perform their assigned QC responsibilities and must be allowed sufficient time to carry out these responsibilities. The QC plan will clearly state the duties and responsibilities of each staff member. Other technical specifications may specify individuals for maintaining quality control for specific areas of work. These individuals shall be under the direction of the CQC System Manager.

3.4.4 Additional Requirement

In addition to the above experience and/or education requirements the CQC System Manager shall have completed the course entitled "Construction Quality Management For Contractors". This course is periodically offered at each of the four area offices in the Omaha District according to the following revolving training schedule:.

Badger Area	First Session	Between 15 & 25 April
	Second Session	Between 15 & 25 October
Point of Contact	Roy Brewer	(319) 753-1386
Black Hills Area	First Session	Between 1 & 10 March
	Second Session	Between 1 & 10 September
Point of Contact	Dwight Pochant	(605) 923-2983
Fort Crook Area	First Session	Between 15 & 25 January
	Second Session	Between 15 & 25 July
Point of Contact	Al Kreisler	(402) 293-2540
Rocky Mountain	First Session	Between 1 & 10 June
	Second Session	Between 1 & 10 December
Point of Contact	Paul Jendzejec	(719) 556-4184

The exact date and location for the sessions will be determined approximately 30 days in advance of the training. The cost of training is presently established at $50 to be paid by each student in advance of the training. For information about a particular session, the best source is the point of contact listed above.

3.4.5 Organizational Changes

The Contractor shall maintain the CQC staff at full strength at all times. When it is necessary to make changes to the CQC staff, the Contractor shall revise the CQC Plan to reflect the changes and submit the changes to the Contracting Officer for acceptance.

3.5 SUBMITTALS AND DELIVERABLES

Submittals, if needed, shall be made as specified in Section 01330 SUBMITTAL PROCEDURES. The CQC organization shall be responsible for certifying that all submittals and deliverables are in compliance with the contract requirements. When Section 15950A HEATING, VENTILATING AND AIR CONDITIONING (HVAC) CONTROL SYSTEMS; 15951A DIRECT DIGITAL CONTROL FOR HVAC; 15990A TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS; or 15995A COMMISSIONING OF HVAC SYSTEMS are included in the contract, the submittals

required by those sections shall be coordinated with Section 01330 SUBMITTAL PROCEDURES to ensure adequate time is allowed for each type of submittal required.

3.6 CONTROL

Contractor Quality Control is the means by which the Contractor ensures that the construction, to include that of subcontractors and suppliers, complies with the requirements of the contract. At least three phases of control shall be conducted by the CQC System Manager for each definable feature of the construction work as follows:

3.6.1 Preparatory Phase

This phase shall be performed prior to beginning work on each definable feature of work, after all required plans/documents/materials are approved/accepted, and after copies are at the work site. This phase shall include:

a. A review of each paragraph of applicable specifications, reference codes, and standards. Prior to the preparatory meeting for each definable feature of work, the Contractor shall provide all technical references (i.e. building codes, life safety codes, etc.) referenced in the project specifications for feature(s) of work being addressed at the preparatory meeting. These technical references shall be onsite and available for use by Contractor and Government personnel before the preparatory meeting is held and maintained until the feature(s) of work is/are accepted by the Government.

b. A review of the contract drawings.

c. A check to assure that all materials and/or equipment have been tested, submitted, and approved.

d. Review of provisions that have been made to provide required control inspection and testing.

e. Examination of the work area to assure that all required preliminary work has been completed and is in compliance with the contract.

f. A physical examination of required materials, equipment, and sample work to assure that they are on hand, conform to approved shop drawings or submitted data, and are properly stored.

g. A review of the appropriate activity hazard analysis to assure safety requirements are met.

h. Discussion of procedures for controlling quality of the work including repetitive deficiencies. Document construction tolerances and workmanship standards for that feature of work.

i. A check to ensure that the portion of the plan for the work to be performed has been accepted by the Contracting Officer.

j. Discussion of the initial control phase.

k. The Government shall be notified at least 48 hours in advance of

beginning the preparatory control phase. This phase shall include a meeting conducted by the CQC System Manager and attended by the superintendent, other CQC personnel (as applicable), and the foreman responsible for the definable feature. The results of the preparatory phase actions shall be documented by separate minutes prepared by the CQC System Manager and attached to the daily CQC report. The Contractor shall instruct applicable workers as to the acceptable level of workmanship required in order to meet contract specifications.

3.6.2 Initial Phase

This phase shall be accomplished at the beginning of a definable feature of work. The following shall be accomplished:

a. A check of work to ensure that it is in full compliance with contract requirements. Review minutes of the preparatory meeting.

b. Verify adequacy of controls to ensure full contract compliance. Verify required control inspection and testing.

c. Establish level of workmanship and verify that it meets minimum acceptable workmanship standards. Compare with required sample panels as appropriate.

d. Resolve all differences.

e. Check safety to include compliance with and upgrading of the safety plan and activity hazard analysis. Review the activity analysis with each worker.

f. The Government shall be notified at least 48 hours in advance of beginning the initial phase. Separate minutes of this phase shall be prepared by the CQC System Manager and attached to the daily CQC report. Exact location of initial phase shall be indicated for future reference and comparison with follow-up phases.

g. The initial phase should be repeated for each new crew to work onsite, or any time acceptable specified quality standards are not being met.

3.6.3 Follow-up Phase

Daily checks shall be performed to assure control activities, including control testing, are providing continued compliance with contract requirements, until completion of the particular feature of work. The checks shall be made a matter of record in the CQC documentation. Final follow-up checks shall be conducted and all deficiencies corrected prior to the start of additional features of work which may be affected by the deficient work. The Contractor shall not build upon nor conceal non-conforming work.

3.6.4 Additional Preparatory and Initial Phases

Additional preparatory and initial phases shall be conducted on the same definable features of work if: the quality of on-going work is unacceptable; if there are changes in the applicable CQC staff, onsite production supervision or work crew; if work on a definable feature is resumed after a substantial period of inactivity; or if other problems

develop.

3.7 TESTS

3.7.1 Testing Procedure

The Contractor shall perform specified or required tests to verify that control measures are adequate to provide a product which conforms to contract requirements. Upon request, the Contractor shall furnish to the Government duplicate samples of test specimens for possible testing by the Government. Testing includes operation and/or acceptance tests when specified. The Contractor shall procure the services of a Corps of Engineers approved testing laboratory or establish an approved testing laboratory at the project site. The Contractor shall perform the following activities and record and provide the following data:

a. Verify that testing procedures comply with contract requirements.

b. Verify that facilities and testing equipment are available and comply with testing standards.

c. Check test instrument calibration data against certified standards.

d. Verify that recording forms and test identification control number system, including all of the test documentation requirements, have been prepared.

e. Results of all tests taken, both passing and failing tests, shall be recorded on the CQC report for the date taken. Specification paragraph reference, location where tests were taken, and the sequential control number identifying the test shall be given. If approved by the Contracting Officer, actual test reports may be submitted later with a reference to the test number and date taken. An information copy of tests performed by an offsite or commercial test facility shall be provided directly to the Contracting Officer. Failure to submit timely test reports as stated may result in nonpayment for related work performed and disapproval of the test facility for this contract.

3.7.2 Testing Laboratories

3.7.2.1 Capability Check

The Government reserves the right to check laboratory equipment in the proposed laboratory for compliance with the standards set forth in the contract specifications and to check the laboratory technician's testing procedures and techniques. Laboratories utilized for testing soils, concrete, asphalt, and steel shall meet criteria detailed in ASTM D 3740 and ASTM E 329.

3.7.2.2 Capability Recheck

If the selected laboratory fails the capability check, the Contractor will be assessed the actual cost for the recheck to reimburse the Government for each succeeding recheck of the laboratory or the checking of a subsequently selected laboratory. Such costs will be deducted from the contract amount due the Contractor.

3.7.3 Onsite Laboratory

The Government reserves the right to utilize the Contractor's control testing laboratory and equipment to make assurance tests, and to check the Contractor's testing procedures, techniques, and test results at no additional cost to the Government.

3.7.4 Furnishing or Transportation of Samples for Testing

Costs incidental to the transportation of samples or materials shall be borne by the Contractor. Samples of materials for test verification and acceptance testing by the Government shall be delivered to the Resident or Area (as directed) Office.

Coordination for each specific test, exact delivery location, and dates will be made through the Resident or Area (as directed) Office.

3.8 COMPLETION INSPECTION

3.8.1 Punch-Out Inspection

Near the end of the work, or any increment of the work established by a time stated in the SPECIAL CONTRACT REQUIREMENTS Clause, "Commencement, Prosecution, and Completion of Work", or by the specifications, the CQC Manager shall conduct an inspection of the work. A punch list of items which do not conform to the approved drawings and specifications shall be prepared and included in the CQC documentation, as required by paragraph DOCUMENTATION. The list of deficiencies shall include the estimated date by which the deficiencies will be corrected. The CQC System Manager or staff shall make a second inspection to ascertain that all deficiencies have been corrected. Once this is accomplished, the Contractor shall notify the Government that the facility is ready for the Government Pre-Final inspection.

3.8.2 Pre-Final Inspection

The Government will perform the pre-final inspection to verify that the facility is complete and ready to be occupied. A Government Pre-Final Punch List may be developed as a result of this inspection. The Contractor's CQC System Manager shall ensure that all items on this list have been corrected before notifying the Government, so that a Final inspection with the customer can be scheduled. Any items noted on the Pre-Final inspection shall be corrected in a timely manner. These inspections and any deficiency corrections required by this paragraph shall be accomplished within the time slated for completion of the entire work or any particular increment of the work if the project is divided into increments by separate completion dates.

3.8.3 Final Acceptance Inspection

The Contractor's Quality Control Inspection personnel, plus the superintendent or other primary management person, and the Contracting Officer's Representative shall be in attendance at the final acceptance inspection. Additional Government personnel including, but not limited to, those from Base/Post Civil Facility Engineer user groups, and major commands may also be in attendance. The final acceptance inspection will be formally scheduled by the Contracting Officer based upon results of the Pre-Final inspection. Notice shall be given to the Contracting Officer at least 14 days prior to the final acceptance inspection and shall include

the Contractor's assurance that all specific items previously identified to the Contractor as being unacceptable, along with all remaining work performed under the contract, will be complete and acceptable by the date scheduled for the final acceptance inspection. Failure of the Contractor to have all contract work acceptably complete for this inspection will be cause for the Contracting Officer to bill the Contractor for the Government's additional inspection cost in accordance with the contract clause titled "Inspection of Construction".

3.9 DOCUMENTATION

The Contractor shall maintain current records providing factual evidence that required quality control activities and/or tests have been performed. These records shall include the work of subcontractors and suppliers and shall be on an acceptable form that includes, as a minimum, the following information:

a. Contractor/subcontractor and their area of responsibility.

b. Operating plant/equipment with hours worked, idle, or down for repair.

c. Work performed each day, giving location, description, and by whom. When Network Analysis (NAS) is used, identify each phase of work performed each day by NAS activity number.

d. Test and/or control activities performed with results and references to specifications/drawings requirements. The control phase shall be identified (Preparatory, Initial, Follow-up). List of deficiencies noted, along with corrective action.

e. Quantity of materials received at the site with statement as to acceptability, storage, and reference to specifications/drawings requirements.

f. Submittals and deliverables reviewed, with contract reference, by whom, and action taken.

g. Offsite surveillance activities, including actions taken.

h. Job safety evaluations stating what was checked, results, and instructions or corrective actions. Include information identified by the "Responsible Individual(s)" for Safety as outlined in SECTION 01400, SPECIAL SAFETY REQUIREMENTS.

i. Instructions given/received and conflicts in plans and/or specifications.

j. Contractor's verification statement.

These records shall indicate a description of trades working on the project; the number of personnel working; weather conditions encountered; and any delays encountered. These records shall cover both conforming and deficient features and shall include a statement that equipment and materials incorporated in the work and workmanship comply with the contract. The original and one copy of these records in report form shall be furnished to the Contracting Officer's Representative on the first day following the date(s) covered by the report, except that reports need not be submitted for days on which no work is performed. As a minimum, one

report shall be prepared and submitted for every 7 days of no work and on the last day of a no work period. All calendar days shall be accounted for throughout the life of the contract. The first report following a day of no work shall be for that day only. Reports shall be signed and dated by the CQC System Manager. The report from the CQC System Manager shall include copies of test reports and copies of reports prepared by all subordinate quality control personnel.

3.10 SAMPLE FORMS

Sample forms enclosed at the end of this section.

3.11 NOTIFICATION OF NONCOMPLIANCE

The Contracting Officer will notify the Contractor of any detected noncompliance with the foregoing requirements. The Contractor shall take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the work site, shall be deemed sufficient for the purpose of notification. If the Contractor fails or refuses to comply promptly, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to such stop orders shall be made the subject of claim for extension of time or for excess costs or damages by the Contractor.

_____
(FIRM NAME)

DAILY QUALITY CONTROL REPORT

Daily Report No.: _____ DATE: _____
Contract No. _____
Project Title & Location:
_____
Weather: ____ Precipitation: _____ in. _____ Temp:____ Min. ____ Max. ____

1. Contract/Subcontractors and Area of Responsibility:

NUMBER:	TRADE	HOURS	EMPLOYER	LOCATION/DESCRIPTION WORK

2. Operating Plant or Equipment. (Not hand tools)

Plant/Equipment	Date of Arrival/Departure	Date of Safety Check	Hours Used	Hours Idle	Hours Repair

3. Work Performed Today: (Indicate location and description of work performed by prime and/or subcontractors. When network analysis is used, identify work by NAS activity number).

4. Control Activities Performed:
   Preparatory Inspections: (Identify feature of work and attach minutes).
   Initial Inspections: (Identify feature of work and attach minutes).
   Follow-Up Inspections: (List inspections performed, results of inspection compared to specification requirements, and corrective actions taken when deficiencies are noted).

5. Tests Performed and Test Results: (Identify test requirement by paragraph number in specifications and/or sheet number in plans).

6. Material Received: (Note inspection results and storage provided).

7. Submittals Reviewed:

(a) Submittal No.	(b) Spec/Plan Reference	(c) By Whom	(d) Action

8. Offsite Surveillance Activities, Including Action Taken:

_____
_____
_____
_____
_____
_____
_____
_____

9. Job Safety: (List items checked, results, instructions and corrective actions taken).

_____
_____
_____
_____
_____
_____
_____
_____
_____

10. Remarks: (Instructions received or given. Conflict(s) in Plans and/or specifications. Delays encountered.).

_____
_____
_____
_____
_____
_____
_____

Contractor's Verification: On behalf of the Contractor, I certify this report is complete and correct, and all materials and equipment used and work performed during this reporting period are in compliance with the contract plans and specifications, to the best of my knowledge, except as may be noted above.

_____
CQC System Manager Date

-- End of Section --

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SECTION 01670

RECYCLED / RECOVERED MATERIALS

12/01

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SECTION 01670

RECYCLED / RECOVERED MATERIALS

12/01

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 247	Comprehensive Procurement Guideline for Products Containing Recovered Materials

1.2 OBJECTIVES

Government procurement policy is to acquire, in a cost effective manner, items containing the highest percentage of recycled and recovered materials practicable consistent with maintaining a satisfactory level of competition without adversely affecting performance requirements or exposing suppliers' employees to undue hazards from the recovered materials. The Environmental Protection Agency (EPA) has designated certain items which must contain a specified percent range of recovered or recycled materials. EPA designated products specified in this contract comply with the stated policy and with the EPA guidelines. The Contractor shall make all reasonable efforts to use recycled and recovered materials in providing the EPA designated products and in otherwise utilizing recycled and recovered materials in the execution of the work.

1.3 EPA DESIGNATED ITEMS INCORPORATED IN THE WORK

Various sections of the specifications contain requirements for materials that have been designated by EPA as being products which are or can be made with recovered or recycled materials. These items, when incorporated into the work under this contract, shall contain at least the specified percentage of recycled or recovered materials unless adequate justification (non-availability) for non-use is provided. When a designated item is specified as an option to a non-designated item, the designated item requirements apply only if the designated item is used in the work.

1.4 EPA PROPOSED ITEMS INCORPORATED IN THE WORK

Products other than those designated by EPA are still being researched and are being considered for future Comprehensive Procurement Guideline (CPG) designation. It is recommended that these items, when incorporated in the work under this contract, contain the highest practicable percentage of recycled or recovered materials, provided specified requirements are also met.

1.5 EPA LISTED ITEMS USED IN CONDUCT OF THE WORK BUT NOT INCORPORATED IN THE WORK

There are many products listed in 40 CFR 247 which have been designated or proposed by EPA to include recycled or recovered materials that may be used by the Contractor in performing the work but will not be incorporated into the work. These products include office products, temporary traffic control products, and pallets. It is recommended that these non-construction products, when used in the conduct of the work, contain the highest practicable percentage of recycled or recovered materials and that these products be recycled when no longer needed.

-- End of Section --

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DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01781

OPERATION AND MAINTENANCE DATA

12/01

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SECTION 01781

OPERATION AND MAINTENANCE DATA
12/01

PART 1 GENERAL

1.1 SUBMISSION OF OPERATION AND MAINTENANCE DATA

Submit Operation and Maintenance (O&M) Data specifically applicable to this contract and a complete and concise depiction of the provided equipment, product, or system. Organize and present information in sufficient detail to clearly explain O&M requirements at the system, equipment, component, and subassembly level. Include an index preceding each submittal. Submit in accordance with this section and Section 01330 SUBMITTAL PROCEDURES.

1.1.1 Package Quality

Documents must be fully legible. Poor quality copies and material with hole punches obliterating the text or drawings will not be accepted.

1.1.2 Package Content

Data package content shall be as shown in the paragraph titled "Schedule of Operation and Maintenance Data Packages." Comply with the data package requirements specified in the individual technical sections, including the content of the packages and addressing each product, component, and system designated for data package submission.

1.1.3 Changes to Submittals

Manufacturer-originated changes or revisions to submitted data shall be furnished by the Contractor if a component of an item is so affected subsequent to acceptance of the O&M Data. Changes, additions, or revisions required by the Contracting Officer for final acceptance of submitted data, shall be submitted by the Contractor within 30 calendar days of the notification of this change requirement.

1.2 TYPES OF INFORMATION REQUIRED IN O&M DATA PACKAGES

1.2.1 Operating Instructions

Include specific instructions, procedures, and illustrations for the following phases of operation:

1.2.1.1 Safety Precautions

List personnel hazards and equipment or product safety precautions for all operating conditions.

1.2.1.2 Operator Prestart

Include procedures required to set up and prepare each system for use.

1.2.1.3 Startup, Shutdown, and Post-Shutdown Procedures

Provide narrative description for Startup, Shutdown and Post-shutdown operating procedures including the control sequence for each procedure.

1.2.1.4 Normal Operations

Provide narrative description of Normal Operating Procedures. Include Control Diagrams with data to explain operation and control of systems and specific equipment.

1.2.1.5 Emergency Operations

Include Emergency Procedures for equipment malfunctions to permit a short period of continued operation or to shut down the equipment to prevent further damage to systems and equipment. Include Emergency Shutdown Instructions for fire, explosion, spills, or other foreseeable contingencies. Provide guidance and procedures for emergency operation of all utility systems including required valve positions, valve locations and zones or portions of systems controlled.

1.2.1.6 Operator Service Requirements

Include instructions for services to be performed by the operator such as lubrication, adjustment, inspection, and recording gage readings.

1.2.1.7 Environmental Conditions

Include a list of Environmental Conditions (temperature, humidity, and other relevant data) that are best suited for the operation of each product, component or system. Describe conditions under which the item equipment should not be allowed to run.

1.2.2 Preventive Maintenance

Include the following information for preventive and scheduled maintenance to minimize corrective maintenance and repair.

1.2.2.1 Lubrication Data

Include preventative maintenance lubrication data, in addition to instructions for lubrication provided under paragraph titled "Operator Service Requirements":

a. A table showing recommended lubricants for specific temperature ranges and applications.

b. Charts with a schematic diagram of the equipment showing lubrication points, recommended types and grades of lubricants, and capacities.

c. A Lubrication Schedule showing service interval frequency.

1.2.2.2 Preventive Maintenance Plan and Schedule

Include manufacturer's schedule for routine preventive maintenance, inspections, tests and adjustments required to ensure proper and economical operation and to minimize corrective maintenance. Provide manufacturer's projection of preventive maintenance work-hours on a daily, weekly,

monthly, and annual basis including craft requirements by type of craft. For periodic calibrations, provide manufacturer's specified frequency and procedures for each separate operation.

1.2.3 Corrective Maintenance (Repair)

Include manufacturer's recommended procedures and instructions for correcting problems and making repairs.

1.2.3.1 Troubleshooting Guides and Diagnostic Techniques

Include step-by-step procedures to promptly isolate the cause of typical malfunctions. Describe clearly why the checkout is performed and what conditions are to be sought. Identify tests or inspections and test equipment required to determine whether parts and equipment may be reused or require replacement.

1.2.3.2 Wiring Diagrams and Control Diagrams

Wiring diagrams and control diagrams shall be point-to-point drawings of wiring and control circuits including factory-field interfaces. Provide a complete and accurate depiction of the actual job specific wiring and control work. On diagrams, number electrical and electronic wiring and pneumatic control tubing and the terminals for each type, identically to actual installation configuration and numbering.

1.2.3.3 Maintenance and Repair Procedures

Include instructions and alist of tools required to repair or restore the product or equipment to proper condition or operating standards.

1.2.3.4 Removal and Replacement Instructions

Include step-by-step procedures and a list required tools and supplies for removal, replacement, disassembly, and assembly of components, assemblies, subassemblies, accessories, and attachments. Provide tolerances, dimensions, settings and adjustments required. Instructions shall include a combination of text and illustrations.

1.2.3.5 Spare Parts and Supply Lists

Include lists of spare parts and supplies required for maintenance and repair to ensure continued service or operation without unreasonable delays. Special consideration is required for facilities at remote locations. List spare parts and supplies that have a long lead-time to obtain.

1.2.4 Corrective Maintenance Work-Hours

Include manufacturer's projection of corrective maintenance work-hours including requirements by type of craft. Corrective maintenance that requires completion or participation of the equipment manufacturer shall be identified and tabulated separately.

1.2.5 Appendices

Provide information required below and information not specified in the preceding paragraphs but pertinent to the maintenance or operation of the product or equipment. Include the following:

1.2.6 Parts Identification

Provide identification and coverage for all parts of each component, assembly, subassembly, and accessory of the end items subject to replacement. Include special hardware requirements, such as requirement to use high-strength bolts and nuts. Identify parts by make, model, serial number, and source of supply to allow reordering without further identification. Provide clear and legible illustrations, drawings, and exploded views to enable easy identification of the items. When illustrations omit the part numbers and description, both the illustrations and separate listing shall show the index, reference, or key number that will cross-reference the illustrated part to the listed part. Parts shown in the listings shall be grouped by components, assemblies, and subassemblies in accordance with the manufacturer's standard practice. Parts data may cover more than one model or series of equipment, components, assemblies, subassemblies, attachments, or accessories, such as typically shown in a master parts catalog

1.2.6.1 Warranty Information

List and explain the various warranties and include the servicing and technical precautions prescribed by the manufacturers or contract documents in order to keep warranties in force. Include warranty information for primary components such as the compressor of air conditioning system.

1.2.6.2 Personnel Training Requirements

Provide information available from the manufacturers that is needed for use in training designated personnel to properly operate and maintain the equipment and systems.

1.2.6.3 Testing Equipment and Special Tool Information

Include information on test equipment required to perform specified tests and on special tools needed for the operation, maintenance, and repair of components.

1.2.6.4 Contractor Information

Provide a list that includes the name, address, and telephone number of the General Contractor and each Subcontractor who installed the product or equipment, or system. For each item, also provide the name address and telephone number of the manufacturer's representative and service organization most convenient to the project site. Provide the name, address, and telephone number of the product, equipment, and system manufacturers.

1.3 SCHEDULE OF OPERATION AND MAINTENANCE DATA PACKAGES

Furnish the O&M data packages specified in individual technical sections. The required information for each O&M data package is as follows:

1.3.1 Data Package 1

a. Safety precautions

b. Maintenance and repair procedures

c. Warranty information

d. Contractor information

e. Spare parts and supply list

1.3.2 Data Package 2

a. Safety precautions

b. Normal operations

c. Environmental conditions

d. Lubrication data

e. Preventive maintenance plan and schedule

f. Maintenance and repair procedures

g. Removal and replacement instructions

h. Spare parts and supply list

i. Parts identification

j. Warranty information

k. Contractor information

1.3.3 Data Package 3

a. Safety precautions

b. Normal operations

c. Emergency operations

d. Environmental conditions

e. Lubrication data

f. Preventive maintenance plan and schedule

g. Troubleshooting guides and diagnostic techniques

h. Wiring diagrams and control diagrams

i. Maintenance and repair procedures

j. Removal and replacement instructions

k. Spare parts and supply list

l. Parts identification

m. Warranty information

n. Testing equipment and special tool information

o. Contractor information

1.3.4 Data Package 4

a. Safety precautions

b. Operator prestart

c. Startup, shutdown, and post-shutdown procedures

d. Normal operations

e. Emergency operations

f. Operator service requirements

g. Environmental conditions

h. Lubrication data

i. Preventive maintenance plan and schedule

j. Troubleshooting guides and diagnostic techniques

k. Wiring diagrams and control diagrams

l. Maintenance and repair procedures

m. Removal and replacement instructions

n. Spare parts and supply list

o. Corrective maintenance man-hours

p. Parts identification

q. Warranty information

r. Personnel training requirements

s. Testing equipment and special tool information

t. Contractor information

1.3.5 Data Package 5

a. Safety precautions

b. Operator prestart

c. Start-up, shutdown, and post-shutdown procedures

d. Normal operations

e. Environmental conditions

f. Preventive maintenance plan and schedule

g. Troubleshooting guides and diagnostic techniques

h. Wiring and control diagrams

i. Maintenance and repair procedures

j. Spare parts and supply list

k. Testing equipments and special tools

l. Warranty information

m. Contractor information

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

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SECTION 02220

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09/03

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SECTION 02220

DEMOLITION
09/03

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A10.6	(1990; R 1998) Safety Requirements for Demolition Operations

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(1996) Safety and Health Requirements Manual

1.2 GENERAL REQUIREMENTS

Do not begin demolition until authorization is received from the Contracting Officer. The work includes demolition, salvage of identified items and materials, and removal of resulting rubbish and debris. Rubbish and debris shall be removed from Government property daily, unless otherwise directed, to avoid accumulation at the demolition site. Materials that cannot be removed daily shall be stored in areas specified by the Contracting Officer. In the interest of occupational safety and health, the work shall be performed in accordance with EM 385-1-1, Section 23, Demolition, and other applicable Sections. In the interest of conservation, salvage shall be pursued to the maximum extent possible (in accordance with Section 01572 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT, if applicable; salvaged items and materials shall be disposed of as specified.

1.3 REGULATORY AND SAFETY REQUIREMENTS

Comply with federal, state, and local hauling and disposal regulations. In addition to the requirements of the "Contract Clauses," safety requirements shall conform with ANSI A10.6.

1.4 DUST AND DEBRIS CONTROL

Prevent the spread of dust and debris and avoid the creation of a nuisance or hazard in the surrounding area. Do not use water if it results in hazardous or objectionable conditions such as, but not limited to, ice, flooding, or pollution.

1.5 PROTECTION

1.5.1 Traffic Control Signs

Where pedestrian and driver safety is endangered in the area of removal work, use traffic barricades with flashing lights. Notify the Contracting Officer prior to beginning such work.

1.5.2 Existing Work

Before beginning any demolition work, the Contractor shall survey the site and examine the drawings and specifications to determine the extent of the work. The Contractor shall take necessary precautions to avoid damage to existing items to remain in place, to be reused, or to remain the property of the Government; any damaged items shall be repaired or replaced as approved by the Contracting Officer. The Contractor shall coordinate the work of this section with all other work and shall construct and maintain shoring, bracing, and supports as required. The Contractor shall ensure that structural elements are not overloaded and shall be responsible for increasing structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under this contract. Do not overload structural elements or pavements to remain. Provide new supports and reinforcement for existing construction weakened by demolition or removal work. Repairs, reinforcement, or structural replacement must have Contracting Officer approval.

1.5.3 Weather Protection

For portions of the building to remain, protect building interior and materials and equipment from the weather at all times. Where removal of existing roofing is necessary to accomplish work, have materials and workmen ready to provide adequate and temporary covering of exposed areas so as to ensure effectiveness and to prevent displacement.

1.5.4 Trees

Trees within the project site which might be damaged during demolition, and which are indicated to be left in place, shall be protected by a 6 foot high fence. The fence shall be securely erected a minimum of 5 feet from the trunk of individual trees or follow the outer perimeter of branches or clumps of trees. Any tree designated to remain that is damaged during the work under this contract shall be replaced in kind or as approved by the Contracting Officer.

1.5.5 Facilities

Protect electrical and mechanical services and utilities. Where removal of existing utilities and pavement is specified or indicated, provide approved barricades, temporary covering of exposed areas, and temporary services or connections for electrical and mechanical utilities. Floors, roofs, walls, columns, pilasters, and other structural components that are designed and constructed to stand without lateral support or shoring, and are determined to be in stable condition, shall remain standing without additional bracing, shoring, of lateral support until demolished, unless directed otherwise by the Contracting Officer. The Contractor shall ensure that no elements determined to be unstable are left unsupported and shall be responsible for placing and securing bracing, shoring, or lateral supports as may be required as a result of any cutting, removal, or demolition work performed under this contract.

1.5.6 Protection of Personnel

During the demolition work the Contractor shall continuously evaluate the condition of the structure being demolished and take immediate action to protect all personnel working in and around the demolition site. No area, section, or component of floors, roofs, walls, columns, pilasters, or other structural element will be allowed to be left standing without sufficient bracing, shoring, or lateral support to prevent collapse or failure while workmen remove debris or perform other work in the immediate area.

1.6 BURNING

The use of burning at the project site for the disposal of refuse and debris will not be permitted.

1.7 RELOCATIONS

Perform the removal and reinstallation of relocated items as indicated with workmen skilled in the trades involved. Repair items to be relocated which are damaged or replace damaged items with new undamaged items as approved by the Contracting Officer.

1.8 USE OF EXPLOSIVES

Use of explosives will not be permitted.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 EXISTING FACILITIES TO BE REMOVED

3.1.1 Structures

Existing structures indicated shall be removed as indicated on plans. Interior walls, other than retaining walls and partitions, shall be removed to top of concrete slab on ground. Sidewalks, curbs, gutters and street light bases shall be removed as indicated.

3.1.2 Utilities and Related Equipment

Remove existing utilities, as indicated and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by the Contracting Officer. When utility lines are encountered that are not indicated on the drawings, the Contracting Officer shall be notified prior to further work in that area. Remove meters and related equipment and deliver to a location in accordance with instructions of the Contracting Officer. If utility lines are encountered that are not shown on drawings, contact the Contracting Officer for further instructions.

3.1.3 Paving and Slabs

Remove concrete and asphaltic concrete paving and slabs including aggregate base. Provide neat sawcuts at limits of pavement removal as indicated.

3.1.4 Masonry

Sawcut and remove masonry so as to prevent damage to surfaces to remain and to facilitate the installation of new work. Where new masonry adjoins existing, the new work shall abut or tie into the existing construction as indicated.

3.1.5 Concrete

Saw concrete along straight lines to a depth of not less than 2 inches. Make each cut in walls perpendicular to the face and in alignment with the cut in the opposite face. Break out the remainder of the concrete provided that the broken area is concealed in the finished work, and the remaining concrete is sound. At locations where the broken face cannot be concealed, grind smooth or saw cut entirely through the concrete.

3.1.6 Patching

Where removals leave holes and damaged surfaces exposed in the finished work, patch and repair these holes and damaged surfaces to match adjacent finished surfaces. Where new work is to be applied to existing surfaces, perform removals and patching in a manner to produce surfaces suitable for receiving new work. Finished surfaces of patched area shall be flush with the adjacent existing surface and shall match the existing adjacent surface as closely as possible as to texture and finish. Patching shall be as specified and indicated, and shall include:

a. Holes and depressions caused by previous physical damage or left as a result of removals in existing masonry walls to remain shall be completely filled with an approved masonry patching material, applied in accordance with the manufacturer's printed instructions.

b. Where existing partitions have been removed leaving damaged or missing resilient tile flooring, patch to match the existing floor tile.

c. Patch acoustic lay-in ceiling where partitions have been removed. The transition between the different ceiling heights shall be effected by continuing the higher ceiling level over to the first runner on the lower ceiling and closing the vertical opening with a painted sheet metal strip.

3.1.7 Cylinders and Canisters

Remove all fire suppression system cylinders and canisters and dispose of in accordance with the paragraph entitled "Disposal of Ozone Depleting Substance (ODS)."

3.1.8 Locksets on Swinging Doors

The Contractor shall remove all locksets from all swinging doors indicated to be removed and disposed of. Contractor shall give the locksets to the Contracting Officer after their removal.

3.2 DISPOSITION OF MATERIAL

3.2.1 Title to Materials

Except where specified in other sections, all materials and equipment

removed, and not reused, shall become the property of the Contractor and shall be removed from Government property. Title to materials resulting from demolition, and materials and equipment to be removed, is vested in the Contractor upon approval by the Contracting Officer of the Contractor's demolition and removal procedures, and authorization by the Contracting Officer to begin demolition. The Government will not be responsible for the condition or loss of, or damage to, such property after contract award. Materials and equipment shall not be viewed by prospective purchasers or sold on the site.

3.2.2 Salvaged Materials and Equipment

Remove materials and equipment that are indicated to be removed by the Contractor and that are to remain the property of the Government, and deliver to a storage site.

Contractor shall salvage items and material to the maximum extent possible.

Material salvaged for the Contractor shall be stored as approved by the Contracting Officer and shall be removed from Government property before completion of the contract. Material salvaged for the Contractor shall not be sold on the site.

Salvaged items to remain the property of the Government shall be removed in a manner to prevent damage, and packed or crated to protect the items from damage while in storage or during shipment. Items damaged during removal or storage shall be repaired or replaced to match existing items. Containers shall be properly identified as to contents.

Defense Depot Richmond VA (DDVA)
SW0400
Cylinder Operations
800 Jefferson Davis Highway
Richmond, VA 23297-5000

3.2.3 Unsalvageable Material

Concrete, masonry, and other noncombustible material, except concrete permitted to remain in place, shall be disposed of in the disposal area .

3.3 CLEANUP

Debris and rubbish shall be removed from excavations. Debris shall be removed and transported in a manner that prevents spillage on streets or adjacent areas. Local regulations regarding hauling and disposal shall apply.

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SECTION 02231

CLEARING AND GRUBBING
09/03

PART 1 GENERAL

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 PROTECTION

3.1.1 Roads and Walks

Keep roads and walks free of dirt and debris at all times.

3.1.2 Trees, Shrubs, and Existing Facilities

Trees and vegetation to be left standing shall be protected from damage incident to clearing, grubbing, and construction operations by the erection of barriers or by such other means as the circumstances require.

3.1.3 Utility Lines

Protect existing utility lines that are indicated to remain from damage. Notify the Contracting Officer immediately of damage to or an encounter with an unknown existing utility line. The Contractor shall be responsible for the repairs of damage to existing utility lines that are indicated or made known to the Contractor prior to start of clearing and grubbing operations. When utility lines which are to be removed are encountered within the area of operations, the Contractor shall notify the Contracting Officer in ample time to minimize interruption of the service.

3.2 CLEARING

Clearing shall consist of the felling, trimming, and cutting of trees into sections and the satisfactory disposal of the trees and other vegetation designated for removal, including downed timber, snags, brush, and rubbish occurring within the areas to be cleared. Trees, stumps, roots, brush, and other vegetation in areas to be cleared shall be cut off flush with or below the original ground surface, except such trees and vegetation as may be indicated or directed to be left standing. Trees designated to be left standing within the cleared areas shall be trimmed of dead branches 1-1/2 inches or more in diameter and shall be trimmed of all branches the heights directed. Limbs and branches to be trimmed shall be neatly cut close to the bole of the tree or main branches. Cuts more than 1-1/2 inches in diameter shall be painted with an approved tree-wound paint.

3.3 TREE REMOVAL

Where directed, trees and stumps that are designated as trees shall be removed from areas outside those areas designated for clearing and grubbing. This work shall include the felling of such trees and the removal of their stumps and roots as specified in paragraph GRUBBING. Trees shall be disposed of as specified in paragraph DISPOSAL OF MATERIALS.

3.4 GRUBBING

Grubbing shall consist of the removal and disposal of stumps, roots larger than 3 inches in diameter, and matted roots from the designated grubbing areas. Material to be grubbed, together with logs and other organic or metallic debris not suitable for foundation purposes, shall be removed to a depth of not less than 18 inches below the original surface level of the ground in areas indicated to be grubbed and in areas indicated as construction areas under this contract, such as areas for buildings, and areas to be paved. Depressions made by grubbing shall be filled with suitable material and compacted to make the surface conform with the original adjacent surface of the ground.

3.5 DISPOSAL OF MATERIALS

3.5.1 Saleable Timber

All timber on the project site noted for clearing and grubbing shall become the property of the Contractor, and shall be removed from the project site and disposed of off site.

3.5.2 Nonsaleable Materials

Logs, stumps, roots, brush, rotten wood, and other refuse from the clearing and grubbing operations, except for salable timber, shall be disposed of outside the limits of Government-controlled land at the Contractor's responsibility, except when otherwise directed in writing. Such directive will state the conditions covering the disposal of such products and will also state the areas in which they may be placed.

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SECTION 02300

EARTHWORK
08/03

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C 33	(2002a) Concrete Aggregates
ASTM D 422	(1963; R 1998) Particle-Size Analysis of Soils
ASTM D 698	(2000a) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600 kN-m/cu. m.))
ASTM D 1140	(2000) Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve
ASTM D 1556	(2000) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(2000) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu.m.))
ASTM D 1883	(1999) CBR (California Bearing Ratio) of Laboratory-Compacted Soils
ASTM D 2487	(2000) Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(2001) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 4318	(2000) Liquid Limit, Plastic Limit, and Plasticity Index of Soils

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C600	(1999) Installation of Ductile-Iron Water Mains and Their Appurtenances

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 530/F-93/004	1993; Rev O; Updates I, II, IIA, IIB, and

	III) Test Methods for Evaluating Solid Waste (Vol IA, IB, IC, and II) (SW-846)
EPA 600/4-79/020	(1983) Methods for Chemical Analysis of Water and Wastes

1.2 DEFINITIONS

1.2.1 Satisfactory Materials

Satisfactory materials shall comprise any materials classified by ASTM D 2487 as GW, GP, GM, GP-GM, GW-GM, GC, GP-GC, GM-GC, SW, SP. Satisfactory materials for grading shall be comprised of stones less than 8 inches, except for fill material for pavements and railroads which shall be comprised of stones less than 3 inches in any dimension.

1.2.2 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials are unsatisfactory. Unsatisfactory materials also include man-made fills; trash; refuse; backfills from previous construction; and material classified as satisfactory which contains root and other organic matter or frozen material. The Contracting Officer shall be notified of any contaminated materials.

1.2.3 Degree of Compaction

Degree of compaction required is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557 abbreviated as a percent of laboratory maximum density.

1.2.4 Topsoil

Material suitable for topsoils obtained from excavations is defined as: Natural, friable soil representative of productive, well-drained soils in the area, free of subsoil, stumps, rocks larger than one inch diameter, brush, weeds, toxic substances, and other material detrimental to plant growth. Amend topsoil pH range to obtain a pH of 5.5 to 7.

1.2.5 Hard/Unyielding Materials

Weathered rock, dense consolidated deposits, or conglomerate materials which are not included in the definition of "rock" with stones greater than 3 inches in any dimension or as defined by the pipe manufacturer, whichever is smaller. These materials usually require the use of heavy excavation equipment, ripper teeth, or jack hammers for removal.

1.2.6 Unstable Material

Unstable material shall consist of materials too wet to properly support the utility pipe, conduit, or appurtenant structure.

1.2.7 Select Granular Material

1.2.7.1 General Requirements

Select granular material shall consist of materials classified as GW, GP, SW, SP, by ASTM D 2487 where indicated. The liquid limit of such material

shall not exceed 35 percent when tested in accordance with ASTM D 4318. The plasticity index shall not be greater than 12 percent when tested in accordance with ASTM D 4318, and not more than 35 percent by weight shall be finer than No. 200 sieve when tested in accordance with ASTM D 1140.

1.2.7.2 California Bearing Ratio Values

Bearing Ratio: At 0.1 inch penetration, the bearing ratio shall be 8 percent at 95 percent ASTM D 1557 maximum density as determined in accordance with ASTM D 1883 for a laboratory soaking period of not less than 4 days. The combined material shall conform to NDDOT Section 816 Aggregates.

1.2.8 Initial Backfill Material

Initial backfill shall consist of select granular material or satisfactory materials free from rocks 3 inches or larger in any dimension or free from rocks of such size as recommended by the pipe manufacturer, whichever is smaller. When the pipe is coated or wrapped for corrosion protection, the initial backfill material shall be free of stones larger than 3 inches in any dimension or as recommended by the pipe manufacturer, whichever is smaller.

1.2.9 Expansive Soils

Expansive soils are defined as soils that have a plasticity index equal to or greater than when tested in accordance with ASTM D 4318.

1.2.10 Nonfrost Susceptible (NFS) Material

Nonfrost susceptible material shall be a uniformly graded washed sand with a maximum particle size of 3/4 inch and less than 5 percent passing the No. 200 size sieve, and with not more than 3 percent by weight finer than 0.02 mm grain size.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Dewatering Work Plan; G-AO

Submit 15 days prior to starting work.

SD-03 Product Data

Utilization of Excavated Materials; G-AO
Rock Excavation
Opening of any Excavation or Borrow Pit

Procedure and location for disposal of unused satisfactory material. Proposed source of borrow material. Notification of

encountering rock in the project. Advance notice on the opening of excavation or borrow areas. Advance notice on shoulder construction for rigid pavements.

SD-06 Test Reports

Testing
Borrow Site Testing

Within 24 hours of conclusion of physical tests, 3 copies of test results, including calibration curves and results of calibration tests. Results of testing at the borrow site.

SD-07 Certificates

Testing

Qualifications of the commercial testing laboratory or Contractor's testing facilities.

1.4 SUBSURFACE DATA

Subsurface soil boring logs are appended to the SPECIAL CONTRACT REQUIREMENTS. These data represent the best subsurface information available; however, variations may exist in the subsurface between boring locations.

1.5 CLASSIFICATION OF EXCAVATION

Excavation specified shall be done on a classified basis, in accordance with the following designations and classifications.

1.5.1 Common Excavation

Common excavation shall include the satisfactory removal and disposal of all materials not classified as rock excavation.

1.5.2 Rock Excavation

Rock excavation shall include excavating, grading, and disposing of material classified as rock and shall include the satisfactory removal and disposal of boulders 1/2 cubic yard or more in volume; solid rock; rock material that is in ledges, bedded deposits, and unstratified masses, which cannot be removed without systematic drilling and blasting; firmly cemented conglomerate deposits possessing the characteristics of solid rock impossible to remove without systematic drilling and blasting; and hard materials (see Definitions). The removal of any concrete or masonry structures, except pavements, exceeding 1/2 cubic yard in volume that may be encountered in the work shall be included in this classification. If at any time during excavation, including excavation from borrow areas, the Contractor encounters material that may be classified as rock excavation, such material shall be uncovered and the Contracting Officer notified by the Contractor. The Contractor shall not proceed with the excavation of this material until the Contracting Officer has classified the materials as common excavation or rock excavation and has taken cross sections as required. Failure on the part of the Contractor to uncover such material, notify the Contracting Officer, and allow ample time for classification and cross sectioning of the undisturbed surface of such material will cause the forfeiture of the Contractor's right of claim to any classification or

volume of material to be paid for other than that allowed by the Contracting Officer for the areas of work in which such deposits occur.

1.6 DEWATERING WORK PLAN

Submit procedures for accomplishing dewatering work.

PART 2 PRODUCTS

2.1 REQUIREMENTS FOR OFFSITE SOILS

Offsite soils brought in for use as backfill shall be tested for TPH, BTEX and full TCLP including ignitability, corrosivity and reactivity. Backfill shall contain less than 100 parts per million (ppm) of total petroleum hydrocarbons (TPH) and less than 10 ppm of the sum of Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX) and shall not fail the TCPL test. TPH concentrations shall be determined by using EPA 600/4-79/020 Method 418.1. BTEX concentrations shall be determined by using EPA 530/F-93/004 Method 5030/8020. TCLP shall be performed in accordance with EPA 530/F-93/004 Method 1311. Provide Borrow Site Testing for TPH, BTEX and TCLP from a composite sample of material from the borrow site, with at least one test from each borrow site. Material shall not be brought on site until tests have been approved by the Contracting Officer.

2.2 BURIED WARNING AND IDENTIFICATION TAPE

Metallic core or metallic-faced, acid- and alkali-resistant, polyethylene plastic warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 3 inch minimum width, color coded as specified below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording. Color and printing shall be permanent, unaffected by moisture or soil.

Warning Tape Color Codes

Yellow:	Electric
Yellow:	Gas, Oil; Dangerous Materials
Orange:	Telephone and Other Communications
Blue:	Water Systems
Green:	Sewer Systems
White:	Steam Systems

2.2.1 Warning Tape for Metallic Piping

Acid and alkali-resistant polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of tape shall be 0.003 inch. Tape shall have a minimum strength of 1500 psi lengthwise, and 1250 psi crosswise, with a maximum 350 percent elongation.

2.2.2 Detectable Warning Tape for Non-Metallic Piping

Polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of the tape shall be 0.004 inch. Tape shall have a minimum strength of 1500 psi lengthwise and 1250 psi crosswise. Tape shall be manufactured with integral wires, foil

backing, or other means of enabling detection by a metal detector when tape is buried up to 3 feet deep. Encase metallic element of the tape in a protective jacket or provide with other means of corrosion protection.

2.3 DETECTION WIRE FOR NON-METALLIC PIPING

Detection wire shall be insulated single strand, solid copper with a minimum of 12 AWG.

2.4 MATERIAL FOR RIP-RAP

Provide bedding material and rock conforming to these requirements for construction indicated.

2.4.1 Bedding Material

Consisting of sand, gravel, or crushed rock, well graded, with a maximum particle size of 2 inches. Material shall be composed of tough, durable particles. Fines passing the No. 200 standard sieve shall have a plasticity index less than six.

2.4.2 Rock

Rock fragments sufficiently durable to ensure permanence in the structure and the environment in which it is to be used. Rock fragments shall be free from cracks, seams, and other defects that would increase the risk of deterioration from natural causes. The size of the fragments shall be such that no individual fragment exceeds a weight of 150 pounds and that no more than 10 percent of the mixture, by weight, consists of fragments weighing 2 pounds or less each. Specific gravity of the rock shall be a minimum of 2.50. The inclusion of more than trace (1 percent) quantities of dirt, sand, clay, and rock fines will not be permitted.

2.5 CAPILLARY WATER BARRIER

Capillary Water Barrier shall consist of clean, poorly graded crushed rock, crushed gravel, or uncrushed gravel placed beneath a building slab with a vapor barrier to cut off the capillary flow of pore water to the area immediately below. Fine aggregate grading shall conform to ASTM C 33 with a maximum of 3 percent by weight passing ASTM D 1140, No. 200 sieve The barrier should consist of either a minimum 50 mil membrane or combination of a 20 mil membrane with an 8 oz per square yard non-woven geotextile. A modulus of subgrade reaction "K" of 150 pci is recommended for this case (without frost penetration)..

PART 3 EXECUTION

3.1 STRIPPING OF TOPSOIL

Where indicated or directed, topsoil shall be stripped entirely. Topsoil shall be spread on areas already graded and prepared for topsoil, or transported and deposited in stockpiles convenient to areas that are to receive application of the topsoil later, or at locations indicated or specified. Topsoil shall be kept separate from other excavated materials, brush, litter, objectionable weeds, roots, stones larger than 2 inches in diameter, and other materials that would interfere with planting and maintenance operations. Any surplus of topsoil from excavations and grading shall be removed from the site.

3.2 GENERAL EXCAVATION

The Contractor shall perform excavation of every type of material encountered within the limits of the project to the lines, grades, and elevations indicated and as specified. Grading shall be in conformity with the typical sections shown and the tolerances specified in paragraph FINISHING. Satisfactory excavated materials shall be transported to and placed in fill or embankment within the limits of the work. Unsatisfactory materials encountered within the limits of the work shall be excavated below grade and replaced with satisfactory materials as directed. Such excavated material and the satisfactory material ordered as replacement shall be included in excavation. Surplus satisfactory excavated material not required for fill or embankment shall be disposed of in areas approved for surplus material storage. Unsatisfactory excavated material shall be disposed of outside of government controlled land. During construction, excavation and fill shall be performed in a manner and sequence that will provide proper drainage at all times. Material required for fill or embankment in excess of that produced by excavation within the grading limits shall be excavated from from other approved areas selected by the Contractor as specified.

3.2.1 Drainage Structures

Excavations shall be made to the lines, grades, and elevations shown, or as directed. Trenches and foundation pits shall be of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown. Rock or other hard foundation material shall be cleaned of loose debris and cut to a firm, level, stepped, or serrated surface. Loose disintegrated rock and thin strata shall be removed. When concrete or masonry is to be placed in an excavated area, the bottom of the excavation shall not be disturbed. Excavation to the final grade level shall not be made until just before the concrete or masonry is to be placed.

3.2.2 Drainage

Provide for the collection and disposal of surface and subsurface water encountered during construction. Completely drain construction site during periods of construction to keep soil materials sufficiently dry. The Contractor shall establish/construct storm drainage features (ponds/basins) at the earliest stages of site development, and throughout construction grade the construction area to provide positive surface water runoff away from the construction activity and/or provide temporary ditches, swales, and other drainage features and equipment as required to maintain dry soils. When unsuitable working platforms for equipment operation and unsuitable soil support for subsequent construction features develop, remove unsuitable material and provide new soil material as specified herein. It is the responsibility of the Contractor to assess the soil and ground water conditions presented by the plans and specifications and to employ necessary measures to permit construction to proceed.

3.2.3 Dewatering

Groundwater flowing toward or into excavations shall be controlled to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. French drains, sumps, ditches or trenches will not be permitted within 3 feet of the foundation of any structure, except with specific written approval, and after specific contractual provisions for

restoration of the foundation area have been made. Control measures shall be taken by the time the excavation reaches the water level in order to maintain the integrity of the in situ material. While the excavation is open, the water level shall be maintained continuously, at least 2 feet below the working level.

3.2.4 Trench Excavation Requirements

The trench shall be excavated as recommended by the manufacturer of the pipe to be installed. Trench walls below the top of the pipe shall be sloped, or made vertical, and of such width as recommended in the manufacturer's installation manual. Where no manufacturer's installation manual is available, trench walls shall be made vertical. Trench walls more than 4 feet high shall be shored, cut back to a stable slope, or provided with equivalent means of protection for employees who may be exposed to moving ground or cave in. Vertical trench walls more than 4 feet high shall be shored. Trench walls which are cut back shall be excavated to at least the angle of repose of the soil. Special attention shall be given to slopes which may be adversely affected by weather or moisture content. The trench width below the top of pipe shall not exceed 24 inches plus pipe outside diameter (O.D.) for pipes of less than 24 inches inside diameter and shall not exceed 36 inches plus pipe outside diameter for sizes larger than 24 inches inside diameter. Where recommended trench widths are exceeded, redesign, stronger pipe, or special installation procedures shall be utilized by the Contractor. The cost of redesign, stronger pipe, or special installation procedures shall be borne by the Contractor without any additional cost to the Government.

3.2.4.1 Bottom Preparation

The bottoms of trenches shall be accurately graded to provide uniform bearing and support for the bottom quadrant of each section of the pipe. Bell holes shall be excavated to the necessary size at each joint or coupling to eliminate point bearing. Stones of 3 inches or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, shall be removed to avoid point bearing.

3.2.4.2 Removal of Unyielding Material

Where unyielding material is encountered in the bottom of the trench, such material shall be removed 4 inches below the required grade and replaced with suitable materials as provided in paragraph BACKFILLING AND COMPACTION.

3.2.4.3 Removal of Unstable Material

Where unstable material is encountered in the bottom of the trench, such material shall be removed to the depth directed and replaced to the proper grade with select granular material as provided in paragraph BACKFILLING AND COMPACTION. When removal of unstable material is required due to the Contractor's fault or neglect in performing the work, the resulting material shall be excavated and replaced by the Contractor without additional cost to the Government.

3.2.4.4 Excavation for Appurtenances

Excavation for manholes, catch-basins, inlets, or similar structures shall be sufficient to leave at least 12 inches clear between the outer structure surfaces and the face of the excavation or support members. Removal of unstable material shall be as specified above. When concrete or

masonry is to be placed in an excavated area, special care shall be taken not to disturb the bottom of the excavation. Excavation to the final grade level shall not be made until just before the concrete or masonry is to be placed.

3.2.5 Underground Utilities

Movement of construction machinery and equipment over pipes and utilities during construction shall be at the Contractor's risk. Excavation made with power-driven equipment is not permitted within two feet of known Government-owned utility or subsurface construction. For work immediately adjacent to or for excavations exposing a utility or other buried obstruction, excavate by hand. Start hand excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured. Support uncovered lines or other existing work affected by the contract excavation until approval for backfill is granted by the Contracting Officer. Report damage to utility lines or subsurface construction immediately to the Contracting Officer.

3.2.6 Structural Excavation

Ensure that footing subgrades have been inspected and approved by the Contracting Officer prior to concrete placement. Backfill and compact over excavations and changes in grade due to pile driving operations to 95 percent of ASTM D 698 maximum density.

3.3 SELECTION OF BORROW MATERIAL

Borrow material shall be selected to meet the requirements and conditions of the particular fill or embankment for which it is to be used. Borrow material shall be obtained from the borrow areas from approved private sources. Unless otherwise provided in the contract, the Contractor shall obtain from the owners the right to procure material, pay royalties and other charges involved, and bear the expense of developing the sources, including rights-of-way for hauling. Necessary clearing, grubbing, and satisfactory drainage of borrow pits and the disposal of debris thereon shall be considered related operations to the borrow excavation.

3.4 OPENING AND DRAINAGE OF EXCAVATION AND BORROW PITS

The Contractor shall notify the Contracting Officer sufficiently in advance of the opening of any excavation or borrow pit to permit elevations and measurements of the undisturbed ground surface to be taken. Except as otherwise permitted, borrow pits and other excavation areas shall be excavated providing adequate drainage. Overburden and other spoil material shall be transported to designated spoil areas or otherwise disposed of as directed. Borrow pits shall be neatly trimmed and drained after the excavation is completed. The Contractor shall ensure that excavation of any area, operation of borrow pits, or dumping of spoil material results in minimum detrimental effects on natural environmental conditions.

3.5 SHORING

3.5.1 General Requirements

Shoring, including sheet piling, shall be furnished and installed as necessary to protect workmen, banks, adjacent paving, structures, and utilities. Shoring, bracing, and sheeting shall be removed as excavations are backfilled, in a manner to prevent caving.

3.5.2 Geotechnical Engineer

The Contractor is required to hire a Professional Geotechnical Engineer to provide inspection of excavations and soil/groundwater conditions throughout construction. The Geotechnical Engineer shall be responsible for performing pre-construction and periodic site visits throughout construction to assess site conditions. The Geotechnical Engineer shall update the excavation, sheeting and dewatering plans as construction progresses to reflect changing conditions and shall submit an updated plan if necessary. A written report shall be submitted, at least monthly, informing the Contractor and Contracting Officer of the status of the plan and an accounting of the Contractor's adherence to the plan addressing any present or potential problems. The Geotechnical Engineer shall be available to meet with the Contracting Officer at any time throughout the contract duration.

3.6 GRADING AREAS

Where indicated, work will be divided into grading areas within which satisfactory excavated material shall be placed in embankments, fills, and required backfills. Stockpiles shall be kept in a neat and well drained condition, giving due consideration to drainage at all times. The ground surface at stockpile locations shall be cleared, grubbed, and sealed by rubber-tired equipment, excavated satisfactory and unsatisfactory materials shall be separately stockpiled. Stockpiles of satisfactory materials shall be protected from contamination which may destroy the quality and fitness of the stockpiled material. If the Contractor fails to protect the stockpiles, and any material becomes unsatisfactory, such material shall be removed and replaced with satisfactory material from approved sources.

3.7 FINAL GRADE OF SURFACES TO SUPPORT CONCRETE

Excavation to final grade shall not be made until just before concrete is to be placed. Only excavation methods that will leave the foundation rock in a solid and unshattered condition shall be used. Approximately level surfaces shall be roughened, and sloped surfaces shall be cut as indicated into rough steps or benches to provide a satisfactory bond. Shales shall be protected from slaking and all surfaces shall be protected from erosion resulting from ponding or flow of water.

3.8 GROUND SURFACE PREPARATION

3.8.1 General Requirements

Unsatisfactory material in surfaces to receive fill or in excavated areas shall be removed and replaced with satisfactory materials as directed by the Contracting Officer. The surface shall be scarified to a depth of 6 inches before the fill is started. Sloped surfaces steeper than 1 vertical to 4 horizontal shall be plowed, stepped, benched, or broken up so that the fill material will bond with the existing material. When subgrades are less than the specified density, the ground surface shall be broken up to a minimum depth of 6 inches, pulverized, and compacted to the specified density. When the subgrade is part fill and part excavation or natural ground, the excavated or natural ground portion shall be scarified to a depth of 12 inches and compacted as specified for the adjacent fill.

3.8.2 Frozen Material

Material shall not be placed on surfaces that are muddy, frozen, or contain frost. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, or other approved equipment well suited to the soil being compacted. Material shall be moistened or aerated as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used. Minimum subgrade density shall be as specified in paragraph TESTING.

3.9 UTILIZATION OF EXCAVATED MATERIALS

Unsatisfactory materials removed from excavations shall be disposed of as indicated. Satisfactory material removed from excavations shall be used, insofar as practicable, in the construction of fills, embankments, subgrades, shoulders, bedding (as backfill), and for similar purposes. No satisfactory excavated material shall be wasted without specific written authorization. Satisfactory material authorized to be wasted shall be disposed of as directed. Newly designated waste areas on Government-controlled land shall be cleared and grubbed before disposal of waste material thereon. Coarse rock from excavations shall be stockpiled and used for constructing slopes or embankments adjacent to streams, or sides and bottoms of channels and for protecting against erosion. No excavated material shall be disposed of to obstruct the flow of any stream, endanger a partly finished structure, impair the efficiency or appearance of any structure, or be detrimental to the completed work in any way.

3.10 BURIED TAPE AND DETECTION WIRE

3.10.1 Buried Warning and Identification Tape

Provide buried utility lines with utility identification tape. Bury tape 12 inches below finished grade; under pavements and slabs, bury tape 6 inches below top of subgrade.

3.10.2 Buried Detection Wire

Bury detection wire directly above non-metallic piping at a distance not to exceed 12 inches above the top of pipe. The wire shall extend continuously and unbroken, from manhole to manhole. The ends of the wire shall terminate inside the manholes at each end of the pipe, with a minimum of 3 feet of wire, coiled, remaining accessible in each manhole. The wire shall remain insulated over it's entire length. The wire shall enter manholes between the top of the corbel and the frame, and extend up through the chimney seal between the frame and the chimney seal. For force mains, the wire shall terminate in the valve pit at the pump station end of the pipe.

3.11 BACKFILLING AND COMPACTION

Backfill adjacent to any and all types of structures shall be placed and compacted to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials to prevent wedging action or eccentric loading upon or against the structure. Ground surface on which backfill is to be placed shall be prepared as specified in paragraph PREPARATION OF GROUND SURFACE FOR EMBANKMENTS. Compaction requirements for backfill materials shall also conform to the applicable portions of paragraphs PREPARATION OF GROUND SURFACE FOR EMBANKMENTS, EMBANKMENTS, and SUBGRADE PREPARATION, and Section 02630 STORM-DRAINAGE SYSTEM. Compaction shall be accomplished by

sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

3.11.1 Trench Backfill

Trenches shall be backfilled to the grade shown. The trench shall be backfilled to 2 feet above the top of pipe prior to performing the required pressure tests. The joints and couplings shall be left uncovered during the pressure test.

3.11.1.1 Replacement of Unyielding Material

Unyielding material removed from the bottom of the trench shall be replaced with select granular material or initial backfill material.

3.11.1.2 Replacement of Unstable Material

Unstable material removed from the bottom of the trench or excavation shall be replaced with select granular material placed in layers not exceeding 6 inches loose thickness.

3.11.1.3 Bedding and Initial Backfill

Bedding shall be of the type and thickness shown. Initial backfill material shall be placed and compacted with approved tampers to a height of at least one foot above the utility pipe or conduit. The backfill shall be brought up evenly on both sides of the pipe for the full length of the pipe. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe. Except as specified otherwise in the individual piping section, provide bedding for buried piping in accordance with AWWA C600, Type 4, except as specified herein. Backfill to top of pipe shall be compacted to 95 percent of ASTM D 698 maximum density. Plastic piping shall have bedding to spring line of pipe.

3.11.1.4 Final Backfill

The remainder of the trench, except for roadways, shall be filled with satisfactory material. Backfill material shall be placed and compacted as follows:

a. Roadways: Backfill shall be placed up to the required elevation as specified. Water flooding or jetting methods of compaction will not be permitted.

b. Sidewalks, Turfed or Seeded Areas and Miscellaneous Areas: Backfill shall be deposited in layers of a maximum of 12 inch loose thickness, and compacted to 90 percent maximum density for cohesive soils and 95 percent maximum density for cohesionless soils. Compaction by water flooding or jetting will not be permitted. This requirement shall also apply to all other areas not specifically designated above.

3.11.2 Backfill for Appurtenances

After the manhole, catchbasin, inlet, or similar structure has been constructed and the concrete has been allowed to cure for 3 days, backfill shall be placed in such a manner that the structure will not be damaged by the shock of falling earth. The backfill material shall be deposited and compacted as specified for final backfill, and shall be brought up evenly on all sides of the structure to prevent eccentric loading and excessive

stress.

3.12 SPECIAL REQUIREMENTS

Special requirements for both excavation and backfill relating to the specific utilities are as follows:

3.12.1 Gas Distribution

Trenches shall be excavated to a depth that will provide not less than 30 inches of cover. Trenches shall be graded as specified for pipe-laying requirements in Section 02556A GAS DISTRIBUTION SYSTEM.

3.12.2 Water Lines

Trenches shall be of a depth to provide a minimum cover of 7.0 feet from the existing ground surface, or from the indicated finished grade, whichever is lower, to the top of the pipe. For fire protection yard mains or piping, an additional 6 inches of cover is required.

3.12.3 Heat Distribution System

Initial backfill material shall be free of stones larger than 1/4 inch in any dimension.

3.12.4 Electrical Distribution System

Direct burial cable and conduit or duct line shall have a minimum cover of 30 inches from the finished grade, unless otherwise indicated. Special trenching requirements for direct-burial electrical cables and conduits are specified in Section 16375A ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND.

3.12.5 Rip-Rap Construction

Construct rip-rap on bedding material in the areas indicated. Trim and dress indicated areas to conform to cross sections, lines and grades shown within a tolerance of 0.1 foot.

3.12.5.1 Bedding Placement

Spread bedding material uniformly to a thickness of at least 3 inches on prepared subgrade as indicated.

3.12.5.2 Stone Placement

Place rock for rip-rap on prepared bedding material to produce a well graded mass with the minimum practicable percentage of voids in conformance with lines and grades indicated. Distribute larger rock fragments, with dimensions extending the full depth of the rip-rap throughout the entire mass and eliminate "pockets" of small rock fragments. Rearrange individual pieces by mechanical equipment or by hand as necessary to obtain the distribution of fragment sizes specified above.

3.13 EMBANKMENTS

3.13.1 Earth Embankments

Earth embankments shall be constructed from satisfactory materials free of organic or frozen material and rocks with any dimension greater than 3

inches. The material shall be placed in successive horizontal layers of loose material not more than 8 inches in depth. Each layer shall be spread uniformly on a soil surface that has been moistened or aerated as necessary, and scarified or otherwise broken up so that the fill will bond with the surface on which it is placed. After spreading, each layer shall be plowed, disked, or otherwise broken up; moistened or aerated as necessary; thoroughly mixed; and compacted to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials. Compaction requirements for the upper portion of earth embankments forming subgrade for pavements shall be identical with those requirements specified in paragraph SUBGRADE PREPARATION. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

3.14 SUBGRADE PREPARATION

3.14.1 Proof Rolling

Proof rolling shall be done on an exposed subgrade free of surface water (wet conditions resulting from rainfall) which would promote degradation of an otherwise acceptable subgrade. After stripping, proof roll the existing subgrade with six passes of a dump truck loaded with 4 cubic yards of soil. Operate the truck in a systematic manner to ensure the number of passes over all areas, and at speeds between 2 1/2 to 3 1/2 mph. Notify the Contracting Officer a minimum of 3 days prior to proof rolling. Proof rolling shall be performed in the presence of the Contracting Officer. Rutting or pumping of material shall be undercut as directed by the Contracting Officer and replaced with fill and backfill material.

3.14.2 Construction

Subgrade shall be shaped to line, grade, and cross section, and compacted as specified. This operation shall include plowing, disking, and any moistening or aerating required to obtain specified compaction. Soft or otherwise unsatisfactory material shall be removed and replaced with satisfactory excavated material or other approved material as directed. Rock encountered in the cut section shall be excavated to a depth of 6 inches below finished grade for the subgrade. Low areas resulting from removal of unsatisfactory material or excavation of rock shall be brought up to required grade with satisfactory materials, and the entire subgrade shall be shaped to line, grade, and cross section and compacted as specified. The elevation of the finish subgrade shall not vary more than 0.05 foot from the established grade and cross section.

3.14.3 Compaction

Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. Except for paved areas, each layer of the embankment shall be compacted to at least 95 percent of laboratory maximum density.

3.14.3.1 Subgrade for Pavements

Subgrade for pavements shall be compacted to at least 95 percentage laboratory maximum density for the depth below the surface of the pavement shown. When more than one soil classification is present in the subgrade, the top 12 inches of subgrade shall be scarified, windrowed, thoroughly blended, reshaped, and compacted.

3.15 FINISHING

The surface of excavations, embankments, and subgrades shall be finished to a smooth and compact surface in accordance with the lines, grades, and cross sections or elevations shown. The degree of finish for graded areas shall be within 0.1 foot of the grades and elevations indicated except that the degree of finish for subgrades shall be specified in paragraph SUBGRADE PREPARATION. Gutters and ditches shall be finished in a manner that will result in effective drainage. The surface of areas to be turfed shall be finished to a smoothness suitable for the application of turfing materials. Settlement or washing that occurs in graded, topsoiled, or backfilled areas prior to acceptance of the work, shall be repaired and grades re-established to the required elevations and slopes.

3.15.1 Subgrade and Embankments

During construction, embankments and excavations shall be kept shaped and drained. Ditches and drains along subgrade shall be maintained to drain effectively at all times. The finished subgrade shall not be disturbed by traffic or other operation and shall be protected and maintained by the Contractor in a satisfactory condition until ballast, subbase, base, or pavement is placed. The storage or stockpiling of materials on the finished subgrade will not be permitted. No subbase, base course, ballast, or pavement shall be laid until the subgrade has been checked and approved, and in no case shall subbase, base, surfacing, pavement, or ballast be placed on a muddy, spongy, or frozen subgrade.

3.15.2 Capillary Water Barrier

Capillary water barrier under concrete floor and area-way slabs on grade shall be placed directly on the subgrade and shall be compacted with a minimum of two passes of a hand-operated plate-type vibratory compactor.

3.15.3 Grading Around Structures

Areas within 5 feet outside of each building and structure line shall be constructed true-to-grade, shaped to drain, and shall be maintained free of trash and debris until final inspection has been completed and the work has been accepted.

3.16 PLACING TOPSOIL

On areas to receive topsoil, the compacted subgrade soil shall be scarified to a 2 inch depth for bonding of topsoil with subsoil. Topsoil then shall be spread evenly to a thickness of 4 inches and graded to the elevations and slopes shown. Topsoil shall not be spread when frozen or excessively wet or dry. Material required for topsoil in excess of that produced by excavation within the grading limits shall be obtained from offsite areas.

3.17 TESTING

Testing shall be performed by an approved commercial testing laboratory. When test results indicate, as determined by the Contracting Officer, that compaction is not as specified, the material shall be removed, replaced and recompacted to meet specification requirements. Tests on recompacted areas shall be performed to determine conformance with specification requirements. Inspections and test results shall be certified by a registered professional civil engineer. These certifications shall state

that the tests and observations were performed by or under the direct supervision of the engineer and that the results are representative of the materials or conditions being certified by the tests.

3.17.1 Fill and Backfill Material Gradation

One test per 200 cubic yards stockpiled or in-place source material. Gradation of fill and backfill material shall be determined in accordance with ASTM D 422.

3.17.2 In-Place Densities

a. One test per 2000 square feet, or fraction thereof, of each lift of fill or backfill areas compacted by other than hand-operated machines.

b. One test per 2000 square feet, or fraction thereof, of each lift of fill or backfill areas compacted by hand-operated machines.

c. One test per 100 linear feet, or fraction thereof, of each lift of embankment or backfill for roads.

3.17.3 Check Tests on In-Place Densities

If ASTM D 2922 is used, in-place densities shall be checked by ASTM D 1556 as follows:

a. One check test per lift for each 2000 square feet, or fraction thereof, of each lift of fill or backfill compacted by other than hand-operated machines.

b. One check test per lift for each 2000 square feet, of fill or backfill areas compacted by hand-operated machines.

c. One check test per lift for each 100 linearfeet, or fraction thereof, of embankment or backfill for roads.

3.17.4 Moisture Contents

In the stockpile, excavation, or borrow areas, a minimum of two tests per day per type of material or source of material being placed during stable weather conditions shall be performed. During unstable weather, tests shall be made as dictated by local conditions and approved by the Contracting Officer.

3.17.5 Optimum Moisture and Laboratory Maximum Density

Tests shall be made for each type material or source of material including borrow material to determine the optimum moisture and laboratory maximum density values. One representative test per 2000 cubic yards of fill and backfill, or when any change in material occurs which may affect the optimum moisture content or laboratory maximum density.

3.17.6 Tolerance Tests for Subgrades

Continuous checks on the degree of finish specified in paragraph SUBGRADE PREPARATION shall be made during construction of the subgrades.

3.17.7 Displacement of Sewers

After other required tests have been performed and the trench backfill compacted to the finished grade surface, the pipe shall be inspected to determine whether significant displacement has occurred. This inspection shall be conducted in the presence of the Contracting Officer. Pipe sizes larger than 36 inches shall be entered and examined, while smaller diameter pipe shall be inspected by shining a light or laser between manholes or manhole locations, or by the use of television cameras passed through the pipe. If, in the judgement of the Contracting Officer, the interior of the pipe shows poor alignment or any other defects that would cause improper functioning of the system, the defects shall be remedied as directed at no additional cost to the Government.

3.18 DISPOSITION OF SURPLUS MATERIAL

Surplus material or other soil material not required or suitable for filling or backfilling, and brush, refuse, stumps, roots, and timber shall be removed from Government property as directed by the Contracting Officer.

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FINAL FOUNDATION ANALYSIS
ADAL PHYSICAL FITNESS CENTER
MINOT AIR FORCE BASE, NORTH DAKOTA

1. Scope

The results of the foundation investigation and analysis for the Addition and Alteration to the Physical Fitness Center at Minot Air Force Base, North Dakota are presented in this report. The scope of the study was to (1) evaluate the engineering properties of the subsoils; (2) provide allowable soil bearing pressures and (3) recommend types and depths of foundation elements and other measures pertinent to foundation design and construction.

2. Proposed Construction

This project involves the demolition of a portion of the existing fitness center and construction of an addition to southeast side. The addition will consist of a combination of single story administration space and large, open gymnasium space. A 210-space parking lot is also planned for the eastern portion of the site.

3. Subsurface Investigations

3.1. General

An Omaha District drill crew conducted the field investigation for the ADAL Physical Fitness Center project on 3-7 December 2003. The exploratory program consisted of thirteen test borings numbered sequentially from MI03-1 through MI03-13. Boring locations were determined by Setter Leach & Lindstrom and were located and staked in the field by the Corps of Engineers Core Drill Crew by measuring distances from existing structures. Base personnel provided utility clearances with assistance from the Corps of Engineers Field Geologist. Borings MI03-1, MI03-4, MI03-5, MI03-9 and MI03-11 had to be moved approximately fifty feet northeast of their original locations due to a gas line indicated on utility maps but undetected in the field. Boring MI04-13 was moved twenty-five feet to the west because of a snowdrift. Global Positioning System (GPS) coordinates of the borings are provided in Table 2; these coordinates are direct readings from a hand-held GPS unit indicating 15-foot accuracy at the time of the readings. The borings were advanced with a Gus Pech 1300C truck-mounted soil-sampling rig using 4.25-inch inside diameter (I.D.) hollow stem augers with a 4.25-inch bullet bit, and were all drilled to a depth of 20 feet. Holes were abandoned by filling with a high solids (30%) bentonite grout.

TABLE 1: Summary of Borings

Boring Number	Total Depth (ft)	Collapse Depth (ft)	Water During Drilling (ft)	Water After Drilling (ft)
MI02-1	20	16.6	Not Visible	16.1
MI02-2	20	11.3	Not Visible	6.7
MI02-3	20	18.3	Not Visible	Not Visible
MI02-4	20	13.2	Not Visible	12.9
MI03-5	20	10.6	Not Visible	8.3
MI02-6	20	14.0	Not Visible	9.5
MI02-7	20	17.0	Not Visible	14.8
MI02-8	20	16.5	Not Visible	15.5
MI02-9	20	Not Recorded	Not Recorded	Not Recorded
MI02-10	20	17.9	Not Visible	Not Visible
MI02-11	20	17.2	16.4	16.4
MI02-12	20	18.0	Not Visible	Not Visible
MI02-13	20	18.0	16.0	16.0

Table 2: Boring Coordinates

Boring Number	Latitude	Longitude
MI02-1	N 48° 25′ 00.9″	W 101° 19′ 45.1″
MI02-2	N 48° 25′ 01.4″	W 101° 19′ 44.7″
MI02-3	N 48° 25′ 01.3″	W 101° 19′ 43.5″
MI02-4	N 48° 25′ 00.2″	W 101° 19′ 43.8″
MI02-5	N 48° 24′ 59.5″	W 101° 19′ 41.4″
MI02-6	N 48° 24′ 59.9″	W 101° 19′ 40.6″
MI02-7	N 48° 25′ 00.9″	W 101° 19′ 39.6″
MI02-8	N 48° 25′ 00.9″	W 101° 19′ 41.3″
MI02-9	N 48° 24′ 58.4″	W 101° 19′ 38.8″
MI02-10	N 48° 24′ 59.7″	W 101° 19′ 37.2″
MI02-11	N 48° 24′ 56.4″	W 101° 19′ 33.6″
MI02-12	N 48° 24′ 57.8″	W 101° 19′ 32.3″
MI02-13	N 48° 24′ 54.5″	W 101° 19′ 30.8″

3.2. Standard Penetration Tests

Standard penetration tests (SPT) were taken in all borings at depth intervals of 2.5 feet for the first 10 feet and every 5 feet for the remaining depth of the boring. The standard penetration samples were obtained in accordance with ASTM D 1586-99 "Penetration Test and Split-Barrel Sampling of Soils", using a 140-pound automatic trip hammer.

3.3. Disturbed Sampling

Representative disturbed samples of the subsoils were taken with a 2-inch outside diameter (O.D.) standard steel split spoon sampler using a 140-pound automatic SPT hammer, in accordance with ASTM D 1586-99. Samples were collected every 2.5 feet for the first 10 feet, then every 5 feet for the remaining depth of the hole. Samples were placed in a pint jar and the lid sealed airtight with at least three wraps of electrical tape. Each jar was labeled, denoting the hole and sample number, depth, date collected, and the

project name. The jars were placed in wooden boxes that were subsequently labeled with the appropriate project information.

3.4. Undisturbed Sampling

Undisturbed samples were taken using 3-inch O.D. Shelby tubes. The Shelby tubes were hydraulically pushed a distance of 2 feet; the pressure exerted (pounds per square inch) and duration (seconds) of the 2-foot push were recorded on the field log. Undisturbed samples were taken at a depth of 5-7 and 10-12 feet in borings MI03-1, MI02-3 and MI02-6, and MI03-11. Undisturbed Shelby tube samples were secured with packers and endcaps; endcaps were secured with at least five wraps of electrical tape. Shelby tubes were wiped clean and labeled on the outside with project, hole and depth information; in addition, a sample tag was completed and placed inside the tube prior to securing the endcaps. The tubes were placed inside foam-padded wooden boxes (two per box) for shipment.

4. Laboratory Testing

Samples with transmittal sheets were shipped to the Terracon Inc. laboratory in Omaha, Nebraska. Tests were performed to determine visual classification, Atterberg Limits, grain size distribution, natural moisture content, sulfate ion content, soil pH, soil resistivity, unconfined compressive strength and consolidation characteristics. All tests were conducted in accordance with EM 1110-2-1906 "Laboratory Soils Testing".

Based upon the results of the testing program, the field logs were revised and supplemented as shown on the boring logs. These final logs represent an interpretation and compilation of the content of the field logs and the results of the laboratory tests of the field samples. The stratification lines shown on the boring logs represent the approximate boundaries between soil types and may be gradual. Boring logs have been provided in conjunction with this report, and are available from the Geotechnical Branch, Soils Section A, of the Omaha District.

5. Site Conditions

5.1. General Geology

Minot AFB is on the western edge of the Western Lakes Section of the Central Lowlands Physiographic Province. Topographically the area is a gently undulating ground moraine plain. The moraine deposits are of Wisconsin age. Local relief is generally less than 30 feet, and the plain slopes 20-80 feet per mile to the northeast. The Souris River drains the area and flows north into Lake Winnipeg, Canada. Bedrock in the vicinity is the Paleocene Tongue River Formation of the Fort Union Group and is typically approximately 130 feet below the surface.

5.2. Site-Specific Geology

The site is currently a grass-covered lot. The existing Physical Fitness Center is located generally to the west, and a paved parking lot for maintenance personnel is located to the south. Several of the borings were located between wings of the existing building.

Overburden at the explored locations consisted predominantly of sandy lean clay with a liquid limit of approximately 30 to 37. Instances of clayey sand with a liquid limit of approximately 19 to 27 were reported as well. Refer to the boring logs for locations and depths of these soil types. The occurrence of cobbles was infrequent, however the glacially-derived soils in the Minot area often contain significant cobbles or even boulders, thus they cannot be ruled out during excavation. Boring MI03-7 encountered what was probably a large cobble at a depth of 4.5 feet and had to be offset.

5.3. Ground Water

Ground water was observed in nine of the thirteen borings 24 hours following drilling. The range of depths at which water was reported indicates the variable, but generally low permeability of the clayey soils in the region. Based on the borehole observations and past experience at the installation, ground water is believed to have been at a depth of approximately six to eight feet below the ground surface at the time of drilling. Drilling took place in December, which is traditionally a time of low water levels. During the spring or following periods of heavy precipitation saturated soil conditions have been encountered to the ground surface during previous investigations and construction projects. These soils typically do not yield significant volumes of ground water, or a high infiltration rate, however construction is difficult when they are saturated due to their high clay content and resulting sensitivity.

5.4. Seismic Evaluation

In reference to the U.S. Army Corps of Engineers Technical Instructions "Seismic Design for Buildings, TI 809-04 dated 31 December 1998, and the Federal Emergency Management Agency (FEMA) publication, NEHRP Recommended Provisions for Seismic Regulations for New Buildings and Other Structures, 1997 Edition, Minot AFB has a spectral response acceleration for short periods (0.2 second) of 0.07g, and a 1.0 second spectral response of 0.02g. Both accelerations were interpolated from 1:5,000,000 scale maps prepared by the U.S. Geologic Survey (USGS), Building Seismic Safety Council (BSSC), and FEMA for 0.2 Sec. Spectral Response Acceleration (5% of Critical Damping), Site Class B, and 1.0 Sec. Spectral Response Acceleration (5% Critical Damping), Site Class B, respectively. The spectral response accelerations taken from these maps must be adjusted for site class effects using coefficients provided in the aforementioned guidance. For design purposes, the reference site condition is taken as National Earthquake Hazards Reduction Program (NEHRP) site class D.

The adjusted maximum considered earthquake spectral response acceleration parameters are:

The Short-Period Spectral Acceleration ($S_{MS} = F_a S_S$) for site class D is (1.6 x 0.07) <u>0.112</u>.

The 1-Second Period Spectral Acceleration ($S_{M1} = F_v S_1$) for site class D is (2.4 x 0.02) <u>0.048.</u>

6. Subsurface Recommendations

6.1. General

Soils at the project site consist primarily of sandy lean clay. These soils have proven to be generally suitable for use as structural fill and backfill, and for pavement and floor slab subgrades. High plasticity clay was not encountered at the boring locations and is not common in the Minot area. If high plasticity clay (liquid limit greater than 50) is encountered during excavation, it should not be subsequently used for structural fill or backfill material. Prior to adding fill to the site, topsoil should be stripped and the subgrade soils scarified and recompacted. A slope of at least 1 percent and preferably 5 percent should be maintained within 10 feet of structures to ensure adequate drainage.

6.2. Foundation Recommendations: Shallow Spread and Continuous Footings

The recommended foundation type for this design is shallow spread and continuous footings bearing on a layer of recompacted native subgrade. A settlement analysis conducted on consolidation test data from two locations with two depth intervals at each location indicated that in excess of 1.5 inch of settlement could occur with even a moderate excess bearing pressure of 1500 psf. In order to a ensure against differential settlement, and allow more reasonably sized footings, it is recommended that a 3-foot thick layer of existing soil be removed and compacted in lifts not exceeding 8 inches in loose thickness below footings. This material should be placed at a density of not less than 92 percent of maximum Modified Proctor density at a moisture content of between -2 and +2 percent of optimum. The base of the excavation should be three feet beyond the outside edges of the footing, and the sides should slope upward at an angle not steeper than 1 horizontal to 1 vertical. Footings placed on this layer of engineered fill may be designed for an excess bearing capacity of 2000 psf. This value represents the maximum allowable bearing pressure at the base of the footings in excess of that due to existing surrounding overburden. The surcharge load from any fill must be subtracted from this allowable value.

An exception to this recommendation is where demolition of the structure ends and new spread footings will be constructed adjacent to existing ones. At these locations it is desirable not to disturb soil below the base of the existing footings, and to place the new ones on the exposed subgrade. For these conditions an excess bearing pressure of 1000 psf should be used.

All exterior footings for heated structures should be founded a minimum of 5.5 feet below final exterior grade to provide adequate frost protection.

All footings for unheated structures should be founded a minimum of 7.0 feet below final exterior grade to provide adequate frost protection.

6.3. Slabs on Grade

A vapor barrier and six-inch capillary water barrier will be required beneath all floor slabs on grade. The barrier should consist of either a minimum 50-mil membrane or combination of a 20-mil membrane with an 8-oz per square yard non-woven geotextile. The barrier and membrane should be constructed in accordance with the detail provided in the Structural Engineering Design Guide. A modulus of subgrade reaction "K" of 150 pci is recommended for this case (without frost penetration).

6.4. Pavement Design

Soil underlying pavement is predominantly sandy clay. These soils have a frost design classification of F3.

If rigid pavement design does not consider frost penetration, a modulus of subgrade reaction "K" of 150 pci is recommended for design purposes. Flexible pavement designs should use a California Bearing Ratio (CBR) value of 8 for subgrades compacted to 95 percent of maximum density per ASTM D 1557-78 when frost is not allowed to penetrate the subgrade. If frost penetration is considered in the design of rigid or flexible pavements, the design shall be in accordance with TM 5-818-2 "Pavement Design for Seasonal Frost Conditions".

6.5. Settlement

Based on an analysis conducted on consolidation tests performed on material from representative samples and a simulated layer of recompacted material, total settlement should not exceed 1.0 inch under the recommended loading conditions if fill is placed as described in the Foundation Recommendations section. Differential settlement should not exceed 0.50 inch under such conditions. As is typical of clay-rich soil environments, settlement considerations govern the maximum allowable bearing capacity.

6.6. Cementing Properties

Sulfate ion content tests were performed on representative samples from site borings. Test results indicated a sulfate ion content at less than 0.2 percent. Based on criteria outlined in ACI 201.2, a moderate exposure condition exists and sulfate-resistant cement will not be required for concrete in contact with soil or groundwater.

Due to the potential for alkali-aggregate reactivity within the boundaries of the Omaha District, cement meeting the optional chemical requirements for low alkali cement on Table 2, ASTM C 150 will also be specified for all concrete. The Resource Conservation Recovery Act (RCRA) mandates, where possible, all concrete specifications will also include the option to use pozzolan as a partial replacement for Portland cement.

6.7. Corrosion Potential

Soil resistivity tests were performed on representative samples from the typical utility depth in borings MI03-1, MI03-4 and MI03-6. Test results indicated a resistivity of 540, 460 and 300 ohm-cm, respectively. In accordance with corrosion classifications in the Department of the Army TM 5-811-4 (17 March 1965), "Electrical Design, Corrosion Control", a "severe" corrosion potential is expected. Soil pH measured 7.7, 7.9 and 8.4, respectively.

7. Construction Considerations

Care must be taken to prevent undermining or otherwise disturbing existing footings and their subgrade when either demolishing the present structure or constructing the new one. Large areas of subgrade below the base of adjacent

footings should not be excavated at one time, however small sections for trenching or other purposes may be excavated if they are backfilled promptly.

Dewatering of excavations for footings and utility trenches will likely be necessary depending on the time of year they are performed and the precipitation history. Protecting the exposed subgrade from moisture gain is vital in aiding uninterrupted backfilling and subsequent construction. In rare instances saturated subgrades at the base of over excavations have had to be reinforced with either crushed concrete or stone to create a firm enough surface to achieve adequate compaction of overlying soil lifts. This action is typically used as a field-directed remedy rather than a design feature as it is not necessary for most conditions.

CENWO-ED-GA 22 March 2004

MEMORANDUM FOR CENWO-PM-M (Bringewatt)

SUBJECT: Final Foundation Analysis for the ADAL Physical Fitness Center at Minot Air Force Base, North Dakota

1. Enclosed is the Final Foundation Analysis for the design of the ADAL Physical Fitness Center project at Minot AFB, North Dakota.

2. Questions regarding this report may be directed to Gordon Lewis, CENWO-ED-GA, 402) 221-4306.

Encl
as

JOHN W. MONZINGO, P.E.
Chief, Geotechnical Engineering
and Sciences Branch

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Monzingo/CENWO-ED-G

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CF: Project Directory

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SECTION 02510A

WATER DISTRIBUTION SYSTEM
12/03

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D 1784	(1999ae1) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 2774	(2001) Underground Installation of Thermoplastic Pressure Piping
ASTM D 3839	(1994a) Underground Installation of "Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Pipe

AMERICAN WATER WORKS ASSOCIATION(AWWA)

AWWA B300	(1999) Hypochlorites
AWWA B301	(1999) Liquid Chlorine
AWWA C104	(1995) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C110	(1998) Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (76 mm through 1219 mm), for Water
AWWA C153	(2000) Ductile-Iron Compact Fittings for Water Service
AWWA C500	(2002; A C500a-95) Metal-Seated Gate Valves for Water Supply Service
AWWA C509	(2001) Resilient-Seated Gate Valves for Water Supply Service
AWWA C900	(1997) Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings 4 In. Through 12 In. (100 mm Through 300 mm), for Water Distribution
AWWA M23	(2002) Manual: PVC Pipe - Design and Installation

ASBESTOS CEMENT PRODUCT PRODUCERS ASSOCIATION (ACPPA)

ACPPA 1344	(1988) Recommended Work Practices for A/C Pipe

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 24	(2002) Installation of Private Fire Service Mains and Their Appurtenances
NFPA 49	(1994) Hazardous Chemicals Data
NFPA 325-1	(1994) Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids
NFPA 704	(2001) Identification of the Hazards of Materials for Emergency Response

NSF INTERNATIONAL (NSF)

NSF 14	(2003) Plastics Piping System Components and Related Materials
NSF 61	(2002e) Drinking Water System Components - Health Effects

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 21	(1982; R 2000) White or Colored Silicone Alkyd Paint (Type I, High Gloss and Type II, Medium Gloss)
SSPC Paint 25	(1997; R 2000) Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand Cleaned Steel, Type I and Type II

1.2 PIPING

This section covers water distribution and service lines, and connections to building service at a point approximately 5 feet outside buildings and structures to which service is required. The Contractor shall have a copy of the manufacturer's recommendations for each material or procedure to be utilized available at the construction site at all times.

1.2.1 Service Lines

Piping for water service lines 3 inchesand larger shall be polyvinyl chloride (PVC) plastic, unless otherwise shown or specified.

1.2.2 Distribution Lines 80 mm (3 Inches) or Larger

Piping for water distribution lines 3 inches or larger shall be polyvinyl chloride (PVC).

1.2.3 Sprinkler Supply Lines

Piping for water lines supplying sprinkler systems for building fire protection shall conform to NFPA 24 from the point of connection with the water distribution system to the building 5 foot line.

1.2.4 Potable Water Lines

Piping and components of potable water systems which come in contact with the potable water shall conform to NSF 61.

1.2.5 Plastic Piping System

Plastic piping system components (PVC) intended for transportation of potable water shall comply with NSF 14 and be legibly marked with their symbol.

1.2.6 Excavation, Trenching, and Backfilling

Excavation, trenching, and backfilling shall be in accordance with the applicable provisions of Section 02300 EARTHWORK, except as modified herein.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Installation

The manufacturer's recommendations for each material or procedure to be utilized.

Satisfactory Installation

A statement signed by the principal officer of the contracting firm stating that the installation is satisfactory and in accordance with the contract drawings and specifications, and the manufacturer's prescribed procedures and techniques, upon completion of the project and before final acceptance.

SD-06 Test Reports

Bacteriological Disinfection

Test results from commercial laboratory verifying disinfection.

1.4 HANDLING

Pipe and accessories shall be handled to ensure delivery to the trench in sound, undamaged condition, including no injury to the pipe coating or lining. If the coating or lining of any pipe or fitting is damaged, the repair shall be made by the Contractor in a satisfactory manner, at no additional cost to the Government. No other pipe or material shall be placed inside a pipe or fitting after the coating has been applied. Pipe shall be carried into position and not dragged. Use of pinch bars and tongs for aligning or turning pipe will be permitted only on the bare ends

of the pipe. The interior of pipe and accessories shall be thoroughly cleaned of foreign matter before being lowered into the trench and shall be kept clean during laying operations by plugging or other approved method. Before installation, the pipe shall be inspected for defects. Material found to be defective before or after laying shall be replaced with sound material without additional expense to the Government. Rubber gaskets that are not to be installed immediately shall be stored in a cool and dark place.

1.4.1 Miscellaneous Plastic Pipe and Fittings

Polyvinyl Chloride (PVC), and fittings shall be handled and stored in accordance with the manufacturer's recommendations. Storage facilities shall be classified and marked in accordance with NFPA 704, with classification as indicated in NFPA 49 and NFPA 325-1.

PART 2 PRODUCTS

2.1 PIPE

Pipe shall conform to the respective specifications and other requirements specified below.

2.1.1 Plastic Pipe

2.1.1.1 PVC Plastic Pipe

Pipe, couplings and fittings shall be manufactured of material conforming to ASTM D 1784, Class 12454B.

a. Pipe 4 through 12 inch Diameter: Pipe, couplings and fittings shall conform to AWWA C900, Class 150, CIOD pipe dimensions, elastomeric-gasket joint, unless otherwise shown or specified.

2.2 FITTINGS AND SPECIALS

2.2.1 PVC Pipe System

a. For pipe 4 inch diameter and larger, fittings and specials shall be iron, bell end in accordance with AWWA C110, 150 psi pressure rating unless otherwise shown or specified, except that profile of bell may have special dimensions as required by the pipe manufacturer; or fittings and specials may be of the same material as the pipe with elastomeric gaskets, all in conformance with AWWA C900. Iron fittings and specials shall be cement-mortar lined (standard thickness) in accordance with AWWA C104. Fittings shall be bell and spigot or plain end pipe, or as applicable. Ductile iron compact fittings shall be in accordance with AWWA C153.

2.3 JOINTS

2.3.1 Plastic Pipe Jointing

2.3.1.1 PVC Pipe

Joints, fittings, and couplings shall be as specified for PVC pipe. Joints

connecting pipe of differing materials shall be made in accordance with the manufacturer's recommendations, and as approved by the Contracting Officer.

2.4 VALVES

2.4.1 Gate Valves

Gate valves shall be designed for a working pressure of not less than 150 psi. Valve connections shall be as required for the piping in which they are installed. Valves shall have a clear waterway equal to the full nominal diameter of the valve, and shall be opened by turning counterclockwise. The operating nut or wheel shall have an arrow, cast in the metal, indicating the direction of opening.

a. Valves 3 inches and larger shall be iron body, bronze mounted, and shall conform to AWWA C500. Flanges shall not be buried. An approved pit shall be provided for all flanged connections.

b. Resilient-Seated Gate Valves: For valves 3 to 12 inches in size, resilient-seated gate valves shall conform to AWWA C509.

2.4.2 Indicator Post for Valves

Each valve shown on the drawings with the designation "P.I.V." shall be equipped with indicator post conforming to the requirements of NFPA 24. Operation shall be by a wrench which shall be attached to each post.

2.5 VALVE BOXES

Valve boxes shall be cast iron or concrete, except that concrete boxes may be installed only in locations not subjected to vehicular traffic. Cast-iron boxes shall be extension type with slide-type adjustment and with flared base. The minimum thickness of metal shall be 3/16 inch. Concrete boxes shall be the standard product of a manufacturer of precast concrete equipment. The word "WATER" shall be cast in the cover. The box length shall adapt, without full extension, to the depth of cover required over the pipe at the valve location.

2.6 FIRE HYDRANTS

Hydrants shall be waterous, Model WB-67 break off type, MUELLER A40, KENNEDY K-12 break off type, or manufacturer's approved equal with valve opening at least 5-1/4 inches in diameter and designed so that the flange at the main valve seat can be removed with the main valve seat apparatus remaining intact, closed and reasonably tight against leakage and with a breakable valve rod coupling and breakable flange connections located no more than 8 inches above the ground grade. Hydrants shall have a 6 inch bell connection, two 2-1/2 inch hose connections and one 4-1/2 inch pumper connection. Outlets shall have American National Standard fire-hose coupling threads. Working parts shall be bronze. Design, material, and workmanship shall be equal to the latest stock pattern ordinarily produced by the manufacturer. Hydrants shall be painted with 1 coat of red iron oxide, zinc oxide primer conforming to SSPC Paint 25 and 2 finish coats of silicone alkyd paint conforming to SSPC Paint 21, of the installation's standard colors or as directed by the Contracting Officer. Suitable bronze adapter for each outlet, with caps, shall be furnished.

2.7 MISCELLANEOUS ITEMS

2.7.1 Tapping Sleeves

Tapping sleeves of the sizes indicated for connection to existing main shall be the cast gray, ductile, or malleable iron, split-sleeve type with flanged or grooved outlet, and with bolts, follower rings and gaskets on each end of the sleeve. Construction shall be suitable for a maximum working pressure of 150 psi. Bolts shall have square heads and hexagonal nuts. Longitudinal gaskets and mechanical joints with gaskets shall be as recommended by the manufacturer of the sleeve. When using grooved mechanical tee, it shall consist of an upper housing with full locating collar for rigid positioning which engages a machine-cut hole in pipe, encasing an elastomeric gasket which conforms to the pipe outside diameter around the hole and a lower housing with positioning lugs, secured together during assembly by nuts and bolts as specified, pretorqued to 50 foot-pound.

2.7.2 Disinfection

Chlorinating materials shall conform to the following:

Chlorine, Liquid: AWWA B301.

Hypochlorite, Calcium and Sodium: AWWA B300.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Cutting of Pipe

Cutting of pipe shall be done in a neat and workmanlike manner without damage to the pipe. Unless otherwise recommended by the manufacturer and authorized by the Contracting Officer, cutting shall be done with an approved type mechanical cutter. Wheel cutter shall be used when practicable.

3.1.2 Adjacent Facilities

3.1.2.1 Sewer Lines

Where the location of the water pipe is not clearly defined in dimensions on the drawings, the water pipe shall not be laid closer horizontally than 10 feet from a sewer except where the bottom of the water pipe will be at least 12 inches above the top of the sewer pipe, in which case the water pipe shall not be laid closer horizontally than 6 feet from the sewer. Where water lines cross under gravity-flow sewer lines, the sewer pipe, for a distance of at least 10 feet each side of the crossing, shall be fully encased in concrete or shall be made of pressure pipe with no joint located within 3 feet horizontally of the crossing. Water lines shall in all cases cross above sewage force mains or inverted siphons and shall be not less than 2 feet above the sewer main. Joints in the sewer main, closer horizontally than 3 feet to the crossing, shall be encased in concrete.

3.1.2.2 Water Lines

Water lines shall not be laid in the same trench with sewer lines, gas lines, fuel lines, or electric wiring.

3.1.2.3 Structures

Where water pipe is required to be installed within 3 feet of existing structures, the water pipe shall be sleeved as required in Paragraph "Casing Pipe". The Contractor shall install the water pipe and sleeve ensuring that there will be no damage to the structures and no settlement or movement of foundations or footings.

3.1.3 Joint Deflection

3.1.3.1 Offset for Flexible Plastic Pipe

Maximum offset in alignment between adjacent pipe joints shall be as recommended by the manufacturer and approved by the Contracting Officer, but shall not exceed 5 degrees.

3.1.4 Placing and Laying

Pipe and accessories shall be carefully lowered into the trench by means of derrick, ropes, belt slings, or other authorized equipment. Water-line materials shall not be dropped or dumped into the trench. Abrasion of the pipe coating shall be avoided. Except where necessary in making connections with other lines or as authorized by the Contracting Officer, pipe shall be laid with the bells facing in the direction of laying. The full length of each section of pipe shall rest solidly upon the pipe bed, with recesses excavated to accommodate bells, couplings, and joints. Pipe that has the grade or joint disturbed after laying shall be taken up and relaid. Pipe shall not be laid in water or when trench conditions are unsuitable for the work. Water shall be kept out of the trench until joints are complete. When work is not in progress, open ends of pipe, fittings, and valves shall be securely closed so that no trench water, earth, or other substance will enter the pipes or fittings. Where any part of the coating or lining is damaged, the repair shall be made by and at the Contractor's expense in a satisfactory manner. Pipe ends left for future connections shall be valved, plugged, or capped, and anchored, as shown.

3.1.4.1 Plastic Pipe Installation

RTRP shall be installed in accordance with ASTM D 3839. RPMP shall be installed in accordance with the manufacturer's recommendations. PE Pipe shall be installed in accordance with ASTM D 2774. PVC pipe shall be installed in accordance with AWWA M23.

3.1.4.2 Piping Connections

Where connections are made between new work and existing mains, the connections shall be made by using specials and fittings to suit the actual conditions. When made under pressure, these connections shall be installed using standard methods as approved by the Contracting Officer. Connections to existing asbestos-cement pipe shall be made in accordance with ACPPA 1344.

3.1.4.3 Penetrations

Pipe passing through walls of valve pits and structures shall be provided with ductile-iron or Schedule 40 steel wall sleeves. Annular space between walls and sleeves shall be filled with rich cement mortar. Annular space between pipe and sleeves shall be filled with mastic.

3.1.4.4 Flanged Pipe

Flanged pipe shall only be installed above ground or with the flanges in valve pits.

3.1.5 Jointing

3.1.5.1 PVC Plastic Pipe Requirements

a. Pipe 4 through 12 inch diameter: Joints shall be elastomeric gasket as specified in AWWA C900. Jointing procedure shall be as specified for pipe less than 4 inch diameter with configuration using elastomeric ring gasket.

3.1.5.2 Transition Fittings

Connections between different types of pipe and accessories shall be made with transition fittings approved by the Contracting Officer.

3.1.6 Installation of Service Lines

Service lines shall include the pipeline connecting building piping to water distribution lines to the connections with the building service at a point approximately 5 feet outside the building where such building service exists. Where building services are not installed, the Contractor shall terminate the service lines approximately 5 feet from the site of the proposed building at a point designated by the Contracting Officer. Such service lines shall be closed with plugs or caps. All service stops and valves shall be provided with service boxes. Service lines shall be constructed in accordance with the following requirements:

3.1.6.1 Service Lines Larger than 50 mm (2 Inches)

Service lines larger than 2 inches shall be connected to the main by a tapped saddle, tapping sleeve and valve, service clamp or reducing tee, depending on the main diameter and the service line diameter, and shall have a gate valve. Lines 3 inches and larger may use gate valves.

3.1.6.2 Service Lines for Sprinkler Supplies

Water service lines used to supply building sprinkler systems for fire protection shall be connected to the water distribution main in accordance with NFPA 24.

3.1.7 Setting of Fire Hydrants, Meters, Valves and Valve Boxes

3.1.7.1 Location of Fire Hydrants

Fire hydrants shall be located and installed as shown. Each hydrant shall be connected to the main with a 6 inch branch line having at least as much cover as the distribution main. Hydrants shall be set plumb with pumper nozzle facing the roadway, with the center of the lowest outlet not less than 18 inches above the finished surrounding grade, and the operating nut not more than 48 inches above the finished surrounding grade. Fire hydrants designated on the drawings as low profile shall have the lowest outlet not less than 18 inches above the finished surrounding grade, the top of the hydrant not more than 24 inches above the finished surrounding

grade. Except where approved otherwise, the backfill around hydrants shall be thoroughly compacted to the finished grade immediately after installation to obtain beneficial use of the hydrant as soon as practicable. The hydrant shall be set upon a slab of concrete not less than 4 inches thick and 15 inchessquare. Not less than 7 cubic feet of free-draining broken stone or gravel shall be placed around and beneath the waste opening of dry barrel hydrants to ensure drainage.

3.1.7.2 Location of Valves

After delivery, valves, including those in hydrants, shall be drained to prevent freezing and shall have the interiors cleaned of all foreign matter before installation. Stuffing boxes shall be tightened and hydrants and valves shall be fully opened and fully closed to ensure that all parts are in working condition. Check, pressure reducing, vacuum, and air relief valves shall be installed in valve pits. Valves and valve boxes shall be installed where shown or specified, and shall be set plumb. Valve boxes shall be centered on the valves. Boxes shall be installed over each outside gate valve unless otherwise shown. Where feasible, valves shall be located outside the area of roads and streets. Earth fill shall be tamped around each valve box or pit to a distance of 4 feet on all sides of the box, or the undisturbed trench face if less than 4 feet.

3.1.8 Tapped Tees and Crosses

Tapped tees and crosses for future connections shall be installed where shown.

3.1.9 Thrust Restraint

Plugs, caps, tees and bends deflecting 11.25 degrees or more, either vertically or horizontally, on waterlines 4 inches in diameter or larger, and fire hydrants shall be provided with thrust restraints. Valves shall be securely anchored or shall be provided with thrust restraints to prevent movement. Thrust restraints shall be thrust blocks.

3.1.9.1 Thrust Blocks

Thrust blocking shall be concrete of a mix not leaner than: 1 cement, 2-1/2 sand, 5 gravel; and having a compressive strength of not less than 2,000 psi after 28 days. Blocking shall be placed between solid ground and the hydrant or fitting to be anchored. Unless otherwise indicated or directed, the base and thrust bearing sides of thrust blocks shall be poured directly against undisturbed earth. The sides of thrust blocks not subject to thrust may be poured against forms. The area of bearing shall be as shown or as directed. Blocking shall be placed so that the fitting joints will be accessible for repair. Steel rods and clamps, protected by galvanizing or by coating with bituminous paint, shall be used to anchor vertical down bends into gravity thrust blocks.

3.2 HYDROSTATIC TESTS

Where any section of a water line is provided with concrete thrust blocking for fittings or hydrants, the hydrostatic tests shall not be made until at least 5 days after installation of the concrete thrust blocking, unless otherwise approved.

3.2.1 Pressure Test

After the pipe is laid, the joints completed, fire hydrants permanently installed, and the trench partially backfilled leaving the joints exposed for examination, the newly laid piping or any valved section of piping shall, unless otherwise specified, be subjected for 1 hour to a hydrostatic pressure test of 200 psi. Water supply lines designated on the drawings shall be subjected for 1 hour to a hydrostatic pressure test of 200 psi. Each valve shall be opened and closed several times during the test. Exposed pipe, joints, fittings, hydrants, and valves shall be carefully examined during the partially open trench test. Joints showing visible leakage shall be replaced or remade as necessary. Cracked or defective pipe, joints, fittings, hydrants and valves discovered in consequence of this pressure test shall be removed and replaced with sound material, and the test shall be repeated until the test results are satisfactory. The requirement for the joints to remain exposed for the hydrostatic tests may be waived by the Contracting Officer when one or more of the following conditions is encountered:

a. Wet or unstable soil conditions in the trench.

b. Compliance would require maintaining barricades and walkways around and across an open trench in a heavily used area that would require continuous surveillance to assure safe conditions.

c. Maintaining the trench in an open condition would delay completion of the project.

The Contractor may request a waiver, setting forth in writing the reasons for the request and stating the alternative procedure proposed to comply with the required hydrostatic tests. Backfill placed prior to the tests shall be placed in accordance with the requirements of Section 02300 EARTHWORK.

3.2.2 Leakage Test

Leakage test shall be conducted after the pressure tests have been satisfactorily completed. The duration of each leakage test shall be at least 2 hours, and during the test the water line shall be subjected to not less than 200 psi pressure. Water supply lines designated on the drawings shall be subjected to a pressure equal to 200 psi. Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved or approved section, necessary to maintain pressure within 5 psi of the specified leakage test pressure after the pipe has been filled with water and the air expelled. Piping installation will not be accepted if leakage exceeds the allowable leakage which is determined by the following formula:

L = 0.0001351ND(P raised to 0.5 power)

L = Allowable leakage in gallons per hour
N = Number of joints in the length of pipeline tested
D = Nominal diameter of the pipe in inches
P = Average test pressure during the leakage test, in psi gauge

Should any test of pipe disclose leakage greater than that calculated by the above formula, the defective joints shall be located and repaired until the leakage is within the specified allowance, without additional cost to the Government.

3.2.3 Time for Making Test

Except for joint material setting or where concrete thrust blocks necessitate a 5-day delay, pipelines jointed with rubber gaskets, mechanical or push-on joints, or couplings may be subjected to hydrostatic pressure, inspected, and tested for leakage at any time after partial completion of backfill. Cement-mortar lined pipe may be filled with water as recommended by the manufacturer before being subjected to the pressure test and subsequent leakage test.

3.2.4 Concurrent Hydrostatic Tests

The Contractor may elect to conduct the hydrostatic tests using either or both of the following procedures. Regardless of the sequence of tests employed, the results of pressure tests, leakage tests, and disinfection shall be as specified. Replacement, repair or retesting required shall be accomplished by the Contractor at no additional cost to the Government.

a. Pressure test and leakage test may be conducted concurrently.

b. Hydrostatic tests and disinfection may be conducted concurrently, using the water treated for disinfection to accomplish the hydrostatic tests. If water is lost when treated for disinfection and air is admitted to the unit being tested, or if any repair procedure results in contamination of the unit, disinfection shall be reaccomplished.

3.3 BACTERIOLOGICAL DISINFECTION

3.3.1 Disinfection Procedure

Before acceptance of potable water operation, each unit of completed waterline shall be disinfected as specified. After pressure tests have been made, the unit to be disinfected shall be thoroughly flushed with water until all entrained dirt and mud have been removed before introducing the chlorinating material. The chlorinating material shall be either liquid chlorine, calcium hypochlorite, or sodium hypochlorite, conforming to paragraph MISCELLANEOUS ITEMS. The chlorinating material shall provide a dosage of not less than 50 ppm and shall be introduced into the water lines in an approved manner. Polyvinyl Chloride (PVC) pipe lines shall be chlorinated using only the above specified chlorinating material in solution. The agent shall not be introduced into the line in a dry solid state. The treated water shall be retained in the pipe long enough to destroy all non-spore forming bacteria. Except where a shorter period is approved, the retention time shall be at least 24 hours and shall produce not less than 25 ppm of free chlorine residual throughout the line at the end of the retention period. Valves on the lines being disinfected shall be opened and closed several times during the contact period. The line shall then be flushed with clean water until the residual chlorine is reduced to less than 1.0 ppm. During the flushing period, each fire hydrant on the line shall be opened and closed several times.

3.3.2 Sampling

From several points in the unit, personnel from the Contractor's commercial laboratory shall take at least 3 water samples from different points, approved by the Contracting Officer, in proper sterilized containers and perform a bacterial examination in accordance with state approved methods.

The commercial laboratory shall be certified by the state's approving authority for examination of potable water.

3.3.3 Acceptance Requirements

The disinfection shall be repeated until tests indicate the absence of pollution for at least 2 full days. The unit will not be accepted until satisfactory bacteriological results have been obtained.

3.4 CLEANUP

Upon completion of the installation of water lines, and appurtenances, all debris and surplus materials resulting from the work shall be removed. The Contractor shall submit a statement of Satisfactory Installation as specified in the Submittals paragraph.

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SECTION 02531

SANITARY SEWERS
07/03

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE-OF-WAY ASSOCIATION (AREMA)

AREMA 1-5	(2001; R 2002) Pipelines

ASTM INTERNATIONAL (ASTM)

ASTM A 48	(1994ae1) Gray Iron Castings
ASTM C 150	(2002a) Portland Cement
ASTM C 260	(2001) Air-Entraining Admixtures for Concrete
ASTM C 270	(2002) Mortar for Unit Masonry
ASTM C 33	(2002a) Concrete Aggregates
ASTM C 443	(2002) Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM C 478	(2002a) Precast Reinforced Concrete Manhole Sections
ASTM C 478M	(1997) Precast Reinforced Concrete Manhole Sections (Metric)
ASTM C 923	(2002) Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals
ASTM C 94/C 94M	(2000e2) Ready-Mixed Concrete
ASTM C 969	(2002) Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
ASTM C 990	(2001a) Joints for Concrete Pipe,

	Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealers
ASTM D 2321	(2000) Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D 2412	(2002) Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
ASTM D 3034	(2000) Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D 3212	(1996a) Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D 4101	(2002a) Propylene Injection and Extrusion Materials
ASTM D 412	(1998a) Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension
ASTM D 624	(2000e1) Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
ASTM F 477	(2002e1) Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F 949	(2001a) Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS A-A-60005	(Basic) Frames, Covers, Gratings, Steps, Sump and Catch Basin, Manhole

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.27	Fixed Ladders

UNI-BELL PVC PIPE ASSOCIATION (UBPPA)

UBPPA UNI-B-6	(1998) Recommended Practice for the Low-Pressure Air Testing of Installed Sewer Pipe

1.2 GENERAL REQUIREMENTS

The construction required herein shall include appurtenant structures and building sewers to points of connection with the building drains 5 feet outside the building to which the sewer system is to be connected. The Contractor shall replace damaged material and redo unacceptable work at no additional cost to the Government. Excavation and backfilling is specified in Section 02300 EARTHWORK. Backfilling shall be accomplished after inspection by the Contracting Officer. Before, during, and after

installation, plastic pipe and fittings shall be protected from any environment that would result in damage or deterioration to the material. The Contractor shall have a copy of the manufacturer's instructions available at the construction site at all times and shall follow these instructions unless directed otherwise by the Contracting Officer. Solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials required to install the plastic pipe shall be stored in accordance with the manufacturer's recommendation and shall be discarded if the storage period exceeds the recommended shelf life. Solvents in use shall be discarded when the recommended pot life is exceeded.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Precast concrete manhole

Metal items

Frames, covers, and gratings

SD-03 Product Data

Pipeline materials

Submit manufacturer's standard drawings or catalog cuts.

SD-07 Certificates

Portland Cement

Certificates of compliance stating the type of cement used in manufacture of concrete pipe, fittings and precast manholes.

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 Delivery and Storage

1.4.1.1 Piping

Inspect materials delivered to site for damage; store with minimum of handling. Store materials on site in enclosures or under protective coverings. Store rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes and fittings free of dirt and debris.

1.4.1.2 Metal Items

Check upon arrival; identify and segregate as to types, functions, and sizes. Store off the ground in a manner affording easy accessibility and

not causing excessive rusting or coating with grease or other objectionable materials.

1.4.2 Handling

Handle pipe, fittings, and other accessories in such manner as to ensure delivery to the trench in sound undamaged condition. Carry, do not drag, pipe to trench.

PART 2 PRODUCTS

2.1 PIPELINE MATERIALS

Pipe shall conform to the respective specifications and other requirements specified below.

2.1.1 PVC Plastic Gravity Sewer Piping

2.1.1.1 PVC Plastic Gravity Pipe and Fittings

ASTM D 3034, SDR 35, or ASTM F 949 with ends suitable for elastomeric gasket joints.

2.1.1.2 PVC Plastic Gravity Joints and Jointing Material

Joints shall conform to ASTM D 3212. Gaskets shall conform to ASTM F 477.

2.2 CONCRETE MATERIALS

2.2.1 Cement Mortar

Cement mortar shall conform to ASTM C 270, Type M with Type II cement.

2.2.2 Portland Cement

Portland cement shall conform to ASTM C 150, Type II for concrete used in manholes and type optional with the Contractor for cement used in concrete cradle, concrete encasement, and thrust blocking. Air-entraining admixture conforming to ASTM C 260 shall be used with Type V cement. Where aggregates are alkali reactive, as determined by Appendix XI of ASTM C 33, a cement containing less than 0.60 percent alkalies shall be used.

2.2.3 Portland Cement Concrete

Portland cement concrete shall conform to ASTM C 94/C 94M, compressive strength of 4000 psi at 28 days, except for concrete cradle and encasement or concrete blocks for manholes. Concrete used for cradle and encasement shall have a compressive strength of 2500 psiminimum at 28 days. Concrete in place shall be protected from freezing and moisture loss for 7 days. Text

2.3 MISCELLANEOUS MATERIALS

2.3.1 Precast Concrete Manholes

Precast concrete manhole risers, base sections, and tops shall conform to ASTM C 478; base and first riser shall be monolithic.

2.3.2 Gaskets and Connectors

Gaskets for joints between manhole sections shall conform to ASTM C 443. Resilient connectors for making joints between manhole and pipes entering manhole shall conform to ASTM C 923 or ASTM C 990.

2.3.3 External Preformed Rubber Joint Seals

An external preformed rubber joint seal shall be an accepted method of sealing cast iron covers to precast concrete sections to prevent ground water infiltration into sewer systems. All finished and sealed manholes constructed in accordance with paragraph entitled "Manhole Construction" shall be tested for leakage in the same manner as pipelines as described in paragraph entitled "Leakage Tests." The seal shall be multi-section with a neoprene rubber top section and all lower sections made of Ethylene Proplene Di Monomer (EPDM) rubber with a minimum thickness of 60 mils. Each unit shall consist of a top and bottom section and shall have mastic on the bottom of the bottom section and mastic on the top and bottom of the top section. The mastic shall be a non-hardening butyl rubber sealant and shall seal to the cone/top slab of the manhole/catch basin and over the lip of the casting. Extension sections shall cover up to two more adjusting rings. Properties and values are listed in the following tables:

Properties, Test Methods and Minimum Values for
Rubber used in Preformed Joint Seals

Physical Properties	Test Methods	EPDM	Neoprene	Butyl mastic
Tensile, psi	ASTM D 412	1840	2195	-
Elogation percent	ASTM D 412	553	295	350
Tear Resistance, ppi	ASTM D 624 (Die B)	280	160	-

2.3.4 Metal Items

2.3.4.1 Frames, Covers, and Gratings for Manholes

FS A-A-60005, cast iron; figure numbers shall be as indicated:

Frames and covers shall be cast iron, ductile iron or reinforced concrete. Cast iron frames and covers shall be as indicated or shall be of type suitable for the application, circular, without vent holes. The frames and covers shall have a combined weight of not less than 400 pounds. Reinforced concrete frames and covers shall be as indicated or shall conform to ASTM A 48 or ASTM C 478M. The word "Sewer" shall be stamped or cast into covers so that it is plainly visible.

2.3.4.2 Manhole Steps

Zinc-coated steel conforming to 29 CFR 1910.27. As an option, plastic or rubber coating pressure-molded to the steel may be used. Plastic coating shall conform to ASTM D 4101, copolymer polypropylene. Rubber shall conform to ASTM C 443, except shore A durometer hardness shall be 70 plus or minus

5. Aluminum steps or rungs will not be permitted. Steps are not required in manholes less than 4 feet deep.

PART 3 EXECUTION

3.1 INSTALLATION OF PIPELINES AND APPURTENANT CONSTRUCTION

3.1.1 General Requirements for Installation of Pipelines

Apply except where specific exception is made in the following paragraphs entitled "Special Requirements."

3.1.1.1 Location

The work covered by this section shall terminate at a point approximately 5 feet from the building. Where the location of the sewer is not clearly defined by dimensions on the drawings, do not lay sewer line closer horizontally than 10 feet to a water main or service line.

3.1.1.2 Earthwork

Perform earthwork operations in accordance with Section 02300 EARTHWORK.

3.1.1.3 Connections to Existing Lines

Obtain approval from the Contracting Officer before making connection to existing line. Conduct work so that there is minimum interruption of service on existing line.

3.1.2 Special Requirements

3.1.2.1 Installation of PVC Plastic Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the requirements of ASTM D 2321 for laying and joining pipe and fittings. Make joints with the gaskets specified for joints with this piping and assemble in accordance with the requirements of ASTM D 2321 for assembly of joints. Make joints to other pipe materials in accordance with the recommendations of the plastic pipe manufacturer.

3.1.2.2 Pipeline Installation Beneath Railroad Right-of-Way

Where pipeline passes under the right-of-way of a commercial railroad, install piping in accordance with the specifications for pipelines conveying nonflammable substances in AREMA 1-5.

3.1.3 Concrete Work

Cast-in-place concrete is included in Section 03300, "Cast-In-Place Concrete."

The pipe shall be supported on a concrete cradle, or encased in concrete where indicated or directed.

3.1.4 Manhole Construction

Construct base slab of cast-in-place concrete or use precast concrete base sections. Make inverts in cast-in-place concrete and precast concrete bases with a smooth-surfaced semi-circular bottom conforming to the inside contour of the adjacent sewer sections. For changes in direction of the sewer and entering branches into the manhole, make a circular curve in the manhole invert of as large a radius as manhole size will permit. For cast-in-place concrete construction, either pour bottom slabs and walls integrally or key and bond walls to bottom slab. No parging will be permitted on interior manhole walls. For precast concrete construction, make joints between manhole sections with the gaskets specified for this purpose; install in the manner specified for installing joints in concrete piping. Parging will not be required for precast concrete manholes. Cast-in-place concrete work shall be in accordance with the requirements specified under paragraph entitled "Concrete Work" of this section. Make joints between concrete manholes and pipes entering manholes with the resilient connectors specified for this purpose; install in accordance with the recommendations of the connector manufacturer. Where a new manhole is constructed on an existing line, remove existing pipe as necessary to construct the manhole. Cut existing pipe so that pipe ends are approximately flush with the interior face of manhole wall, but not protruding into the manhole. Use resilient connectors as previously specified for pipe connectors to concrete manholes.

3.1.5 Miscellaneous Construction and Installation

3.1.5.1 Connecting to Existing Manholes

Pipe connections to existing manholes shall be made so that finish work will conform as nearly as practicable to the applicable requirements specified for new manholes, including all necessary concrete work, cutting, and shaping. The connection shall be centered on the manhole. Holes for the new pipe shall be of sufficient diameter to allow packing cement mortar around the entire periphery of the pipe but no larger than 1.5 times the diameter of the pipe. Cutting the manhole shall be done in a manner that will cause the least damage to the walls.

3.1.5.2 Metal Work

a. Workmanship and finish: Perform metal work so that workmanship and finish will be equal to the best practice in modern structural shops and foundries. Form iron to shape and size with sharp lines and angles. Do shearing and punching so that clean true lines and surfaces are produced. Make castings sound and free from warp, cold shuts, and blow holes that may impair their strength or appearance. Give exposed surfaces a smooth finish with sharp well-defined lines and arises. Provide necessary rabbets, lugs, and brackets wherever necessary for fitting and support.

3.2 FIELD QUALITY CONTROL

3.2.1 Field Tests and Inspections

The Contracting Officer will conduct field inspections and witness field tests specified in this section. The Contractor shall perform field tests and provide labor, equipment, and incidentals required for testing. Be

able to produce evidence, when required, that each item of work has been constructed in accordance with the drawings and specifications.

3.2.2 Tests for Nonpressure Lines

Check each straight run of pipeline for gross deficiencies by holding a light in a manhole; it shall show a practically full circle of light through the pipeline when viewed from the adjoining end of line. When pressure piping is used in a nonpressure line for nonpressure use, test this piping as specified for nonpressure pipe.

3.2.2.1 Leakage Tests

Test lines for leakage by either infiltration tests or exfiltration tests, or by low-pressure air tests. Prior to testing for leakage, backfill trench up to at least lower half of pipe. When necessary to prevent pipeline movement during testing, place additional backfill around pipe sufficient to prevent movement, but leaving joints uncovered to permit inspection. When leakage or pressure drop exceeds the allowable amount specified, make satisfactory correction and retest pipeline section in the same manner. Correct visible leaks regardless of leakage test results.

a. Infiltration tests and exfiltration tests: Perform these tests for sewer lines made of the specified materials, not only concrete, in accordance with ASTM C 969. Make calculations in accordance with the Appendix to ASTM C 969.

b. Low-pressure air tests: Perform tests as follows:

(1) PVC plastic pipelines: Test in accordance with UBPPA UNI-B-6. Allowable pressure drop shall be as given in UBPPA UNI-B-6. Make calculations in accordance with the Appendix to UBPPA UNI-B-6.

3.2.2.2 Deflection Testing

Perform a deflection test on entire length of installed plastic pipeline on completion of work adjacent to and over the pipeline, including leakage tests, backfilling, placement of fill, grading, paving, concreting, and any other superimposed loads determined in accordance with ASTM D 2412. Deflection of pipe in the installed pipeline under external loads shall not exceed 4.5 percent of the average inside diameter of pipe. Determine whether the allowable deflection has been exceeded by use of a pull-through device or a deflection measuring device.

a. Pull-through device: This device shall be a spherical, spheroidal, or elliptical ball, a cylinder, or circular sections fused to a common shaft. Circular sections shall be so spaced on the shaft that distance from external faces of front and back sections will equal or exceed diameter of the circular section. Pull-through device may also be of a design promulgated by the Uni-Bell Plastic Pipe Association, provided the device meets the applicable requirements specified in this paragraph, including those for diameter of the device, and that the mandrel has a minimum of 9 arms. Ball, cylinder, or circular sections shall conform to the following:

(1) A diameter, or minor diameter as applicable, of 95 percent of the average inside diameter of the pipe; tolerance of plus 0.5

percent will be permitted.

(2) Homogeneous material throughout, shall have a density greater than 1.0 as related to water at 39.2 degrees F, and shall have a surface Brinell hardness of not less than 150.

(3) Center bored and through-bolted with a 1/4 inch minimum diameter steel shaft having a yield strength of not less than 70,000 pounds per square inch, with eyes or loops at each end for attaching pulling cables.

(4) Each eye or loop shall be suitably backed with a flange or heavy washer such that a pull exerted on opposite end of shaft will produce compression throughout remote end.

b. Deflection measuring device: Sensitive to 1.0 percent of the diameter of the pipe being tested and shall be accurate to 1.0 percent of the indicated dimension. Deflection measuring device shall be approved prior to use.

c. Pull-through device procedure: Pass the pull-through device through each run of pipe, either by pulling it through or flushing it through with water. If the device fails to pass freely through a pipe run, replace pipe which has the excessive deflection and completely retest in same manner and under same conditions.

d. Deflection measuring device procedure: Measure deflections through each run of installed pipe. If deflection readings in excess of 4.5 percent of average inside diameter of pipe are obtained, retest pipe by a run from the opposite direction. If retest continues to show a deflection in excess of 4.5 percent of average inside diameter of pipe, replace pipe which has excessive deflection and completely retest in same manner and under same conditions.

3.2.3 Field Tests for Concrete

Field testing requirements are covered in Section 03300 CAST IN PLACE STRUCTURAL CONCRETE.

-- End of Section --

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SECTION 02552A

PRE-ENGINEERED UNDERGROUND HEAT DISTRIBUTION SYSTEM
01/04

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 300	(2002) Inorganic Zinc Rich Primer

ASTM INTERNATIONAL (ASTM)

ASTM A 106	(2002a) Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A 134	(1996; R 2001) Pipe, Steel, Electric-Fusion (Arc)-Welded (Sizes NPS 16 and Over)
ASTM A 135	(2001) Electric-Resistance-Welded Steel Pipe
ASTM A 139	(2000) Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over)
ASTM A 167	(1999) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 234/A 234M	(2002) Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
ASTM A 36/A 36M	(2001) Carbon Structural Steel
ASTM A 53/A 53M	(2002) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM D 2487	(2000) Soils for Engineering Purposes (Unified Soil Classification System)

ASME INTERNATIONAL (ASME)

ASME B16.11	(2002) Forged Fittings, Socket-Welding and Threaded
ASME B16.9	(2001) Factory-Made Wrought Steel Buttwelding Fittings

ASME B31.1	(2001) Power Piping
ASME B40.100	(2000) Pressure Gauges and Gauge Attachments

ISA - THE INSTRUMENTATION, SYSTEMS AND AUTOMATION SOCIETY (ISA)

ISA MC96.1	(1982) Temperature Measurement Thermocouples

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Heat Distribution System; G-AO.

A complete description of the design and assembly of the system, materials of construction and field installation instructions, not later than 21 days prior to the start of field measurements. Submittal shall also include sufficient system details to show that the specified minimum insulation thickness has been met. A detailed design layout of the system (plan and elevation views) showing size, type, elevations and location of each component to be used in the system, the design and location of anchors, pipe guides, pipe supports, expansion loops, Z-bends, L-bends, end seals, leak plates, joint locations, pipe and insulation thickness and sizes, types, and movements, connection to manhole and building wall penetrations, and including, if applicable, details of transition point to aboveground or other type systems. Also, if applicable, type and details of the cathodic protection system to be used. Detailed design layout drawings shall be stamped by a registered Professional Engineer.

SD-03 Product Data

Expansion Loops and Bends; G-AE.

Piping system product data including carrier pipe, conduit, insulation, spacers, etc. Pipe-stress and system-expansion calculations for each expansion compensation elbow using a finite element computer generated 3 dimensional analysis, not later than 7 days after notice to proceed. Calculations shall demonstrate that pipe stresses from temperature changes are within the allowable requirements in ASME B31.1 and that the anchors and the guides will withstand the resultant forces. Detailed design layout drawings shall include all analysis node points. As a minimum, computer analysis results shall include node stresses, forces, moments and displacements. Calculations shall be stamped by a registered Professional Engineer in the employ of the UHDS manufacturer.

Cathodic Protection Installation; G-AO.

Design life calculations for the cathodic protection system, not later than 7 days after notice to proceed. Calculations shall be stamped by an NACE qualified corrosion engineer.

Interruption of Existing Service; G-AO.

Schedule of proposed outages and interruptions of existing services, 14 days in advance.

Work Plan; G-AO.

A proposed schedule of activities, not later than 2 days after notice to proceed.

Quality Assurance Plan

Manufacturer's quality assurance plan not later than 2 days after notice to proceed.

UHDS Manufacturer's Representative Reports

A daily written report from the representative of the UHDS manufacturer, whenever the representative is required to be on the jobsite.

Connecting to Existing Work; G-AO.

Changes required to the UHDS design due to interferences or conflicts, upon realization of interferences or conflicts.

SD-06 Test Reports

Thermal Performance Testing; G-AO.

Manufacturer's data sheets on all UHDS components and the instrumentation required for thermal performance testing, 2 days after notice to proceed. Because of its geometry, the PIPI system is exempt from the thermal performance test requirement.

Operational Test; G-AO.

Schedule of testing, 14 days in advance.

Tests; G-AO.

A proposed test procedure and proposed samples of test data sheets for each required test, 30 days prior to the proposed test date. The procedure shall contain a complete description of the proposed test with calibration curves or test results furnished by an independent testing laboratory of each instrument, meter, gauge, and thermometer to be used in the tests. The test shall not commence until the procedure has been approved.

Test reports in booklet form showing all factory and field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system.

SD-07 Certificates

Manufacturer; G-AO.

Certification stating that the UHDS manufacturer regularly and currently manufactures direct-buried systems, and that the designs of the system and equipment to be provided for this project conform to specification requirements. This certification shall be an original signed by a principal officer of the UHDS manufacturer and shall be submitted at least 2 weeks prior to the start of work.

Manufacturer's Representative; G-AO.

A letter from the system manufacturer, at least 2 weeks prior to the start of work, listing the experience and training of the manufacturer's representative.

UHDS Design; G-AO

A Certificate of Satisfactory Operation certifying that at least 3 systems installed by the UHDS manufacturer within the previous 5 years are operating satisfactorily, not later than 7 days after notice to proceed.

Certificate of Compliance; G-AO.

Upon completion of the work, and before final acceptance, a notarized statement signed by a principal officer of both the UHDS manufacturer and the Contractor, certifying that the system has been installed satisfactorily and in accordance with the contract drawings, specifications, UHDS manufacturer's detailed design layout drawings and with the UHDS manufacturer's recommendations.

Testing Firm

A Certificate of Qualification from the independent testing firm or firms, not later than 7 days after notice to proceed.

Welding

Certification of Acceptability of all welds made in the field, upon completion of the project. This certification shall consist of a letter, signed by an official of the independent testing firm or firms examining welds, stating that all provisions of this specification have been complied with, and that all welds inspected radiographically have met the specified acceptability standards.

SD-10 Operation and Maintenance Data

Heat Distribution System; G-AO.

Operation and maintenance manual listing routine maintenance procedures, possible breakdowns and repairs, procedures for recording conduit temperatures biannually, and troubleshooting guides, before completion of work. Manual shall include as-built piping layout of the system including final elevations.

1.3 DEFINITIONS

The following definitions shall apply to the work.

1.3.1 Heat Distribution System

A complete pre-engineered, underground heat distribution system including all required components such as carrier pipes, high temperature hot water supply pipe, high temperature hot water return pipe, and fittings, anchors, pipe supports, insulation, protective casing, and cathodic protection, for the system supplied. The pre-engineered system does not include valve manholes and the piping and equipment inside the valve manholes; Section 02560 VALVES, PIPING, AND EQUIPMENT IN VALVE MANHOLES shall be used for pertinent requirements. The pre-engineered system shall include all piping and components to a point at least 6 inches inside the building and valve manhole walls. The UHDS shall not use any part of the building or valve manhole structure as an anchor point.

1.3.2 Direct-Buried

A system which is buried, without the need for a field-fabricated protective enclosure such as a concrete trench or tunnel.

1.3.3 UHDS Types

1.3.3.1 Drainable-Dryable-Testable (DDT) Direct-Buried System

A factory-fabricated system including an air and water-tight outer protective casing, air space and an insulated carrier pipe. Drains and vents are provided at the end plates of the system (in manholes or buildings). The drains are normally capped but the caps can be removed to drain water which may leak into the air space if there is a failure in the casing or the carrier pipe. The vents allow water vapor to escape and provide a tell-tale sign of leakage.

1.4 WORK DESCRIPTION

1.4.1 Scope

The work shall include the design and fabrication; furnishing; installing, and testing of a direct buried underground insulated heat-distribution system and insulated high temperature hot water supply pipe, insulated high temperature hot water return pipe consisting of piping as indicated, cathodic protection system (where required by this specification), together with fittings and appurtenances necessary for a complete and operable system. Gland type end seals will not be permitted. DDT systems with fiberglass casings shall not be provided.

1.4.2 UHDS Design

The UHDS manufacturer shall be responsible for the complete design of the UHDS, the product to be supplied, fabrication, witnessing installation and testing of the system within the design parameters established by the contract drawings and specifications, and in compliance with the detailed design. The complete design of the UHDS shall be sealed by a Professional Engineer in the employ of the UHDS manufacturer.

1.4.3 Contract drawings

The contract drawings accompanying this specification provide information on:

a. The size of carrier pipes, approximate length, and site location of the system.

b. The routing and elevation of the piping along the route.

c. Location and design of manholes.

d. The obstacles that must be avoided along the path.

e. Location of piping anchors (anchors will be no closer than 3 feet or further than 5 feet from entrance to manholes or buildings) at manholes and/or buildings. The UHDS manufacturer shall incorporate anchors as needed for the system.

f. Operating pressure and temperature of system.

1.5 QUALIFICATIONS

1.5.1 Manufacturer

The UHDS manufacturer is the company responsible for the design and manufacture of the pre-engineered system. The manufacturer shall submit certification of past experience as specified in the submittals paragraph; the certificate shall indicate the location, type of system, size of system, point of contact (POC) including phone number, for information verification. This certificate of satisfactory operation shall be an original signed by a principal officer of the UHDS manufacturer. The UHDS manufacturer directs the installation of the system and has a representative on the jobsite. The manufacturer shall submit a Work Plan indicating when various items of work and tests are to be carried out and when its representative will be present at job site. The manufacturer shall submit a list of characteristics indicating what defects or damage will necessitate replacement. The manufacturer shall submit a Quality Assurance Plan for fabrication, delivery, storage, installation and testing of the system. The manufacturer shall submit data sheets for all coatings and indicating thicknesses of insulation for carrier pipes.

1.5.2 Manufacturer's Representative

The UHDS manufacturer's representative shall be a person who regularly performs the duties specified, is certified in writing by the UHDS manufacturer to be technically qualified and experienced in the installation of the system, and shall be authorized by the manufacturer to make and sign the daily reports specified. The UHDS manufacturer's representative shall be under the direct employ and supervision of the UHDS manufacturer.

1.5.3 Corrosion Engineer

Corrosion engineer refers to a person who, by knowledge of the physical sciences and the principles of engineering and mathematics acquired by professional education and related practical experience, is qualified to engage in the practice of corrosion control. Such person may be a licensed professional corrosion engineer or certified as being qualified by the

National Association of Corrosion Engineers (NACE), if such licensing or certification includes 3 years experience in corrosion control on underground metallic surfaces of the type under this contract. NACE certification shall be technologist, corrosion specialist, or cathodic protection specialist. The corrosion engineer shall make at least 3 visits to the project site. The first of these visits shall include obtaining soil resistivity data, acknowledging the type of pipeline coatings to be used and reporting to the Contractor the type of cathodic protection required. Once the submittals are approved and the materials delivered, the corrosion engineer shall revisit the site to ensure the Contractor understands installation practices and laying out the components. The third visit shall involve testing the installed cathodic protection systems and training applicable personnel on proper maintenance techniques. The corrosion engineer shall supervise, inspect, and test the installation and performance of the cathodic protection system.

1.5.4 Testing Firm

The Testing Firm must be able to certify that: weld examination methods and procedures, and the interpretation of radiographic films will be performed in accordance with ASME B31.1; the firm intends to utilize the proper film exposure, techniques, and penetrameter to produce density and geometric sharpness in sufficient clarity to determine presence of defects; and that all radiographic films will be reviewed and interpreted, and reading reports signed, by not less than a Certified American Society for Nondestructive Testing Level III Radiographer.

1.6 SYSTEM REQUIREMENTS

1.6.1 Cathodic Protection

Cathodic protection shall be provided for systems with coated steel casings in accordance with paragraph Cathodic Protection Installation.

1.6.2 Operating Characteristics

The high temperature hot water supply system shall have an operating temperature of degrees 500 F and an operating pressure of 665 psig.High temperature hot water return system shall have an operating temperature of degrees 500 F and an operating pressure of 665 psig.

1.6.3 Rated Characteristics

Thermal expansion calculations shall be computed for the supply and return piping using the following design characteristics and installation temperature. The system design conditions for high temperature hot water supply and/or return shall be a temperature of 450 degrees F and a pressure of 665 psig. For calculation purposes, the installation temperature shall not be higher than the ambient temperature at the site: degrees -26 F.

1.7 STANDARD PRODUCTS

The designed system and equipment provided for this project shall be of current production and shall essentially duplicate systems that have been in satisfactory use for at least 5 years prior to bid opening at 3 locations. The systems shall have been operated under pressure, temperature and site characteristics that are equal to or more severe than the operating conditions in this specification and shall have distributed the same medium. The system shall be supported by a service organization

that can reach the site after a service call within 48 hours.

1.8 SITE CLASSIFICATION

Classification of the site conditions for the UHDS shall be based on ASTM D 2487 and the following criteria.

PART 2 PRODUCTS

2.1 FACTORY FABRICATED, DIRECT-BURIED DDT SYSTEMS

2.1.1 DDT High Temperature Hot Water Carrier Pipes

Requirements shall be in accordance with paragraph HEAT DISTRIBUTION PIPING.

2.1.2 DDT Carrier Pipe Insulation

Carrier pipe insulation shall conform to minimum thicknesses and type listed in Tables 1 and 2 as required for temperature specified under paragraph Rated Characteristics.

2.1.3 Insulation Banding and Scrim

Stainless steel bands and clips, at least 1/2 inch wide, conforming to ASTM A 167 (304 stainless steel), at a maximum spacing of 18 inches shall be used over the scrim to secure the insulation onto the carrier pipe; a minimum of 2 bands shall be used for each 4 foot section of insulation. Scrim shall be vinyl-coated fiberglass with 18 x 16 mesh (number of filaments per 1 inch) and made of 0.013 inch diameter vinyl-coated fibrous glass yarn.

2.1.4 Casing

Casing shall be smooth-wall steel, electric resistance spiral welded, conforming to ASTM A 134, ASTM A 135, or ASTM A 139 and the values tabulated below. Eccentric connectors shall be provided between casing sections as needed to provide drainage of casing section between manholes and between manholes and buildings.

Casing Diameter (in)	Minimum Thickness (in)
6 - 26	0.250
27 - 36	0.250
37 - 42	0.250
46	0.250

2.1.5 Casing End Plates, Vents, and Drains

End plates shall be made of ASTM A 36/A 36M steel, minimum thickness 1/2 inch for conduit pipe sizes above 12 inches and 0.375 inches for conduit pipe sizes 12 inches and less. A 1 inch ASTM A 53/A 53M, Sch 40, galvanized vent riser pipe shall be provided on end plate vent opening. Vent pipe shall extend to top of manhole and terminate 12 inches above grade with a 180 degree bend. A 1 inch drain shall be provided at the bottom and vent at the top. Brass plugs and half coupling, constructed with welded steel and welded to the end plate, shall be furnished; drains shall be plugged; vents shall not be plugged.

2.1.6 Air Space

Continuous 1 inch minimum air space shall be provided between carrier pipe insulation and casing.

2.1.7 Casing Coating

Coating shall be rated by manufacturer for continuous service for at least 25 years at temperatures of 230 degrees F. Coating shall be applied in accordance with the coating manufacturer's instructions, shall be factory inspected for holidays and repaired as necessary.

2.1.7.1 Fusion-Bonded Epoxy

Casing coating shall be fusion-bonded epoxy, minimum thickness 0.04 inches.

2.1.7.2 Urethane Elastomer

Coating shall be urethane elastomer, minimum thickness 0.04 inches.

2.1.8 Coating of End Plates and Conduit Extending into Manholes

End plates and conduit extending into manholes shall be coated with a zinc-rich coating conforming to AASHTO M 300 Type IA, except that volatile organic compounds shall not exceed 2.8 pounds/gallon. The zinc-rich coating shall be applied in accordance with the coating manufacturer's requirements including surface preparation. No additional top coat shall be applied.

2.1.9 Carrier Pipe Guides

Carrier pipe guides shall be spaced 10 feet on centers maximum, no more than 5 feet from pipe ends, with a minimum of 3 guides per elbow section. Guides shall be designed to allow thermal expansion without damage, to provide proper pipe guiding, and to allow horizontal movement in 2 directions as required at expansion loops and bends. Design of supports shall permit flow of water through the support. Pipe insulation shall extend through the pipe guides and be protected by steel sleeves. Design of guides shall negate metal-to-metal contact between the casing and the carrier pipe. Insulation or non-metallic material used to ensure no metal-to-metal contact shall not be compressed by the weight of the carrier pipe when full of water.

2.1.10 Anchor Plates

Anchor plate shall be ASTM A 36/A 36M steel, welded to carrier pipe and casing, 1/2 inch minimum thickness, with passages for air flow and water drainage thru the annular air space in the system. Exterior surface of the anchor plate shall be coated with the same coating material as the casing.

2.1.11 Field Connection of Casing Sections

Field connection of casing shall be made using a compatible steel section, welded to casing sections, coated on all surfaces with UHDS manufacturer's coating field repair compound, and covered with a 0.05 inch minimum thickness polyethylene shrink sleeve designed for a service temperature exceeding 176 degrees F.

2.1.12 Manufacturer's Identification

Embossed brass or stainless steel tag, hung by brass or stainless steel chain at each end of each conduit or insulated piping in the manholes and buildings, shall be provided. The tag shall identify UHDS manufacturer's name, date of installation, Government contract number, and manufacturer's project number.

2.2 PIPE INSULATION TYPE AND MINIMUM THICKNESS

The Contractor shall comply with EPA requirements. Materials containing asbestos will not be permitted. The minimum thickness of insulation for the heat distribution system shall be in accordance with Tables 1 and 2 in which the insulations listed have passed the 96 hour boiling water test.

TABLE 1
MINIMUM PIPE INSULATION THICKNESS (inches)

For Steam (16 to 408 psig) and High Temperature Hot Water Supply and Return (250 to 450 degrees F)

Nominal Pipe Diameter (inches)	INSULATIONS For Drainable/Dryable Systems		
	Delta	Thermo-12 Super Caltemp	MPT-PF MPT-PC
1.0	2.5	4.0	2.0
1.5	2.5	4.0	2.0
2.0	3.5	4.5	2.5
2.5	3.5	4.5	2.5
3.0	4.0	5.0	3.0
4.0	4.0	5.0	3.0
5.0	4.0	5.0	3.0
6.0	4.5	5.5	3.5
8.0	4.5	5.5	3.5
10.0	5.0	6.0	4.0
12.0	5.0	6.0	4.0
14.0	5.0	6.0	4.0
16.0	5.0	6.0	4.0
18.0	5.0	6.0	4.0

NOTE: 1) Delta is available from Rockwool in Leeds, Alabama.
2) MPT is available from Mineral Products of Texas in Houston, TX
3) Thermo-12 and Super Caltemp are available from Johns Manville in Denver, Colorado.

2.3 HEAT DISTRIBUTION PIPING

2.3.1 High Temperature Hot Water Pipe

Pipe material shall be steel; seamless ASTM A 53/A 53M, Grade B or ASTM A 106, Grade B; or electric resistance welded ASTM A 53/A 53M, Grade B; Schedule 40. Standard weight will be permitted for pipe sizes 12 inches

and above. ASTM A 53/A 53M, Type F furnace butt welded pipe will not be allowed. Joints will not be allowed in factory fabricated straight section of carrier pipes. Factory fabricated piping sections, as part of an expansion loop or bend, shall have all welded joints 100% radiographically inspected in accordance with ASME B31.1. Radiographs shall be reviewed and interpreted by a Certified American Society for Nondestructive Testing (ASNT) Level III radiographer, employed by the testing firm, who shall sign the reading report.

2.3.1.1 Joints

Joints shall be butt-weld except socket-weld joints will be permitted for pipe sizes 2 inches and smaller. Dye penetrant may be used in place of 100% radiographic inspection for pipe sizes 2 inches and below. Location and elevation of all field joints shall be indicated on detailed design layout drawings. Split-ring welding rings may be used.

2.3.2 Fittings

Welds in factory fittings shall be radiographically inspected. Radiographs shall be reviewed and interpreted by a Certified ASNT Level III radiographer, employed by the testing firm, who shall sign the reading report. The Contracting Officer may review all inspection records, and if any welds inspected are found unacceptable in accordance with ASME B31.1, the fitting shall be removed, replaced, and radiographically reexamined at no cost to the Government.

2.3.2.1 Butt-Welded

Fittings shall be steel; ASTM A 234/A 234M, Grade B or ASME B16.9, same schedule as adjoining pipe. Elbows shall be long radius unless otherwise indicated. Tees shall be full size or reducing as required, having interior surfaces smoothly contoured. Split-ring welding rings may be used.

2.3.2.2 Socket-Welded

Fittings shall be forged steel ASME B16.11; 2000 pound class shall be used for pipe sizes 2 inch and below. Dye penetrant inspection may be used in lieu of radiographic inspection of welded fittings for pipe sizes 2 inches and below.

2.4 EXPANSION LOOPS AND BENDS

Stresses shall be less than the maximum allowable stress from the Power Piping Code (ASME B31.1). Detailed design layout drawings and stress and anchor force calculations shall be provided for all loops and bends. Locations of all anchors, guides and supports shall be shown. The calculations shall be based on design characteristics (pressures and temperatures) specified for both the supply and return lines.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

3.1.1 Job Conditions

Phasing of construction shall be as shown on contract drawings.

3.1.2 Interruption of Existing Service

The Contractor shall arrange, phase and perform work and provide temporary facilities, materials, equipment, and connections to utilities, to ensure adequate heat distribution service for existing installations at all times. Only necessary interruptions required for making connections will be permitted, and only at times when approval is obtained from the Contracting Officer. All interruptions shall be as approved by the Contracting Officer.

3.1.3 Grading

Unless otherwise shown on the contract drawings or the detailed design layout drawings, high temperature hot water supply/return lines shall be graded uniformly downward not less than 5.0 inches in 100 feet to the lower point of entry between manholes and/or building entries.

3.1.4 Connecting to Existing Work

New work shall be connected to existing work in a neat and workmanlike manner. Connections shall be made only in manholes. Where an existing structure must be cut or existing utilities interfere, such obstructions shall be bypassed, removed, replaced or relocated, restored and repaired. Any changes required to the UHDS design as a result of interferences or conflicts shall be approved by the UHDS designer and the Contracting Officer. Work disturbed or damaged shall be replaced to its prior condition.

3.1.5 Coordination

The location of all items of equipment and work of all trades shall be coordinated. Operability and maintainability of the equipment and systems shall be maintained.

3.1.6 Variations

Any variations from the approved, detailed design layout drawings shall be submitted to the Contracting Officer for approval. Variations shall be signed and sealed by the UHDS manufacturers' professional engineer responsible for the complete design of the UHDS.

3.1.7 Storage and Handling During Installation

Equipment and material placed on the job shall remain in the custody of the Contractor until final acceptance whether or not the Contractor has been reimbursed for the equipment and material by the Government. The Contractor shall be solely responsible for the protection of the equipment and material against damage from any source while stored or during installation. Materials shall be protected against damage from UV light, and entry of water and mud, by installing watertight protection on open ends at all times. Sections of the casing or carrier piping found to have been subjected to full or partial submergence in water (which would allow the insulation to become wet) shall be immediately replaced. Materials awaiting installation shall be covered to protect from UV degradation.

3.2 PIPE, PIPING JOINTS AND FITTINGS

3.2.1 Joint Preparation

Pipe and fittings shall be cleaned inside and outside before and after

assembly. Dirt, scale, and other foreign matter shall be removed from inside the piping by use of a pipe swab or pipe pig before connecting pipe sections, valves, equipment or fittings. Eccentric connectors shall be used as needed between casing sections to provide drainage of casing section between manholes and between manholes and buildings.

3.2.2 Direction Changes

Changes in direction shall be made with factory-built reinforced fittings. Field-fabricated fittings and miters will not be permitted.

3.3 WELDING

The Contractor shall be responsible for welding quality and shall:

a. Conduct tests of the welding procedures used in the work, determine the suitability of the procedures used, determine that the welds made will meet the required tests, and determine that the welding operators have the ability to make sound welds under standard conditions.

b. Comply with ASME B31.1.

c. Perform all welding operations required for construction and installation of the heat distribution system.

3.3.1 Qualification of Welders

Rules of procedure for qualification of all welders and general requirements for fusion welding shall conform with the applicable portions of ASME B31.1, and as outlined below.

3.3.2 Examining Welders

The Contractor shall examine each welder to determine the ability of the welder to meet the required qualifications. Welders shall be tested for welds in all positions, including welds with the axis horizontal (not rolled) and with the axis vertical. Each welder shall:

a. Weld only in positions in which they have qualified.

b. Identify welds with the specific code marking signifying name and number assigned.

3.3.3 Examination Results

The Contractor shall furnish a list of welder's names and corresponding code markings. Welders which fail to meet the prescribed welding qualifications shall be retested. Welders who fail the second test shall be disqualified for work on this project.

3.3.4 Beveling

Field and shop bevels shall be done by mechanical means or by flame cutting. Where beveling is done by flame cutting, surfaces shall be thoroughly cleaned of scale and oxidation just prior to welding.

3.3.5 Alignment

Split welding rings shall be used for field joints on carrier pipes above 2 inches to assure proper alignment, complete weld penetration, and prevention of weld spatter reaching the interior of the pipe. Field joints 2 inches and smaller shall be made with welding sockets.

3.3.6 Erection

Piping shall not be split, bent, flattened, or otherwise damaged before, during, or after installation. Where the pipe temperature falls to 32 degrees F or lower, the pipe shall be heated to approximately 100 degrees F for a distance of 1 foot on each side of the weld before welding, and the weld shall be finished before the pipe cools to 32 degrees F.

3.3.7 Defective Welds

Defective welds shall be replaced and reinspected in accordance with ASME B31.1. Repairing defective welds by adding weld material over the defect or by peening will not be permitted. Welders responsible for defective welds shall be tested for qualification.

3.3.8 Electrodes

Electrodes shall be stored in a dry, heated area, and shall be kept free of moisture and dampness during fabrication operations. Electrodes that have lost part of their coating shall not be used.

3.3.9 Radiographic Testing

An approved independent testing firm regularly engaged in radiographic testing shall perform radiographic examination of 100% of the field welds in the carrier piping of direct-buried systems in accordance with ASME B31.1. The following shall be furnished: a set of films showing each weld inspected, a reading report evaluating the quality of each weld, and a location plan showing the physical location where each weld is to be found in the completed project, prior to installing casing field joints, backfilling and hydrostatic testing. All radiographs shall be reviewed and interpreted by a Certified American Society for Nondestructive Testing Level III radiographer, employed by the testing firm, who shall sign the reading report. The Contracting Officer may review all inspection records, and if any welds inspected are found unacceptable they shall be removed, rewelded, and radiographically reexamined at no cost to the Government.

3.4 HEAT DISTRIBUTION SYSTEM INSTALLATION

The UHDS manufacturer's representative shall oversee the delivery, storage, installation and testing of the system. Work shall be in accordance with the requirements specified and with the printed instructions of the manufacturer. These specifications shall take precedence over the printed instructions if conflicts arise. Printed instructions shall be submitted to the Contracting Officer prior to system installation.

3.4.1 Verification of Final Elevations

For the PIPI system, prior to covering the top of the pipe with PIPI, measure and record the elevation of the top of each pipe at each field joint, 1/3 points along each pipe section, and the top of each elbow. For the PIPI system, elevations of the top of each pipe shall be measured and

recorded. Elevations shall be taken at every completed field joint, 1/3 points along each pipe section and top of elbows. These measurements shall be checked against the contract drawings and shall confirm that the conduit system has been installed to the elevations shown on the contract drawings. Slope shall be uniform to within 0.1%. These measurements shall be recorded by the Contractor, included in the UHDS manufacturer's representative daily report, and given to the Contracting Officer prior to covering the casing with backfill material.

3.4.2 Excavation, Trenching, and Backfilling

Excavation, trenching, and backfilling shall be performed as required by the UHDS manufacturer's design and as specified in Section 02300 EARTHWORK. Pipe shall lay on a 12 inch minimum sand bed and shall be backfilled with sand on all sides to a minimum of 6 inches as measured from outside of casing. This sand bedding requirement does not apply to the PIPI system. Foundation for system shall be firm and stable. Foundation and backfill shall be free from rocks or substances which could damage the system coating. Concrete anchor and thrust blocks shall be installed in undisturbed earth. Backfilling shall not commence until system has been satisfactorily pressure tested (both hydrostatic test of carrier and air test of casing). Minimum depth of burial to the top of the casing (or PIPI envelope) shall be 39 inches. Maximum depth of burial to the top of the casing (or PIPI envelope) shall be 10 feet.

3.4.3 UHDS Manufacturer's Representative Responsibilities

The UHDS Manufacturer's representative shall be present at the job site and witness when the following types of work are being performed:

a. Inspection and unloading (not applicable to PIPI).

b. Inspection of trench prior to commencing installation of system.

c. Inspection of concrete anchors and thrust blocks.

d. Pneumatic and Hydrostatic testing.

e. Field joint closure work (not applicable to PIPI).

f. Air test of casing (not applicable to all WSL systems).

g. Holiday test of conduit coating (not applicable to all WSL systems).

h. Repair of any coating (not applicable to all WSL systems).

i. Installation of cathodic protection system (not applicable to all WSL systems).

j. Initial backfill up to 10 inches above the top of the casing.

k. Verification of final elevations. Elevation readings shall be witnessed and recorded.

l. Testing of cathodic protection system (not applicable to all WSL systems).

m. Operational tests.

The UHDS manufacturer's representative shall notify the Contractor immediately of any problems. The UHDS manufacturer's representative shall notify the Contracting Officer of problems requiring immediate action; otherwise, the daily reports shall note any problems encountered and indicate the corrective actions taken.

3.4.4 UHDS Manufacturer's Representative Reports

The UHDS manufacturer's representative shall: prepare and sign a written daily report; present the original daily report to the Contracting Officer no later than one working day after it is prepared; and forward 1 copy to the manufacturer's main office. The report shall state whether or not the condition and quality of the materials used and the delivery, storage, installation and testing of the system are in accordance with the drawings, specifications, and manufacturer's printed instructions and are satisfactory in all respects. When any work connected with the installation is unsatisfactory, the report shall state what corrective action has been taken or shall contain the UHDS manufacturer's recommendations for corrective action. The report shall identify any condition that could result in an unsatisfactory installation, including such items as open conduit ends left in the trench overnight and improper manhole entries. The daily reports shall be reviewed, signed and sealed, on a weekly basis, by the registered engineer responsible for the system design. Signed and sealed copies of the daily reports shall be submitted with the payment request. Requests for payment will be denied if the weekly review is not accomplished. Upon completion of the work and before final acceptance, a notarized Certificate of Compliance, signed by a principal officer of both the manufacturing and the contracting firms, stating that the installation is satisfactory and in accordance with drawings, specifications, and manufacturer's instructions shall be delivered to the Contracting Officer. The UHDS manufacturer shall retain a copy of all daily reports and the Certificate of Compliance for 5 years after final acceptance of the system by the Government.

3.4.5 Protection

Casing coating shall be protected from damage during unloading, storage, rigging and installation. Casing and carrier pipe ends shall be protected from water intrusion during unloading, storage, rigging and installation. Piping and accessories shall be protected from damage due to exposure to UV light.

3.4.6 Defective Material

The UHDS manufacturer's representative shall take prompt action to remove from the site all damaged or defective material, subject to rejection in accordance with the quality assurance provisions included in the manufacturer's submittals and printed instructions, and shall order prompt replacement of such material.

3.4.7 Cathodic Protection Installation

Provide cathodic protection for all steel casing systems and all buried exposed metal. Assume that 25 percent of the exterior of the UHDS is exposed metal. Cathodic protection systems shall have a minimum design life of 25 years and shall conform to Section 13110A CATHODIC PROTECTION SYSTEM (SACRIFICIAL ANODE). Dielectric pipe flanges and waterways, and isolation devices shall be provided at all points necessary. Test stations

at grade shall be provided on each section of the piping system. Dielectric waterways shall have temperature and pressure rating equal to or greater than that specified for the connecting piping. Waterways shall have metal connections on both ends suited to match the connecting piping. Dielectric waterways shall be internally lined with an insulator specifically designed to prevent current flow between dissimilar metals. Dielectric flanges shall meet the performance requirements described herein for dielectric waterways.

3.5 TESTS

Leak-tightness of all piping systems shall be demonstrated by performing pressure tests (hydrostatic, pneumatic) and operational tests. Heat distribution system shall be pressure tested in conformance with specified requirements and printed instructions for the system supplied; tests shall include carrier piping and casing. The carrier pipe shall be hydrostatically tested. Casings of DDT systems shall be pneumatically tested. Casing and end seals of WSL system shall be tested for intrusion of water into the casing and insulation. Mercury shall not be used in thermometers required for the tests.

3.5.1 Holiday Testing of Direct-buried System Steel Casings

Entire exterior surface of the casing, including the bottom exterior surface, shall be tested for faults in coating after installation in trench, prior to backfilling, using test method and voltage recommended by coating manufacturer. If any holidays are found, they shall be repaired and the coating retested. System shall not be backfilled until all holidays are eliminated.

3.5.2 Pneumatic, Hydrostatic and Operational Tests

Before conducting heat distribution system tests, lines shall be flushed with high pressure water until discharge shows no foreign matter.

3.5.2.1 Pneumatic Test

The casing of DDT systems shall be pneumatically tested after welding and before field coating using air as the test medium. The test pressure shall be 15 psig. Persons not working on the test operations shall be kept out of the testing area while testing is proceeding. The test shall be made on the system as a whole or on sections that can be isolated. Joints in sections shall be tested prior to backfilling when trenches must be backfilled before the completion of other pipeline sections. The test shall continue for 24 hours from the time of the initial readings to the final readings of pressure and temperature. The initial test readings of the instrument shall not be made for at least 1 hour after the casing has been subjected to the full test pressure, and neither the initial nor final readings shall be made at times of rapid changes in atmospheric conditions. There shall be no indication of reduction of pressure during the test after corrections have been made for changes in atmospheric conditions in conformity with the relationship $T(1)P(2) = T(2)P(1)$, in which T and P denote absolute temperature and pressure, respectively, and the numbers denote initial (1) and final (2) readings. Pressure shall be measured with a pressure gauge conforming to ASME B40.100. A throttling type needle valve or a pulsation dampener and shutoff valve may be included. The diameter of the face shall be at least 4.5 inches with a measurable range of 0 to 15 psig and graduations of at least 0.5 psig. During the test, the entire system shall be completely isolated from all compressors and other

sources of air pressure. Each joint shall be tested while under test pressure by means of soap and water or an equivalent nonflammable solution prior to backfilling or concealing any work. All labor, materials and equipment for conducting the tests shall be furnished by the Contractor and shall be subject to inspection at all times during the tests. The Contractor shall maintain proper safety precautions for air pressure testing at all times during the tests.

3.5.2.2 Hydrostatic Test

Carrier piping shall be tested hydrostatically before insulation is applied at field joints and shall be proved tight at a pressure 1.5 times the heat distribution supply pressure of 665 psig for 2 hours. There shall be no indication of reduction of pressure during the test. Pressure shall be measured with a device calibrated to be read in increments not greater than 0.1 psi.

3.5.2.3 Operational Test

Prior to acceptance of the installation, Contractor shall subject system to operating tests simulating actual operating conditions to demonstrate satisfactory functional and operating efficiency. These operating tests shall cover a period of not less than 6 hours for each portion of system tested. Contractor shall submit for approval a schedule of the tests to be performed. The contractor shall provide calibrated instruments, equipment, facilities and labor, at no additional cost to the Government. When failures occur, problems shall be repaired and test repeated.

3.5.3 Deficiencies

Deficiencies discovered shall be corrected at the Contractor's expense. Major deficiencies, or failure to correct deficiencies, may be considered cause for rejecting the entire installation.

3.6 VALVE MANHOLES

Valve manholes, piping, and equipment in valve manholes shall be in accordance with the contract drawings and Section 02560 VALVES,PIPING, AND EQUIPMENT IN VALVE MANHOLES.

3.7 BURIED UTILITY WARNING AND IDENTIFICATION

3.7.1 Plastic Marking Tape

Polyethylene plastic tape manufactured specifically for warning and identifying buried utility lines shall be supplied and installed. Tape shall be buried above the pipe during the trench backfilling operation and shall be buried approximately 12 inches below grade. Tape shall be polyethylene with a metallic core. Tape shall be acid- and alkali-resistant and shall have a minimum strength of 1750 psi lengthwise and 1500 psi crosswise with an elongation factor of 350 percent. The tape shall be manufactured with integral wires, foil backing or other means to enable detection by a metal detector when the tape is buried up to 3 feet deep. The metallic core of the tape shall be encased in a protective jacket or provided with other means to protect it from corrosion. The tape shall be of a type specifically manufactured for marking and locating metallic underground utilities. Tape shall be 6 inches wide and printed with a caution and identification of the piping system over the entire tape length. Tape shall be yellow with bold black letters. Tape color and

lettering shall be unaffected by moisture and other substances contained in the backfill material.

3.7.2 Markers for Underground Piping

Markers for underground piping shall be located along the distribution and service lines. Markers shall be placed as indicated approximately 2 feet to the right of the distribution system when facing in direction of flow in the supply line. The marker shall be concrete 6 inch square or round section 2 feet long. The top edge of the marker shall have a minimum 1/2 inch chamfer all around. The letters HTHW shall be impressed or cast on the top, and on one side of the markers to indicate the type of system that is being identified. Each letter shall be formed with a V-shaped groove and shall have a width of stroke at least 1/4 inch at the top and depth of 1/4 inch. The top of the marker shall protrude not more than 2 inches above finished grade.

3.8 THERMAL PERFORMANCE TESTING

The equipment and procedures specified shall be used to ensure acceptable thermal performance of the installed system. The test results shall be submitted for approval. All materials and procedures described for this test shall be included as deliverables of the construction contract for the system, unless otherwise noted. Due to its geometry, the PIPI system is exempt from this requirement.

3.8.1 Equipment

3.8.1.1 Casing Temperature Measurement

Before backfilling, and after field joint closures have been welded to the casing and the coating has been applied and cured, temperature sensors shall be attached to the exterior of every other field joint closure. The sensors shall be attached with epoxy suitable for use at 500 degrees F. A sensor shall be adhered with epoxy to the coated casing near the midpoint of every other pipe section between field joints. The sensor shall not be located closer than 5 feet from any guide in the interior of the casing. After the sensors have been adhered to the casing, 2 complete wraps of duct tape shall be used to secure and protect the sensor. The radial position of the sensors shall be located 45 degrees from the top center of the casing, at either the 1:30 or 10:30 position, away from the adjacent heat distribution system pipe if present. All sensors shall be type T thermocouples in accordance with ISA MC96.1 copper constantan 20 gauge thermocouples, made from special limits grade thermocouple wire, 0.5 degrees C or 0.4 percent maximum error, with each conductor insulated and an overall jacket on both conductors. Insulation on the thermocouple wires shall be suitable for service at 500 degrees F. The thermocouple wire between sensor location and termination point shall be continuous with no splicing or other connections. Each sensor shall be shown with a special symbol on the detailed design layout drawings and shall be identified by a number and/or letter code, starting from the upstream manhole.

3.8.1.2 Carrier Pipe Temperature Measurement

Carrier pipe temperature shall be measured within the manhole where the panel box is located. Carrier pipe temperature shall be measured by a sensor adhered with epoxy directly to the exterior of the carrier pipe. All sensors shall be type T thermocouples in accordance with ISA MC96.1 copper constantan 20 gauge thermocouples, made from special limits grade

thermocouple wire, 0.5 degrees C or 0.4 percent maximum error, with each conductor insulated and an overall jacket on both conductors. Insulation on the thermocouple wires shall be suitable for service at 500 degrees F. The thermocouple wire between sensor location and termination point shall be continuous with no splicing or other connections. The location of this sensor shall be at either the 1:30 or 10:30 position. At the location of the sensor, the carrier pipe shall be insulated with calcium silicate insulation at least 5 inches thick. This insulation shall extend at least 6 inches on each side of the actual sensor location and shall be clad with an aluminum jacket.

3.8.1.3 Terminals

The wires from each casing or carrier pipe temperature sensor shall be extended into the nearest manhole and terminated in a panel box. The panel box shall be a NEMA Type 4 waterproof enclosure, of suitable size, mounted near the top of the manhole at a location near the manhole entrance, accessible without entrance into the manhole, where possible. The termination of the sensor wires shall be with an approved connector of type OMEGA Miniature Jack Panel (MJP-*-*-T). The thermocouple jack panel shall be mounted to the back plate of the panel box. The temperature sensors shall be labeled at their termination within the panel box; a drawing showing the location of each temperature sensor shall be laminated and attached to the inside of the panel box. All temperature sensors shall be verified as operational by an independent laboratory, hired by the Contractor, after backfilling is complete but before the system is accepted.

3.8.2 Thermal Performance Test

After the system construction is complete, including backfilling, and the system has reached operating condition for at least 30 days, all of the temperature sensors shall be read by an independent laboratory with experience and equipment appropriate for the sensors used. The temperature shall be recorded for each sensor. The temperatures shall be tabulated and submitted in accordance with specified requirements. If temperatures exceed values in Table 3, that portion shall be repaired and temperatures again measured and recorded.

TABLE 3

Carrier Pipe Temperat. TP (degrees C)	Carrier Pipe Temperat. TP (degrees F)	Acceptable Casing Temperature TC (degrees C)	Acceptable Casing Temperature TC (degrees F)
121	250	43	110
135	275	47	116
149	300	50	123
163	325	54	129
177	350	58	136
204	400	65	149
218	425	68	155
232	450	72	162

The following equations were used to calculate the above values:

T@ <(0.261) X (TP) + 44.3 (for English units)
T, <(0.261) X (TP) + 11.5 (for Metric units)

For carrier pipe temperatures between those given in Table 3, the maximum acceptable casing temperature may be either interpolated from the values in Table 3 or calculated using the equations above.

-- End of Section --

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SECTION 02556A

GAS DISTRIBUTION SYSTEM
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PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN GAS ASSOCIATION (AGA)

AGA XR0104	(2001) AGA Plastic Pipe Manual for Gas Service

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B109.2	(2000) Diaphragm-Type Gas Displacement Meters (500 cubic ft./hour Capacity and Over)

ASTM INTERNATIONAL (ASTM)

ASTM D 2513	(2001ae1) Thermoplastic Gas Pressure Pipe, Tubing, and Fittings
ASTM D 2683	(1998) Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing
ASTM D 3261	(1997) Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
ASTM D 3350	(2002a) Polyethylene Plastics Pipe and Fittings Materials

ASME INTERNATIONAL (ASME)

ASME B1.20.1	(1983; R 2001) Pipe Threads, General Purpose, Inch
ASME B16.5	(1996) Pipe Flanges and Flanged Fittings
ASME B16.9	(2001) Factory-Made Wrought Steel Buttwelding Fittings
ASME B16.11	(2002) Forged Fittings, Socket-Welding and Threaded
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges

ASME B16.40	(2002) Manually Operated Thermoplastic Gas Shutoffs and Valves in Gas Distribution Systems
ASME B31.8	(2000) Gas Transmission and Distribution Piping Systems

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-25	(1998) Standard Marking System for Valves, Fittings, Flanges and Unions

NACE INTERNATIONAL (NACE)

NACE RP0185	(1996) Extruded, Polyolefin Resin Coating Systems with Soft Adhesives for Underground or Submerged Pipe

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

49 CFR 192	Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise indicated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Pipe, Fittings, and Associated Materials

Drawings shall contain complete schematic and piping diagrams and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Drawings shall show proposed layout and anchorage of the system and appurtenances, and equipment relationship to other parts of the work including clearances for maintenance and operation.

SD-03 Product Data

Materials and Equipment; G-AO

A complete list of equipment and materials, including manufacturer's descriptive and technical literature, performance charts and curves, catalog cuts, and installation instructions, including, but not limited to the following:

a. Dielectric Waterways and Flange Kits.

b. Meters.

c. Pressure Reducing Valves.

d. Regulators.

Connections to Existing Lines

Notification of the Contractor's schedule for making connections to existing gas lines, at least 10 days in advance.

Jointing Polyethylene Piping; G-AO

A copy of qualified jointing procedures, training procedures, qualifications of trainer, and training test results for joiners and inspectors.

Connection and Abandonment Plan; G-AO

A copy of procedures for gas line tie in, hot taps, abandonment/removal or demolition, purging, and plugging as applicable in accordance with ASME B31.8.

SD-06 Test Reports

Pressure and Leak Tests; G-AO

Data from all pressure tests of the distribution system.

1.3 GENERAL REQUIREMENTS

1.3.1 Jointing Polyethylene Piping

Piping shall be joined by performance qualified joiners using qualified procedures in accordance with AGA XR0104. Manufacturer's prequalified joining procedures shall be used. Joints shall be inspected by an inspector qualified in the joining procedures being used and in accordance with AGA XR0104. Joiners and inspectors shall be qualified at the jobsite by a person who has been trained and certified by the manufacturer of the pipe, to train and qualify joiners and inspectors in each joining procedure to be used on the job. Training shall include use of equipment, explanation of the procedure, and successfully making joints which pass tests specified in AGA XR0104. The Contracting Officer shall be notified at least 24 hours in advance of the date to qualify joiners and inspectors.

1.3.2 Standard Products

Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Asbestos or products containing asbestos shall not be used. Equipment shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site. Valves, flanges, and fittings shall be marked in accordance with MSS SP-25.

1.3.3 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work.

1.3.4 Handling

Pipe and components shall be handled carefully to ensure a sound, undamaged condition. Particular care shall be taken not to damage pipe coating. No pipe or material of any kind shall be placed inside another pipe or fitting after the coating has been applied, except as specified in paragraph INSTALLATION. Plastic pipe shall be handled in conformance with AGA XR0104.

PART 2 PRODUCTS

2.1 PIPE, FITTINGS, AND ASSOCIATED MATERIALS

2.1.1 Small Fittings

Fittings 1-1/2 inches and smaller shall conform to ASME B16.11.

2.1.2 Fittings, 2 Inches and Larger

Pipe flanges and flanged fittings including bolts, nuts, and bolt patterns shall be in accordance with ASME B16.5. Buttweld fittings shall be in accordance with ASME B16.9. Weld neck flanges shall be used.

2.1.3 Flange Gaskets

Gaskets shall be non-asbestos compressed material in accordance with ASME B16.21, 1/16 inch minimum thickness, full face or self-centering flat ring type. The gaskets shall contain aramid fibers bonded with nitrile butadiene rubber (NBR), or glass fibers bonded with polytetrafluoroethylene, suitable for maximum 600 degrees F service and meeting applicable requirements of ASME B31.8.

2.1.4 Pipe Threads

Pipe threads shall conform to ASME B1.20.1.

2.1.5 Polyethylene Pipe, Tubing, Fittings and Joints

Polyethylene pipe, tubing, fittings and joints shall conform to ASTM D 3350 and ASTM D 2513, pipe designations PE 2406 and PE 3408, rated SDR 17 or less, as specified in ASME B31.8. Pipe sections shall be marked as required by ASTM D 2513. Butt fittings shall conform to ASTM D 3261 and socket fittings shall conform to ASTM D 2683. Fittings shall match the service rating of the pipe.

2.2 VALVES

Valves shall be suitable for shutoff or isolation service and shall conform to the following:

2.2.1 Polyethylene Valves

Polyethylene valves shall conform to ASME B16.40. Polyethylene valves, in sizes 1/2 inch to 6 inches, may be used with polyethylene distribution and

service lines, in lieu of steel valves, for underground installation only.

2.3 PRESSURE REGULATORS

Regulators shall have ferrous bodies, shall provide backflow protection, and shall be designed to meet the pressure, load and other service conditions.

2.3.1 Service Line Regulators

Pressure regulators for individual service lines shall have ferrous bodies. Regulator shall be capable of reducing distribution line pressure to pressures required for users. Regulators shall be provided where gas will be distributed at pressures in excess of 10 inches of water column. Pressure relief shall be set at a lower pressure than would cause unsafe operation of any connected user. Regulators for liquified petroleum gas shall be adjusted to 10 to 12 inches of water column. Pressure relief for liquified petroleum gas shall be set at 16 inches of water column. Regulator shall have single port with orifice diameter no greater than that recommended by the manufacturer for the maximum gas pressure at the regulator inlet. Regulator valve vent shall be of resilient materials designed to withstand flow conditions when pressed against the valve port. Regulator shall be capable of regulating downstream pressure within limits of accuracy and shall be capable of limiting the buildup of pressure under no-flow conditions to 50 percent or less of the discharge pressure maintained under flow conditions. Regulator shall have a self contained service regulator. Regulator pipe connections shall not exceed 2 inchsize.

2.4 METERS

Meters shall conform to ANSI B109.2. Meters shall be pedestal mounted and be provided with a strainer immediately upstream. Meters shall be suitable for accurately measuring and handling gas at pressures, temperatures, and flow rates indicated. Meters shall have a pulse switch initiator capable of operating up to speeds of 500 pulses per minute with no false pulses and shall require no field adjustments. Initiators shall provide the maximum number of pulses up to 500 per minute that is obtainable from the manufacturer. It shall provide not less than one pulse per 100 cubic feet of gas.

2.5 PROTECTIVE COVERING MATERIALS

Continuously extruded polyethylene and adhesive coating system materials shall conform to NACE RP0185, Type A.

PART 3 EXECUTION

3.1 EXCAVATION AND BACKFILLING

Earthwork shall be as specified in Section 02300 EARTHWORK.

3.2 GAS MAINS

Pipe for gas mains shall be polyethylene. Polyethylene mains shall not be installed aboveground.

3.3 SERVICE LINES AND EMERGENCY GAS SUPPLY CONNECTION

Service lines shall be constructed of materials specified for gas mains and

shall extend from a gas main to and including the point of delivery within 5 feet of the building. The point of delivery is the meter set assembly. The service lines shall be connected to the gas mains as indicated. Where indicated, service line shall be provided with an isolation valve of the same size as the service line. The service lines shall be as short and as straight as practicable between the point of delivery and the gas main and shall not be bent or curved laterally unless necessary to avoid obstructions or otherwise permitted. Service lines shall be laid with as few joints as practicable using standard lengths of pipe. Shorter lengths shall be used only for closures. Polyethylene service lines shall not be installed aboveground .

3.4 WORKMANSHIP AND DEFECTS

Pipe, tubing, and fittings shall be clear and free of cutting burrs and defects in structure or threading and shall be thoroughly brushed and blown free of chips and scale. Defective pipe, tubing, or fittings shall be replaced and shall not be repaired.

3.5 INSTALLATION

Gas distribution system and equipment shall be installed in conformance with the manufacturer's recommendations and applicable sections of ASME B31.8, AGA XR0104 and 49 CFR 192. Abandoning existing gas piping shall be done in accordance with ASME B31.8. Pipe shall be cut without damaging the pipe. Unless otherwise authorized, cutting shall be done by an approved type of mechanical cutter. Wheel cutters shall be used where practicable. On steel pipe 6 inches and larger, an approved gas-cutting-and-beveling machine may be used. Cutting of plastic pipe shall be in accordance with AGA XR0104. Valve installation in plastic pipe shall be designed to protect the plastic pipe against excessive torsional or shearing loads when the valve is operated and from other stresses which may be exerted through the valve or valve box.

3.5.1 Installing Pipe Underground

Gas mains and service lines shall be graded as indicated. Mains shall have 30 inch minimum cover; service lines shall have 30 inch minimum cover; and both mains and service lines shall be placed on firmly compacted select material for the full length. Where indicated, the main shall be encased, bridged, or designed to withstand any anticipated external loads as specified in ASME B31.8. The encasement material shall be standard weight black steel pipe with a protective coating as specified. The pipe shall be separated from the casing by insulating spacers and sealed at the ends with casing bushings. Trench shall be excavated below pipe grade, bedded with bank sand, and compacted to provide full-length bearing. Laying the pipe on blocks to produce uniform grade will not be permitted. The pipe shall be clean inside before it is lowered into the trench and shall be kept free of water, soil, and all other foreign matter that might damage or obstruct the operation of the valves, regulators, meters, or other equipment. When work is not in progress, open ends of pipe or fittings shall be securely closed by expandable plugs or other suitable means. Minor changes in line or gradient of pipe that can be accomplished through the natural flexibility of the pipe material without producing permanent deformation and without overstressing joints may be made when approved. Changes in line or gradient that exceed the limitations specified shall be made with fittings. When cathodic protection is furnished, electrically insulated joints or flanges shall be provided. When polyethylene or fiberglass piping is installed underground, foil backed magnetic tape shall be placed

above the pipe to permit locating with a magnetic detector. After laying of pipe and testing, trench shall be backfilled in accordance with Section 02300 EARTHWORK.

3.6 PIPE JOINTS

Pipe joints shall be designed and installed to effectively sustain the longitudinal pullout forces caused by the contraction of piping or superimposed loads.

3.6.1 Polyethylene Pipe Jointing Procedures

Jointing procedures shall conform to AGA XR0104. Indiscriminate heat fusion joining of plastic pipe or fittings made from different polyethylene resins by classification or by manufacturer shall be avoided if other alternative joining procedures are available. If heat fusion joining of dissimilar polyethylenes is required, special procedures are required. The method of heat fusion joining dissimilar polyethylene resins shall be tested in accordance with paragraph TESTS, subparagraph Destructive Tests of Plastic Pipe Joints.

3.6.2 Connections Between Metallic and Plastic Piping

Connections shall be made only outside, underground, and with approved transition fittings.

3.7 VALVE BOXES

Valve boxes of cast iron not less than 3/16 inch thick shall be installed at each underground valve except where concrete or other type of housing is indicated. Valve boxes shall be provided with locking covers that require a special wrench for removal. Wrench shall be furnished for each box. The word "gas" shall be cast in the box cover. When the valve is located in a roadway, the valve box shall be protected by a suitable concrete slab at least 3 square feet. When in a sidewalk, the top of the box shall be in a concrete slab 2 feet square and set flush with the sidewalk. Boxes shall be adjustable extension type with screw or slide-type adjustments. Valve boxes shall be separately supported, not resting on the pipe, so that no traffic loads can be transmitted to the pipe. Valves shall only be located in valve boxes or inside of buildings.

3.8 PRESSURE REGULATOR INSTALLATION

3.8.1 Service Line Regulators

A shutoff valve, meter set assembly, and service regulator shall be installed on the service line outside the building, 18 inches above the ground on the riser. An insulating joint shall be installed on the inlet side of the meter set assembly and service regulator and shall be constructed to prevent flow of electrical current. A 3/8 inch tapped fitting equipped with a plug shall be provided on both sides of the service regulator for installation of pressure gauges for adjusting the regulator. All service regulator vents and relief vents shall terminate in the outside air in rain and insect resistant fittings. The open end of the vent shall be located where gas can escape freely into the atmosphere, away from any openings into the building and above areas subject to flooding.

3.9 METER INSTALLATION

Meters shall be installed in accordance with ASME B31.8. Permanent gas meters shall be installed with provisions for isolation and removal for calibration and maintenance, and shall be suitable for operation in conjunction with an energy monitoring and control system.

3.10 CONNECTIONS TO EXISTING LINES

Connections between new work and existing gas lines, where required, shall be made in accordance with ASME B31.8, using proper fittings to suit the actual conditions. When connections are made by tapping into a gas main, the connecting fittings shall be the same size as the pipe being connected.

3.10.1 Connections to Publicly or Privately Operated Gas Utility Lines

Contractor shall provide materials for the connections to the existing gas lines. Final connections and the turning on of gas shall be made by the utility. Existing lines that are to be a abandoned or taken out of service shall be disconnected, purged and capped, plugged or otherwise effectively sealed by the Utility. The Contractor shall notify the Contracting Officer, in writing, 10 days before final connections and turning on of gas lines. The Contractor shall make necessary arrangements with the Utility for tie in and activation of new gas lines. Only the Operating Agency/Utility Company may reactivate the system after tie in. The Contractor shall furnish a certification by the Operating Agency/Utility Company that all Utility work has been satisfactorily completed.

3.10.2 Connection to Government Owned/Operated Gas Lines

The Contractor shall provide connections to the existing gas lines in accordance with approved procedures. Deactivation of any portion of the existing system shall only be done at the valve location shown on the drawings. Reactivation of any existing gas lines will only be done by the Government. The Contractor's Connection and Abandonment Plan shall be submitted and approved prior to making any connections to existing gas lines. This plan shall include the Operating Agency's required procedures which may be obtained from the Base. The Contractor shall notify the Contracting Officer, in writing, 10 days before connections to existing lines are to be made.

a. If facilities are abandoned in place, they shall be physically disconnected from the piping system. The open ends of all abandoned facilities shall be purged, capped, plugged or otherwise effectively sealed. Abandonment shall not be completed until it has been determined that the volume of gas or liquid hydrocarbons contained within the abandoned section poses no potential hazard. Air or inert gas may be used for purging, or the facility may be filled with water or other inert material. If air is used for purging, the Contractor shall ensure that a combustible mixture is not present after purging.

b. When a main is abandoned, together with the service lines connected to it, only the customer's end of such service lines is required to be sealed as stipulated above.

c. Service lines abandoned from the active mains shall be disconnected as close to the main as practicable.

d. All valves left in the abandoned segment shall be closed.

e. All abovegrade valves, risers, and vault and valve box covers shall be removed. Vault and valve box voids shall be filled with suitable compacted backfill material.

3.11 CATHODIC PROTECTION

Cathodic protection shall be provided for all metallic gas piping installed underground and shall be installed as specified in Section 13110A CATHODIC PROTECTION SYSTEM (SACRIFICIAL ANODE).

3.12 TESTS

3.12.1 Destructive Tests of Plastic Pipe Joints

Each day, prior to making polyethylene heat fusion joints or fiberglass adhesive joints, a joint of each size and type to be installed that day shall be made by each person performing joining of plastic pipe that day and destructively tested. At least 3 longitudinal straps shall be cut from each joint. Each strap shall be visually examined, shall not contain voids or discontinuities on the cut surfaces of the joint area, and shall be deformed by bending, torque, or impact, and if failure occurs, it must not initiate in the joint area. If a joint fails the visual or deformation test, the qualified joiner who made that joint shall not make further field joints in plastic pipe on this job until that person has been retrained and requalified. The results of the destructive tests shall be recorded to include the date and time of the tests, size and type of the joints, ambient conditions, fusion iron temperature and names of inspectors and joiners.

3.12.2 Pressure and Leak Tests

The system of gas mains and service lines shall be tested after construction and before being placed in service using air as the test medium. The normal operating pressure for the system is 20. The test pressure is 50. Prior to testing the system, the interior shall be blown out, cleaned and cleared of all foreign materials. All meters, regulators, and controls shall be removed before blowing out and cleaning and reinstalled after clearing of all foreign materials. Testing of gas mains and service lines shall be done with due regard for the safety of employees and the public during the test. Persons not working on the test operations shall be kept out of the testing area while testing is proceeding. The test shall be made on the system as a whole or on sections that can be isolated. Joints in sections shall be tested prior to backfilling when trenches must be backfilled before the completion of other pipeline sections. The test shall continue for at least 24 hours from the time of the initial readings to the final readings of pressure and temperature. The initial test readings of the instrument shall not be made for at least 1 hour after the pipe has been subjected to the full test pressure, and neither the initial nor final readings shall be made at times of rapid changes in atmospheric conditions. The temperatures shall be representative of the actual trench conditions. There shall be no indication of reduction of pressure during the test after corrections have been made for changes in atmospheric conditions in conformity with the relationship $T(1)P(2)=T(2)P(1)$, in which T and P denote absolute temperature and pressure, respectively, and the numbers denote initial and final readings. During the test, the entire system shall be completely isolated from all compressors and other sources of air pressure. Each joint shall be tested by means of soap and water or an equivalent

nonflammable solution prior to backfilling or concealing any work. The testing instruments shall be approved by the Contracting Officer. All labor, materials and equipment for conducting the tests shall be furnished by the Contractor and shall be subject to inspection at all times during the tests. The Contractor shall maintain safety precautions for air pressure testing at all times during the tests.

-- End of Section --

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SECTION 02560

VALVES, PIPING, AND EQUIPMENT IN VALVE MANHOLES
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PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designations only.

ASTM INTERNATIONAL (ASTM)

ASTM A 106	(2002a) Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A 193/A 193M	(2001b) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 194/A 194M	(2001a) Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service or Both
ASTM A 234/A 234M	(2002) Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
ASTM A 53/A 53M	(2002) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 733	(2001) Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
ASTM B 209	(2002a) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM C 449/C 449M	(2000) Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement
ASTM C 533	(1995; R 2001) Calcium Silicate Block and Pipe Thermal Insulation
ASTM C 547	(2000) Mineral Fiber Pipe Insulation
ASTM C 552	(2000e1) Cellular Glass Thermal Insulation
ASTM E 84	(2001) Surface Burning Characteristics of Building Materials

ASME INTERNATIONAL (ASME)

ASME B1.20.1	(1983; R 2001) Pipe Threads, General Purpose, Inch

ASME B16.5	(1996) Pipe Flanges and Flanged Fittings
ASME B16.9	(2001) Factory-Made Wrought Steel Buttwelding Fittings
ASME B16.11	(2002) Forged Fittings, Socket-Welding and Threaded
ASME B16.20	(2000) Metallic Gaskets for Pipe Flanges - Ring-Joint, Spiral-Wound, and Jacketed
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.34	(1996) Valves Flanged, Threaded, and Welding End
ASME B31.1	(2001) Power Piping
ASME B40.100	(2000) Pressure Gauges and Gauge Attachments
ASME BPVC SEC IX	(2001) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-110	(1996) Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends
MSS SP-25	(1998) Standard Marking System for Valves, Fittings, Flanges and Unions
MSS SP-45	(1998) Bypass and Drain Connections
MSS SP-58	(1993) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	(2002) Pipe Hangers and Supports - Selection and Application
MSS SP-72	(1999) Ball Valves with Flanged or Butt-Welding Ends for General Service
MSS SP-80	(1997) Bronze Gate, Globe, Angle and Check Valves
MSS SP-83	(2001) Class 3000 Steel Pipe Unions Socket-Welding and Threaded

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2002) National Electrical Code

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 16	(1982; R 2000) Coal Tar Epoxy-Polyamide Black (or Dark Red) Paint
SSPC SP 10	(2000) Near-White Blast Cleaning

UNDERWRITERS LABORATORIES (UL)

UL 723	(1996; Rev thru Sep 2001) Test for Surface Burning Characteristics of Building Materials

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings; G-AO

Detail drawings, as specified, 30 days after notice to proceed.

SD-03 Product Data

Piping and Fittings
Valves
Insulation

Expansion Joints

Manufacturer's descriptive data and technical literature, performance charts, catalog cuts and installation instructions.

SD-10 Operation and Maintenance Data

Valve Manholes and Accessories
Data Package 2

Data Package 2 in accordance with Section 01781 OPERATION AND MAINTENANCE DATA.

Six copies of operation and six copies of maintenance manuals shall be provided for the equipment furnished. Operation manuals shall detail the step-by-step procedures required for equipment startup, operation, and shutdown. Operation manuals shall include the manufacturer's name, model number, parts list, and brief description of all equipment and their basic operating features. Maintenance manuals shall list routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. Maintenance manuals shall include piping and equipment layout and simplified wiring and control diagrams indicating location of

electrical components with terminals designated for wiring, as installed.

1.3 DESCRIPTION

This specification covers valve manholes and the valves and equipment shown in the manholes on the drawings.

1.3.1 Detail Drawings

The Contractor shall submit detail drawings for valve manholes and the piping and equipment in the valve manholes, such as steam traps, valves, sump pumps, pressure gauges, thermometers and insulation, including a complete list of equipment and materials, including manufacturer's descriptive and technical literature, performance charts and curves, catalog cuts, and installation instructions. Drawings shall also contain complete wiring and schematic diagrams. Drawings shall show pipe anchors and guides, and layout and anchorage of equipment and appurtenances in valve manholes, and equipment relationship to other parts of the work including clearances for maintenance and operation.

1.3.2 Insulated Sections

The Contractor shall submit sample sections for insulation of pipe, elbow, tee, valve, support point, and terminating points. After approval of materials and prior to insulation of piping, a display shall be prepared of insulated sections showing compliance with specifications including showing fastening, sealing, jacketing, straps, waterproofing, supports, hangers, anchors, and saddles. Approved display sample sections shall remain on display at the jobsite during the construction period until no longer needed by Contracting Officer, then removed.

1.4 DELIVERY AND STORAGE

All materials and equipment delivered and placed in storage shall be stored with protection from the weather, excessive humidity, and excessive temperature variation; dirt, dust, or other contaminants.

1.5 FIELD MEASUREMENTS

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Equipment shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site.

2.2 NAMEPLATES

Each major item of equipment such as sump pump, motor, steam trap, and pressure reducing valve shall have the manufacturer's name, address, type

or style, model or serial number, and catalog number on a plate secured to the item of equipment.

2.3 ASBESTOS PROHIBITION

Asbestos and asbestos-containing products shall not be used.

2.4 ELECTRICAL WORK

Motors, manual or automatic motor control equipment, and protective or signal devices required for the operation specified shall be provided under this section in accordance with NFPA 70 and Section 16375A ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND.

2.5 PIPING AND FITTINGS

2.5.1 General Requirements

Piping, fittings and piping accessories inside the valve manholes shall conform to the requirements of ASME B31.1 and shall be suitable for the working pressure and temperature requirements of the system. To the greatest extent possible, the piping and fittings inside the valve manholes shall match the piping and fittings located on the outside of the valve manhole. All piping in valve manholes shall be steel with joints welded except that joints 3/4 inch and smaller may be threaded. When threaded joints are used on High Temperature Water Systems, the interface area where the pipe threads meet the threaded fittings shall be seal welded (continuous fillet weld) to preclude any water leakage. No supports, anchors, or stays shall be attached to any piping system in places where either the installation of or the movement of the pipe and its contents will cause damage to the construction.

2.5.2 Steel Pipe

Pipe shall be black steel, seamless or electric-resistance welded, conforming to the requirements of ASTM A 53/A 53M, Grade B or ASTM A 106, Grade B. Pipe up to and including 10 inches in diameter shall be schedule 40. Pipe 12 inches in diameter and greater shall be 0.375 inch nominal wall thickness. Gauge piping and piping 3/4 inch in diameter and smaller shall be schedule 80.

2.5.2.1 Nipples

Nipples shall conform to ASTM A 733 as required to match adjacent piping.

2.5.2.2 Pipe Threads

Pipe threads shall conform to ASME B1.20.1. Pipe threads may be used only on pipe 3/4 inch or smaller. All pipe which is to be threaded shall be schedule 80.

2.5.3 Fittings

All fittings, valves, flanges and unions shall have the manufacturer's trademark affixed in accordance with MSS SP-25 so as to permanently identify the manufacturer.

2.5.3.1 Welded Fittings

Welded fittings shall conform to ASTM A 234/A 234M, buttwelded or socket welded, as required to match connecting piping. Buttwelded fittings shall conform to ASME B16.9, and socket welded fittings shall conform to ASME B16.11.

2.5.3.2 Unions

Unions shall conform to MSS SP-83 as required to match adjacent piping.

2.5.3.3 Ball Valves

Ball valves shall conform to MSS SP-72 for flanged or buttwelded valves or MSS SP-110 for threaded ball valves.

2.5.4 Insulating Flanges and Dielectric Waterways

2.5.4.1 Insulating Flanges

For systems in which cathodic protection is provided, insulating flanges or flange gasket kits shall be installed in the valve manhole at the pipe connection to or from the heat distribution system and at dissimilar metals and when the carrier pipe and appurtenances are supported in such a way as to electrically ground or alter the cathodic protection system voltages or currents. The kit shall consist of flanges, a flange gasket, nuts and bolts, bolt sleeves, and one insulating washer and one steel washer for both ends of each bolt. The manufacturer shall certify that the gasket kits are capable of electrically isolating the pipe at the 665 psig pressure and 500 degrees F temperature of the heating medium at the point of application. Evidence of satisfactory installations operating not less than 2 years shall be submitted in accordance with paragraph SUBMITTALS before materials are delivered. The Contractor shall ensure that these kits are provided and properly installed according to manufacturer's published instructions. Bolts shall be torqued to the correct tightness and in the correct bolt pattern as recommended by the manufacturer's published instructions. Steel flanges shall conform to ASME B16.5 Class appropriate for pressure and shall match valves or flanged fittings on which used. Steel flanges shall be flat faced. Gaskets shall be non-asbestos compressed material in accordance with ASME B16.21, 1/16 inch thickness, full face or self centering flat ring type. Bolts shall conform to the requirements of ASTM A 193/A 193M, Grade B7. The bolt head shall be marked to identify the manufacturer and the standard to which the bolt complies. Lengths of bolts shall be such that not less than two full threads extend beyond the nut with the bolt tightened to the required tension and the washer seated. Nuts shall conform to the requirements of ASTM A 194/A 194M, Grade 7.

2.5.4.2 Dielectric Waterways

Dielectric waterways shall have temperature and pressure rating equal to or greater than that specified for the connecting piping and shall be used for joining dissimilar metals on 3/4 inch and smaller threaded pipe. Waterways shall have metal connections on both ends suited to match connecting piping. Dielectric waterways shall be internally lined with an insulator specifically designed to prevent current flow between dissimilar metals. Dielectric flanges shall meet the performance requirements described herein for dielectric waterways.

2.5.4.3 Gaskets Non-Insulating

Provide spiral wound, non-asbestos gasket with centering ring per ASME B16.20.

2.6 VALVES

Unless otherwise specified, valves shall comply with the material, fabrication, and operating requirements of ASME B31.1. Valves shall be suitable for the temperature and pressure requirements of the system on which used. Valves for hot water shall conform to ASME B31.1 as suitable for the application. Valves 3/4 inch and smaller may be bronze where seal welding is not required. Valves 6 inches and larger shall have a 1 inch minimum gate or globe bypass valve sized in conformance with MSS SP-45.

2.6.1 Steel Valves

Steel globe, gate, angle, and check valves shall conform to the requirements of ASME B16.34 and ASME B31.1 for the temperature and pressure requirements of the system. Gate valves 2-1/2 inches and smaller shall be rising stem. Gate valves 3 inches and larger shall be outside screw and yoke.

2.6.2 Bronze Valves

2.6.2.1 Globe, Gate, and Angle Valves

Bronze globe, gate, and angle valves shall conform to requirements of MSS SP-80, union bonnet type.

2.6.2.2 Check Valves

Bronze check valves shall conform to the requirements of MSS SP-80.

2.6.3 Packing

Packing used with valves shall not contain asbestos. Valve stem packing shall be die-formed, ring type specifically designated as suitable for the temperature and pressure of the service and compatible with the fluid in the system. Packing shall be polytetrafluoroethylene with minimum 50 percent graphite filament. Valves 1-1/2 inches and smaller shall have four or five packing rings and valves 2 inches and larger shall have at least six packing rings. Spiral or continuous packing will not be acceptable. A metal insert shall be provided having proper clearance around the valve stem at the bottom of the stuffing box and acting as a base for the packing material. Packing glands shall be furnished with a liner of noncorrosive material and shall be of one piece construction with provisions for not less than two bolts for packing adjustment.

2.7 PRESSURE GAUGES

Gauges shall conform to ASME B40.100, and shall be provided with throttling type needle valve or a pulsation dampener and shut-off valve. Minimum dial size shall be 4-1/4 inches.

2.8 DIAL THERMOMETERS

Dial type thermometer shall be 3-1/2 inches in diameter with stainless steel case, remote-type bulb or direct-type bulb as required. The

thermometer shall have an accuracy of plus or minus 2 degrees F. Thermometer wells of the separable socket type shall be provided for each thermometer with direct-type bulb. The thermometer shall have a white face with black digits graduated in 2 degrees F increments.

2.9 INSULATION AND JACKETING

2.9.1 General Provisions

All piping, fittings, valves, etc., in the valve manholes shall be insulated. Insulation shall be premolded, precut or job fabricated to fit and shall be removable and reusable. Thickness of insulation shall be in accordance with Tables 1 and 2. Insulation jackets shall be provided for all pipe and fitting insulation. Insulation shall conform to EPA requirements in accordance with Section 01670 RECYCLED / RECOVERED MATERIALS.

2.9.2 Insulation

Insulation for all piping, fittings, and valves shall be molded calcium silicate conforming to ASTM C 533, Type I, or molded mineral fiber insulation conforming to ASTM C 547, Class 2, or cellular glass insulation conforming to ASTM C 552. All insulation shall be asbestos free. Laminated construction shall not be used unless the thickness exceeds 4 inches. Insulations and the manufacturers approved for use are:

a. Delta, available from Rockwool in Leeds, Alabama.

b. MPT-PC and MPT-PF, available from Mineral Products of Texas in Houston, TX.

c. Thermo-12, Super Caltemp, available from Johns Manville in Denver, Colorado.

d. Foamglass (cellular glass), available from Pittsburgh Corning Corporation.

2.9.3 Aluminum Jackets

Aluminum jackets shall be smooth sheet, 0.016 inch nominal thickness and conform to the requirements of ASTM B 209, Type 3003, 3105, or 5005.

2.9.4 Bands

Bands for aluminum jacket shall be 3/8 inch wide and 32 gauge thickness made of aluminum or annealed stainless steel. Bands for insulation shall be 1/2 inch wide and 32 gauge thickness made of annealed stainless steel.

2.9.5 Insulation for Flanges, Unions, Valves, and Fittings

Flanges, unions, valves, and fittings shall be insulated with premolded prefabricated, or field fabricated segments of insulation of the same material and thickness as the manhole pipe insulation. Insulation shall be removable and reusable and shall have essentially the same thermal characteristics and thickness as the adjoining piping.

2.9.6 Finishing Cement

Mineral fiber hydraulic-setting thermal insulating cement in accordance

with ASTM C 449/C 449M.

2.9.7 Glass Tape

Glass tape shall meet the requirements of UL 723 and ASTM E 84.

2.9.8 Plain Weave, Untreated

The ends shall be properly interlocked with the picks to ensure that there shall be no raveling of the tape edges. The tape shall have an average weight of 5.8 plus or minus 10 percent ounces per square yard. An average thickness of 0.007 plus or minus 0.001 inches. Warp ends/wales of 42 plus or minus 2 per inch or filling picks/courses of 32 plus or minus 2 per inch, a minimum breaking strength of 150 pounds per inch of width, and after heating to 900 degrees F for 2 hours. A minimum breaking strength of 40 pounds per inch of width.

2.9.9 Knitted, Untreated

The wales shall be properly interlocked with the courses to ensure that there shall be no raveling of the tape edges. The tape shall have an average weight of 4.5 plus or minus 10 percent ounces per square yard. An average thickness of 0.007 plus or minus 0.001 inches, warp ends/wales of 16 plus or minus 2 per inch. A minimum breaking strength of 40 pounds per inch of width and, after heating to 900 degrees F for 2 hours. A minimum breaking strength of 21 pounds per inch of width.

2.9.10 Distortion Requirements

There shall be no distortion of the tape when a sample 24 inches in length is spread across a flat horizontal surface and observed for evidence of distortion (such as tendency to curl rather than lie flat). The width tolerance is plus or minus 1/8 inch.

2.9.11 Open-Weave Tape

Tape shall be open-weave type and shall be used for embedding between coats of adhesive or coating materials.

2.10 CONCRETE VALVE MANHOLE ACCESSORIES

2.10.1 Valve Manhole Construction

2.10.2 Pipe Sleeves

Pipe sleeves of sufficient length to pass through valve manhole or building walls shall be provided. Pipe sleeves shall be zinc-coated steel pipe, conforming to the requirement of ASTM A 53/A 53M, Schedule 40 or standard weight. The pipe sleeves shall be secured in the proper position and location during construction of the valve manhole or building wall. For manhole top penetrations, the diameter of the pipe sleeve will be large enough to allow at least 1/4 inch of clearance between the pipe insulation and the sleeve, and, the sleeve will be sized to accommodate the specific mechanical seal size used for the conduit penetration. The space between the sleeve and the pipe casing, and the caulking and sealing materials shall be selected so there shall be NO electrical continuity between the pipe sleeve and the pipe casing when finished.

2.10.2.1 Pipe Sleeves for Conduit Penetrations

A modular mechanical type sealing assembly will be used between the valve manhole pipe sleeve and the conduit casing. The mechanical seal shall consist of interlocking elastomeric links shaped to continuously fill the annular space between the casing and sleeve. The link material shall be a synthetic elastomeric capable of withstanding long term exposure at 400 degrees F without deterioration. The links shall be attached to each other with corrosion resistant steel bolts, nuts and pressure plates. The link, bolts, nuts and pressure plates shall be the product of single manufacturer and shall be furnished as the product of single manufacturer and shall be furnished as a package or kit. The links shall be loosely assembled with bolts to form a continuous rubber belt around the casing with a pressure plate under each bolt head and each nut. After the seal assembly is properly positioned in the sleeve, tightening of the bolt shall cause the rubber sealing elements to expand and provide a watertight seal between the casing and the sleeve. The pipe sleeve diameter shall be sized so that no more than one half of the seal assembly's expansion capability is used to achieve a water seal.

2.10.3 Pipe Supports

Pipe Supports shall be in accordance with MSS SP-58 and MSS SP-69, type as shown. All pipe supports, including structural cross support members, shall be galvanized in accordance with Section 05500A MISCELLANEOUS METAL. Chains, straps, or single point supports shall not be used.

2.11 EXPANSION JOINTS

2.11.1 Guided Slip Tube

Internally-externally guided type, injected semiplastic type packing, with service outlets. Joints shall be for minimum working pressure of ASME Class 150. Provide single or double slip tube type as indicated. Provide flanged or buttwelding end connections as indicated.

2.11.2 Flexible Ball

Provide chromium plated steel balls capable of 360-degree rotation plus 15-degree angular flex movement. Provide pressure molded composition gaskets designed for continuous operation temperature of 525 degrees F. Joints shall be for minimum working pressure of ASME Class 150. Provide flanged or buttwelding end connections as indicated.

2.11.3 Bellows-Type

Type 304 staniless steel corrugated bellows, reinforced with rings, internal sleeves, and external protective covers. Provide limit stops to limit total movement in both directions. Cold set the joints to compensate for temperature at time of installation. Joints shall withstand 10,000 cycles over a 20 year period. Joints shall be for minimum working pressure of ASME Class 150. Provide single or double bellows expansion joint as indicated. Provide first pipe alignment guide no more than four pipe diameters from the expansion joint; provide second pipe alignment guide no more than 14 pipe diameters from the first guide. Provide flanged or buttwelding end connections as indicated.

2.12 MISCELLANEOUS METAL

Miscellaneous metal not otherwise specified, shall conform to Section 05500A MISCELLANEOUS METAL. Miscellaneous metal bolted together, shop welded, or assembled in the field, and pipe supports, including structural cross support members and anchors, shall be hot-dip galvanized in accordance with Section 05500A MISCELLANEOUS METAL.

PART 3 EXECUTION

3.1 SITE WORK

3.1.1 Excavation, Trenching, and Backfilling

Excavation, trenching, and backfilling of the valve manholes shall be as shown and in accordance with Section 02300 EARTHWORK.

3.1.2 Electric Work

Any wiring required for the operation of the equipment specified, but not shown on the electrical drawings, shall be provided under this section in accordance with Section 16375A ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND.

3.1.3 Painting

The heat affected zone of field welded galvanized surfaces and other galvanized surfaces damaged during installation shall be cleaned in compliance with SSPC SP 10, and painted in accordance with Section 09900 PAINTS AND COATINGS. Steel and iron appurtenances, piping, and supports shall be cleaned in compliance with SSPC SP 10, and painted in accordance with SSPC Paint 16, coal-tar epoxy-polyamide.

3.2 PIPING

3.2.1 General

All piping in valve manholes shall be steel and insulated. Insulation shall be protected with an aluminum jacket. Pipe shall be accurately cut to measurements established at the site and shall be worked into place without springing or forcing. Pipe and insulation shall clear all openings and equipment. Excessive cutting or other weakening of structural members to facilitate piping installation will not be permitted. Burrs shall be removed from ends of pipe by reaming. Installation shall permit free expansion and contraction without damage to joints or hangers. Piping shall be installed in accordance with ASME B31.1. Joints for piping in valve manholes shall be welded, except joints at traps, strainers, and at valves and piping 3/4 inch and smaller which may be threaded. Flanged joints will be permitted for dielectric isolation only. Supports, anchors, or stays shall not be attached where either expansion or the weight of the pipe will cause damage to permanent construction. The method of attaching supports shall not interfere with the operation of the cathodic protection system.

3.2.2 Welded Joints

Joints between sections of pipe, between sections of pipe and valves, and between sections of pipe and fittings shall be welded except where joints are allowed to be screwed for pipe sizes 3/4 inch and smaller. The welding shall conform to the requirements specified in paragraph WELDING.

3.2.3 Flanged and Threaded Joints

3.2.3.1 Flanged Joints

Flanged joints shall be faced true, provided with gaskets, and made perfectly square and tight. Flanged joints shall be used only for electrical isolation and in other special cases where connected equipment is available with only flanged joints, or when specifically shown on the drawings. Electrically isolated flange joints shall be provided at all connections to or from the heat distribution system and between dissimilar metals.

3.2.3.2 Threaded Joints

Threaded joints shall have graphite or inert filler and oil, graphite compound, or polytetrafluoroethylene tape applied to the male threads only. Unions shall be provided at all screwed valves, strainers and connections to equipment 3/4 inch and smaller. Dielectric unions shall be used at connections of dissimilar metals in 3/4 inch and smaller piping. When used on High Temperature Water Systems, threaded joints shall be seal welded.

3.2.4 Reducing Fittings

Eccentric reducers in horizontal runs shall be installed with the straight side down. Changes in horizontal piping sizes shall be made through eccentric reducing fittings.

3.2.5 Branch Connections

Branches from mains shall branch off top of mains as indicated or as approved. Connections shall ensure unrestricted circulation, elimination of air pockets, and shall permit the complete drainage of the system. Branch connections may be made with either welding tees or forged branch outlet fittings. Branch outlet fittings where used shall be forged and shall be no larger than two nominal pipe sizes smaller than the main run. Branch outlet fittings shall be reinforced to withstand external strains and designed to withstand full pipe bursting strength.

3.2.6 Pipe Supports in Valve Manholes

Horizontal and vertical runs of pipe in valve manholes shall be securely supported.

3.3 WELDING

Piping shall be welded in accordance with qualified procedures, using performance qualified welders and welding operators. Procedures and welders shall be qualified in accordance with ASME BPVC SEC IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer may be accepted as permitted by ASME B31.1. The Contracting Officer shall be notified 24 hours in advance of tests and the tests shall be performed at the work site. The welder or welding operator shall apply his assigned symbol near each weld he makes as a permanent record. Structural members shall be welded in accordance with Section 05090A WELDING, STRUCTURAL.

3.4 INSULATION

The insulation shall be installed so that it will not be damaged by pipe expansion or contraction. Insulation shall not become wet before, during, or after installation. Insulation installed over welds shall be grooved to assure a snug fit. Insulation shall be held in place with stainless steel straps. A minimum of 2 bands shall be installed on each individual length of insulation and maximum spacing shall not exceed 18 inch centers.

3.4.1 Installation

Material shall be installed in accordance with published installation instructions of the manufacturer. Insulation materials shall not be applied until piping tests are completed. Prior to application, surfaces shall be thoroughly cleaned of moisture, grease, dirt, rust, and scale, and painted where required.

3.4.2 Insulation on Pipes Passing Through Sleeves

Insulation shall be continuous, as required by paragraph Pipe Sleeves Through Valve Manhole Cover. Aluminum jackets shall be provided over the insulation. When penetrating valve manhole walls, aluminum jacket shall extend not less than 2 inches beyond the sleeve on each side of the wall and shall be secured with an aluminum band on each side of the wall. Where flashing is provided, the jacket shall be secured with not less than one band located not more than 1 inch from the end of the jacket. When penetrating valve manhole tops, pipe shall be insulated as required for valve manhole service as indicated.

3.4.3 Covering of Insulation in Valve Manholes

The insulation for pipe, flanges, valves, and fittings shall be covered with aluminum jackets.

3.4.4 Insulation of Piping Accessories in Valve Manholes

Flanges, couplings, unions, valves, fittings, and other pipe accessories, unless otherwise shown or approved, shall be insulated with removable and reusable factory premolded, prefabricated, or field fabricated insulation. For accessories in valve manholes, aluminum sheet shall be applied over the insulation. Where accessories are designated not to be insulated, the adjoining insulation and jacket shall terminate neatly. The terminations for the chilled water systems shall provide a complete vapor seal.

3.4.5 Insulation Thickness

The minimum thickness of insulation for the heat distribution system shall be in accordance with Tables 1 and 2.

TABLE 1
Minimum Pipe Insulation Thickness (In inches)

For High Temperature
Hot Water Supply and Return (250 to 450 degrees F)

Nominal Pipe Diameter (inches)	MPT-PC MPT-PF	Delta	Thermo-12 Super Caltemp	Foamglass
1.0	2.0	2.5	4.0	4.5
1.5	2.0	2.5	4.0	4.5
2.0	2.5	3.5	4.5	5.0
2.5	2.5	3.5	4.5	5.0
3.0	3.0	4.0	5.0	6.0
4.0	3.0	4.0	5.0	6.0
5.0	3.0	4.0	5.0	6.0
6.0	3.5	4.5	5.5	6.0
8.0	3.5	4.5	5.5	6.0
10.0	4.0	5.0	6.0	6.5
12.0	4.0	5.0	6.0	6.5
14.0	4.0	5.0	6.0	6.5
16.0	4.0	5.0	6.0	6.5
18.0	4.0	5.0	6.0	6.5

3.5 VALVE MANHOLES AND ACCESSORIES

3.5.1 Piping and Equipment in Valve Manholes

Piping and equipment in valve manholes shall be installed to provide easy access without stepping on piping or equipment, and to provide sufficient working room. Piping and equipment in valve manholes shall be installed and supported as shown on the drawings. All globe, angle and gate valves shall be installed with the stems horizontal or above. The Contractor shall submit Data Package 2 as related to all equipment provided for the project.

3.6 TESTS

Tests of piping in the valve manholes will be performed as part of the testing of the direct buried conduit system. These tests shall include the piping in the valve manhole and shall be in accordance with the system supplier's Approved Brochure or the contract specifications.

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SECTION 02564

(NORTH DAKOTA) PAVEMENTS FOR SMALL PROJECTS
08/00

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION (NDDOT)

NDDOT	(1997) Standard Specification for Road and Bridge Construction

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO MP 1	(1998) Provisional Specification for Performance Graded Asphalt Binder
AASHTO T 104	Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
AASHTO T 180	(2001) Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and an 457-mm (18-in) Drop
AASHTO TP53	(2000) Determining Asphalt Content of Hot Mix Asphalt by the Ignition Method

ASTM INTERNATIONAL (ASTM)

ASTM C 136	(2001) Sieve Analysis of Fine and Coarse Aggregates
ASTM C 309	(1998a) Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 566	(1997) Total Evaporable Moisture Content of Aggregate by Drying
ASTM D 1461	(1985; R 2001) Moisture or Volatile Distillates in Bituminous Paving Mixtures
ASTM D 1557	(2000) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu.m.))
ASTM D 2041	(2000) Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures

ASTM D 2172	(2001e1) Quantitative Extraction of Bitumen from Bituminous Paving Mixtures
ASTM D 2726	(2000) Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures
ASTM D 2950	(1991; R 1997) Density of Bituminous Concrete in Place by Nuclear Method
ASTM D 3666	(2002) Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials
ASTM D 4867/D 4867M	(1996) Effect of Moisture on Asphalt Concrete Paving Mixtures
ASTM D 5444	(1998) Mechanical Size Analysis of Extracted Aggregate
ASTM D 6307	(1998) Asphalt Content of Hot Mix Asphalt by Ignition Method

U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 649	(1995) Standard Test Method for Unit Weight, Marshall Stability, and Flow of Bituminous Mixtures
COE CRD-C 650	(1995) Standard Test Method for Density and Percent Voids of Compacted Bituminous Paving Mixtures

ASPHALT INSTITUTE (AI)

AI MS-2	(6th Edition; R 1997) Mix Design Methods for Asphalt

1.2 MEASUREMENT AND PAYMENT

Section "MEASUREMENT AND PAYMENT" of the NDDOT shall not apply.

1.3 MODIFICATION TO THE NDDOT

Reference to "Engineer" and "Department" in the NDDOT shall mean the Contracting Officer or Representative. Sections "Acceptance", "Method of Measurement" and "Basis of Payment" shall not apply.

1.4 DEFINITIONS

For the purposes of this specification, the following definitions apply.

1.4.1 Degree of Compaction

Degree of compaction of aggregate base course, and aggregate surface course shall be expressed as a percentage of the maximum density obtained by the test procedure presented in either ASTM D 1557 or AASHTO T 180, Method D.

The maximum density shall be determined in accordance with ASTM D 1557 if the material gradation contains less than 30 percent retained on the 3/4 inch sieve or AASHTO T 180 if the material gradation contains more than 30 percent retained on the 3/4 inch sieve. In this specification, degree of compaction shall be a percentage of laboratory maximum density.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Plant, Equipment, and Tools

SD-06 Test Reports

Initial Tests; G-AO

Certified copies of test results for approval not less than 20 days before material is required for the work.

SD-07 Certificates

Asphalt Cement Binder; G-AO

Copies of certified test data.

Copies of certified test data

SD-08 Manufacturer's Instructions

Manufacturer's Recommendations; G-AO

Where installation procedures, or any part thereof, are required to be in accordance with the manufacturer's recommendations, printed copies of these recommendations, 20 days prior to use on the project. Installation of the material will not be allowed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.

SD-09 Manufacturer's Field Reports

Job Mix Formula; G-AO

Proposed JMF.

Contractor Quality Control; G-AO

The Contractor shall submit all QC test results to the Contracting Officer on a daily basis as the tests are performed.

Acceptability of Work; G-AO

The Contractor shall submit all test results to the Contracting Officer on a daily basis as the tests are performed.

1.6 SAMPLING AND TESTING

Sampling and testing shall be the responsibility of the Contractor. Sampling and testing shall be performed by a testing laboratory approved in accordance with Section 01451A CONTRACTOR QUALITY CONTROL. Work requiring testing will not be permitted until the testing laboratory has been inspected and approved. The materials shall be tested to establish compliance with the specified requirements; testing shall be performed at the specified frequency. The Contracting Officer may specify the time and location of the tests.

1.7 APPROVAL OF MATERIAL

The source of the material for aggregate base course shall be selected 30 days prior to the time the material will be required in the work. Tentative approval of material will be based on initial test results and manufacturer's recommendations. Final approval of the materials will be based on sieve analysis, liquid limit, and plasticity index tests performed on samples taken from the completed and fully compacted base and subbase course.

1.8 WEATHER LIMITATIONS

1.8.1 Hot-Mix Asphalt Pavement

The hot-mix asphalt pavement shall not be placed upon a wet surface or when the surface temperature of the underlying course is less than specified in Table 1. The temperature requirements may be waived by the Contracting Officer, if requested; however, all other requirements, including compaction, shall be met.

Table 1. Surface Temperature Limitations of Underlying Course

Mat Thickness, inches	Degrees F
Less than 3	45

1.8.2 Base Course, Aggregate Surface Course

Construction of aggregate base course shall be done when the atmospheric temperature is above 35 degrees F. When the temperature falls below 35 degrees F, the Contractor shall protect all completed areas by approved methods against detrimental effects of freezing. Completed areas damaged by freezing, rainfall, or other weather conditions shall be corrected to meet specified requirements.

1.9 PLANT, EQUIPMENT AND TOOLS

All plant, equipment, and tools used in the performance of the work shall be subject to approval before the work is started and shall be maintained in satisfactory working condition at all times. The equipment shall be adequate and shall have the capability of producing pavements meeting the requirements as set forth herein.

1.10 HOT-MIX ASPHALT EQUIPMENT

Equipment for the preparation and placement of hot-mix asphalt shall conform to the requirements specified in the NDDOT, Section 408.03, "EQUIPMENT".

PART 2 PRODUCTS

2.1 HOT-MIX ASPHALT PAVEMENT

Bituminous wearing course shall conform to the requirements specified in the NDDOT, Section 408, "HOT BITUMINOUS PAVEMENT", except as modified herein. The aggregate shall be Class 29. Coarse aggregate shall meet the following additional requirements: Percentage of loss shall not exceed 12 after 5 cycles when performed in accordance with AASHTO T 104, using sodium sulfate. The Contractor shall develop the mix design. The laboratory used to develop the JMF shall meet the requirements of ASTM D 3666. A Certification signed by the manager of the laboratory stating that it meets these requirements or clearly listing all deficiencies shall be submitted to the Contracting Officer prior to the start of construction. The asphalt mix shall be dense-graded and composed of a mixture of well-graded aggregate, mineral filler if required, and asphalt material. The hot-mix asphalt shall be designed using Marshall method of mix design contained in AI MS-2 and the criteria shown in Table 3. If the Tensile Strength Ratio (TSR) of the composite mixture, as determined by ASTM D 4867/D 4867M is less than 75, the aggregates shall be rejected or the asphalt mixture treated with an approved anti-stripping agent. The amount of anti-stripping agent added shall be sufficient to produce a TSR of not less than 75. If an antistrip agent is required, it shall be provided by the Contractor at no additional cost. The hot-mix asphalt pavement shall not contain more than 15 percent reclaimed asphalt pavement.

2.1.1 JMF Requirements

The job mix formula shall be submitted in writing by the Contractor for approval at least 14 days prior to the start of the test section and shall include as a minimum:

a. Percent passing each sieve size.

b. Percent of asphalt cement

c. Percent of each aggregate and mineral filler to be used.

d. Asphalt viscosity grade, penetration grade, or performance grade

e. Number of blows of hammer per side of molded specimen.

f. Laboratory mixing temperature.

g. Lab compaction temperature.

h. Temperature-viscosity relationship of the asphalt cement.

i. Plot of the combined gradation on the 0.45 power gradation chart, stating the nominal maximum size.

j. Graphical plots of stability, flow, air voids, voids in the mineral aggregate, and unit weight versus asphalt content as shown in

AI MS-2.

k. Specific gravity and absorption of each aggregate.

l. Percent natural sand.

m. Percent particles with 2 or more fractured faces (in coarse aggregate).

n. Fine aggregate angularity.

o. Percent flat or elongated particles (in coarse aggregate).

p. Tensile Strength Ratio(TSR).

q. List of all modifiers and amount.

r. Percentage and properties (asphalt content, binder properties, and aggregate properties) of reclaimed asphalt pavement (RAP) if RAP is Used.

Table 2. Marshall Design Criteria

Test Property	50 Blow Mix
Stability, pounds minimum	*1000
Flow, 0.01 inch	8-18
Air voids, percent	3-5
Percent Voids in mineral aggregate VMA, (minimum) Class 29	15.0
TSR, minimum percent	75

* This is a minimum requirements. The average during construction shall be significantly higher than this number to ensure compliance with the specifications.
** Calculate VMA in accordance with AI MS-2, based on ASTM D 2726 bulk specific gravity for the aggregate.

2.1.2 Adjustments to Field JMF

The Laboratory JMF for each minimum shall be in effect until a new formula is approved in writing by the Contracting Officer. Should a change in sources of any materials be made, a new laboratory JMF design shall be performed and a new JMF approved before the new material is used.

2.1.3 Asphalt Cement Binder

Asphalt cement conform to the requirement specified in Section 818, "Bituminous Materials" of the NDDOT. Asphalt cement binder shall be either viscosity grade AC-5 or penetration grade 120-150 or AASHTO MP 1 Performance Grade (PG) 58046. Test data indicating grade certification shall be provided by the supplier at the time of delivery of each load to

the mix plant. Copies of these certifications shall be submitted to the Contracting Officer. The supplier is defined as the last source of any modification to the binder.

2.2 CONCRETE SIDEWALK AND CURB AND GUTTER

Portland cement concrete shall conform to Section 802, "PORTLAND CEMENT CONCRETE", of the NDDOT, except as modified herein. Concrete shall be Class AE.

2.3 CURING COMPOUND

Curing materials for concrete sidewalk and curb and gutter shall conform to ASTM C 309. Liquid membrane-forming compound shall be white pigmented type 2.

2.4 AGGREGATE BASE ACOURSE (ABC)

Aggregate base course shall conform to the requirements specified in Section 816.03, "AGGREGATES FOR SURFACING, BASE, ASPHALT MIXES, BLOTTER, AND SEAL COATS" of the NDDOT, except as modified herein. Aggregate base course shall be NDDOT Class 5 except as otherwise specified herein. The portion retained on the No. 4 sieve shall be known as coarse aggregate; that portion passing the No. 4 sieve shall be known as fine aggregate. Aggregates shall be angular particles of uniform density. Coarse aggregate shall be crushed gravel, crushed stone, crushed recycled concrete, or crushed slag. Fine aggregate shall consist of screenings, angular sand, crushed recycled concrete fines, or other finely divided mineral matter processed or naturally combined with the coarse aggregate. Materials that break up when alternately frozen and thawed or wetted and dried shall not be used. The amount of flat and elongated particles shall not exceed 30 percent. A flat particle is one having a ratio of width to thickness greater than 3; an elongated particle is one having a ratio of length to width greater than 3. In the portion retained on each sieve specified, the crushed aggregates shall contain at least 50 percent by weight of crushed pieces having two or more freshly fractured faces with the area of each face being at least equal to 75 percent of the smallest midsectional area of the piece. When two fractures are contiguous, the angle between planes of the fractures must be at least 30 degrees in order to count as two fractured faces. Crushed gravel shall be manufactured from gravel particles 50 percent of which, by weight, are retained on the maximum size sieve. The portion of the material passing the No. 40 sieve shall have a liquid limit not greater than 25 and a plasticity index not greater than 5. When tested for gradation, the percentage passing the 0.02 mm sieve shall not exceed 3.0 percent.

2.5 INITIAL TESTS

One of each of the following tests shall be performed on the proposed aggregate base course, and aggregate surface course material prior to commencing construction to demonstrate that the proposed material meets all specified requirements when furnished. If materials from more than one source are going to be utilized, this testing shall be completed for each source.

a. Sieve Analysis including 0.02 mm size material.

b. Liquid limit and plasticity index moisture-density relationship.

c. Moisture-density relationship.

d. Wear.

PART 3 EXECUTION

3.1 PAVEMENT REMOVAL

Where bituminous pavement is to be removed at the locations shown on the drawings, the pavement shall be sawed with a pre-approved concrete saw so as to leave a straight true edge. The pavement material and existing base course shall be removed in a manner that will not damage the adjacent in-place pavement to remain and as shown on the drawings. Pavement material from the removal area shall be disposed of outside the limits of Government controlled land at the Contractor's expense.

3.2 HOT-MIX ASPHALT PAVEMENT

Hot-mix asphalt pavement wearing course shall be placed to the requirements specified in the NDDOT, Section 408, "HOT BITUMINOUS PAVEMENT", except as modified herein.

3.2.1 Contractor Quality Control

A standard lot for all requirements will be equal to 8 hours of production.

3.2.1.1 Asphalt Content

A minimum of two tests to determine asphalt content will be performed per lot by one of the following methods: the extraction method in accordance with ASTM D 2172, Method A or B, the ignition method in accordance with the AASHTO TP53 or ASTM D 6307, or the nuclear method in accordance with ASTM D 4125, provided the nuclear gauge is calibrated for the specific mix being used. For the extraction method, the weight of ash, as described in ASTM D 2172, shall be determined as part of the first extraction test performed at the beginning of plant production; and as part of every tenth extraction test performed thereafter, for the duration of plant production. The last weight of ash value obtained shall be used in the calculation of the asphalt content for the mixture.

3.2.1.2 Gradation

Aggregate gradations shall be determined a minimum of twice per lot from mechanical analysis of recovered aggregate in accordance with ASTM D 5444. When asphalt content is determined by the nuclear method, aggregate gradation shall be determined from hot bin samples on batch plants, or from the cold feed on drum mix plants. For batch plants, aggregates shall be tested in accordance with ASTM C 136 using actual batch weights to determine the combined aggregate gradation of the mixture.

3.2.1.3 Temperatures

Temperatures shall be checked at least four times per lot, at necessary locations, to determine the temperature at the dryer, the asphalt cement in the storage tank, the asphalt mixture at the plant, and the asphalt mixture at the job site.

3.2.1.4 Aggregate Moisture

The moisture content of aggregate used for production shall be determined a minimum of once per lot in accordance with ASTM C 566.

3.2.1.5 Moisture Contnet of Mixture

The moisture content of the mixture shall be determined at least once per lot in accordance with ASTM D 1461 or an approved alternate procedure.

3.2.1.6 Laboratory Air Voids, Marshall Stability and Flow

Mixture samples shall be taken at least four times per lot and compacted into specimens, using 75 blows per side with the Marshall hammer. After compaction, the laboratory air voids of each specimen shall be determined, as well as the Marshall stability and flow.

3.2.2 Acceptability of Work

The pavement will be accepted on the basis of tests made by the the Contractor or its suppliers, as specified herein. The Government may, at its discretion, make check tests to validate the results of the Contractor's testing.

3.2.2.1 Sampling Pavements

Samples of the finished pavement, shall be obtained by the Contractor. The location of the samples shall be as directed and the cores shall be at least 4 inches in diameter. The samples shall be tested by the Contractor to determine conformance to density. Specimens shall be tested in accordance with the requirements of Method 101 of COE CRD-C 650. Three samples shall be taken and tested for each 750 tons or less of bituminous mixture placed each day. A minimum of one core shall be obtained from the longitudinal joint. The Contractor shall fill all cores holes with new material and shall meet the requirements as described herein.

3.2.2.2 Laboratory Air Voids

Laboratory air voids will be calculated by determining the Marshall density of each lab compacted specimen using ASTM D 2726 and determining the theoretical maximum density of every other sublot sample using ASTM D 2041. Laboratory air void calculations for each sublot will use the latest theoretical maximum density values obtained, either for that sublot or the previous sublot. The mean absolute deviation of the four laboratory air void contents (one from each sublot) from the JMF air void content will be evaluated. The mean absolute deviation shall be less than 1.00. All laboratory air void tests will be completed and reported within 24 hours after completion of construction of each lot.

3.2.2.3 In-place Density

Density of the compacted mixture of the bituminous wearing course shall be between 97 and 100 percent (joint density 95 to 100 percent) of the maximum laboratory compacted density. The maximum laboratory compacted specimens shall be determined from the same mixture taken from the plant in accordance to COE CRD-C 649 and CRD-C 650. Densities of the in-place compacted mixture may be determined by the nuclear method in accordance with ASTM D 2950 for Contractor quality control purposes. In any event, the basis of acceptance for density shall be determined from the specific

gravity method.

3.2.2.4 Surface Smoothness

After the final rolling, but not later than 24 hours after placement, the surface of the pavement in each entire lot shall be tested by the Contractor in such a manner as to reveal all surface irregularities exceeding the tolerances specified below. If any pavement areas are ground, these areas shall be retested immediately after grinding. All testing shall be performed in the presence of the Contracting Officer. Detailed notes of the results of the testing shall be kept and a copy furnished to the Government immediately after each day's testing. The entire area of the pavement shall be tested in both a longitudinal and a transverse direction on parallel lines. The transverse lines shall be 25 feet or less apart, as directed. The longitudinal lines shall be at the centerline of each paving lane for lines less than 20 feet and at the third points for lanes 20 feet or greater. Other areas having obvious deviations shall also be tested. Longitudinal testing lines shall be continuous across all joints. Where drawings show required deviations from a plane surface (crowns, drainage inlets, etc.), the surface shall be finished to meet the approval of the Contracting Officer. The straightedge shall be held in contact with the surface and moved ahead one-half the length of the straightedge for each successive measurement. The amount of surface irregularity shall be determined by placing the freestanding (unleveled) straightedge on the pavement surface and allowing it to rest upon the two highest spots covered by its length, and measuring the maximum gap between the straightedge and the pavement surface in the area between these two high points. The finished surfaces of the pavements shall have no abrupt change of 3/16 inch or more, and all pavements shall be within the tolerances specified in Table 3 when checked with an approved 10 foot straightedge.

Table 3. Straightedge Surface Smoothness - Pavements

Pavement Category	Direction of Testing	Tolerance, Inches
All Paved Areas	Longitudinal	3/16
	Transverse	3/16

3.3 CONCRETE SIDEWALK AND CURB AND GUTTER

The subgrade shall be in a moist condition when concrete is placed. The subgrade shall be prepared and protected to produce a subgrade free from frost when the concrete is deposited. Forms shall be cleaned and coated with form oil each time before concrete is placed. Wood forms may, instead, be thoroughly wetted with water before concrete is placed, except that with probable freezing temperatures, oiling is mandatory.

3.3.1 Sidewalks

Except as otherwise specified herein, portland cement concrete sidewalk shall be placed in accordance with Section 750, "SIDEWALKS AND DRIVEWAYS" of the NDDOT. Subgrade shall be placed and compacted in conformance with Section 02300 EARTHWORK. The subgrade shall be tested for grade and cross section by means of a template extending the full width of the sidewalk and supported between side forms. Finished surfaces shall not vary more than 5/16 inch from the testing edge of a 10-foot straightedge. Permissible deficiency in section thickness will be up to 1/4 inch. All slab edges, including those at formed joints, shall be finished with an edger having a

radius of 1/8 inch. Transverse joint shall be edged before brooming, and the brooming shall eliminate the flat surface left by the surface face of the edger. Sidewalk joints shall be constructed to divide the surface into square or rectangular areas. Spacing of transverse and longitudinal contraction and expansion joints shall be as indicated. At the end of the curing period, expansion joints shall be carefully cleaned and filled with cold-applied joint sealant (gray or stone color) as indicated on the drawings. The joint opening shall be thoroughly cleaned before the sealing material is placed. Sealing material shall not be spilled on exposed surfaces of the concrete. Concrete at the joint shall be surface dry and the atmospheric and concrete temperatures shall be above 50 degrees F at the time of application of joint sealing material.

3.3.2 Curb and Gutter

Except as otherwise specified herein, portland cement concrete curb and gutter shall be placed in accordance with Section 748, "CURB AND GUTTER", of the NDDOT. The subgrade shall be tested for grade and cross section by means of a template extending the full width of the curb and gutter. Concrete shall be placed to the section required in a single lift. Consolidation shall be achieved by using approved mechanical vibrators. Curve shaped gutters shall be finished with a standard curb "mule". Approved slipformed curb and gutter machines may be used in lieu of hand placement. Exposed surfaces shall be floated and finished with a smooth wood float until true to grade and section and uniform in texture. The edges of the gutter and top of the curb shall be rounded with an edging tool to a radius as shown on the drawings. Finished surfaces shall not vary more than 1/4 inch from the testing edge of a 10-foot straightedge. Permissible deficiency in section thickness will be up to 1/4 inch. Contraction joints shall be spaced so that monolithic sections between curb returns will not be less than 5 feet nor greater than 15 feet in length. Contraction joints shall be constructed by means of 1/8 inch thick separators and of a section conforming to the cross section of the curb and gutter. Separators shall be removed as soon as practicable after concrete has set sufficiently to preserve the width and shape of the joint and prior to finishing. Expansion joints shall be formed by means of preformed expansion joint filler material cut and shaped to the cross section of curb and gutter. Expansion joints at least 1/2 inch in width shall be provided at intervals not exceeding 40 feet. Expansion joints and the top 1 inch depth of contraction joints shall be sealed with cold or hot-applied sealant immediately following curing of the concrete or as soon thereafter as weather permits. The joint opening shall be thoroughly cleaned before the sealing material is placed. Sealing material shall not be spilled on exposed surfaces of the concrete. Concrete at the joint shall be surface dry and the atmospheric and concrete temperatures shall be above 50 degrees F at the time of application of joint sealing material. Excess material on exposed surfaces of the concrete shall be removed immediately and concrete surfaces cleaned.

3.3.3 Curing and Protection

Concrete shall be protected against loss of moisture and rapid temperature changes for at least 7 days from the beginning of the curing operation. Concrete shall be cured using one of the following methods.

3.3.3.1 Mat Method

The entire exposed surface shall be covered with 2 or more layers of burlap. Mats shall overlap each other at least 6 inches. The mat shall be

thoroughly wetted with water prior to placing on concrete surface and shall be kept continuously in a saturated condition and in intimate contact with concrete for not less than 7 days.

3.3.3.2 Impervious Sheeting Method

The entire exposed surface shall be wetted with a fine spray of water and then covered with impervious sheeting material. Sheets shall be laid directly on the concrete surface with the light-colored side up and overlapped 12 inches when a continuous sheet is not used. The curing medium shall not be less than 18 inches wider than the concrete surface to be cured, and shall be securely weighted down by heavy wood planks, or a bank of moist earth placed along edges and laps in the sheets. Sheets shall be satisfactorily repaired or replaced if torn or otherwise damaged during curing. The curing medium shall remain on the concrete surface to be cured for not less than 7 days.

3.3.3.3 Membrane Curing Method

A uniform coating of white-pigmented membrane-curing compound shall be applied to the entire exposed surface of the concrete.

3.4 AGGREGATE COURSES

Aggregate base course, and aggregate surface course shall be placed in accordance with Section 302, "AGGREGATE BASE OR SURFACE COURSE" of the NDDOT, except as modified herein. The aggregate base course shall be compacted to 100 percent of laboratory maximum density.

3.4.1 General Requirements

When the aggregate course is constructed in more than one layer, the previously constructed layer shall be cleaned of loose and foreign matter by sweeping with power sweepers or power brooms, except that hand brooms may be used in areas where power cleaning is not practicable. Adequate drainage shall be provided during the entire period of construction to prevent water from collecting or standing on the working area. Line and grade stakes shall be provided as necessary for control. Grade stakes shall be in lines parallel to the centerline of the area under construction and suitably spaced for string lining.

3.4.2 Preparation of Underlying Course

Prior to constructing the aggregate courses, the underlying course or subgrade shall be cleaned of all foreign substances. At the time of construction of the aggregate course, the underlying course shall contain no frozen material. The surface of the underlying course or subgrade shall meet specified compaction and surface tolerances. Ruts or soft yielding spots in the underlying courses, areas having inadequate compaction, and deviations of the surface from the requirements set forth herein shall be corrected by loosening and removing soft or unsatisfactory material and by adding approved material, reshaping to line and grade, and recompacting to specified density requirements. The finished underlying course shall not be disturbed by traffic or other operations and shall be maintained by the Contractor in a satisfactory condition until the aggregate course is placed.

3.4.3 Installation

3.4.3.1 Mixing

The coarse and fine aggregates shall be mixed and placed to obtain uniformity of the material. The Contractor shall make adjustments in mixing procedures or in equipment as directed to obtain true grades, to minimize segregation or degradation, to obtain the required water content, and to insure a satisfactory aggregate course meeting all requirements of this specification.

3.4.3.2 Placing

The mixed material shall be placed on the underlying course or subgrade in layers of uniform thickness with an approved spreader. When a compacted layer 6 inches or less in thickness is required, the material shall be placed in a single layer. When a compacted layer in excess of 6 inches is required, the material shall be placed in layers of equal thickness. No layer shall exceed 6 inches or less than 3 inches when compacted. The layers shall be so placed that when compacted they will be true to the grades or levels required with the least possible surface disturbance. Adjustments in placing procedures or equipment shall be made as may be directed to obtain true grades, to minimize segregation and degradation, to adjust the water content, and to insure an acceptable aggregate course.

3.4.3.3 Edges of Base Course

Approved material shall be placed along the edges of aggregate course in such quantity as will compact to the thickness of the course being constructed. When the course is being constructed in two or more layers, at least a 1 foot width of this material shall be rolled and compacted simultaneously with rolling and compacting of each layer of aggregate course.

3.4.3.4 Compaction

Each layer of the aggregate course shall be compacted as specified with approved compaction equipment. Water content shall be maintained during the compaction procedure to within plus or minus 1 percent of the optimum water content determined from laboratory tests. Rolling shall begin at the outside edge of the surface and proceed to the center, overlapping on successive trips at least one-half the width of the roller. Alternate trips of the roller shall be slightly different lengths. Speed of the roller shall be such that displacement of the aggregate does not occur. In all places not accessible to the rollers, the mixture shall be compacted with hand-operated power tampers. Compaction shall continue until each layer has a degree of compaction that is at least 100 percent of laboratory maximum density through the full depth of the layer. The Contractor shall make such adjustments in compacting or finishing procedures as may be directed to obtain true grades, to minimize segregation and degradation, to reduce or increase water content, and to ensure a satisfactory aggregate course. Any materials that are found to be unsatisfactory shall be removed and replaced with satisfactory material or reworked, as directed, to meet the requirements of this specification.

3.4.3.5 Aggregatae Base Course Finishing

The surface of the top layer of aggregate base course shall be finished after final compaction by cutting any overbuild to grade and rolling with a

steel-wheeled roller. Thin layers of material shall not be added to the top layer of base course to meet grade. If the elevation of the top layer is 1/2 inch or more below grade, then the top layer should be scarified to a depth of at least 3 inches and new material shall be blended in and compacted to bring to grade. Adjustments to rolling and finishing procedures shall be made as directed to minimize segregation and degradation, obtain grades, maintain moisture content, and insure an acceptable aggregate base course. Should the surface become rough, corrugated, uneven in texture, or traffic marked prior to completion, the unsatisfactory portion shall be scarified, reworked and recompacted or it shall be replaced as directed.

3.4.4 Acceptability of Work

The aggregate base course, subbase course, and rigid pavement base course will be accepted on the basis of tests made by the Contractor as specified herein. The Government may, at its discretion, make check tests to validate the results of the Contractor's testing.

3.4.4.1 In-Place Tests

One of each of the following tests shall be performed on samples taken from the placed and compacted aggregate course. Samples shall be taken and tested at the rates indicated for each layer of material placed.

a. Density tests shall be performed on every lift of material placed and at a frequency of one set of tests for every 250 square yards, or portion thereof, of completed area.

b. Sieve Analysis including 0.02 mm size material shall be performed on every lift of material placed and at a frequency of one test for every 1000 square meters, or portion thereof, of completed area for every 500 tons, or portion thereof, of material placed.

c. Liquid limit and plasticity index tests shall be performed at the same frequency as the sieve analysis.

3.4.4.2 Thickness

The total compacted thickness of the aggregate course shall be within 1/2 inch of the thickness indicated. Where the measured thickness is more than 1/2 inch deficient, such areas shall be corrected by scarifying, adding new material of proper gradation, reblading, and recompacting as directed. Where the measured thickness is more than 1/2 inch thicker than indicated, the course shall be considered as conforming to the specified thickness requirements. Average job thickness shall be the average of all thickness measurements taken for the job, but shall be within 1/4 inch of the thickness indicated. The total thickness of the aggregate course shall be measured at intervals in such a manner as to ensure one measurement for each 500 square yards of aggregate course. Measurements shall be made in 3 inch diameter test holes penetrating the aggregate course.

3.4.4.3 Smoothness

The surface of the top layer shall show no deviations in excess of 3/8 inch when tested with a 10 foot straightedge applied parallel with and at right angles to the centerline of the area to be paved. Measurements shall be taken in successive positions parallel to the centerline of the area to be paved. Measurements shall also be taken perpendicular to the centerline at

50 foot intervals. Deviations exceeding this amount shall be corrected by removing material and replacing with new material, or by reworking existing material and compacting it to meet these specifications.

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SECTION 02630

STORM DRAINAGE
07/03

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 198	(1998) Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets

ASTM INTERNATIONAL (ASTM)

ASTM A 48/A 48M	(2000) Gray Iron Castings
ASTM A 536	(1984; R 1999e1) Ductile Iron Castings
ASTM B 26/B 26M	(2002) Aluminum-Alloy Sand Castings
ASTM C 76	(2002) Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C 231	(1997el) Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 270	(2002) Mortar for Unit Masonry
ASTM C 443	(2002) Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM C 478	(2002a) Precast Reinforced Concrete Manhole Sections
ASTM C 923	(2002) Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals
ASTM D 1557	(2000) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu.m.))
ASTM D 1751	(1999) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)

ASTM D 1752	(1984; R 1996e1) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D 2167	(1994; R 2001) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2922	(2001) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(2001) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Placing Pipe

Printed copies of the manufacturer's recommendations for installation procedures of the material being placed, prior to installation.

SD-04 Samples

Pipe for Culverts and Storm Drains

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery and Storage

Materials delivered to site shall be inspected for damage, unloaded, and stored with a minimum of handling. Materials shall not be stored directly on the ground. The inside of pipes and fittings shall be kept free of dirt and debris. Before, during, and after installation, plastic pipe and fittings shall be protected from any environment that would result in damage or deterioration to the material. The Contractor shall have a copy of the manufacturer's instructions available at the construction site at all times and shall follow these instructions unless directed otherwise by the Contracting Officer. Solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials required to install plastic pipe shall be stored in accordance with the manufacturer's recommendations and shall be discarded if the storage period exceeds the recommended shelf life. Solvents in use shall be discarded when the recommended pot life is exceeded.

1.3.2 Handling

Materials shall be handled in a manner that ensures delivery to the trench in sound, undamaged condition. Pipe shall be carried to the trench, not dragged.

PART 2 PRODUCTS

2.1 PIPE FOR CULVERTS AND STORM DRAINS

Pipe for culverts and storm drains shall be of the sizes indicated and shall conform to the requirements specified.

2.1.1 Concrete Pipe

ASTM C 76, Class III.

2.2 MISCELLANEOUS MATERIALS

2.2.1 Concrete

Unless otherwise specified, concrete and reinforced concrete shall conform to the requirements for 4000 psi concrete under Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. The concrete mixture shall have air content by volume of concrete, based on measurements made immediately after discharge from the mixer, of 5 to 7 percent when maximum size of coarse aggregate exceeds 1-1/2 inches. Air content shall be determined in accordance with ASTM C 231. The concrete covering over steel reinforcing shall not be less than 1 inch thick for covers and not less than 1-1/2 inches thick for walls and flooring. Concrete covering deposited directly against the ground shall have a thickness of at least 3 inches between steel and ground. Expansion-joint filler material shall conform to ASTM D 1751, or ASTM D 1752, or shall be resin-impregnated fiberboard conforming to the physical requirements of ASTM D 1752.

2.2.2 Mortar

Mortar for pipe joints, connections to other drainage structures, and brick or block construction shall conform to ASTM C 270, Type M, except that the maximum placement time shall be 1 hour. The quantity of water in the mixture shall be sufficient to produce a stiff workable mortar but in no case shall exceed 5 gallons of water per sack of cement. Water shall be clean and free of harmful acids, alkalies, and organic impurities. The mortar shall be used within 30 minutes after the ingredients are mixed with water. The inside of the joint shall be wiped clean and finished smooth. The mortar head on the outside shall be protected from air and sun with a proper covering until satisfactorily cured.

2.2.3 Precast Reinforced Concrete Manholes

Precast reinforced concrete manholes shall conform to ASTM C 478. Joints between precast concrete risers and tops shall be full-bedded in cement mortar and shall be smoothed to a uniform surface on both interior and exterior of the structure.

2.2.4 Frame and Cover for Gratings

Frame and cover for gratings shall be cast gray iron, ASTM A 48/A 48M,

Class 35B; cast ductile iron, ASTM A 536, Grade 65-45-12; or cast aluminum, ASTM B 26/B 26M, Alloy 356.OT6. Weight, shape, size, and waterway openings for grates and curb inlets shall be as indicated on the plans.

2.3 RESILIENT CONNECTORS

Flexible, watertight connectors used for connecting pipe to manholes and inlets shall conform to ASTM C 923.

2.4 HYDROSTATIC TEST ON WATERTIGHT JOINTS

2.4.1 Concrete Pipe

A hydrostatic test shall be made on the watertight joint types as proposed. Only one sample joint of each type needs testing; however, if the sample joint fails because of faulty design or workmanship, an additional sample joint may be tested. During the test period, gaskets or other jointing material shall be protected from extreme temperatures which might adversely affect the performance of such materials. Performance requirements for joints in reinforced and nonreinforced concrete pipe shall conform to AASHTO M 198 or ASTM C 443.

2.5 EROSION CONTROL RIPRAP

Provide nonerodible rock not exceeding 15 inches in its greatest dimension and choked with sufficient small rocks to provide a dense mass with a minimum thickness of 8 inches.

PART 3 EXECUTION

3.1 EXCAVATION FOR PIPE CULVERTS, STORM DRAINS, AND DRAINAGE STRUCTURES

Excavation of trenches, and for appurtenances and backfilling for culverts and storm drains, shall be in accordance with the applicable portions of Section 02300 EARTHWORK.

3.1.1 Trenching

The width of trenches at any point below the top of the pipe shall be not greater than the outside diameter of the pipe plus 24 inches to permit satisfactory jointing and thorough tamping of the bedding material under and around the pipe. Sheeting and bracing, where required, shall be placed within the trench width as specified. Contractor shall not overexcavate. Where trench widths are exceeded, redesign with a resultant increase in cost of stronger pipe or special installation procedures will be necessary. Cost of this redesign and increased cost of pipe or installation shall be borne by the Contractor without additional cost to the Government.

3.1.2 Removal of Unstable Material

Where wet or otherwise unstable soil incapable of properly supporting the pipe, as determined by the Contracting Officer, is unexpectedly encountered in the bottom of a trench, such material shall be removed to the depth required and replaced to the proper grade with select granular material, compacted as provided in paragraph BACKFILLING. When removal of unstable material is due to the fault or neglect of the Contractor while performing shoring and sheeting, water removal, or other specified requirements, such removal and replacement shall be performed at no additional cost to the Government.

3.2 BEDDING

The bedding surface for the pipe shall provide a firm foundation of uniform density throughout the entire length of the pipe.

3.2.1 Concrete Pipe Requirements

When no bedding class is specified or detailed on the drawings, concrete pipe shall be bedded in a soil foundation accurately shaped and rounded to conform to the lowest one-fourth of the outside portion of circular pipe or to the lower curved portion of pipe arch for the entire length of the pipe or pipe arch. When necessary, the bedding shall be tamped. Bell holes and depressions for joints shall be not more than the length, depth, and width required for properly making the particular type of joint.

3.3 PLACING PIPE

Each pipe shall be thoroughly examined before being laid; defective or damaged pipe shall not be used. Pipelines shall be laid to the grades and alignment indicated. Proper facilities shall be provided for lowering sections of pipe into trenches. Lifting lugs in vertically elongated metal pipe shall be placed in the same vertical plane as the major axis of the pipe. Pipe shall not be laid in water, and pipe shall not be laid when trench conditions or weather are unsuitable for such work. Diversion of drainage or dewatering of trenches during construction shall be provided as necessary.

3.3.1 Concrete Pipe

Laying shall proceed upgrade with spigot ends of bell-and-spigot pipe and tongue ends of tongue-and-groove pipe pointing in the direction of the flow.

3.4 JOINTING

3.4.1 Concrete Pipe

3.4.1.1 Cement-Mortar Bell-and-Spigot Joint

The first pipe shall be bedded to the established gradeline, with the bell end placed upstream. The interior surface of the bell shall be thoroughly cleaned with a wet brush and the lower portion of the bell filled with mortar as required to bring inner surfaces of abutting pipes flush and even. The spigot end of each subsequent pipe shall be cleaned with a wet brush and uniformly matched into a bell so that sections are closely fitted. After each section is laid, the remainder of the joint shall be filled with mortar, and a bead shall be formed around the outside of the joint with sufficient additional mortar. If mortar is not sufficiently stiff to prevent appreciable slump before setting, the outside of the joint shall be wrapped or bandaged with cheesecloth to hold mortar in place.

3.5 DRAINAGE STRUCTURES

3.5.1 Manholes and Inlets

Construction shall be of reinforced concrete or precast reinforced concrete

complete with frames and covers or gratings; and with fixed galvanized steel ladders where indicated. Pipe studs and junction chambers of prefabricated corrugated metal manholes shall be fully bituminous-coated and paved when the connecting branch lines are so treated. Pipe connections to concrete manholes and inlets shall be made with flexible, watertight connectors.

3.6 STEEL LADDER INSTALLATION

Ladder shall be adequately anchored to the wall by means of steel inserts spaced not more than 6 feet vertically, and shall be installed to provide at least 6 inches of space between the wall and the rungs. The wall along the line of the ladder shall be vertical for its entire length.

3.7 BACKFILLING

3.7.1 Backfilling Pipe in Trenches

After the pipe has been properly bedded, selected material from excavation or borrow, at a moisture content that will facilitate compaction, shall be placed along both sides of pipe in layers not exceeding 6 inches in compacted depth. The backfill shall be brought up evenly on both sides of pipe for the full length of pipe. The fill shall be thoroughly compacted under the haunches of the pipe. Each layer shall be thoroughly compacted with mechanical tampers or rammers. This method of filling and compacting shall continue until the fill has reached an elevation of at least 12 inches above the top of the pipe. The remainder of the trench shall be backfilled and compacted by spreading and rolling or compacted by mechanical rammers or tampers in layers not exceeding 8 inches. Tests for density shall be made as necessary to ensure conformance to the compaction requirements specified below. Where it is necessary, in the opinion of the Contracting Officer, that sheeting or portions of bracing used be left in place, the contract will be adjusted accordingly. Untreated sheeting shall not be left in place beneath structures or pavements.

3.7.2 Backfilling Pipe in Fill Sections

For pipe placed in fill sections, backfill material and the placement and compaction procedures shall be as specified below. The fill material shall be uniformly spread in layers longitudinally on both sides of the pipe, not exceeding 6 inches in compacted depth, and shall be compacted by rolling parallel with pipe or by mechanical tamping or ramming. Prior to commencing normal filling operations, the crown width of the fill at a height of 12 inches above the top of the pipe shall extend a distance of not less than twice the outside pipe diameter on each side of the pipe or 12 feet, whichever is less. After the backfill has reached at least 12 inches above the top of the pipe, the remainder of the fill shall be placed and thoroughly compacted in layers not exceeding 8 inches.

3.7.3 Movement of Construction Machinery

When compacting by rolling or operating heavy equipment parallel with the pipe, displacement of or injury to the pipe shall be avoided. Movement of construction machinery over a culvert or storm drain at any stage of construction shall be at the Contractor's risk. Any damaged pipe shall be repaired or replaced.

3.7.4 Compaction

3.7.4.1 General Requirements

Cohesionless materials include gravels, gravel-sand mixtures, sands, and gravelly sands. Cohesive materials include clayey and silty gravels, gravel-silt mixtures, clayey and silty sands, sand-clay mixtures, clays, silts, and very fine sands. When results of compaction tests for moisture-density relations are recorded on graphs, cohesionless soils will show straight lines or reverse-shaped moisture-density curves, and cohesive soils will show normal moisture-density curves.

3.7.4.2 Minimum Density

Backfill over and around the pipe and backfill around and adjacent to drainage structures shall be compacted at the approved moisture content to the following applicable minimum density, which will be determined as specified below.

a. Under paved roads, streets, parking areas, and similar-use pavements including adjacent shoulder areas, the density shall be not less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless material, up to the elevation where requirements for pavement subgrade materials and compaction shall control.

b. Under unpaved or turfed traffic areas, density shall not be less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless material.

c. Under nontraffic areas, density shall be not less than that of the surrounding material.

3.7.5 Determination of Density

Testing shall be the responsibility of the Contractor and performed at no additional cost to the Government. Testing shall be performed by an approved commercial testing laboratory or by the Contractor subject to approval. Tests shall be performed in sufficient number to ensure that specified density is being obtained. Laboratory tests for moisture-density relations shall be made in accordance with ASTM D 1557 except that mechanical tampers may be used provided the results are correlated with those obtained with the specified hand tamper. Field density tests shall be determined in accordance with ASTM D 2167 or ASTM D 2922. When ASTM D 2922 is used, the calibration curves shall be checked and adjusted, if necessary, using the sand cone method as described in paragraph Calibration of the referenced publications. ASTM D 2922 results in a wet unit weight of soil and when using this method ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall be checked along with density calibration checks as described in ASTM D 3017 or ASTM D 2922. Test results shall be furnished the Contracting Officer. The calibration checks of both the density and moisture gauges shall be made at the beginning of a job on each different type of material encountered and at intervals as directed.

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SECTION 02754A

CONCRETE PAVEMENTS FOR SMALL PROJECTS
07/01

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ACI INTERNATIONAL (ACI)

ACI 211.1	(1991) Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
ACI 301	(1999) Standard Specifications for Structural Concrete
ACI 305R	(1999) Hot Weather Concreting

ASTM INTERNATIONAL (ASTM)

ASTM A 184/A 184M	(1996) Fabricated Deformed Steel Bar Mats for Concrete Reinforcement
ASTM A 615/A 615M	(2001b) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM C 31/C 31M	(2000e1) Making and Curing Concrete Test Specimens in the Field
ASTM C 33	(2002a) Concrete Aggregates
ASTM C 39/C 39M	(2001) Compressive Strength of Cylindrical Concrete Specimens
ASTM C 94/C 94M	(2000e2) Ready-Mixed Concrete
ASTM C 123	(1998) Lightweight Particles in Aggregate
ASTM C 143/C 143M	(2000) Slump of Hydraulic Cement Concrete
ASTM C 150	(2002a) Portland Cement
ASTM C 192/C 192M	(2000) Making and Curing Concrete Test Specimens in the Laboratory
ASTM C 231	(1997el) Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 260	(2001) Air-Entraining Admixtures for

	Concrete
ASTM C 494/C 494M	(1999ae1) Chemical Admixtures for Concrete
ASTM C 618	(2000) Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
ASTM C 666	(1997) Resistance of Concrete to Rapid Freezing and Thawing
ASTM C 881	(1999) Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C 1077	(1998) Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation

U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 130	(1989) Scratch Hardness of Coarse Aggregate Particles
COE CRD-C 300	(1990) Specifications for Membrane-Forming Compounds for Curing Concrete
COE CRD-C 540	(1971; R 1981) Standard Specification for Nonbituminous Inserts for Contraction Joints in Portland Cement Concrete Airfield Pavements, Sawable Type

NATIONAL READY MIXED CONCRETE ASSOCIATION (NRMCA)

NRMCA CPMB 100	(2000) Concrete Plant Standards

1.2 SYSTEM DESCRIPTION

This section is intended to stand alone for construction of concrete (rigid) pavement. However, where the construction covered herein interfaces with other sections, the construction at each interface shall conform to the requirements of both this section and the other section, including tolerances for both.

1.3 ACCEPTABILITY OF WORK

The pavement will be accepted on the basis of tests made by the Government and by the Contractor or its suppliers, as specified herein. The Government may, at its discretion, make check tests to validate the results of the Contractor's testing. Concrete samples shall be taken by the Contractor at the placement to determine the slump, air content, and strength of the concrete. Test cylinders shall be made for determining conformance with the strength requirements of these specifications and, when required, for determining the time at which pavements may be placed into service. All air content measurements shall be determined in accordance with ASTM C 231. All slump tests shall be made in accordance with ASTM C 143/C 143M. All test cylinders shall be 6 by 12 inch cylinders and shall be fabricated in accordance with ASTM C 192/C 192M, using only steel molds, cured in accordance with ASTM C 31/C 31M, and

tested in accordance with ASTM C 39/C 39M. A strength test shall be the average of the strengths of two cylinders made from the same sample of concrete and tested at 28 days. The Contractor shall furnish all materials, labor, and facilities required for molding, curing, testing, and protecting test specimens at the site and in the laboratory.

1.3.1 Evaluation Sampling

Sampling, testing, and mixture proportioning shall be performed by a commercial Testing Laboratory, conforming with ASTM C 1077. The individuals who sample and test concrete and concrete constituents shall be certified as American Concrete Institute (ACI) Concrete Field Testing Technicians, Grade I. The individuals who perform the inspection of concrete shall be certified as ACI Concrete Construction Inspector, Level II. All mix design, weekly quality control reports, smoothness reports, and project certification reports shall be signed by a Registered Engineer.

1.3.2 Surface Testing

Surface testing for surface smoothness and plan grade shall be performed as indicated below by the Testing Laboratory. The measurements shall be properly referenced in accordance with paving lane identification and stationing, and a report given to the Government within 24 hours after measurement is made. A final report of surface testing, signed by a Registered Engineer, containing all surface measurements and a description of all actions taken to correct deficiencies, shall be provided to the Government upon conclusion of surface testing.

1.3.2.1 Surface Smoothness Requirements

The finished surfaces of the pavements shall have no abrupt change of 1/8 inch or more, and all pavements shall be within the tolerances specified in Table 1 when checked with the straightedge.

TABLE 1
STRAIGHTEDGE SURFACE SMOOTHNESS--PAVEMENTS

Pavement Category	Direction of Testing	Tolerances inches
Roads and Streets	Longitudinal	3/16
	Transverse	1/4

1.3.2.2 Surface Smoothness Testing Method

The surface of the pavement shall be tested with the straightedge to identify all surface irregularities exceeding the tolerances specified above. The entire area of the pavement shall be tested in both a longitudinal and a transverse direction on parallel lines once in each direction. The straightedge shall be held in contact with the surface and moved ahead one-half the length of the straightedge for each successive measurement. The amount of surface irregularity shall be determined by placing the straightedge on the pavement surface and allowing it to rest upon the two highest spots covered by its length and measuring the maximum gap between the straightedge and the pavement surface, in the area between

these two high points.

1.3.3 Plan Grade Testing and Conformance

The finished surface of the pavements shall conform, within the tolerances shown in Table 1, to the lines, grades, and cross sections shown. The finished surface of new abutting pavements shall coincide at their juncture. The surfaces of pavements shall vary not more than 0.06 foot above or below the plan grade line or elevation indicated. Each pavement category shall be checked by the Contractor for conformance with plan grade requirements by running lines of levels at intervals to determine the elevation at each joint intersection.

1.4 PRECONSTRUCTION TESTING OF MATERIALS

The Contractor shall not be entitled to any additional payment or extension of time because of delays caused by sampling and testing additional sources, or samples, necessitated by failure of any samples. Aggregates shall be sampled and tested by the Test Laboratory and shall be representative of the materials to be used for the project. Test results, signed by a Registered Engineer, shall be submitted 45 days before commencing paving. No aggregate shall be used unless test results show that it meets all requirements of these specifications, including compliance with ASTM C 33 and deleterious materials limitations.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Equipment; G-AO

Manufacturer's literature on the concrete plant; mixing equipment; hauling equipment; placing and finishing, and curing equipment; at least 7 days prior to start of paving.

Paving; G-AO

Paving Schedules at least 7 days prior to start of paving.

Mixture Proportions; G-AO

The report of the Contractor's mixture proportioning studies showing the proportions of all ingredients and supporting information on aggregate and other materials that will be used in the manufacture of concrete, at least 14 days prior to commencing concrete placing operations.

1.6 EQUIPMENT

1.6.1 Batching and Mixing

The batching plant shall conform to NRMCA CPMB 100, the equipment requirements in ASTM C 94/C 94M, and as specified. Water shall not be

weighed or measured cumulatively with another ingredient. All concrete materials batching shall meet ASTM C 94/C 94M requirements. Mixers shall be truck mixers. Batching, mixers, mixing time, permitted reduction of mixing time, and concrete uniformity shall meet the requirements of ASTM C 94/C 94M, and shall be documented in the initial weekly QC Report.

1.6.2 Transporting Equipment

Transporting equipment shall be in conformance with ASTM C 94/C 94M and as specified herein. Concrete shall be transported to the paving site in rear-dump trucks, in truck mixers designed with extra large blading and rear opening specifically for low slump concrete, or in agitators. Bottom-dump trucks shall not be used for delivery of concrete.

1.6.3 Delivery Equipment

When concrete transport equipment cannot operate on the paving lane, side-delivery transport equipment consisting of self-propelled moving conveyors shall be used to deliver concrete from the transport equipment and discharge it in front of the paver. Front-end loaders, dozers, or similar equipment shall not be used to distribute the concrete.

1.6.4 Curing Equipment

Equipment for curing is specified in paragraph CURING.

1.6.5 Texturing Equipment

Texturing equipment shall be as specified below.

1.6.5.1 Deep Texturing Equipment

Texturing equipment shall consist of a stiff bristled broom. The broom shall be hand-dragged in a straight line across the paving lane perpendicular to the centerline.

1.6.6 Sawing Equipment

Equipment for sawing joints and for other similar sawing of concrete shall be standard diamond-tip-bladed concrete saws mounted on a wheeled chassis.

1.6.7 Straightedge

The Contractor shall furnish and maintain at the job site one 12 foot straightedge for testing concrete surface smoothness. The straightedge shall be constructed of aluminum or magnesium alloy and shall have blades of box or box-girder cross section with flat bottom, adequately reinforced to insure rigidity and accuracy. Straightedges shall have handles for operation on the pavement.

PART 2 PRODUCTS

2.1 CEMENTITIOUS MATERIALS

Cementitious materials shall be only portland cement in combination with pozzolan and shall conform to appropriate specifications listed below.

2.1.1 Portland Cement

Portland cement shall conform to ASTM C 150 Type II, low-alkali.

2.1.2 Pozzolan (Fly Ash)

Fly ash shall conform to ASTM C 618 Class F, including all the supplementary optional physical requirements. Fly ash shall conform to EPA requirements in accordance with Section 01670 RECYCLED / RECOVERED MATERIALS.

2.2 AGGREGATES

Aggregates shall consist of clean, hard, uncoated particles meeting the requirements of ASTM C 33, including deleterious materials, abrasion loss and soundness requirements of ASTM C 33, and other requirements specified herein. Aggregate not having a satisfactory demonstrable service record shall have a durability factor of 50 or more when subjected to freezing and thawing in concrete in accordance with ASTM C 666.

2.2.1 Coarse Aggregate

Coarse aggregate shall consist of crushed gravel, crushed stone, or a combination thereof. The nominal maximum size of the coarse aggregate shall be 1-1/2 inches and shall conform to the gradations provided in NDDOT Section 816.02. When the nominal maximum size is greater than 1 inch, the aggregates shall be furnished in two ASTM C 33 size groups, No. 67 and No. 4. The amount of deleterious material in each size of coarse aggregate shall not exceed the limits shown in ASTM C 33 Class 1N, 4M or 4S, depending on the weathering region, and the following limits:

a. Lightweight particles 1.0 max. percent by mass (ASTM C 123).

b. Other soft particles 2.0 max. percent by mass (COE CRD-C 130).

c. Total of all deleterious 5.0 max. percent by mass (substances listed in ASTM C 33 and above, exclusive of material finer than No. 200 sieve).

d. The separation medium for lightweight particles shall have a density of Sp. Gr. of 2.0.

2.2.2 Fine Aggregate

Fine aggregate shall consist of natural sand, manufactured sand, or a combination of the two, and shall be composed of clean, hard, durable particles. All fine aggregate shall be composed of clean, hard, durable particles meeting the requirements of ASTM C 33 and the requirements herein. The amount of deleterious material in the fine aggregate shall not exceed the limits in ASTM C 33and shall not exceed the following limits:

a. Lightweight particles (ASTM C 123) 1.0 percent max. by mass using a medium with a density of Sp. Gr. of 2.0.

b. The total of all deleterious material types, listed in ASTM C 33 and above, shall not exceed 3.0 percent of the mass of the fine aggregate.

Gradation of fine aggregate shall meet NDDOT Section 816.01.

2.3 CHEMICAL ADMIXTURES

Air-entraining admixture shall conform to ASTM C 260. An accelerator shall be used only when specified in paragraph SPECIFIED CONCRETE STRENGTH AND OTHER PROPERTIES and shall not be used to reduce the amount of cementitious material used. Accelerator shall conform to ASTM C 494/C 494M Type C. Calcium chloride and admixtures containing calcium chloride shall not be used. A water-reducing or retarding admixture shall meet the requirements of ASTM C 494/C 494M. Type G or H admixtures are not allowed.

2.4 CURING MATERIALS

Membrane forming curing compound shall be a white pigmented compound conforming to COE CRD-C 300. Burlap shall be new or shall be clean material never used for anything other than curing concrete.

2.5 WATER

Water for mixing and curing shall be clean, potable, and free of injurious amounts of oil, acid, salt, or alkali.

2.6 JOINT MATERIALS

2.6.1 Expansion Joint Material

Expansion joint filler shall be a preformed material conforming to NDDOT Section 826.02. Expansion joint filler shall be 3/4 inch thick.

2.6.2 Contraction Joint Inserts

Sawable contraction joint inserts shall conform to COE CRD-C 540. No metal inserts of any kind shall be used.

2.7 REINFORCING

2.7.1 General

Reinforcing bars and bar mats shall conform to NDDOT Section 836.02. Bar mats shall conform to ASTM A 184/A 184M. Reinforcement shall be free from loose, flaky rust, loose scale, oil, grease, mud, or other coatings that might reduce the bond with concrete.

2.8 DOWELS AND TIE BARS

2.8.1 Dowels

Dowels shall be single piece, plain (non-deformed) steel bars conforming to ASTM A 615/A 615M Grade 60 or higher. Dowels shall be free of loose, flaky rust and loose scale and shall be clean and straight.

2.8.2 Tie Bars

Tie bars shall be deformed steel bars conforming to ASTM A 615/A 615M Grade 40 or 60. Grade 60 or higher shall not be used for bars that are bent and straightened during construction.

2.9 EPOXY RESIN

All epoxy-resin materials shall be two-component materials conforming to ASTM C 881, Class as appropriate for each application temperature to be encountered; except, that in addition, the materials shall meet the following requirements:

a. Material for use for embedding dowels and anchor bolts shall be Type IV, Grade 3.

b. Material for use as patching for complete filling of spalls, wide cracks, and other voids and for use in preparing epoxy resin mortar shall be Type III, Grade as approved.

c. Material for injecting cracks shall be Type IV, Grade 1.

d. Material for bonding freshly mixed portland cement concrete, mortar, or freshly mixed epoxy resin concrete to hardened concrete shall be Type V, Grade as approved.

2.10 SPECIFIED CONCRETE STRENGTH AND OTHER PROPERTIES

Specified compressive strength, f'c, for concrete is 4,500 psi at 28 days. Maximum allowable water-cementitious material ratio is 0.45. The water-cementitious material ratio is based on absolute volume equivalency, where the ratio is determined using the weight of cement for a cement only mix, or using the total volume of cement plus pozzolan converted to an equivalent weight of cement by the absolute volume equivalency method described in ACI 211.1. The concrete shall be air-entrained with a total air content of 6 plus or minus 1 percent. The maximum allowable slump of the concrete shall be 3 inchesfor pavement constructed with fixed forms. The strength of the concrete will be considered satisfactory so long as the average of all sets of three consecutive test results equals or exceeds the specified compressive strength f'c and no individual test result falls below the specified strength f'c by more than 500 psi. Additional analysis or testing, including taking cores and/or load tests may be required at the Contractor's expense when the strength of the concrete in the structure is considered potentially deficient.

2.11 MIXTURE PROPORTIONS

2.11.1 Composition Concrete

Composition concrete shall be composed of cementitious material, water, fine and coarse aggregates, and admixtures. Fly ash, if used, shall be used only at a rate between 15 and 35 percent by mass of the total cementitious material conform to EPA requirements in accordance with Section 01670 RECYCLED / RECOVERED MATERIALS. Admixtures shall consist of air entraining admixture. High range water-reducing admixtures and admixtures to produce flowable concrete shall not be used. No substitutions shall be made in the materials used in the mixture proportions without additional tests to show that the quality of the concrete is satisfactory.

2.11.2 Concrete Mixture Proportioning Studies

Trial design batches, mixture proportioning studies, and testing shall be the responsibility of the Contractor, and shall be performed by the Test Laboratory and signed by a Registered Engineer. No concrete pavement shall

be placed until the Contracting Officer has approved the Contractor's mixture proportions. All materials used in mixture proportioning studies shall be representative of those proposed for use on the project. If there is a change in materials, additional mixture design studies shall be made using the new materials. Trial mixtures having proportions, slumps, and air content suitable for the work shall be based on methodology described in ACI 211.1. At least three different water-cementitious ratios, which will produce a range of strength encompassing that required on the project, shall be used. Laboratory trial mixtures shall be proportioned for maximum permitted slump and air content. Maximum sand content shall be 40 percent of the total aggregate SSD weight. Aggregate quantities shall be based on the mass in a saturated surface dry condition.

2.11.3 Mixture Proportioning Procedure

The Contractor shall perform the following:

a. Fabricate, cure and test 6 test cylinders per age for each mixture at 7 and 28 days.

b. Using the average strength for each w/(c+p), plot the results from each of the three mixtures on separate graphs for w/(c+p) versus 28-day strength.

c. From the graphs select a w/(c+p) which will produce a mixture giving a 28-day strength equal to the required strength determined in accordance with the following paragraph.

2.11.4 Average Strength Required for Mixtures

In order to ensure meeting, during production, the strength requirements specified, the mixture proportions selected shall produce a required average strength, f'cr, exceeding the specified strength, f'c, in accordance with procedures in Chapter 3 of ACI 301, "Proportioning."

PART 3 EXECUTION

3.1 CONDITIONING OF UNDERLYING MATERIAL

Underlying material, base course, upon which concrete is to be placed shall be clean, damp, and free from debris, waste concrete or cement, frost, ice, and standing or running water. After the underlying material has been prepared for concrete placement, no equipment shall be permitted thereon.

3.2 WEATHER LIMITATIONS

3.2.1 Hot Weather Paving

The temperature of concrete shall not exceed 90 degrees F. Steel forms, dowels and reinforcing shall be cooled prior to concrete placement when steel temperatures are greater than 120 degrees F.

3.2.2 Cold Weather Paving

The ambient temperature of the air at the placing site and the temperature of surfaces to receive concrete shall be not less 40 degrees F. The temperature of the concrete when placed shall be not less than 50 degrees F. Materials entering the mixer shall be free from ice, snow, or frozen lumps. Salt, chemicals or other materials shall not be incorporated in the

concrete to prevent freezing. Calcium chloride shall not be used at any time. Covering and other means shall be provided for maintaining the concrete at a temperature of at least 50 degrees F for not less than 72 hours after placing, and at a temperature above freezing for the remainder of the curing period. Pavement damaged by freezing shall be completely removed and replaced at the Contractor's expense as specified in paragraph, REPAIR, REMOVAL, AND REPLACEMENT OF SLABS.

3.3 CONCRETE PRODUCTION

3.3.1 General Requirements

Concrete shall be deposited in front of the paver within 45 minutes from the time cement has been charged into the mixing drum, except that if the ambient temperature is above 90 degrees F, the time shall be reduced to 30 minutes. Every load of concrete delivered to the paving site shall be accompanied by a batch ticket from the operator of the batching plant. Tickets shall show at least the mass, or volume, of all ingredients in each batch delivered, the water meter and revolution meter reading on truck mixers and the time of day. Tickets shall be delivered to the placing foreman who shall keep them on file and deliver them to the Government daily.

3.3.2 Transporting and Transfer-Spreading Operations

Non-agitating equipment shall be used only on smooth roads and for haul time less than 15 minutes. No equipment shall be allowed to operate on the prepared and compacted underlying material . Additional water may be added to truck mixers to bring the slump within the specified range provided the mixture water-cement ratio is not exceeded.

3.4 PAVING

Pavement shall be constructed with paving and finishing equipment utilizing fixed forms.

3.4.1 Consolidation

The vibrators shall be inserted into the concrete not closer to the underlying material than 2 inches. Excessive vibration shall not be permitted. Concrete in small, odd-shaped slabs shall be vibrated with a hand-operated immersion vibrator. Vibrators shall not be used to transport or spread the concrete.

3.4.2 Required Results

The pavers shall produce a thoroughly consolidated slab throughout, true to line and grade within specified tolerances. The operation shall produce a surface finish free of irregularities, tears, voids of any kind, and any other discontinuities. It shall produce only a very minimum of paste at the surface. No water, other than true fog sprays (mist), shall be applied to the concrete surface during paving and finishing.

3.4.3 Fixed Form Paving

Forms shall be steel, except that wood forms may be used for curves having a radius of 150 feet or less, and for fillets. Forms may be built up with metal or wood, added only to the base, to provide an increase in depth of not more than 25 percent. The base width of the form shall be not less

than eight-tenths of the vertical height of the form, except that forms 8 inches or less in vertical height shall have a base width not less than the vertical height of the form. Wood forms for curves and fillets shall be adequate in strength and rigidly braced. Forms shall be set on firm material cut true to grade so that each form section when placed will be firmly in contact with the underlying layer for its entire base. Forms shall not be set on blocks or on built-up spots of underlying material. Forms shall remain in place at least 12 hours after the concrete has been placed. Forms shall be removed without injuring the concrete.

3.4.4 Placing Reinforcing Steel

Reinforcement shall be positioned on suitable chairs securely fastened to the subgrade prior to concrete placement, or may be placed on an initial layer of consolidated concrete, with the subsequent layer placed within 30 minutes of the first layer placement.

3.4.5 Placing Dowels and Tie Bars

Dowels shall be installed with alignment not greater than 1/8 inch per ft. Except as otherwise specified below, location of dowels shall be within a horizontal tolerance of plus or minus 5/8 inch and a vertical tolerance of plus or minus 3/16 inch. The portion of each dowel intended to move within the concrete or expansion cap shall be painted with one coat of rust inhibiting primer paint, and then oiled just prior to placement. Dowels in joints shall be omitted when the center of the dowel is located within a horizontal distance from an intersecting joint equal to or less than one-fourth of the slab thickness.

3.4.5.1 Contraction Joints

Dowels in longitudinal and transverse contraction joints within the paving lane shall be held securely in place by means of rigid metal basket assemblies. The dowels shall be welded to the assembly or held firmly by mechanical locking arrangements that will prevent them from becoming distorted during paving operations. The basket assemblies shall be held securely in the proper location by means of suitable anchors.

3.4.5.2 Construction Joints-Fixed Form Paving

Installation of dowels shall be by the bonded-in-place method, supported by means of devices fastened to the forms. Installation by removing and replacing in preformed holes will not be permitted.

3.4.5.3 Dowels Installed in Hardened Concrete

Installation shall be by bonding the dowels into holes drilled into the hardened concrete. Holes approximately 1/8 inch greater in diameter than the dowels shall be drilled into the hardened concrete. Dowels shall be bonded in the drilled holes using epoxy resin injected at the back of the hole before installing the dowel and extruded to the collar during insertion of the dowel so as to completely fill the void around the dowel. Application by buttering the dowel shall not be permitted. The dowels shall be held in alignment at the collar of the hole, after insertion and before the grout hardens, by means of a suitable metal or plastic collar fitted around the dowel. The vertical alignment of the dowels shall be checked by placing the straightedge on the surface of the pavement over the top of the dowel and measuring the vertical distance between the straightedge and the beginning and ending point of the exposed part of the

dowel.

3.4.5.4 Expansion Joints

Dowels in expansion joints shall be installed by the bonded-in-place method or by bonding into holes drilled in hardened concrete, using procedures specified above.

3.5 FINISHING

Clary screeds, "bridge deck" finishers, or other rotating pipe or tube type equipment shall not be permitted. Hand finishing shall be used. Equipment to be used for supplemental hand finishing shall primarily be 10 to 12 feet cutting straightedges; only very sparing use of bull floats shall be allowed. At no time shall water be added to the surface of the slab in any way, except for fog (mist) sprays to prevent plastic shrinkage cracking.

3.5.1 Surface Correction

While the concrete is still plastic, irregularities and marks in the pavement surface shall be eliminated by means of cutting straightedges, 10 to 12 feet in length. Depressions shall be filled with freshly mixed concrete, struck off, consolidated, and refinished. Projections above the required elevation shall also be struck off and refinished. Long-handled, flat "bull floats" shall be used sparingly and only as necessary to correct minor, scattered surface defects. Finishing with hand floats and trowels shall be held to the absolute minimum necessary. Joints and edges shall not be overfinished.

3.5.2 Hand Finishing

Hand finishing operations shall be used for those unusual slabs as specified previously. Grate tampers (jitterbugs) shall not be used. As soon as placed and vibrated, the concrete shall be struck off and screeded. The surface shall be tamped with a strike-off and tamping screed, or vibratory screed. Immediately following the final tamping of the surface, the pavement shall be floated longitudinally. Long-handled, flat bull floats shall be used sparingly and only as necessary to correct surface defects. Finishing with hand floats and trowels shall be held to the absolute minimum necessary. Joints and edges shall not be overfinished. No water shall be added to the pavement during finishing operations.

3.5.3 Texturing

Before the surface sheen has disappeared and before the concrete hardens, the surface of the pavement shall be given a texture as described herein. Following initial texturing on the first day of placement, the Placing Foreman, Contracting Officer representative, and a representative of the Using Agency shall inspect the texturing for compliance with design requirements. After curing is complete, all textured surfaces shall be thoroughly power broomed to remove all debris. Any type of transverse texturing shall produce grooves in straight lines across each lane within a tolerance of plus or minus 1/2 inch of a true line. The concrete in areas of recesses for tie-down anchors, lighting fixtures, and other outlets in the pavement shall be finished to provide a surface of the same texture as the surrounding area.

3.5.3.1 Broom Texturing

Surface texture shall be applied using a stiff bristle broom drag of a type that will uniformly score the surface transverse to the pavement center line. The broom shall be capable of traversing half the width of the pavement in a single pass at a uniform speed and with a uniform pressure. Successive passes of the broom shall be overlapped the minimum necessary to obtain a uniformly textured surface. The scores should be uniform in appearance and approximately 1/16 inchin depth but not more than 1/8 inch in depth. Hand brooming will be permitted on isolated odd shaped slabs or slabs where hand finishing is permitted.

3.5.4 Edging

After texturing has been completed, the edge of the slabs along the forms shall be carefully finished with an edging tool to form a smooth rounded surface of 1/8 inch radius. No water shall be added to the surface during edging.

3.6 CURING

Concrete shall be continuously protected against loss of moisture and rapid temperature changes for at least 7 days from the completion of finishing operations. Unhardened concrete shall be protected from rain and flowing water. During hot weather with low humidity and/or wind, the Contractor shall institute measures to prevent plastic shrinkage cracks from developing. ACI 305R contains means of predicting plastic shrinkage cracking and preventative measures. Plastic shrinkage cracks that occur shall be filled by injection of epoxy resin after the concrete hardens. Plastic shrinkage cracks shall never be troweled over or filled with slurry. Curing shall be accomplished by one of the following methods.

3.6.1 Membrane Curing

A uniform coating of white-pigmented membrane-forming curing compound shall be applied to the entire exposed surface of the concrete including pavement edges as soon as the free water has disappeared from the surface after finishing. If evaporation is high and no moisture is present on the surface even though bleeding has not stopped, fog sprays shall be used to keep the surface moist until setting of the cement occurs. Curing compound shall then be immediately applied. The curing compound shall be applied at a maximum application rate of 200 square feet per gallon. The application of curing compound by hand-operated, mechanical powered pressure sprayers will be used on odd widths or shapes of slabs where indicated and on concrete surfaces exposed by the removal of forms. The compound shall form a uniform, continuous, cohesive film that will not check, crack, or peel and that will be free from pinholes and other discontinuities. Areas where the curing compound develops the above defects or is damaged by heavy rainfall, sawing or other construction operations within the curing period, shall be immediately resprayed.

3.6.2 Moist Curing

Concrete to be moist-cured shall be maintained continuously wet for the entire curing period, commencing immediately after finishing. Surfaces shall be cured by ponding, by continuous sprinkling, by continuously saturated burlap or cotton mats, or by continuously saturated plastic coated burlap. Impervious sheet curing shall not be used.

3.7 JOINTS

No deviation from the jointing pattern shown on the drawings shall be made without written approval of the Design District Pavement or Geotechnical Engineer. All joints shall be straight, perpendicular to the finished grade of the pavement, and continuous from edge to edge or end to end of the pavement with no abrupt offset and no gradual deviation greater than 1/2 inch.

3.7.1 Longitudinal Construction Joints

Dowels shall be installed in the longitudinal construction joints, or the edges shall be thickened as indicated. The dimensions of the keyway shall not vary more than plus or minus 1/8 inch from the dimensions indicated and shall not deviate more than plus or minus 1/4 inch from the mid-depth of the pavement. If any length of completed keyway of 5 feet or more fails to meet the above tolerances, dowels shall be installed.

3.7.2 Transverse Construction Joints

Transverse construction joints shall be installed at a planned transverse joint, at the end of each day's placing operations and when concrete placement is interrupted. Transverse construction joints shall be constructed either by utilizing headers and hand placement and finishing techniques, or by placing concrete beyond the transverse construction joint location and then saw cutting full depth and removing concrete back to the transverse construction joint location. For the latter case, dowels shall be installed using methods for dowels installed in hardened concrete described above. All transverse construction joints shall be dowelled.

3.7.3 Expansion Joints

Expansion joints shall be formed where indicated, and about any structures and features that project through or into the pavement, using preformed joint filler of the type, thickness, and width indicated, and shall extend the full slab depth. Edges of the concrete at the joint face shall be edged. The joint filler strips shall be installed to form a recess at the pavement surface to be filled with joint sealant. Expansion joints shall be constructed with dowels for load transfer.

3.7.4 Contraction Joints

Transverse and longitudinal contraction joints shall be of the weakened-plane or dummy type. Longitudinal contraction joints shall be constructed by sawing a groove in the hardened concrete with a power-driven saw. Transverse contraction joints shall be constructed in conformance with requirements for sawed joints.

3.7.4.1 Sawed Joints

Sawed contraction joints shall be constructed by sawing a groove in the concrete with a 1/8 inch blade to the indicated depth. The time of initial sawing shall vary depending on existing and anticipated weather conditions and shall be such as to prevent uncontrolled cracking of the pavement. Sawing of the joints shall commence as soon as the concrete has hardened sufficiently to permit cutting the concrete without chipping, spalling, or tearing. The joints shall be sawed at the required spacing consecutively in the sequence of the concrete placement. Sawing at a given joint location shall be discontinued when a crack develops ahead of the saw

cut. Immediately after the joint is sawed, the saw cut and adjacent concrete surface shall be thoroughly flushed with water until all waste from sawing is removed from the joint. The surface shall be resprayed with curing compound as soon as free water disappears. The top of the joint opening and the joint groove at exposed edges shall be tightly sealed with cord or backer rod before the concrete in the region of the joint is resprayed with curing compound.

3.7.5 Thickened Edge Joints

Underlying material in the transition area shall meet the requirements for smoothness and compaction specified for all other areas of the underlying material.

3.7.6 Special Joints

Special joints (undercut joints) shall be constructed adjacent to existing pavement as indicated. The concrete shall be worked under the edge of the existing pavement to completely fill the void and shall be thoroughly consolidated by the use of hand-held vibrators.

3.8 REPAIR, REMOVAL, AND REPLACEMENT OF SLABS

New pavement slabs that contain full-depth cracks shall be removed and replaced, as specified herein at no cost to the Government. Removal and replacement shall be full depth, shall be full width of the paving lane, and the limit of removal shall be from each original transverse joint . The Contracting Officer will determine whether cracks extend full depth of the pavement and may require minimum 6 inch diameter cores to be drilled on the crack to determine depth of cracking. Cores shall be drilled and the hole later filled by the Contractor with a well consolidated concrete mixture bonded to the walls of the hole with epoxy resin. Drilling of cores and refilling holes shall be at no expense to the Government. Cracks that do not extend full depth of slab shall be cleaned and then pressure injected with epoxy resin, Type IV, Grade 1. The Contractor shall ensure that the crack is not widened during epoxy resin injection. Where a full depth crack intersects the original transverse joint, the slab(s) containing the crack shall be removed and replaced, with dowels installed, as required below. Spalls along joints shall be repaired as specified.

3.8.1 Removal and Replacement of Full Slabs

Unless there are keys or dowels present, all edges of the slab shall be sawcut full depth. If keys, dowels, or tie bars are present along any edges, these edges shall be sawed full depth 6 inches from the edge if only keys are present, or just beyond the end of dowels or tie bars if they are present. These joints shall then be carefully sawed on the joint line to within 1 inch of the depth of the dowel or key. The main slab shall be further divided by sawing full depth, at appropriate locations, and each piece lifted out and removed. The narrow strips along keyed or doweled edges shall be carefully broken up and removed. Care shall be taken to prevent damage to the dowels, tie bars, or keys or to concrete to remain in place. Protruding portions of dowels shall be painted and lightly oiled. The joint face below keys or dowels shall be suitably trimmed so that there is no abrupt offset. If underbreak occurs at any point along any edge, the area shall be hand-filled with concrete, producing an even joint face from top to bottom, before replacing the removed slab. If underbreak over 4 inches deep occurs, the entire slab containing the underbreak shall be removed and replaced. Where there are no dowels, tie bars, or keys on an

edge, or where they have been damaged, dowels of the size and spacing as specified for other joints in similar pavement shall be installed by epoxy grouting them into holes drilled into the existing concrete. Original damaged dowels or tie bars shall be cut off flush with the joint face. All four edges of the new slab shall thus contain dowels or original keys or original tie bars. Prior to placement of new concrete, the underlying material shall be graded and recompacted, and the surfaces of all four joint faces shall be cleaned of all loose material and contaminants, and coated with a double application of membrane forming curing compound as bond breaker. Placement of concrete shall be as specified for original construction. The resulting joints around the new slab shall be prepared and sealed as specified.

3.8.2 Repairing Spalls Along Joints

Spalls along joints and cracks shall be repaired by first making a vertical saw cut at least 1 inch outside the spalled area and to a depth of at least 2 inches. Saw cuts shall be straight lines forming rectangular areas. The concrete between the saw cut and the joint, or crack, shall be chipped out to remove all unsound concrete. The cavity shall be thoroughly cleaned with high pressure water jets supplemented with compressed air to remove all loose material. Immediately before filling the cavity, a prime coat shall be applied to the dry cleaned surface of all sides and bottom of the cavity, except any joint face. The prime coat shall be applied in a thin coating and scrubbed into the surface with a stiff-bristle brush. Prime coat for portland cement repairs shall be a neat cement grout and for epoxy resin repairs shall be epoxy resin, Type III, Grade 1. The cavity shall be filled with low slump portland cement concrete or mortar, or with epoxy resin concrete or mortar. Portland cement concrete shall be used for larger spalls, those more than 1/3 cu. ft. in size after removal operations; portland cement mortar shall be used for spalls between 0.03 and 1/3 cu. ft; and epoxy resin mortar or Type III, Grade 3 epoxy resin for those spalls less than 0.03 cu. ft. in size after removal operations. Portland cement concretes and mortars shall be very low slump mixtures, proportioned, mixed, placed, tamped, and cured. Epoxy resin mortars shall be made with Type III, Grade 1, epoxy resin, using proportions, mixing, placing, tamping and curing procedures as recommended by the manufacturer. Any repair material on the surrounding surfaces of the existing concrete shall be removed before it hardens. Where the spalled area abuts a joint, an insert or other bond-breaking medium shall be used to prevent bond at the joint face. A reservoir for the joint sealant shall be sawed to the dimensions required for other joints.

3.8.3 Areas Defective in Plan Grade or Smoothness

In areas not meeting the specified limits for surface smoothness and plan grade, high areas shall be reduced to attain the required smoothness and grade, except as depth is limited below. High areas shall be reduced by grinding the hardened concrete with a surface grinding machine after the concrete is 14 days or more old. The depth of grinding shall not exceed 1/4 inch. All pavement areas requiring plan grade or surface smoothness corrections in excess of the specified limits, shall be removed and replaced. In pavement areas given a wire comb or tined texture, areas exceeding 25 square feet that have been corrected by rubbing or grinding shall be retextured by grooving machine sawn grooves meeting the requirements for the wire comb or tined texture. All areas in which grinding has been performed will be subject to the thickness tolerances specified in paragraph Thickness. Any grinding performed on individual slabs with excessive deficiencies shall be performed at the Contractor's

own decision without entitlement to additional compensation if eventual removal of the slab is required.

3.9 PAVEMENT PROTECTION

The Contractor shall protect the pavement against all damage prior to final acceptance of the work. Traffic shall be excluded from the new pavement. As a construction expedient in paving intermediate lanes between newly paved pilot lanes, operation of the hauling equipment will be permitted on the new pavement after the pavement has been cured for 7 days and the joints have been sealed or otherwise protected. All new and existing pavement carrying construction traffic or equipment shall be continuously kept completely clean. Special cleaning and care shall be used where Contractor's traffic uses or crosses active airfield pavement.

3.10 TESTING AND INSPECTION FOR CONTRACTOR QUALITY CONTROL (CQC)

Paragraph ACCEPTABILITY OF WORK contains additional CQC requirements. The Contractor shall perform the inspection and tests described below and, based upon the results of these inspections and tests, shall take the action required and submit reports as specified. When, in the opinion of the Contracting Officer, the paving operation is out of control, concrete placement shall cease.

3.10.1 Batch Plant Control

A daily report shall be prepared indicating checks made for scale accuracy with test weights, checks of batching accuracy, and corrective action taken prior to and during placement for weighing or batching, type and source of cement used, type and source of pozzolan or slag used, amount and source of admixtures used, aggregate source, the required aggregate and water masses per cubic yd, amount of water as free moisture in each size of aggregate, and the batch aggregate and water masses per cubic yd. for each class of concrete batched during each day's plant operation.

3.10.2 Concrete Mixture

a. Air Content Testing. Air content tests shall be made when test specimens are fabricated. In addition, at least two other tests for air content shall be made on randomly selected batches of each separate concrete mixture produced during each 8-hour period of paving. Whenever air content reaches specified limits, an immediate confirmatory test shall be made. If the second test also shows air content at or exceeding specified limits, an adjustment shall immediately be made in the amount of air-entraining admixture batched to bring air content within specified limits. If the next adjusted batch of concrete is not within specified limits, concrete placement shall be halted until concrete air content is within specified limits.

b. Slump Testing. Slump tests shall be made when test specimens are fabricated. Additional tests shall be made when excessive variation in workability is reported by the placing foreman or Government inspector. Whenever slump approaches the maximum limit, an adjustment shall immediately be made in the batch masses of water and fine aggregate, without exceeding the maximum w/(c+p). When a slump result exceeds the specification limit, no further concrete shall be delivered to the paving site until adjustments have been made and slump is again within the limit.

c. Temperature. The temperature of the concrete shall be measured when strength specimens are fabricated.

d. Concrete Strength Testing. Four (4) cylinders from the same batch shall be fabricated, cured and tested for compressive strength, testing two cylinders at 7-day and two cylinders at 28-day age. A minimum of one set of four (4) cylinders shall be fabricated, cured and tested for each shift of concrete placement. Control charts for strength, showing the 7-day and 28-day CQC compressive strengths, and the 28-day required compressive strength, shall be maintained and submitted with weekly CQC Reports.

3.10.3 Inspection Before Placing

Underlying materials, joint locations and types, construction joint faces, forms, reinforcing, dowels, and embedded items shall be inspected by a Registered Engineer in sufficient time prior to each paving operation in order to certify to the Contracting Officer that they are ready to receive concrete. The results of each inspection shall be reported in writing, and the certification signed by the Registered Engineer, prior to each days' paving.

3.10.4 Paving Operations

The placing foreman shall supervise all placing and paving operations, shall determine that the correct quality of concrete is placed in each location as shown, shall insure that the concrete is consolidated full depth and that finishing is performed as specified. The placing foreman shall be responsible for measuring and recording concrete temperatures and ambient temperature hourly during placing operations, weather conditions, time of placement, volume of concrete placed, and method of paving and any problems encountered.

3.10.5 Curing Inspection

a. Moist Curing Inspections. Each day on both work and non-work days, an inspection shall be made of all areas subject to moist curing. The surface moisture condition shall be noted and recorded. When any inspection finds an area of inadequate curing, immediate corrective action shall be taken, and the required curing period for the area shall be extended by 1 day.

b. Membrane Curing Inspection. At the end of each day's placement, the CQC Representative shall determine the quantity of compound used by measurement of the container; shall determine the area of concrete surface covered; shall then compute the rate of coverage in square feet per gallon and shall also note whether or not coverage is uniform. When the coverage rate of the curing compound is less than that specified or when the coverage is not uniform, the entire surface shall be sprayed again.

3.10.6 Cold-Weather Protection

At least once per day, an inspection shall be made of all areas subject to cold-weather protection. Any deficiencies shall be noted, corrected, and reported.

3.10.7 Reports

All results of tests or inspections conducted shall be reported informally as they are completed and in writing daily. A weekly report, signed by a registered engineer, shall be prepared for the updating of control charts and test data, and all CQC inspections and actions covering the entire period from the start of the construction through the current week. Reports of failures and the action taken shall be confirmed in writing in the routine reports. The Contracting Officer has the right to examine all CQC records. A copy of weekly reports shall be faxed to the Design District Pavement or Geotechnical Engineer. At the completion of concrete placement, a certification report shall be prepared containing mix designs, all updated control charts and concrete test data, quality control reports, smoothness reports, and other pertinent data on the concrete, with a certification by a registered engineer that the concrete placed meets all specification requirements. A copy of the certification report shall be mailed to the Design District pavement or Geotechnical Engineer.

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SECTION 02763A

PAVEMENT MARKINGS
04/01

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 247	(1981; R 1996) Glass Beads Used in Traffic Paint

ASTM INTERNATIONAL (ASTM)

ASTM D 4505	(1996) Preformed Plastic Pavement Marking Tape for Extended Service Life

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS TT-B-1325	(Rev C; Notice 1; Canc. Notice 2) Beads (Glass Spheres) Retro-Reflective (Metric)
FS TT-P-1952	(Rev D; Canc. Notice 1) Paint, Traffic and Airfield Marking, Waterborne (Metric)

1.2 UNIT PRICES

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Equipment; G-AO

Lists of proposed equipment, including descriptive data, and notifications of proposed Contractor actions as specified in this section. List of removal equipment shall include descriptive data indicating area of coverage per pass, pressure adjustment range, tank and flow capacities, and safety precautions required for the equipment operation.

SD-06 Test Reports

Sampling and Testing; G-AO

Certified copies of the test reports, prior to the use of the materials at the jobsite. Testing shall be performed in an approved independent laboratory.

1.4 DELIVERY AND STORAGE

All materials shall be delivered and stored in sealed containers that plainly show the designated name, formula or specification number, batch number, color, date of manufacture, manufacturer's name, and directions, all of which shall be plainly legible at time of use.

1.5 EQUIPMENT

All machines, tools and equipment used in the performance of the work shall be approved and maintained in satisfactory operating condition. Equipment operating on roads and runways shall display low speed traffic markings and traffic warning lights.

1.5.1 Paint Application Equipment

The equipment to apply paint to pavements shall be a self-propelled or mobile-drawn pneumatic spraying machine with suitable arrangements of atomizing nozzles and controls to obtain the specified results. The machine shall have a speed during application not less than 5 mph, and shall be capable of applying the stripe widths indicated, at the paint coverage rate specified in paragraph APPLICATION, and of even uniform thickness with clear-cut edges. The paint applicator shall have paint reservoirs or tanks of sufficient capacity and suitable gauges to apply paint in accordance with requirements specified. Tanks shall be equipped with suitable air-driven mechanical agitators. The spray mechanism shall be equipped with quick-action valves conveniently located, and shall include necessary pressure regulators and gauges in full view and reach of the operator. Paint strainers shall be installed in paint supply lines to ensure freedom from residue and foreign matter that may cause malfunction of the spray guns. The paint applicator shall be readily adaptable for attachment of an air-actuated dispenser for the reflective media approved for use. Pneumatic spray guns shall be provided for hand application of paint in areas where the mobile paint applicator cannot be used.

1.5.2 Reflective Media Dispenser

The dispenser for applying the reflective media shall be attached to the paint dispenser and shall operate automatically and simultaneously with the applicator through the same control mechanism. The dispenser shall be capable of adjustment and designed to provide uniform flow of reflective media over the full length and width of the stripe at the rate of coverage specified in paragraph APPLICATION, at all operating speeds of the applicator to which it is attached.

1.5.3 Traffic Controls

Suitable warning signs shall be placed near the beginning of the worksite and well ahead of the worksite for alerting approaching traffic from both

directions. Small markers shall be placed along newly painted lines or freshly placed raised markers to control traffic and prevent damage to newly painted surfaces or displacement of raised pavement markers. Painting equipment shall be marked with large warning signs indicating slow-moving painting equipment in operation.

1.6 HAND-OPERATED, PUSH-TYPE MACHINES

All machines, tools, and equipment used in performance of the work shall be approved and maintained in satisfactory operating condition. Hand-operated push-type machines of a type commonly used for application of paint to pavement surfaces will be acceptable for marking small streets and parking areas. Applicator machine shall be equipped with the necessary paint tanks and spraying nozzles, and shall be capable of applying paint uniformly at coverage specified. Sandblasting equipment shall be provided as required for cleaning surfaces to be painted. Hand-operated spray guns shall be provided for use in areas where push-type machines cannot be used.

1.7 MAINTENANCE OF TRAFFIC

1.7.1 Roads, Streets, and Parking Areas

When traffic must be rerouted or controlled to accomplish the work, the necessary warning signs, flagpersons, and related equipment for the safe passage of vehicles shall be provided.

PART 2 PRODUCTS

2.1 PAINT

The paint shall be homogeneous, easily stirred to smooth consistency, and shall show no hard settlement or other objectionable characteristics during a storage period of 6 months. Paints for roads and streets shall conform to FS TT-P-1952, color as indicated. Pavement marking paints shall comply with applicable state and local laws enacted to ensure compliance with Federal Clean Air Standards. Paint materials shall conform to the volatile organic compounding (VOC) restrictions of the local Air Pollution Control District.

2.2 PREFORMED TAPE

The preformed tape shall be an adherent reflectorized strip in accordance with ASTM D 4505 Type I or IV, Class optional.

2.3 REFLECTIVE MEDIA

Reflective media for roads and streets shall conform to FS TT-B-1325, Type I, Gradation A or AASHTO M 247, Type I.

2.4 SAMPLING AND TESTING

Materials proposed for use shall be stored on the project site in sealed and labeled containers, or segregated at source of supply, sufficiently in advance of needs to allow 60 days for testing. Upon notification by the Contractor that the material is at the site or source of supply, a sample shall be taken by random selection from sealed containers by the Contractor in the presence of a representative of the Contracting Officer. Samples shall be clearly identified by designated name, specification number, batch number, manufacturer's formulation number, project contract number,

intended use, and quantity involved. Testing shall be performed in an approved independent laboratory. If materials are approved based on reports furnished by the Contractor, samples will be retained by the Government for possible future testing should the material appear defective during or after application.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Surfaces to be marked shall be thoroughly cleaned before application of the pavement marking material. Dust, dirt, and other granular surface deposits shall be removed by sweeping, blowing with compressed air, rinsing with water or a combination of these methods as required. Rubber deposits, surface laitance, existing paint markings, and other coatings adhering to the pavement shall be completely removed with scrapers, wire brushes, sandblasting, approved chemicals, or mechanical abrasion as directed. Areas of old pavement affected with oil or grease shall be scrubbed with several applications of trisodium phosphate solution or other approved detergent or degreaser, and rinsed thoroughly after each application. After cleaning, oil-soaked areas shall be sealed with cut shellac to prevent bleeding through the new paint. Pavement surfaces shall be allowed to dry, when water is used for cleaning, prior to striping or marking. Surfaces shall be recleaned, when work has been stopped due to rain.

3.1.1 Pretreatment for Early Painting

Where early painting is required on rigid pavements, a pretreatment with an aqueous solution containing 3 percent phosphoric acid and 2 percent zinc chloride shall be applied to prepared pavement areas prior to painting.

3.1.2 Cleaning Concrete Curing Compounds

On new Portland cement concrete pavements, cleaning operations shall not begin until a minimum of 30 days after the placement of concrete. All new concrete pavements shall be cleaned by either sandblasting or water blasting. The extent of the blasting work shall be to clean and prepare the concrete surface as follows:

a. There is no visible evidence of curing compound on the peaks of the textured concrete surface.

b. There are no heavy puddled deposits of curing compound in the valleys of the textured concrete surface.

c. All remaining curing compound is intact; all loose and flaking material is removed.

d. The peaks of the textured pavement surface are rounded in profile and free of sharp edges and irregularities.

e. The surface to be marked is dry.

3.2 APPLICATION

All pavement markings and patterns shall be placed as shown on the plans.

3.2.1 Paint

Paint shall be applied to clean, dry surfaces, and only when air and pavement temperatures are above 40 degrees F and less than 95 degrees F. Paint temperature shall be maintained within these same limits. New asphalt pavement surfaces and new Portland concrete cement shall be allowed to cure for a period of not less than 30 days before applications of paint. Paint shall be applied pneumatically with approved equipment at rate of coverage specified . The Contractor shall provide guide lines and templates as necessary to control paint application. Special precautions shall be taken in marking numbers, letters, and symbols. Edges of markings shall be sharply outlined.

3.2.1.1 Rate of Application

Nonreflective Markings: Paint shall be applied evenly to the pavement surface to be coated at a rate of 105 plus or minus 5 square feet per gallon.

3.2.1.2 Drying

The maximum drying time requirements of the paint specifications will be strictly enforced to prevent undue softening of bitumen, and pickup, displacement, or discoloration by tires of traffic. If there is a delay in drying of the markings, painting operations shall be discontinued until cause of the slow drying is determined and corrected.

3.2.2 Reflective Media

Application of reflective media shall immediately follow application of pigmented binder. Drop-on application of glass spheres shall be accomplished to insure that reflective media is evenly distributed at the specified rate of coverage. Should there be malfunction of either paint applicator or reflective media dispenser, operations shall be discontinued immediately until deficiency is corrected.

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SECTION 02821A

FENCING
02/02

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A 153/A 153M	(2001a) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 392	(1996) Zinc-Coated Steel Chain-Link Fence Fabric
ASTM A 491	(1996) Aluminum-Coated Steel Chain-Link Fence Fabric
ASTM A 780	(2001) Repair of Damaged and Uncoated Areas of Hot-Dipped Galvanized Coatings
ASTM C 94/C 94M	(2000e2) Ready-Mixed Concrete
ASTM F 1043	(2000) Strength and Protective Coatings on Metal Industrial Chain-Link Fence Framework
ASTM F 1083	(1997) Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures
ASTM F 1184	(1994) Industrial and Commercial Horizontal Slide Gates
ASTM F 626	(1996a) Fence Fittings
ASTM F 900	(1994) Industrial and Commercial Swing Gates

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-07 Certificates

Chain Link Fence; G-AO

Statement, signed by an official authorized to certify on behalf of the manufacturer, attesting that the chain link fence and component materials meet the specified requirements.

PART 2 PRODUCTS

2.1 FENCE FABRIC

Fence fabric shall conform to the following:

2.1.1 Chain Link Fence Fabric

ASTM A 392, Class 1, zinc-coated steel wire with minimum coating weight of 1.2 ounces of zinc per square foot of coated surface, or ASTM A 491, Type I, aluminum-coated steel wire. Fabric shall be fabricated of 9 gauge wire woven in 2 inch mesh. Fabric height shall be as shown. Fabric shall be twisted and barbed on the top selvage and knuckled on the bottom selvage.

2.2 GATES

ASTM F 900 and/or ASTM F 1184. Gate shall be the type and swing shown. Gate frames shall conform to strength and coating requirements of ASTM F 1083 for Group IA, steel pipe, with external coating Type A, nominal pipe size (NPS) 1-1/2. Gate frames shall conform to strength and coating requirements of ASTM F 1043, for Group IC, steel pipe with external coating Type A or Type B, nominal pipe size (NPS) 1-1/2. Gate fabric shall be as specified for chain link fabric. Gate leaves less than 8 feet wide shall have truss rods or intermediate braces. Gate fabric shall be attached to the gate frame by method standard with the manufacturer except that welding will not be permitted. Latches, hinges, stops, keepers, rollers, and other hardware items shall be furnished as required for the operation of the gate. Latches shall be arranged for padlocking so that the padlock will be accessible from both sides of the gate. Stops shall be provided for holding the gates in the open position.

2.3 POSTS

2.3.1 Metal Posts for Chain Link Fence

ASTM F 1083, zinc-coated. Group IA, with external coating Type A steel pipe. Group IC steel pipe, zinc-coated with external coating Type A or Type B and Group II , roll-formed steel sections, shall meet the strength and coating requirements of ASTM F 1043. Group III, ASTM F 1043 steel H-section may be used for line posts in lieu of line post shapes specified for the other classes. Sizes shall be as shown on the drawings. Line posts and terminal (corner, gate, and pull) posts selected shall be of the same designation throughout the fence. Gate post shall be for the gate type specified subject to the limitation specified in ASTM F 900 and/or ASTM F 1184.

2.4 ACCESSORIES

ASTM F 626. Ferrous accessories shall be zinc or aluminum coated. Truss rods shall be furnished for each terminal post. Truss rods shall be provided with turnbuckles or other equivalent provisions for adjustment. Tie wire for attaching fabric to rails, braces, and posts shall be 9 gauge

steel wire and match the coating of the fence fabric. Miscellaneous hardware coatings shall conform to ASTM A 153/A 153M unless modified.

2.5 CONCRETE

ASTM C 94/C 94M, using 3/4 inch maximum size aggregate, and having minimum compressive strength of 3000 psi at 28 days. Grout shall consist of one part portland cement to three parts clean, well-graded sand and the minimum amount of water to produce a workable mix.

PART 3 EXECUTION

3.1 INSTALLATION

Fence shall be installed to the lines and grades indicated. The area on either side of the fence line shall be cleared to the extent indicated. Line posts shall be spaced equidistant at intervals not exceeding 10 feet. Terminal (corner, gate, and pull) posts shall be set at abrupt changes in vertical and horizontal alignment. Fabric shall be continuous between terminal posts; however, runs between terminal posts shall not exceed 500 feet. Any damage to galvanized surfaces, including welding, shall be repaired with paint containing zinc dust in accordance with ASTM A 780.

3.2 EXCAVATION

Post holes shall be cleared of loose material. Waste material shall be spread where directed. The ground surface irregularities along the fence line shall be eliminated to the extent necessary to maintain a 1 inch clearance between the bottom of the fabric and finish grade.

3.3 POST INSTALLATION

3.3.1 Posts for Chain Link Fence

Posts shall be set plumb and in alignment. Except where solid rock is encountered, posts shall be set in concrete to the depth indicated on the drawings. Where solid rock is encountered with no overburden, posts shall be set to a minimum depth of 18 inches in rock. Where solid rock is covered with an overburden of soil or loose rock, posts shall be set to the minimum depth indicated on the drawing unless a penetration of 18 inches in solid rock is achieved before reaching the indicated depth, in which case depth of penetration shall terminate. All portions of posts set in rock shall be grouted. Portions of posts not set in rock shall be set in concrete from the rock to ground level. Posts set in concrete shall be set in holes not less than the diameter shown on the drawings. Diameters of holes in solid rock shall be at least 1 inch greater than the largest cross section of the post. Concrete and grout shall be thoroughly consolidated around each post, shall be free of voids and finished to form a dome. Concrete and grout shall be allowed to cure for 72 hours prior to attachment of any item to the posts. Group II line posts may be mechanically driven, for temporary fence construction only, if rock is not encountered. Driven posts shall be set to a minimum depth of 3 feet and shall be protected with drive caps when being set. For high security fences, fence post rigidity shall be tested by applying a 50 pound force on the post, perpendicular to the fabric, at 5 feet above ground; post movement measured at the point where the force is applied shall be less than or equal to 3/4 inch from the relaxed position; every tenth post shall be tested for rigidity; when a post fails this test, further tests on the next four posts on either side of the failed post shall be made; all failed

posts shall be removed, replaced, and retested at the Contractor's expense.

3.4 RAILS

3.4.1 Top Rail

Top rail shall be supported at each post to form a continuous brace between terminal posts. Where required, sections of top rail shall be joined using sleeves or couplings that will allow expansion or contraction of the rail. Top rail, if required for high security fence, shall be installed as indicated on the drawings.

3.5 BRACES AND TRUSS RODS

Braces and truss rods shall be installed as indicated and in conformance with the standard practice for the fence furnished. Horizontal (compression) braces and diagonal truss (tension) rods shall be installed on fences over 6 feet in height. A center brace or 2 diagonal truss rods shall be installed on 12 foot fences. Braces and truss rods shall extend from terminal posts to line posts. Diagonal braces shall form an angle of approximately 40 to 50 degrees with the horizontal. No bracing is required on fences 6 feet high or less if a top rail is installed.

3.6 CHAIN LINK FABRIC

Chain link fabric shall be installed on the side of the post indicated. Fabric shall be attached to terminal posts with stretcher bars and tension bands. Bands shall be spaced at approximately 15 inch intervals. The fabric shall be installed and pulled taut to provide a smooth and uniform appearance free from sag, without permanently distorting the fabric diamond or reducing the fabric height. Fabric shall be fastened to line posts at approximately 15 inch intervals and fastened to all rails and tension wires at approximately 24 inch intervals. Fabric shall be cut by untwisting and removing pickets. Splicing shall be accomplished by weaving a single picket into the ends of the rolls to be joined. The bottom of the installed fabric shall be 2 plus or minus 1/2 inch above the ground.

3.7 GATE INSTALLATION

Gates shall be installed at the locations shown. Hinged gates shall be mounted to swing as indicated. Latches, stops, and keepers shall be installed as required. Padlocks shall be attached to gates or gate posts with chains. Hinge pins, and hardware shall be welded or otherwise secured to prevent removal.

-- End of Section --

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SECTION 02921A

SEEDING
11/02

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C 602	(1995a; R 2001) Agricultural Liming Materials
ASTM D 2028	(1976; R 1997) Cutback Asphalt (Rapid-Curing Type)
ASTM D 4972	(1995a) pH of Soils
ASTM D 5268	(1992; R 1996) Topsoil Used for Landscaping Purposes
ASTM D 5883	(1996el) Use of Rotary Kiln Produced Expanded Shale, Clay or Slate (ESCS) as a Mineral Amendment in Topsoil Used for Landscaping and Related Purposes
ASTM D 977	(1998) Emulsified Asphalt

U.S. DEPARTMENT OF AGRICULTURE (USDA)

AMS Seed Act	(1995) Federal Seed Act Regulations Part 201

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Equipment; G-AO
Surface Erosion Control Material; G-AO
Chemical Treatment Material; G-AO

Manufacturer's literature including physical characteristics, application and installation instructions for equipment, surface erosion control material and chemical treatment material.

A listing of equipment to be used for the seeding operation.

Delivery; G-AO

Delivery schedule.

Finished Grade and Topsoil; G-AO

Finished grade status.

Topsoil; G-AO

Availability of topsoil from the stripping and stock piling operation.

Quantity Check; G-AO

Bag count or bulk weight measurements of material used compared with area covered to determine the application rate and quantity installed.

Seed Establishment Period; G-AO

Calendar time period for the seed establishment period. When there is more than one seed establishment period, the boundaries of the seeded area covered for each period shall be described.

Maintenance Record; G-AO

Maintenance work performed, area repaired or reinstalled, diagnosis for unsatisfactory stand of grass plants.

Application of Pesticide; G-AO

Pesticide treatment plan with sequence of treatment work with dates and times. The pesticide trade name, EPA registration number, chemical composition, formulation, concentration of original and diluted material, application rate of active ingredients, method of application, area treated, amount applied; and the name and state license number of the state certified applicator shall be included.

SD-04 Samples

Delivered Topsoil; G-AO

Samples taken from several locations at the source.

Soil Amendments; G-AO

A 10 pound sample.

Mulch; G-AO

A 10 pound sample.

SD-06 Test Reports

Equipment Calibration; G-AO

Certification of calibration tests conducted on the equipment used in the seeding operation.

Soil Test; G-AO

Certified reports of inspections and laboratory tests, prepared by an independent testing agency, including analysis and interpretation of test results. Each report shall be properly identified. Test methods used and compliance with recognized test standards shall be described.

SD-07 Certificates

Seed; G-AO
Topsoil; G-AO
pH Adjuster; G-AO
Fertilizer; G-AO

Soil Conditioner; G-AO
Mulch; G-AO
Asphalt Adhesive; G-AO
Pesticide; G-AO

Prior to the delivery of materials, certificates of compliance attesting that materials meet the specified requirements. Certified copies of the material certificates shall include the following:

a. Seed. Classification, botanical name, common name, percent pure live seed, minimum percent germination and hard seed, maximum percent weed seed content, and date tested.

b. Topsoil. Particle size, pH, organic matter content, textural class, soluble salts, chemical and mechanical analyses.

c. pH Adjuster. Calcium carbonate equivalent and sieve analysis.

d. Fertilizer. Chemical analysis and composition percent.

e. Organic Material: Composition and source.

f. Soil Conditioner: Composition and source.

g. Mulch: Composition and source.

h. Asphalt Adhesive: Composition.

1.3 SOURCE INSPECTION

The source of delivered topsoil shall be subject to inspection.

1.4 DELIVERY, INSPECTION, STORAGE, AND HANDLING

1.4.1 Delivery

A delivery schedule shall be provided at least 10 calendar days prior to

the first day of delivery.

1.4.1.1 Delivered Topsoil

Prior to the delivery of any topsoil, its availability shall be verified in paragraph TOPSOIL. A soil test shall be provided for topsoil delivered to the site.

1.4.1.2 Soil Amendments

Soil amendments shall be delivered to the site in the original, unopened containers bearing the manufacturer's chemical analysis. In lieu of containers, soil amendments may be furnished in bulk. A chemical analysis shall be provided for bulk deliveries.

1.4.1.3 Pesticides

Pesticide material shall be delivered to the site in the original, unopened containers bearing legible labels indicating the EPA registration number and the manufacturer's registered uses.

1.4.2 Inspection

Seed shall be inspected upon arrival at the job site for conformity to species and quality. Seed that is wet, moldy, or bears a test date five months or older, shall be rejected. Other materials shall be inspected for compliance with specified requirements. The following shall be rejected: open soil amendment containers or wet soil amendments; topsoil that contains slag, cinders, stones, lumps of soil, sticks, roots, trash or other material over a minimum 1-1/2 inch diameter; and topsoil that contains viable plants and plant parts. Unacceptable materials shall be removed from the job site.

1.4.3 Storage

Materials shall be stored in designated areas. Seed, lime, and fertilizer shall be stored in cool, dry locations away from contaminants. Chemical treatment material shall be stored according to manufacturer's instructions and not with seeding operation materials.

1.4.4 Handling

Except for bulk deliveries, materials shall not be dropped or dumped from vehicles.

1.4.5 Time Limitation

Hydroseeding time limitation for holding seed in the slurry shall be a maximum 24 hours.

PART 2 PRODUCTS

2.1 SEED

2.1.1 Seed Classification

State-certified seed of the latest season's crop shall be provided in original sealed packages bearing the producer's guaranteed analysis for percentages of mixture, purity, germination, hard seed, weed seed content,

and inert material. Labels shall be in conformance with AMS Seed Act and applicable state seed laws.

2.1.2 Permanent Seed Species and Mixtures

Permanent seed species and mixtures shall be proportioned by weight as follows:

Common Name	Mixture Percent by Weight
LAWN SEED	
Kentucky Blue Grass	80%
FIELD SEED	
Perennial Ryegrass	20%

2.1.3 Quality

Weed seed shall be a maximum 1 percent by weight of the total mixture.

2.1.4 Seed Mixing

The mixing of seed may be done by the seed supplier prior to delivery, or on site as directed.

2.1.5 Substitutions

Substitutions will not be allowed without written request and approval from the Contracting Officer.

2.2 TOPSOIL

Topsoil shall be as defined in ASTM D 5268. When available, the topsoil shall be the existing surface soil stripped and stockpiled onsite in accordance with Section 02300 EARTHWORK. When additional topsoil is required beyond the available topsoil from the stripping operation, topsoil shall be delivered and amended as recommended by the soil test for the seed specified. Topsoil shall be free from slag, cinders, stones, lumps of soil, sticks, roots, trash or other material over a minimum 1-1/2 inch diameter. Topsoil shall be free from viable plants and plant parts.

2.3 SOIL AMENDMENTS

Soil amendments shall consist of pH adjuster, fertilizer, organic material and soil conditioners meeting the following requirements. Vermiculite shall not be used.

2.3.1 pH Adjuster

The pH adjuster shall be an agricultural liming material in accordance with ASTM C 602. These materials may be burnt lime, hydrated lime, ground limestone, sulfur, or shells. The pH adjuster shall be used to create a favorable soil pH for the plant material specified.

2.3.1.1 Limestone

Limestone material shall contain a minimum calcium carbonate equivalent of 80 percent. Gradation: A minimum 95 percent shall pass through a No. 8 sieve and a minimum 55 percent shall pass through a No. 60 sieve. To raise soil pH, ground limestone shall be used.

2.3.1.2 Hydrated Lime

Hydrated lime shall contain a minimum calcium carbonate equivalent of 110 percent. Gradation: A minimum 100 percent shall pass through a No. 8 sieve and a minimum 97 percent shall pass through a No. 60 sieve.

2.3.1.3 Burnt Lime

Burnt lime shall contain a minimum calcium carbonate equivalent of 140 percent. Gradation: A minimum 95 percent shall pass through a No. 8 sieve and a minimum 35 percent shall pass through a No. 60 sieve.

2.3.2 Fertilizer

The nutrients ratio shall be 10 percent nitrogen, 20 percent phosphorus, and 10 percent potassium. Fertilizer shall be controlled release commercial grade, free flowing, uniform in composition, and consist of a nitrogen-phosphorus-potassium ratio. The fertilizer shall be derived from sulphur coated urea, urea formaldehyde, plastic or polymer coated pills, or isobutylenediurea (IBDU). Fertilizer shall be balanced with the inclusion of trace minerals and micro-nutrients.

2.3.3 Nitrogen Carrier Fertilizer

It shall be as recommended by the soil test. Nitrogen carrier fertilizer shall be commercial grade, free flowing, and uniform in composition. The fertilizer may be a liquid nitrogen solution.

2.3.4 Soil Conditioner

Soil conditioner shall be sand, super absorbent polymers, calcined clay, or gypsum for use singly or in combination to meet the requirements of the soil test.

2.3.4.1 Sand

Sand shall be clean and free of toxic materials. Gradation: A minimum 95 percent by weight shall pass a No. 10 sieve and a minimum 10 percent by weight shall pass a No. 16 sieve. Greensand shall be balanced with the inclusion of trace minerals and nutrients.

2.3.4.2 Super Absorbent Polymers

To improve water retention in soils, super absorbent polymers shall be sized and applied according to the manufacturer's recommendations. Polymers shall be added as a soil amendment and be cross-linked polyacrylamide, with an absorption capacity of 250-400 times its weight. Polymers shall also be added to the seed and be a starch grafted polyacrylonitrite, with graphite added as a tacky sticker. It shall have an absorption capacity of 100 plus times its weight.

2.3.4.3 Calcined Clay

Calcined clay shall be granular particles produced from montmorillonite clay calcined to a minimum temperature of 1200 degrees F. Gradation: A minimum 90 percent shall pass a No. 8 sieve; a minimum 99 percent shall be retained on a No. 60 sieve; and a maximum 2 percent shall pass a No. 100 sieve. Bulk density: A maximum 40 pounds per cubic foot.

2.3.4.4 Gypsum

Gypsum shall be commercially packaged, free flowing, and a minimum 95 percent calcium sulfate by volume.

2.3.4.5 Expanded Shale, Clay, or Slate (ESCS)

Rotary kiln produced ESCS material shall be in conformance with ASTM D 5883.

2.4 MULCH

Mulch shall be free from weeds, mold, and other deleterious materials. Mulch materials shall be native to the region.

2.4.1 Straw

Straw shall be stalks from oats, wheat, rye, barley, or rice, furnished in air-dry condition and with a consistency for placing with commercial mulch-blowing equipment.

2.4.2 Hay

Hay shall be native hay, sudan-grass hay, broomsedge hay, or other herbaceous mowings, furnished in an air-dry condition suitable for placing with commercial mulch-blowing equipment.

2.5 ASPHALT ADHESIVE

Asphalt adhesive shall conform to the following: Emulsified asphalt, conforming to ASTM D 977, Grade SS-1; and cutback asphalt, conforming to ASTM D 2028, Designation RC-70.

2.6 WATER

Water shall be the responsibility of the Contractor, unless otherwise noted. Water shall not contain elements toxic to plant life.

2.7 PESTICIDE

Pesticide shall be insecticide, herbicide, fungicide, nematocide, rodenticide or miticide. For the purpose of this specification, a soil fumigant shall have the same requirements as a pesticide. The pesticide material shall be EPA registered and approved.

2.8 SURFACE EROSION CONTROL MATERIAL

Surface erosion control material shall conform to the following:

2.8.1 Surface Erosion Control Blanket

Blanket shall be machine produced mat of wood excelsior formed from a web

of interlocking wood fibers; covered on one side with either knitted straw blanket-like mat construction; covered with biodegradable plastic mesh; or interwoven biodegradable thread, plastic netting, or twisted kraft paper cord netting.

2.8.2 Surface Erosion Control Fabric

Fabric shall be knitted construction of polypropylene yarn with uniform mesh openings 3/4 to 1 inch square with strips of biodegradable paper. Filler paper strips shall have a minimum life of 6 months.

2.8.3 Surface Erosion Control Net

Net shall be heavy, twisted jute mesh, weighing approximately 1.22 pounds per linear yard and 4 feet wide with mesh openings of approximately 1 inch square.

2.8.4 Surface Erosion Control Chemicals

Chemicals shall be high-polymer synthetic resin or cold-water emulsion of selected petroleum resins.

2.8.5 Hydrophilic Colloids

Hydrophilic colloids shall be physiologically harmless to plant and animal life without phytotoxic agents. Colloids shall be naturally occurring, silicate powder based, and shall form a water insoluble membrane after curing. Colloids shall resist mold growth.

2.8.6 Erosion Control Material Anchors

Erosion control anchors shall be as recommended by the manufacturer.

PART 3 EXECUTION

3.1 INSTALLING SEED TIME AND CONDITIONS

3.1.1 Seeding Time

Seed shall be installed from 4/1 to 6/1 for spring establishment; from 6/1 to 8/1 for summer establishment; and from 9/1 to 11/15 for dormant seeding.

3.1.2 Seeding Conditions

Seeding operations shall be performed only during periods when beneficial results can be obtained. When drought, excessive moisture, or other unsatisfactory conditions prevail, the work shall be stopped when directed. When special conditions warrant a variance to the seeding operations, proposed alternate times shall be submitted for approval.

3.1.3 Equipment Calibration

Immediately prior to the commencement of seeding operations, calibration tests shall be conducted on the equipment to be used. These tests shall confirm that the equipment is operating within the manufacturer's specifications and will meet the specified criteria. The equipment shall be calibrated a minimum of once every day during the operation. The calibration test results shall be provided within 1 week of testing.

3.1.4 Soil Test

Delivered topsoil, existing soil in smooth graded areas, and stockpiled topsoil shall be tested in accordance with ASTM D 5268 and ASTM D 4972 for determining the particle size, pH, organic matter content, textural class, chemical analysis, soluble salts analysis, and mechanical analysis. Sample collection on site shall be random over the entire site. Sample collection for stockpiled topsoil shall be at different levels in the stockpile. The soil shall be free from debris, noxious weeds, toxic substances, or other materials harmful to plant growth. The test shall determine the quantities and type of soil amendments required to meet local growing conditions for the seed species specified.

3.2 SITE PREPARATION

3.2.1 Finished Grade and Topsoil

The Contractor shall verify that finished grades are as indicated on drawings, and the placing of topsoil, smooth grading, and compaction requirements have been completed in accordance with Section 02300 EARTHWORK, prior to the commencement of the seeding operation.

3.2.2 Application of Soil Amendments

3.2.2.1 Applying pH Adjuster

The pH adjuster shall be applied as recommended by the soil test. The pH adjuster shall be incorporated into the soil to a maximum 4 inch depth or may be incorporated as part of the tillage operation.

3.2.2.2 Applying Fertilizer

The fertilizer shall be applied as recommended by the soil test. Fertilizer shall be incorporated into the soil to a maximum 4 inch depth or may be incorporated as part of the tillage or hydroseeding operation.

3.2.2.3 Applying Soil Conditioner

The soil conditioner shall be as recommended by the soil test. The soil conditioner shall be spread uniformly over the soil a minimum 1 inch depth and thoroughly incorporated by tillage into the soil to a maximum 4 inch depth.

3.2.2.4 Applying Super Absorbent Polymers

Polymers shall be spread uniformly over the soil as recommended by the manufacturer and thoroughly incorporated by tillage into the soil to a maximum 4 inch depth.

3.2.3 Tillage

Soil on slopes up to a maximum 3-horizontal-to-1-vertical shall be tilled to a minimum 4 inch depth. On slopes between 3-horizontal-to-1-vertical and 1-horizontal-to-1 vertical, the soil shall be tilled to a minimum 2 inch depth by scarifying with heavy rakes, or other method. Rototillers shall be used where soil conditions and length of slope permit. On slopes 1-horizontal-to-1 vertical and steeper, no tillage is required. Drainage patterns shall be maintained as indicated on drawings. Areas compacted by construction operations shall be completely pulverized by tillage. Soil

used for repair of surface erosion or grade deficiencies shall conform to topsoil requirements. The pH adjuster, fertilizer, and soil conditioner may be applied during this procedure.

3.2.4 Prepared Surface

3.2.4.1 Preparation

The prepared surface shall be a maximum 1 inch below the adjoining grade of any surfaced area. New surfaces shall be blended to existing areas. The prepared surface shall be completed with a light raking to remove debris.

3.2.4.2 Lawn Area Debris

Debris and stones over a minimum 5/8 inch in any dimension shall be removed from the surface.

3.2.4.3 Protection

Areas with the prepared surface shall be protected from compaction or damage by vehicular or pedestrian traffic and surface erosion.

3.3 INSTALLATION

Prior to installing seed, any previously prepared surface compacted or damaged shall be reworked to meet the requirements of paragraph SITE PREPARATION. Seeding operations shall not take place when the wind velocity will prevent uniform seed distribution.

3.3.1 Installing Seed

Seeding method shall be Drill Seeding . Seeding procedure shall ensure even coverage. Gravity feed applicators, which drop seed directly from a hopper onto the prepared soil, shall not be used because of the difficulty in achieving even coverage, unless otherwise approved. Absorbent polymer powder shall be mixed with the dry seed at the rate recommended by the manufacturer.

3.3.1.1 Drill Seeding

Seed shall be uniformly drilled to a maximum 1/2 inch depth and at the rate of 4 pounds per 1000 square feet, using equipment having drills a maximum 7 inches distance apart. Row markers shall be used with the drill seeder. Half the total rate of seed application shall be drilled in 1 direction, with the remainder of the seed rate drilled at 90 degrees from the first direction. The drilling equipment shall be maintained with half full seed boxes during the seeding operations.

3.3.1.2 Rolling

The entire area shall be firmed with a roller not exceeding 90 pounds per foot roller width. Slopes over a maximum 3-horizontal-to-1 vertical shall not be rolled. Areas seeded with seed drills equipped with rollers shall not be rolled.

3.3.2 Mulching

3.3.2.1 Hay or Straw Mulch

Hay or straw mulch shall be spread uniformly at the rate of 2 tons per acre. Mulch shall be spread by hand, blower-type mulch spreader, or other approved method. Mulching shall be started on the windward side of relatively flat areas or on the upper part of steep slopes, and continued uniformly until the area is covered. The mulch shall not be bunched or clumped. Sunlight shall not be completely excluded from penetrating to the ground surface. All areas installed with seed shall be mulched on the same day as the seeding. Mulch shall be anchored immediately following spreading.

3.3.2.2 Mechanical Anchor

Mechanical anchor shall be a V-type-wheel land packer; a scalloped-disk land packer designed to force mulch into the soil surface; or other suitable equipment.

3.3.3 Watering Seed

Watering shall be started immediately after completing the seeding of an area. Water shall be applied to supplement rainfall at a rate sufficient to ensure moist soil conditions to a minimum 1 inch depth. Run-off and puddling shall be prevented. Watering trucks shall not be driven over turf areas, unless otherwise directed. Watering of other adjacent areas or plant material shall be prevented.

3.4 SURFACE EROSION CONTROL

3.4.1 Surface Erosion Control Material

Where indicated or as directed, surface erosion control material shall be installed in accordance with manufacturer's instructions. Placement of the material shall be accomplished without damage to installed material or without deviation to finished grade.

3.4.2 Temporary Seeding

The application rate shall be 12 pounds per 1000 square yards. When directed during contract delays affecting the seeding operation or when a quick cover is required to prevent surface erosion, the areas designated shall be seeded in accordance with temporary seed species listed under Paragraph SEED.

3.4.2.1 Soil Amendments

When soil amendments have not been applied to the area, the quantity of 1/2 of the required soil amendments shall be applied and the area tilled in accordance with paragraph SITE PREPARATION. The area shall be watered in accordance with paragraph Watering Seed.

3.4.2.2 Remaining Soil Amendments

The remaining soil amendments shall be applied in accordance with the paragraph Tillage when the surface is prepared for installing seed.

3.5 QUANTITY CHECK

For materials provided in bags, the empty bags shall be retained for recording the amount used. For materials provided in bulk, the weight certificates shall be retained as a record of the amount used. The amount of material used shall be compared with the total area covered to determine the rate of application used. Differences between the quantity applied and the quantity specified shall be adjusted as directed.

3.6 APPLICATION OF PESTICIDE

When application of a pesticide becomes necessary to remove a pest or disease, a pesticide treatment plan shall be submitted and coordinated with the installation pest management program.

3.6.1 Technical Representative

The certified installation pest management coordinator shall be the technical representative, and shall be present at all meetings concerning treatment measures for pest or disease control. They may be present during treatment application.

3.6.2 Application

A state certified applicator shall apply required pesticides in accordance with EPA label restrictions and recommendations. Clothing and personal protective equipment shall be used as specified on the pesticide label. A closed system is recommended as it prevents the pesticide from coming into contact with the applicator or other persons. Water for formulating shall only come from designated locations. Filling hoses shall be fitted with a backflow preventer meeting local plumbing codes or standards. Overflow shall be prevented during the filling operation. Prior to each day of use, the equipment used for applying pesticide shall be inspected for leaks, clogging, wear, or damage. Any repairs are to be performed immediately. A pesticide plan shall be submitted.

3.7 RESTORATION AND CLEAN UP

3.7.1 Restoration

Existing turf areas, pavements, and facilities that have been damaged from the seeding operation shall be restored to original condition at Contractor's expense.

3.7.2 Clean Up

Excess and waste material shall be removed from the seeded areas and shall be disposed offsite. Adjacent paved areas shall be cleaned.

3.8 PROTECTION OF INSTALLED AREAS

Immediately upon completion of the seeding operation in an area, the area shall be protected against traffic or other use by erecting barricades and providing signage as required, or as directed. Signage shall be in accordance with Section 10430 EXTERIOR SIGNAGE.

3.9 SEED ESTABLISHMENT PERIOD

3.9.1 Commencement

The seed establishment period to obtain a healthy stand of grass plants shall begin on the first day of seeding work under this contract and shall continue through the remaining life of the contract and end 12 months after the last day of the seeding operation required by this contract. Written calendar time period shall be furnished for the seed establishment period. When there is more than 1 seed establishment period, the boundaries of the seeded area covered for each period shall be described. The seed establishment period shall be coordinated with Section 02930A EXTERIOR PLANTING. The seed establishment period shall be modified for inclement weather, shut down periods, or for separate completion dates of areas.

3.9.2 Satisfactory Stand of Grass Plants

Grass plants shall be evaluated for species and health when the grass plants are a minimum 1 inch high.

3.9.2.1 Lawn Area

A satisfactory stand of grass plants from the seeding operation for a lawn area shall be a minimum 100 grass plants per square foot. Bare spots shall be a maximum 6 inches square. The total bare spots shall be a maximum 2 percent of the total seeded area.

3.9.3 Maintenance During Establishment Period

Maintenance of the seeded areas shall include eradicating weeds, insects and diseases; protecting embankments from surface erosion; maintaining erosion control materials and mulch; protecting installed areas from traffic; mowing; watering; and post-fertilization.

3.9.3.1 Mowing

a. Lawn Areas: Lawn areas shall be mowed to a minimum 3 inch height when the turf is a maximum 4 inches high. Clippings shall be removed when the amount cut prevents sunlight from reaching the ground surface.

3.9.3.2 Post-Fertilization

The fertilizer shall be applied as recommended by the soil test. A maximum 1/2 pound per 1000 square feet of actual available nitrogen shall be provided to the grass plants. The application shall be timed prior to the advent of winter dormancy and shall be made without burning the installed grass plants.

3.9.3.3 Pesticide Treatment

Treatment for disease or pest shall be in accordance with paragraph APPLICATION OF PESTICIDE.

3.9.3.4 Repair or Reinstall

Unsatisfactory stand of grass plants and mulch shall be repaired or

reinstalled, and eroded areas shall be repaired in accordance with paragraph SITE PREPARATION.

3.9.3.5 Maintenance Record

A record of each site visit shall be furnished, describing the maintenance work performed; areas repaired or reinstalled; and diagnosis for unsatisfactory stand of grass plants.

-- End of Section --

SPECIFICATIONS
(FOR CONSTRUCTION CONTRACT)

SOLICITATION NO. W9128F-04-B-0011

ADAL PHYSICAL FITNESS CENTER
PDC NO. QJVF 8800034R2

MINOT AFB, North Dakota

VOLUME 2 OF 3 – DIVISION 03 THRU DIVISION 12

JULY 2004

Prepared By : U.S. Army Corps of Engineers
Omaha District

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ADAL PHYSICAL FITNESS CENTER
MINOT AFB, NORTH DAKOTA

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05/98

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SECTION 03100A

STRUCTURAL CONCRETE FORMWORK
05/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ACI INTERNATIONAL (ACI)

ACI 347R	(1994) Guide to Formwork for Concrete

AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.4	(1995) Basic Hardboard

U.S. DEPARTMENT OF COMMERCE (DOC)

PS1	(1995) Construction and Industrial Plywood (APA V995)

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Form Materials

Manufacturer's data including literature describing form materials, accessories, and form releasing agents.

Form Releasing Agents

Manufacturer's recommendation on method and rate of application of form releasing agents.

1.3 DESIGN

Formwork shall be designed in accordance with methodology of ACI 347R for

anticipated loads, lateral pressures, and stresses. Forms shall be capable of producing a surface which meets the requirements of the class of finish specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. Forms shall be capable of withstanding the pressures resulting from placement and vibration of concrete.

PART 2 PRODUCTS

2.1 FORM MATERIALS

2.1.1 Forms For Class A and Class B Finish

Forms for Class A and Class B finished surfaces shall be plywood panels conforming to PS1, Grade B-B concrete form panels, Class I or II. Other form materials or liners may be used provided the smoothness and appearance of concrete produced will be equivalent to that produced by the plywood concrete form panels.

2.1.2 Forms For Class C Finish

Forms for Class C finished surfaces shall be shiplap lumber; plywood conforming to PS1, Grade B-B concrete form panels, Class I or II; tempered concrete form hardboard conforming to AHA A135.4; other approved concrete form material; or steel, except that steel lining on wood sheathing shall not be used.

2.1.3 Forms For Class D Finish

Forms for Class D finished surfaces, except where concrete is placed against earth, shall be wood or steel or other approved concrete form material.

2.1.4 Form Ties

Form ties shall be factory-fabricated metal ties, shall be of the removable or internal disconnecting or snap-off type, and shall be of a design that will not permit form deflection and will not spall concrete upon removal. Solid backing shall be provided for each tie. Except where removable tie rods are used, ties shall not leave holes in the concrete surface less than 1/4 inch nor more than 1 inch deep and not more than 1 inchin diameter. Removable tie rods shall be not more than 1-1/2 inches in diameter.

2.1.5 Form Releasing Agents

Form releasing agents shall be commercial formulations that will not bond with, stain or adversely affect concrete surfaces. Agents shall not impair subsequent treatment of concrete surfaces depending upon bond or adhesion nor impede the wetting of surfaces to be cured with water or curing compounds.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Formwork

Forms shall be mortar tight, properly aligned and adequately supported to produce concrete surfaces meeting the surface requirements specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE and conforming to

construction tolerance given in TABLE 1. Where concrete surfaces are to have a Class A or Class B finish, joints in form panels shall be arranged as approved. Where forms for continuous surfaces are placed in successive units, the forms shall fit over the completed surface to obtain accurate alignment of the surface and to prevent leakage of mortar. Forms shall not be reused if there is any evidence of surface wear and tear or defects which would impair the quality of the surface. Surfaces of forms to be reused shall be cleaned of mortar from previous concreting and of all other foreign material before reuse. Form ties that are to be completely withdrawn shall be coated with a nonstaining bond breaker.

3.2 CHAMFERING

Except as otherwise shown, external corners that will be exposed shall be chamfered, beveled, or rounded by moldings placed in the forms.

3.3 COATING

Forms for Class A and Class B finished surfaces shall be coated with a form releasing agent before the form or reinforcement is placed in final position. The coating shall be used as recommended in the manufacturer's printed or written instructions. Forms for Class C and D finished surfaces may be wet with water in lieu of coating immediately before placing concrete, except that in cold weather with probable freezing temperatures, coating shall be mandatory. Surplus coating on form surfaces and coating on reinforcing steel and construction joints shall be removed before placing concrete.

3.4 REMOVAL OF FORMS

Forms shall be removed preventing injury to the concrete and ensuring the complete safety of the structure. Formwork for columns, walls, side of beams and other parts not supporting the weight of concrete may be removed when the concrete has attained sufficient strength to resist damage from the removal operation but not before at least 24 hours has elapsed since concrete placement.

TABLE 1

TOLERANCES FOR FORMED SURFACES

1. Variations from the plumb:	In any 10 feet of length ---------- 1/4 inch
a. In the lines and surfaces of columns, piers, walls and in arises	Maximum for entire length ---------- 1 inch
2. Variation from the level or from the grades indicated on the drawings:	In any 10 feet of length ----------1/4 inch In any bay or in any 20 feet of length---------- 3/8 inch
a. In exposed lintels, sills, parapets,	In any bay or in any 20 feet of length ---------- ----- 1/4 inch

TABLE 1

TOLERANCES FOR FORMED SURFACES

	horizontal grooves, and other conspicuous lines	Maximum for entire length---------- 1/2 inch
3.	Variation of the linear building lines from established position in plan	In any 20 feet --------- 1/2 inch Maximum ----------1 inch
4.	Variation of distance between walls, columns, partitions	1/4 inch per 10 feet of distance, but not more than 1/2 inch in any one bay,and not more than 1 inch total variation
5.	Variation in the sizes and locations of sleeves, floor openings, and wall opening	Minus ---------- 1/4 inch Plus ---------- 1/2 inch
6.	Variation in cross-sectional dimensions of columns and in the thickness of slabs and walls	Minus ---------- 1/4 inch Plus ---------- 1/2 inch
7.	Footings:	
	a. Variation of dimensions in plan	Minus ---------- 1/2 inch Plus ---------- 2 inches when formed or plus 3 inches when placed against unformed excavation
	b. Misplacement of eccentricity	2 percent of the footing width in the direction of misplacement but not more than 2 inches
	c. Reduction in thickness of specified thickness	Minus ---------- 5 percent
8.	Variation in steps:	Riser ---------- 1/8 inch
	a. In a flight of stairs	Tread ---------- 1/4 inch
	b. In consecutive steps	Riser ---------- 1/16 inch Tread ---------- 1/8 inch

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SECTION 03200A

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09/97

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SECTION 03200A

CONCRETE REINFORCEMENT
09/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ACI INTERNATIONAL (ACI)

ACI 318/318R	(2002) Building Code Requirements for Structural Concrete and Commentary

ASTM INTERNATIONAL (ASTM)

ASTM A 185	(1997) Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM A 615/A 615M	(2001b) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 706/A 706M	(1998) Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A 767/A 767M	(1997) Zinc-Coated (Galvanized) Steel Bars in Concrete Reinforcement
ASTM A 775/A 775M	(1997e1) Epoxy-Coated Reinforcement Steel Bars

CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

CRSI 1MSP	(2001) Manual of Standard Practice

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Reinforcement; G-AE

Detail drawings showing reinforcing steel placement, schedules, sizes, grades, and splicing and bending details. Drawings shall show support details including types, sizes and spacing.

SD-07 Certificates

Reinforcing Steel

Certified copies of mill reports attesting that the reinforcing steel furnished contains no less than 25 percent recycled scrap steel and meets the requirements specified herein, prior to the installation of reinforcing steel.

1.3 DELIVERY AND STORAGE

Reinforcement and accessories shall be stored off the ground on platforms, skids, or other supports.

PART 2 PRODUCTS

2.1 REINFORCING STEEL

Reinforcing steel shall be deformed bars conforming to ASTM A 615/A 615M or ASTM A 706/A 706M, grades and sizes as indicated. In highly corrosive environments or when directed by the Contracting Officer, reinforcing steel shall conform to ASTM A 767/A 767M or ASTM A 775/A 775M as appropriate.

2.2 WELDED WIRE FABRIC

Welded wire fabric shall conform to ASTM A 185.

2.3 WIRE TIES

Wire ties shall be 16 gauge or heavier black annealed steel wire.

2.4 SUPPORTS

Bar supports for formed surfaces shall be designed and fabricated in accordance with CRSI 1MSP and shall be steel or precast concrete blocks. Precast concrete blocks shall have wire ties and shall be not less than 4 inches square when supporting reinforcement on ground. Precast concrete block shall have compressive strength equal to that of the surrounding concrete. Where concrete formed surfaces will be exposed to weather or where surfaces are to be painted, steel supports within 1/2 inch of concrete surface shall be galvanized, plastic protected or of stainless steel. Concrete supports used in concrete exposed to view shall have the same color and texture as the finish surface. For slabs on grade, supports shall be precast concrete blocks, plastic coated steel fabricated with bearing plates, or specifically designed wire-fabric supports fabricated of plastic.

PART 3 EXECUTION

3.1 REINFORCEMENT

Reinforcement shall be fabricated to shapes and dimensions shown and shall conform to the requirements of ACI 318/318R. Reinforcement shall be cold bent unless otherwise authorized. Bending may be accomplished in the field or at the mill. Bars shall not be bent after embedment in concrete. Safety caps shall be placed on all exposed ends of vertical concrete reinforcement bars that pose a danger to life safety. Wire tie ends shall

face away from the forms.

3.1.1 Placement

Reinforcement shall be free from loose rust and scale, dirt, oil, or other deleterious coating that could reduce bond with the concrete. Reinforcement shall be placed in accordance with ACI 318/318R at locations shown plus or minus one bar diameter. Reinforcement shall not be continuous through expansion joints and shall be as indicated through construction or contraction joints. Concrete coverage shall be as indicated or as required by ACI 318/318R. If bars are moved more than one bar diameter to avoid interference with other reinforcement, conduits or embedded items, the resulting arrangement of bars, including additional bars required to meet structural requirements, shall be approved before concrete is placed.

3.1.2 Splicing

Splices of reinforcement shall conform to ACI 318/318R and shall be made only as required or indicated. Splicing shall be by lapping or by mechanical connection; except that lap splices shall not be used for bars larger than No. 11 unless otherwise indicated. Lapped bars shall be placed in contact and securely tied or spaced transversely apart to permit the embedment of the entire surface of each bar in concrete. Lapped bars shall not be spaced farther apart than one-fifth the required length of lap or 6 inches. Mechanical butt splices shall be in accordance with the recommendation of the manufacturer of the mechanical splicing device. Butt splices shall develop 125 percent of the specified minimum yield tensile strength of the spliced bars or of the smaller bar in transition splices. Bars shall be flame dried before butt splicing. Adequate jigs and clamps or other devices shall be provided to support, align, and hold the longitudinal centerline of the bars to be butt spliced in a straight line.

3.2 WELDED-WIRE FABRIC PLACEMENT

Welded-wire fabric shall be placed in slabs as indicated. Fabric placed in slabs on grade shall be continuous between expansion, construction, and contraction joints. Fabric placement at joints shall be as indicated. Lap splices shall be made in such a way that the overlapped area equals the distance between the outermost crosswires plus 2 inches. Laps shall be staggered to avoid continuous laps in either direction. Fabric shall be wired or clipped together at laps at intervals not to exceed 4 feet. Fabric shall be positioned by the use of supports.

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CAST-IN-PLACE STRUCTURAL CONCRETE
11/01

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ACI INTERNATIONAL (ACI)

ACI 117	(1990; Errata) Standard Tolerances for Concrete Construction and Materials
ACI 211.1	(1991) Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
ACI 214.3R	(1988; R 1997) Simplified Version of the Recommended Practice for Evaluation of Strength Test Results of Concrete
ACI 301	(1999) Standard Specifications for Structural Concrete
ACI 305R	(1999) Hot Weather Concreting
ACI 318/318R	(2002) Building Code Requirements for Structural Concrete and Commentary

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 182	(1991; R 2000) Burlap Cloth Made from Jute or Kenaf

ASTM INTERNATIONAL (ASTM)

ASTM C 1017/C 1017M	(1998) Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C 1064/C 1064M	(1999) Temperature of Freshly Mixed Portland Cement Concrete
ASTM C 1077	(1998) Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
ASTM C 1107	(2002) Packaged Dry, Hydraulic-Cement Grout(Nonshrink)

ASTM C 136	(2001) Sieve Analysis of Fine and Coarse Aggregates
ASTM C 143/C 143M	(2000) Slump of Hydraulic Cement Concrete
ASTM C 150	(2002a) Portland Cement
ASTM C 171	(1997a) Sheet Materials for Curing Concrete
ASTM C 172	(1999) Sampling Freshly Mixed Concrete
ASTM C 173	(1994ael) Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C 192/C 192M	(2000) Making and Curing Concrete Test Specimens in the Laboratory
ASTM C 231	(1997el) Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 260	(2001) Air-Entraining Admixtures for Concrete
ASTM C 309	(1998a) Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 31/C 31M	(2000e1) Making and Curing Concrete Test Specimens in the Field
ASTM C 33	(2002a) Concrete Aggregates
ASTM C 39/C 39M	(2001) Compressive Strength of Cylindrical Concrete Specimens
ASTM C 42/C 42M	(1999) Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C 494/C 494M	(1999ae1) Chemical Admixtures for Concrete
ASTM C 552	(2000e1) Cellular Glass Thermal Insulation
ASTM C 578	(2001) Rigid, Cellular Polystyrene Thermal Insulation
ASTM C 591	(2001) Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM C 618	(2000) Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
ASTM C 685	(2000) Concrete Made by Volumetric Batching and Continuous Mixing
ASTM C 78	(1994) Flexural Strength of Concrete (Using Simple Beam With Third-Point Loading)
ASTM C 881	(1999) Epoxy-Resin-Base Bonding Systems

	for Concrete
ASTM C 94/C 94M	(2000e2) Ready-Mixed Concrete
ASTM C 940	(1998a) Expansion and Bleeding of Freshly Mixed Grouts for Preplaced-Aggregate Concrete in the Laboratory
ASTM C 989	(1999) Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
ASTM D 75	(1987; R 1997) Sampling Aggregates
ASTM E 1155	(1996) Determining Floor Flatness and Levelness Using the F-Number System
ASTM E 96	(2000e1) Water Vapor Transmission of Materials

NATIONAL READY MIXED CONCRETE ASSOCIATION (NRMCA)

NRMCA CPMB 100	(2000) Concrete Plant Standards
NRMCA QC 3	(1984) Quality Control Manual: Section 3, Plant Certifications Checklist: Certification of Ready Mixed Concrete Production Facilities
NRMCA TMMB 100	(1994) Truck Mixer Agitator and Front Discharge Concrete Carrier Standards

U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 104	(1980) Method of Calculation of the Fineness Modulus of Aggregate
COE CRD-C 400	(1963) Requirements for Water for Use in Mixing or Curing Concrete
COE CRD-C 521	(1981) Standard Test Method for Frequency and Amplitude of Vibrators for Concrete

1.2 LUMP SUM CONTRACT

Under this type of contract concrete items will be paid for by lump sum and will not be measured. The work covered by these items consists of furnishing all concrete materials, reinforcement, miscellaneous embedded materials, and equipment, and performing all labor for the forming, manufacture, transporting, placing, finishing, curing, and protection of concrete in these structures.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Mixture Proportions; G-AE

The results of trial mixture design studies along with a statement giving the maximum nominal coarse aggregate size and the proportions of ingredients that will be used in the manufacture of each strength or class of concrete, at least 14 days prior to commencing concrete placing operations. Aggregate weights shall be based on the saturated surface dry condition. The statement shall be accompanied by test results from an approved independent commercial testing laboratory, showing that mixture design studies have been made with materials proposed for the project and that the proportions selected will produce concrete of the qualities indicated. No substitutions shall be made in the materials used in the mixture design studies without additional tests to show that the quality of the concrete is satisfactory.

SD-06 Test Reports

Testing and Inspection for Contractor Quality Control; G-AO

Certified copies of laboratory test reports, including mill tests and all other test data, for portland cement, blended cement, pozzolan, ground granulated blast furnace slag, silica fume, aggregate, admixtures, and curing compound proposed for use on this project.

SD-07 Certificates

Qualifications

Written documentation for Contractor Quality Control personnel.

1.4 QUALIFICATIONS

Contractor Quality Control personnel assigned to concrete construction shall be American Concrete Institute (ACI) Certified Workmen in one of the following grades or shall have written evidence of having completed similar qualification programs:

Concrete Field Testing Technician, Grade I
Concrete Laboratory Testing Technician, Grade I or II
Concrete Construction Inspector, Level II

Concrete Transportation Construction Inspector or
Reinforced Concrete Special Inspector, Jointly certified by American Concrete Institute (ACI), Building Official and Code Administrators International (BOCA), International Conference of Building Officials (ICBO), and Southern Building Code Congress International (SBCCI).

The foreman or lead journeyman of the flatwork finishing crew shall have similar qualification for ACI Concrete Flatwork Technician/Finisher or equal, with written documentation.

1.5 GENERAL REQUIREMENTS

1.5.1 Tolerances

Except as otherwise specified herein, tolerances for concrete batching, mixture properties, and construction as well as definition of terms and application practices shall be in accordance with ACI 117. Level and grade tolerance measurements of slabs shall be made as soon as possible after finishing; when forms or shoring are used, the measurements shall be made prior to removal.

1.5.1.1 Floors

For the purpose of this Section the following terminology correlation between ACI 117 and this Section shall apply:

Floor Profile Quality Classification From ACI 117	This Section
Conventional Bullfloated	Same
Conventional Straightedged	Same
Flat	Float Finish or Trowel Finish
Very Flat	Same. Use only with F-system

Levelness tolerance shall not apply where design requires floors to be sloped to drains or sloped for other reasons.

1.5.1.2 Floors by the F-Number System

The flatness and levelness of floors shall be carefully controlled and the tolerances shall be measured by the F-Number system of Paragraph 4.5.6 and 4.5.6.1 of ACI 117. The Contractor shall furnish an approved floor profilograph or other equipment capable of measuring the floor flatness (FF) number and the floor levelness (FL) number in accordance with ASTM E 1155. The Contractor shall perform the tolerance measurements within 72 hours after floor slab construction while being observed by the Contracting Officer. The tolerances of surfaces beyond the limits of ASTM E 1155 (the areas within 24 inches of embedments and construction joints) shall be acceptable to the Contracting Officer. Tolerances of the following areas shall meet the requirements for the listed surfaces as specified in paragraphs 4.5.6 and 4.5.6.1 of ACI 117.

Float Finish- At Areas to Receive Ceramic Tile and Depressed Area at Banked Running Track
Trowel Finish- All Other Areas

1.5.2 Strength Requirements and w/c Ratio

1.5.2.1 Strength Requirements

Specified compressive strength (f'c) shall be as follows:

COMPRESSIVE STRENGTH	STRUCTURE OR PORTION OF STRUCTURE
4000 psi at 28 days	All Concrete Except as Noted Below

COMPRESSIVE STRENGTH	STRUCTURE OR PORTION OF STRUCTURE
3000 psi at 28 days	Supported Slabs on Composite Metal Deck and Footings

Concrete slabs on-grade shall have a 28-day flexural strength of 650 psi. Concrete made with high-early strength cement shall have a 7-day strength equal to the specified 28-day strength for concrete made with Type I or II portland cement. Compressive strength shall be determined in accordance with ASTM C 39/C 39M. Flexural strength shall be determined in accordance with ASTM C 78.

a. Evaluation of Concrete Compressive Strength. Compressive strength specimens (6 by 12 inch cylinders) shall be fabricated by the Contractor and laboratory cured in accordance with ASTM C 31/C 31M and tested in accordance with ASTM C 39/C 39M. The strength of the concrete will be considered satisfactory so long as the average of all sets of three consecutive test results equals or exceeds the specified compressive strength f'c and no individual test result falls below the specified strength f'c by more than 500 psi. A "test" is defined as the average of two companion cylinders, or if only one cylinder is tested, the results of the single cylinder test. Additional analysis or testing, including taking cores and/or load tests may be required at the Contractor's expense when the strength of the concrete in the structure is considered potentially deficient.

b. Investigation of Low-Strength Compressive Test Results. When any strength test of standard-cured test cylinders falls below the specified strength requirement by more than 500 psi or if tests of field-cured cylinders indicate deficiencies in protection and curing, steps shall be taken to assure that the load-carrying capacity of the structure is not jeopardized. When the strength of concrete in place is considered potentially deficient, cores shall be obtained and tested in accordance with ASTM C 42/C 42M. At least three representative cores shall be taken from each member or area of concrete in place that is considered potentially deficient. The location of cores will be determined by the Contracting Officer to least impair the strength of the structure. Concrete in the area represented by the core testing will be considered adequate if the average strength of the cores is equal to at least 85 percent of the specified strength requirement and if no single core is less than 75 percent of the specified strength requirement. Non-destructive tests (tests other than test cylinders or cores) shall not be used as a basis for acceptance or rejection. The Contractor shall perform the coring and repair the holes. Cores will be tested by the Government.

c. Load Tests. If the core tests are inconclusive or impractical to obtain or if structural analysis does not confirm the safety of the structure, load tests may be directed by the Contracting Officer in accordance with the requirements of ACI 318/318R. Concrete work evaluated by structural analysis or by results of a load test as being understrength shall be corrected in a manner satisfactory to the Contracting Officer. All investigations, testing, load tests, and correction of deficiencies shall be performed by and at the expense of the Contractor and must be approved by the Contracting Officer, except that if all concrete

is found to be in compliance with the drawings and specifications, the cost of investigations, testing, and load tests will be at the expense of the Government.

d. Evaluation of Concrete Flexural Strength. Flexural strength specimens (beams) shall be fabricated by the Contractor and laboratory cured in accordance with ASTM C 31/C 31M and tested in accordance with ASTM C 78. The strength of the concrete will be considered satisfactory so long as the average of all sets of three consecutive test results equals or exceeds the specified flexural strength and no individual test result falls below the specified flexural strength by more than 50 psi.A "test" is defined as the average of two companion beams. Additional analysis or testing, including taking cores and/or load tests may be required at the Contractor's expense when the strength of the concrete in the slab is considered potentially deficient.

1.5.3 Air Entrainment

All normal weight concrete shall be air entrained to contain between 4 and 7 percent total air, except no air entrainment is required for interior slabs. Specified air content shall be attained at point of placement into the forms. Air content for normal weight concrete shall be determined in accordance with ASTM C 231.

1.5.4 Slump

Slump of the concrete, as delivered to the point of placement into the forms, shall be within the following limits. Slump shall be determined in accordance with ASTM C 143/C 143M.

Structural Element	Slump Minimum	Slump Maximum
Walls, piers	2 in.	4 in.
Foundation walls, substructure walls, footings, slabs	1 in.	3 in.
Any structural concrete approved for placement by pumping:		
At pump	2 in.	6 in.
At discharge of line	1 in.	4 in.

When use of a plasticizing admixture conforming to ASTM C 1017/C 1017M or when a Type F or G high range water reducing admixture conforming to ASTM C 494/C 494M is permitted to increase the slump of concrete, concrete shall have a slump of 2 to 4 inches before the admixture is added and a maximum slump of 8 inches at the point of delivery after the admixture is added.

1.5.5 Concrete Temperature

The temperature of the concrete as delivered shall not exceed 90 degrees F. When the ambient temperature during placing is 40 degrees F or less, or is expected to be at any time within 6 hours after placing, the temperature of the concrete as delivered shall be between 55 and 75 degrees F.

1.5.6 Size of Coarse Aggregate

The largest feasible nominal maximum size aggregate (NMSA) specified in paragraph AGGREGATES shall be used in each placement. However, nominal maximum size of aggregate shall not exceed any of the following: three-fourths of the minimum cover for reinforcing bars, three-fourths of the minimum clear spacing between reinforcing bars, one-fifth of the narrowest dimension between sides of forms, or one-third of the thickness of slabs or toppings.

1.5.7 Special Properties and Products

Concrete may contain admixtures other than air entraining agents, such as water reducers, superplasticizers, or set retarding agents to provide special properties to the concrete, if specified or approved. Any of these materials to be used on the project shall be used in the mix design studies.

1.6 MIXTURE PROPORTIONS

Concrete shall be composed of portland cement, other cementitious and pozzolanic materials as specified, aggregates, water and admixtures as specified.

1.6.1 Proportioning Studies for Normal Weight Concrete

Trial design batches, mixture proportioning studies, and testing requirements for various classes and types of concrete specified shall be the responsibility of the Contractor. Except as specified for flexural strength concrete, mixture proportions shall be based on compressive strength as determined by test specimens fabricated in accordance with ASTM C 192/C 192M and tested in accordance with ASTM C 39/C 39M. Samples of all materials used in mixture proportioning studies shall be representative of those proposed for use in the project and shall be accompanied by the manufacturer's or producer's test reports indicating compliance with these specifications. Trial mixtures having proportions, consistencies, and air content suitable for the work shall be made based on methodology described in ACI 211.1, using at least three different water-cement ratios for each type of mixture, which will produce a range of strength encompassing those required for each class and type of concrete required on the project. The maximum water-cement ratios required in subparagraph Water-Cement Ratio will be the equivalent water-cement ratio as determined by conversion from the weight ratio of water to cement plus pozzolan, and ground granulated blast furnace slag (GGBF slag) by the weight equivalency method as described in ACI 211.1. If pozzolan is used in the concrete mixture, the minimum pozzolan content shall be 15 percent by weight of the total cementitious material, and the maximum shall be 35 percent. Laboratory trial mixtures shall be designed for maximum permitted slump and air content. Separate sets of trial mixture studies shall be made for each combination of cementitious materials and each combination of admixtures proposed for use. No combination of either shall be used until proven by such studies, except that, if approved in writing and otherwise permitted by these specifications, an accelerator or a retarder may be used without separate trial mixture study. Separate trial mixture studies shall also be made for concrete for any conveying or placing method proposed which requires special properties and for concrete to be placed in unusually difficult placing locations. The temperature of concrete in each trial batch shall be reported. For each water-cement ratio, at least three test cylinders for each test age shall be made and cured in accordance withASTM C 192/C 192M. They shall be tested at 7 and 28 days in accordance with

ASTM C 39/C 39M. From these test results, a curve shall be plotted showing the relationship between water-cement ratio and strength for each set of trial mix studies. In addition, a curve shall be plotted showing the relationship between 7 day and 28 day strengths. Each mixture shall be designed to promote easy and suitable concrete placement, consolidation and finishing, and to prevent segregation and excessive bleeding.

1.6.2 Proportioning Studies for Flexural Strength Concrete

Trial design batches, mixture proportioning studies, and testing requirements shall conform to the requirements specified in paragraph Proportioning Studies for Normal Weight Concrete, except that proportions shall be based on flexural strength as determined by test specimens (beams) fabricated in accordance with ASTM C 192/C 192M and tested in accordance with ASTM C 78. Procedures given in ACI 211.1 shall be modified as necessary to accommodate flexural strength.

1.6.3 Average Compressive Strength Required for Mixtures

The mixture proportions selected during mixture design studies shall produce a required average compressive strength (f'cr) exceeding the specified compressive strength (f'c) by the amount indicated below. This required average compressive strength, f'cr, will not be a required acceptance criteria during concrete production. However, whenever the daily average compressive strength at 28 days drops below f'cr during concrete production, or daily average 7-day strength drops below a strength correlated with the 28-day f'cr, the mixture shall be adjusted, as approved, to bring the daily average back up to f'cr. During production, the required f'cr shall be adjusted, as appropriate, based on the standard deviation being attained on the job.

1.6.3.1 Computations from Test Records

Where a concrete production facility has test records, a standard deviation shall be established in accordance with the applicable provisions of ACI 214.3R. Test records from which a standard deviation is calculated shall represent materials, quality control procedures, and conditions similar to those expected; shall represent concrete produced to meet a specified strength or strengths (f'c) within 1,000 psi of that specified for proposed work; and shall consist of at least 30 consecutive tests. A strength test shall be the average of the strengths of two cylinders made from the same sample of concrete and tested at 28 days. Required average compressive strength f'cr used as the basis for selection of concrete proportions shall be the larger of the equations that follow using the standard deviation as determined above:

$f'cr = f'c + 1.34S$ where units are in psi

$f'cr = f'c + 2.33S - 500$ where units are in psi

Where S = standard deviation

Where a concrete production facility does not have test records meeting the requirements above but does have a record based on 15 to 29 consecutive tests, a standard deviation shall be established as the product of the

calculated standard deviation and a modification factor from the following table:

NUMBER OF TESTS	MODIFICATION FACTOR FOR STANDARD DEVIATION
15	1.16
20	1.08
25	1.03
30 or more	1.00

1.6.3.2 Computations without Previous Test Records

When a concrete production facility does not have sufficient field strength test records for calculation of the standard deviation, the required average strength f'cr shall be determined as follows:

a. If the specified compressive strength f'c is less than 3,000 psi,

f'cr = f'c + 1000 psi

b. If the specified compressive strength f'c is 3,000 to 5,000 psi,

f'cr = f'c + 1,200 psi

c. If the specified compressive strength f'c is over 5,000 psi,

f'cr = f'c + 1,400 psi

1.6.4 Average Flexural Strength Required for Mixtures

The mixture proportions selected during mixture design studies for flexural strength mixtures and the mixture used during concrete production shall be designed and adjusted during concrete production as approved, except that the overdesign for average flexural strength shall simply be 15 percent greater than the specified flexural strength at all times.

1.7 STORAGE OF MATERIALS

Cement and other cementitious materials shall be stored in weathertight buildings, bins, or silos which will exclude moisture and contaminants and keep each material completely separated. Aggregate stockpiles shall be arranged and used in a manner to avoid excessive segregation and to prevent contamination with other materials or with other sizes of aggregates. Aggregate shall not be stored directly on ground unless a sacrificial layer is left undisturbed. Reinforcing bars and accessories shall be stored above the ground on platforms, skids or other supports. Other materials shall be stored in such a manner as to avoid contamination and deterioration. Admixtures which have been in storage at the project site for longer than 6 months or which have been subjected to freezing shall not be used unless retested and proven to meet the specified requirements. Materials shall be capable of being accurately identified after bundles or containers are opened.

1.8 GOVERNMENT ASSURANCE INSPECTION AND TESTING

Day-to day inspection and testing shall be the responsibility of the Contractor Quality Control (CQC) staff. However, representatives of the Contracting Officer can and will inspect construction as considered

appropriate and will monitor operations of the Contractor's CQC staff. Government inspection or testing will not relieve the Contractor of any of his CQC responsibilities.

1.8.1 Materials

The Government will sample and test aggregates, cementitious materials, other materials, and concrete to determine compliance with the specifications as considered appropriate. The Contractor shall provide facilities and labor as may be necessary for procurement of representative test samples. Samples of aggregates will be obtained at the point of batching in accordance with ASTM D 75. Other materials will be sampled from storage at the jobsite or from other locations as considered appropriate. Samples may be placed in storage for later testing when appropriate.

1.8.2 Fresh Concrete

Fresh concrete will be sampled as delivered in accordance with ASTM C 172 and tested in accordance with these specifications, as considered necessary.

1.8.3 Hardened Concrete

Tests on hardened concrete will be performed by the Government when such tests are considered necessary.

1.8.4 Inspection

Concrete operations may be tested and inspected by the Government as the project progresses. Failure to detect defective work or material will not prevent rejection later when a defect is discovered nor will it obligate the Government for final acceptance.

PART 2 PRODUCTS

2.1 CEMENTITIOUS MATERIALS

Cementitious Materials shall be portland cement, portland-pozzolan cement, portland blast-furnace slag cement, or portland cement in combination with pozzolan and shall conform to appropriate specifications listed below. Use of cementitious materials in concrete which will have surfaces exposed in the completed structure shall be restricted so there is no change in color, source, or type of cementitious material.

2.1.1 Portland Cement

ASTM C 150, Type I low alkali with a maximum 15 percent amount of tricalcium aluminate, or Type II low alkali including false set requirements. White portland cement shall meet the above requirements except that it may be Type I, Type II.

2.1.2 Pozzolan (Fly Ash)

ASTM C 618, Class C or F with the optional requirements for multiple factor, drying shrinkage, and uniformity from Table 2A of ASTM C 618. Requirement for maximum alkalies from Table 1A of ASTM C 618 shall apply. If pozzolan is used, it shall never be less than 15 percent nor more than 35 percent by weight of the total cementitious material. The Contractor shall comply with EPA requirements in accordance with Section 01670

RECYCLED / RECOVERED MATERIALS.

2.1.3 Ground Granulated Blast-Furnace (GGBF) Slag

ASTM C 989, Grade 120.

2.2 AGGREGATES

Aggregates shall conform to the following.

2.2.1 Fine Aggregate

Fine aggregate shall conform to the quality and gradation requirements of ASTM C 33.

2.2.2 Coarse Aggregate

Coarse aggregate shall conform to ASTM C 33, Class 5S, maximum size 3/4 inch.

2.3 CHEMICAL ADMIXTURES

Chemical admixtures, when required or permitted, shall conform to the appropriate specification listed. Admixtures shall be furnished in liquid form and of suitable concentration for easy, accurate control of dispensing.

2.3.1 Air-Entraining Admixture

ASTM C 260 and shall consistently entrain the air content in the specified ranges under field conditions.

2.3.2 Accelerating Admixture

ASTM C 494/C 494M, Type C or E, except that calcium chloride or admixtures containing calcium chloride shall not be used.

2.3.3 Water-Reducing or Retarding Admixture

ASTM C 494/C 494M, Type A, B, or D, except that the 6-month and 1-year compressive and flexural strength tests are waived.

2.3.4 High-Range Water Reducer

ASTM C 494/C 494M, Type F or G, except that the 6-month and 1-year strength requirements are waived. The admixture shall be used only when approved in writing, such approval being contingent upon particular mixture control as described in the Contractor's Quality Control Plan and upon performance of separate mixture design studies.

2.3.5 Other Chemical Admixtures

Chemical admixtures for use in producing flowing concrete shall comply with ASTM C 1017/C 1017M, Type I or II. These admixtures shall be used only when approved in writing, such approval being contingent upon particular mixture control as described in the Contractor's Quality Control Plan and upon performance of separate mixture design studies.

2.4 CURING MATERIALS

2.4.1 Impervious-Sheet

Impervious-sheet materials shall conform to ASTM C 171, type optional, except, that polyethylene sheet shall not be used.

2.4.2 Membrane-Forming Compound

Membrane-Forming curing compound shall conform to ASTM C 309, Type 1-D or 2, except that only a styrene acrylate or chlorinated rubber compound meeting Class B requirements shall be used for surfaces that are to be painted or are to receive bituminous roofing, or waterproofing, or floors that are to receive adhesive applications of resilient flooring. The curing compound selected shall be compatible with any subsequent paint, roofing, waterproofing, or flooring specified. Nonpigmented compound shall contain a fugitive dye, and shall have the reflective requirements in ASTM C 309 waived.

2.4.3 Burlap and Cotton Mat

Burlap and cotton mat used for curing shall conform to AASHTO M 182.

2.5 WATER

Water for mixing and curing shall be fresh, clean, potable, and free of injurious amounts of oil, acid, salt, or alkali, except that non-potable water may be used if it meets the requirements of COE CRD-C 400.

2.6 NONSHRINK GROUT

Nonshrink grout shall conform to ASTM C 1107, Grade A or B or C, and shall be a commercial formulation suitable for the proposed application.

2.7 NONSLIP SURFACING MATERIAL

Nonslip surfacing material shall consist of 55 percent, minimum, aluminum oxide or silicon-dioxide abrasive ceramically bonded together to form a homogeneous material sufficiently porous to provide a good bond with portland cement paste; or factory-graded emery aggregate consisting of not less than 45 percent aluminum oxide and 25 percent ferric oxide. The aggregate shall be well graded from particles retained on the No. 30 sieve to particles passing the No. 8 sieve.

2.8 EPOXY RESIN

Epoxy resins for use in repairs shall conform to ASTM C 881, Type V, Grade 2. Class as appropriate to the existing ambient and surface temperatures.

2.9 EMBEDDED ITEMS

Embedded items shall be of the size and type indicated or as needed for the application. Dovetail slots shall be galvanized steel. Hangers for suspended ceilings shall be as specified in Section 09510 ACOUSTICAL CEILINGS. Inserts for shelf angles and bolt hangers shall be of malleable iron or cast or wrought steel.

2.10 PERIMETER INSULATION

Perimeter insulation shall be polystyrene conforming to ASTM C 578, Type II; polyurethane conforming to ASTM C 591, Type II; or cellular glass conforming to ASTM C 552, Type I or IV. The Contractor shall comply with EPA requirements in accordance with Section 01670 RECYCLED / RECOVERED MATERIALS.

2.11 VAPOR BARRIER

Vapor barrier shall be polyethylene sheeting with a minimum thickness of 6 mils or other equivalent material having a vapor permeance rating not exceeding 0.5 perms as determined in accordance with ASTM E 96.

PART 3 EXECUTION

3.1 PREPARATION FOR PLACING

Before commencing concrete placement, the following shall be performed. Surfaces to receive concrete shall be clean and free from frost, ice, mud, and water. Forms shall be in place, cleaned, coated, and adequately supported, in accordance with Section 03100A STRUCTURAL CONCRETE FORMWORK. Reinforcing steel shall be in place, cleaned, tied, and adequately supported, in accordance with Section 03200A CONCRETE REINFORCEMENT. Transporting and conveying equipment shall be in-place, ready for use, clean, and free of hardened concrete and foreign material. Equipment for consolidating concrete shall be at the placing site and in proper working order. Equipment and material for curing and for protecting concrete from weather or mechanical damage shall be at the placing site, in proper working condition and in sufficient amount for the entire placement. When hot, windy conditions during concreting appear probable, equipment and material shall be at the placing site to provide windbreaks, shading, fogging, or other action to prevent plastic shrinkage cracking or other damaging drying of the concrete.

3.1.1 Foundations

3.1.1.1 Concrete on Earth Foundations

Earth (subgrade, base, or subbase courses) surfaces upon which concrete is to be placed shall be clean, damp, and free from debris, frost, ice, and standing or running water. Prior to placement of concrete, the foundation shall be well drained and shall be satisfactorily graded and uniformly compacted.

3.1.1.2 Excavated Surfaces in Lieu of Forms

Concrete for footings may be placed directly against the soil provided the earth or rock has been carefully trimmed, is uniform and stable, and meets the compaction requirements of Section 02300 EARTHWORK. The concrete shall be placed without becoming contaminated by loose material, and the outline of the concrete shall be within the specified tolerances.

3.1.2 Previously Placed Concrete

Concrete surfaces to which additional concrete is to be bonded shall be prepared for receiving the next horizontal lift by cleaning the construction joint surface with either air-water cutting, sandblasting, high-pressure water jet, or other approved method. Concrete at the side of

vertical construction joints shall be prepared as approved by the Contracting Officer. Air-water cutting shall not be used on formed surfaces or surfaces congested with reinforcing steel. Regardless of the method used, the resulting surfaces shall be free from all laitance and inferior concrete so that clean surfaces of well bonded coarse aggregate are exposed and make up at least 10-percent of the surface area, distributed uniformly throughout the surface. The edges of the coarse aggregate shall not be undercut. The surface of horizontal construction joints shall be kept continuously wet for the first 12 hours during the 24-hour period prior to placing fresh concrete. The surface shall be washed completely clean as the last operation prior to placing the next lift.

3.1.3 Vapor Barrier

Vapor barrier shall be provided beneath the interior on-grade concrete floor slabs. The greatest widths and lengths practicable shall be used to eliminate joints wherever possible. Joints shall be lapped a minimum of 12 inches. Torn, punctured, or damaged vapor barrier material shall be removed and new vapor barrier shall be provided prior to placing concrete. For minor repairs, patches may be made using laps of at least 12 inches. Lapped joints shall be sealed and edges patched with pressure-sensitive adhesive or tape not less than 2 inches wide and compatible with the membrane. Vapor barrier shall be placed directly on underlying subgrade, base course, or capillary water barrier, unless it consists of crushed material or large granular material which could puncture the vapor barrier. In this case, the surface shall be choked with a light layer of sand, as approved, before placing the vapor barrier. Concrete placement shall be controlled so as to prevent damage to the vapor barrier.

3.1.4 Perimeter Insulation

Perimeter insulation shall be installed at locations indicated. Adhesive shall be used where insulation is applied to the interior surface of foundation walls and may be used for exterior application.

3.1.5 Embedded Items

Before placement of concrete, care shall be taken to determine that all embedded items are firmly and securely fastened in place as indicated on the drawings, or required. Conduit and other embedded items shall be clean and free of oil and other foreign matter such as loose coatings or rust, paint, and scale. The embedding of wood in concrete will be permitted only when specifically authorized or directed. Voids in sleeves, inserts, and anchor slots shall be filled temporarily with readily removable materials to prevent the entry of concrete into voids. Welding shall not be performed on embedded metals within 1 feet of the surface of the concrete. Tack welding shall not be performed on or to embedded items.

3.2 CONCRETE PRODUCTION, SMALL PROJECTS

Batch-type equipment shall be used for producing concrete. Ready-mixed concrete shall be batched, mixed, and transported in accordance with ASTM C 94/C 94M, except as otherwise specified. Truck mixers, agitators, and nonagitating transporting units shall comply with NRMCA TMMB 100. Ready-mix plant equipment and facilities shall be certified in accordance with NRMCA QC 3. Approved batch tickets shall be furnished for each load of ready-mixed concrete. Site-mixed concrete shall be produced in accordance with ACI 301, and plant shall conform to NRMCA CPMB 100. In lieu of batch-type equipment, concrete may be produced by volumetric batching

and continuous mixing, which shall conform to ASTM C 685.

3.3 TRANSPORTING CONCRETE TO PROJECT SITE

Concrete shall be transported to the placing site in truck mixers, agitators, or by approved pumping equipment or conveyors.

3.4 CONVEYING CONCRETE ON SITE

Concrete shall be conveyed from mixer or transporting unit to forms as rapidly as possible and within the time interval specified by methods which will prevent segregation or loss of ingredients using following equipment. Conveying equipment shall be cleaned before each placement.

3.4.1 Buckets

The interior hopper slope shall be not less than 58 degrees from the horizontal, the minimum dimension of the clear gate opening shall be at least 5 times the nominal maximum-size aggregate, and the area of the gate opening shall not be less than 2 square feet.The maximum dimension of the gate opening shall not be greater than twice the minimum dimension. The bucket gates shall be essentially grout tight when closed and may be manually, pneumatically, or hydraulically operated except that buckets larger than 2 cubic yardsshall not be manually operated. The design of the bucket shall provide means for positive regulation of the amount and rate of deposit of concrete in each dumping position.

3.4.2 Transfer Hoppers

Concrete may be charged into nonagitating hoppers for transfer to other conveying devices. Transfer hoppers shall be capable of receiving concrete directly from delivery vehicles and shall have conical-shaped discharge features. The transfer hopper shall be equipped with a hydraulically operated gate and with a means of external vibration to effect complete discharge. Concrete shall not be held in nonagitating transfer hoppers more than 30 minutes.

3.4.3 Trucks

Truck mixers operating at agitating speed or truck agitators used for transporting plant-mixed concrete shall conform to the requirements of ASTM C 94/C 94M.

3.4.4 Chutes

When concrete can be placed directly from a truck mixer, or agitator, the chutes normally attached to this equipment by the manufacturer may be used. A discharge deflector shall be used when required by the Contracting Officer. Separate chutes and other similar equipment will not be permitted for conveying concrete.

3.4.5 Belt Conveyors

Belt conveyors shall be designed and operated to assure a uniform flow of concrete from mixer to final place of deposit without segregation of ingredients or loss of mortar and shall be provided with positive means, such as discharge baffle or hopper , for preventing segregation of the concrete at the transfer points and the point of placing. Belt conveyors shall be constructed such that the idler spacing shall not exceed 36 inches.

The belt speed shall be a minimum of 300 feet per minute and a maximum of 750 feet per minute. If concrete is to be placed through installed horizontal or sloping reinforcing bars, the conveyor shall discharge concrete into a pipe or elephant truck that is long enough to extend through the reinforcing bars.

3.4.6 Concrete Pumps

Concrete may be conveyed by positive displacement pump when approved. The pumping equipment shall be piston or squeeze pressure type; pneumatic placing equipment shall not be used. The pipeline shall be rigid steel pipe or heavy-duty flexible hose. The inside diameter of the pipe shall be at least 3 times the nominal maximum-size coarse aggregate in the concrete mixture to be pumped but not less than 4 inches. Aluminum pipe shall not be used.

3.5 PLACING CONCRETE

Mixed concrete shall be discharged within 1-1/2 hours or before the mixer drum has revolved 300 revolutions, whichever comes first after the introduction of the mixing water to the cement and aggregates. When the concrete temperature exceeds 85 degrees F, the time shall be reduced to 45 minutes. Concrete shall be placed within 15 minutes after it has been discharged from the transporting unit. Concrete shall be handled from mixer or transporting unit to forms in a continuous manner until the approved unit of operation is completed. Adequate scaffolding, ramps and walkways shall be provided so that personnel and equipment are not supported by in-place reinforcement. Placing will not be permitted when the sun, heat, wind, or limitations of facilities furnished by the Contractor prevent proper consolidation, finishing and curing. Sufficient placing capacity shall be provided so that concrete can be kept free of cold joints.

3.5.1 Depositing Concrete

Concrete shall be deposited as close as possible to its final position in the forms, and there shall be no vertical drop greater than 5 feet except where suitable equipment is provided to prevent segregation and where specifically authorized. Depositing of the concrete shall be so regulated that it will be effectively consolidated in horizontal layers not more than 12 inches thick, except that all slabs shall be placed in a single layer. Concrete to receive other construction shall be screeded to the proper level. Concrete shall be deposited continuously in one layer or in layers so that fresh concrete is deposited on in-place concrete that is still plastic. Fresh concrete shall not be deposited on concrete that has hardened sufficiently to cause formation of seams or planes of weakness within the section. Concrete that has surface dried, partially hardened, or contains foreign material shall not be used. When temporary spreaders are used in the forms, the spreaders shall be removed as their service becomes unnecessary.

3.5.2 Consolidation

Immediately after placing, each layer of concrete shall be consolidated by internal vibrators, except for slabs 4 inches thick or less. The vibrators shall at all times be adequate in effectiveness and number to properly consolidate the concrete; a spare vibrator shall be kept at the jobsite during all concrete placing operations. The vibrators shall have a frequency of not less than 10,000 vibrations per minute, an amplitude of at

least 0.025 inch, and the head diameter shall be appropriate for the structural member and the concrete mixture being placed. Vibrators shall be inserted vertically at uniform spacing over the area of placement. The distance between insertions shall be approximately 1-1/2 times the radius of action of the vibrator so that the area being vibrated will overlap the adjacent just-vibrated area by a reasonable amount. The vibrator shall penetrate rapidly to the bottom of the layer and at least 6 inches into the preceding layer if there is such. Vibrator shall be held stationary until the concrete is consolidated and then vertically withdrawn slowly while operating. Form vibrators shall not be used unless specifically approved and unless forms are constructed to withstand their use. Vibrators shall not be used to move concrete within the forms. Slabs 4 inches and less in thickness shall be consolidated by properly designed vibrating screeds or other approved technique. Frequency and amplitude of vibrators shall be determined in accordance with COE CRD-C 521. Grate tampers ("jitterbugs") shall not be used.

3.5.3 Cold Weather Requirements

Special protection measures, approved by the Contracting Officer, shall be used if freezing temperatures are anticipated before the expiration of the specified curing period. The ambient temperature of the air where concrete is to be placed and the temperature of surfaces to receive concrete shall be not less than 40 degrees F. The temperature of the concrete when placed shall be not less than 50 degrees F nor more than 75 degrees F. Heating of the mixing water or aggregates will be required to regulate the concrete placing temperature. Materials entering the mixer shall be free from ice, snow, or frozen lumps. Salt, chemicals or other materials shall not be incorporated in the concrete to prevent freezing. Upon written approval, an accelerating admixture conforming to ASTM C 494/C 494M, Type C or E may be used, provided it contains no calcium chloride. Calcium chloride shall not be used.

3.5.4 Hot Weather Requirements

When the ambient temperature during concrete placing is expected to exceed 85 degrees F, the concrete shall be placed and finished with procedures previously submitted and as specified herein. The concrete temperature at time of delivery to the forms shall not exceed the temperature shown in the table below when measured in accordance with ASTM C 1064/C 1064M. Cooling of the mixing water or aggregates or placing concrete in the cooler part of the day may be required to obtain an adequate placing temperature. A retarder may be used, as approved, to facilitate placing and finishing. Steel forms and reinforcements shall be cooled as approved prior to concrete placement when steel temperatures are greater than 120 degrees F. Conveying and placing equipment shall be cooled if necessary to maintain proper concrete-placing temperature.

Maximum Allowable Concrete Placing Temperature

Relative Humidity, Percent, During Time of Concrete Placement	Maximum Allowable Concrete Temperature Degrees
Greater than 60	90 F
40-60	85 F
Less than 40	80 F

Maximum Allowable Concrete Placing Temperature

Relative Humidity, Percent, During Time of Concrete Placement	Maximum Allowable Concrete Temperature Degrees

3.5.5 Prevention of Plastic Shrinkage Cracking

During hot weather with low humidity, and particularly with appreciable wind, as well as interior placements when space heaters produce low humidity, the Contractor shall be alert to the tendency for plastic shrinkage cracks to develop and shall institute measures to prevent this. Particular care shall be taken if plastic shrinkage cracking is potentially imminent and especially if it has developed during a previous placement. Periods of high potential for plastic shrinkage cracking can be anticipated by use of Fig. 2.1.5 of ACI 305R. In addition the concrete placement shall be further protected by erecting shades and windbreaks and by applying fog sprays of water, sprinkling, ponding or wet covering. Plastic shrinkage cracks that occur shall be filled by injection of epoxy resin as directed, after the concrete hardens. Plastic shrinkage cracks shall never be troweled over or filled with slurry.

3.5.6 Placing Concrete in Congested Areas

Special care shall be used to ensure complete filling of the forms, elimination of all voids, and complete consolidation of the concrete when placing concrete in areas congested with reinforcing bars, embedded items, waterstops and other tight spacing. An appropriate concrete mixture shall be used, and the nominal maximum size of aggregate (NMSA) shall meet the specified criteria when evaluated for the congested area. Vibrators with heads of a size appropriate for the clearances available shall be used, and the consolidation operation shall be closely supervised to ensure complete and thorough consolidation at all points. Where necessary, splices of reinforcing bars shall be alternated to reduce congestion. Where two mats of closely spaced reinforcing are required, the bars in each mat shall be placed in matching alignment to reduce congestion.

3.5.7 Placing Flowable Concrete

If a plasticizing admixture conforming to ASTM C 1017/C 1017M is used or if a Type F or G high range water reducing admixture is permitted to increase the slump, the concrete shall meet all requirements of paragraph GENERAL REQUIREMENTS in PART 1. Extreme care shall be used in conveying and placing the concrete to avoid segregation. Consolidation and finishing shall meet all requirements of paragraphs Placing Concrete, Finishing Formed Surfaces, and Finishing Unformed Surfaces. No relaxation of requirements to accommodate flowable concrete will be permitted.

3.6 JOINTS

Joints shall be located and constructed as indicated or approved. Joints not indicated on the drawings shall be located and constructed to minimize the impact on the strength of the structure. Joints shall be perpendicular to the main reinforcement. All reinforcement shall be continued across joints; except that reinforcement or other fixed metal items shall not be continuous through expansion joints, or through construction or contraction

joints in slabs on grade. Reinforcement shall be 2 inches clear from each joint. Except where otherwise indicated, construction joints between interior slabs on grade and vertical surfaces shall consist of 30 pound asphalt-saturated felt, extending for the full depth of the slab. The perimeters of the slabs shall be free of fins, rough edges, spalling, or other unsightly appearance. Reservoir for sealant for construction and contraction joints in slabs shall be formed to the dimensions shown on the drawings by removing snap-out joint-forming inserts, by sawing sawable inserts, or by sawing to widen the top portion of sawed joints. Joints to be sealed shall be cleaned and sealed as indicated and in accordance with Section 07920 JOINT SEALANTS.

3.6.1 Construction Joints

For concrete other than slabs on grade, construction joints shall be located so that the unit of operation does not exceed 60 feet. Concrete shall be placed continuously so that each unit is monolithic in construction. Fresh concrete shall not be placed against adjacent hardened concrete until it is at least 24 hours old. Construction joints shall be located as indicated or approved. Where concrete work is interrupted by weather, end of work shift or other similar type of delay, location and type of construction joint shall be subject to approval of the Contracting Officer. Unless otherwise indicated and except for slabs on grade, reinforcing steel shall extend through construction joints. Construction joints in slabs on grade shall be keyed or doweled as shown. Concrete columns, walls, or piers shall be in place at least 2 hours, or until the concrete begins to lose its plasticity, before placing concrete for beams, girders, or slabs thereon. In walls having door or window openings, lifts shall terminate at the top and bottom of the opening. Other lifts shall terminate at such levels as to conform to structural requirements or architectural details.

3.6.2 Contraction Joints in Slabs on Grade

Contraction joints shall be located and detailed as shown on the drawings. Contraction Joints shall be produced by forming a weakened plane in the concrete slab by sawing a continuous slot with a concrete saw. Regardless of method used to produce the weakened plane, it shall be 1/4 the depth of the slab thickness and between 1/8 and 3/16 inch wide. For saw-cut joints, cutting shall be timed properly with the set of the concrete. Cutting shall be started as soon as the concrete has hardened sufficiently to prevent ravelling of the edges of the saw cut. Cutting shall be completed before shrinkage stresses become sufficient to produce cracking. Reservoir for joint sealant shall be formed as previously specified.

3.7 FINISHING FORMED SURFACES

Forms, form materials, and form construction are specified in Section 03100A STRUCTURAL CONCRETE FORMWORK. Finishing of formed surfaces shall be as specified herein. Unless another type of architectural or special finish is specified, surfaces shall be left with the texture imparted by the forms except that defective surfaces shall be repaired. Unless painting of surfaces is required, uniform color of the concrete shall be maintained by use of only one mixture without changes in materials or proportions for any structure or portion of structure that requires a Class A or B finish. Except for major defects, as defined hereinafter, surface defects shall be repaired as specified herein within 24 hours after forms are removed. Repairs of the so-called "plaster-type" will not be permitted in any location. Tolerances of formed surfaces shall conform to the requirements

of ACI 117. These tolerances apply to the finished concrete surface, not to the forms themselves; forms shall be set true to line and grade. Form tie holes requiring repair and other defects whose depth is at least as great as their surface diameter shall be repaired as specified in paragraph Damp-Pack Mortar Repair. Defects whose surface diameter is greater than their depth shall be repaired as specified in paragraph Repair of Major Defects. Repairs shall be finished flush with adjacent surfaces and with the same surface texture. The cement used for all repairs shall be a blend of job cement with white cement proportioned so that the final color after curing and aging will be the same as the adjacent concrete. Concrete with excessive honeycomb, or other defects which affect the strength of the member, will be rejected. Repairs shall be demonstrated to be acceptable and free from cracks or loose or drummy areas at the completion of the contract and, for Class A and B Finishes, shall be inconspicuous. Repairs not meeting these requirements will be rejected and shall be replaced.

3.7.1 Class D Finish

. Class D finish is required . in the following areas, all footings and foundation walls below grade. Fins, ravelings, and loose material shall be removed, and, except as otherwise indicated or as specified in Section 03100A STRUCTURAL CONCRETE FORMWORK, holes left by removal of form ties shall be reamed and filled. Honeycomb and other defects more than 1/2 inch deep or more than 2 inches in diameter shall be repaired. Defects more than 2 inches in diameter shall be cut back to sound concrete, but in all cases at least 1 inch deep.

3.8 REPAIRS

3.8.1 Damp-Pack Mortar Repair

Form tie holes requiring repair and other defects whose depth is at least as great as their surface diameter but not over 4 inchesshall be repaired by the damp-pack mortar method. Form tie holes shall be reamed and other similar defects shall be cut out to sound concrete. The void shall then be thoroughly cleaned, thoroughly wetted, brush-coated with a thin coat of neat cement grout and filled with mortar. Mortar shall be a stiff mix of 1 part portland cement to 2 parts fine aggregate passing the No. 16 mesh sieve, and minimum amount of water. Only sufficient water shall be used to produce a mortar which, when used, will stick together on being molded into a ball by a slight pressure of the hands and will not exude water but will leave the hands damp. Mortar shall be mixed and allowed to stand for 30 to 45 minutes before use with remixing performed immediately prior to use. Mortar shall be thoroughly tamped in place in thin layers using a hammer and hardwood block. Holes passing entirely through walls shall be completely filled from the inside face by forcing mortar through to the outside face. All holes shall be packed full. Damp-pack repairs shall be moist cured for at least 48 hours.

3.8.2 Repair of Major Defects

Major defects will be considered to be those more than 1/2 inch deep for Class D finishes, more than 2 inches in diameter. Also included are any defects of any kind whose depth is over 4 inches or whose surface diameter is greater than their depth. Major defects shall be repaired as specified below.

3.8.2.1 Surface Application of Mortar Repair

Defective concrete shall be removed, and removal shall extend into completely sound concrete. Approved equipment and procedures which will not cause cracking or microcracking of the sound concrete shall be used. If reinforcement is encountered, concrete shall be removed so as to expose the reinforcement for at least 2 inches on all sides. All such defective areas greater than 12 square inchesshall be outlined by saw cuts at least 1 inch deep. Defective areas less than 12 square inches shall be outlined by a 1 inch deep cut with a core drill in lieu of sawing. All saw cuts shall be straight lines in a rectangular pattern in line with the formwork panels. After concrete removal, the surface shall be thoroughly cleaned by high pressure washing to remove all loose material. Surfaces shall be kept continually saturated for the first 12 of the 24 hours immediately before placing mortar and shall be damp but not wet at the time of commencing mortar placement. The Contractor, at his option, may use either hand-placed mortar or mortar placed with a mortar gun. If hand-placed mortar is used, the edges of the cut shall be perpendicular to the surface of the concrete. The prepared area shall be brush-coated with a thin coat of neat cement grout. The repair shall then be made using a stiff mortar, preshrunk by allowing the mixed mortar to stand for 30 to 45 minutes and then remixed, thoroughly tamped into place in thin layers. If hand-placed mortar is used, the Contractor shall test each repair area for drumminess by firm tapping with a hammer and shall inspect for cracks, both in the presence of the Contracting Officer's representative, immediately before completion of the contract, and shall replace any showing drumminess or cracking. If mortar placed with a mortar gun is used, the gun shall be a small compressed air-operated gun to which the mortar is slowly hand fed and which applies the mortar to the surface as a high-pressure stream, as approved. Repairs made using shotcrete equipment will not be accepted. The mortar used shall be the same mortar as specified for damp-pack mortar repair. If gun-placed mortar is used, the edges of the cut shall be beveled toward the center at a slope of 1:1. All surface applied mortar repairs shall be continuously moist cured for at least 7 days. Moist curing shall consist of several layers of saturated burlap applied to the surface immediately after placement is complete and covered with polyethylene sheeting, all held closely in place by a sheet of plywood or similar material rigidly braced against it. Burlap shall be kept continually wet.

3.8.2.2 Repair of Deep and Large Defects

Deep and large defects will be those that are more than 6 inches deep and also have an average diameter at the surface more than 18 inches or that are otherwise so identified by the Project Office. Such defects shall be repaired as specified herein or directed, except that defects which affect the strength of the structure shall not be repaired and that portion of the structure shall be completely removed and replaced. Deep and large defects shall be repaired by procedures approved in advance including forming and placing special concrete using applied pressure during hardening. Preparation of the repair area shall be as specified for surface application of mortar. In addition, the top edge (surface) of the repair area shall be sloped at approximately 20 degrees from the horizontal, upward toward the side from which concrete will be placed. The special concrete shall be a concrete mixture with low water content and low slump, and shall be allowed to age 30 to 60 minutes before use. Concrete containing a specified expanding admixture may be used in lieu of the above mixture; the paste portion of such concrete mixture shall be designed to have an expansion between 2.0 and 4.0 percent when tested in accordance

with ASTM C 940. A full width "chimney" shall be provided at the top of the form on the placing side to ensure filling to the top of the opening. A pressure cap shall be used on the concrete in the chimney with simultaneous tightening and revibrating the form during hardening to ensure a tight fit for the repair. The form shall be removed after 24 hours and immediately the chimney shall be carefully chipped away to avoid breaking concrete out of the repair; the surface of the repair concrete shall be dressed as required.

3.9 FINISHING UNFORMED SURFACES

The finish of all unformed surfaces shall meet the requirements of paragraph Tolerances in PART 1, when tested as specified herein.

3.9.1 General

The ambient temperature of spaces adjacent to unformed surfaces being finished and of the base on which concrete will be placed shall be not less than 50 degrees F. In hot weather all requirements of paragraphs Hot Weather Requirements and Prevention of Plastic Shrinkage Cracking shall be met. Unformed surfaces that are not to be covered by additional concrete or backfill shall have a float finish, with additional finishing as specified below, and shall be true to the elevation shown on the drawings. Surfaces to receive additional concrete or backfill shall be brought to the elevation shown on the drawings, properly consolidated, and left true and regular. Unless otherwise shown on the drawings, exterior surfaces shall be sloped for drainage, as directed. Where drains are provided, interior floors shall be evenly sloped to the drains. Joints shall be carefully made with a jointing or edging tool. The finished surfaces shall be protected from stains or abrasions. Grate tampers or "jitterbugs" shall not be used for any surfaces. The dusting of surfaces with dry cement or other materials or the addition of any water during finishing shall not be permitted. If bleedwater is present prior to finishing, the excess water shall be carefully dragged off or removed by absorption with porous materials such as burlap. During finishing operations, extreme care shall be taken to prevent over finishing or working water into the surface; this can cause "crazing" (surface shrinkage cracks which appear after hardening) of the surface. Any slabs with surfaces which exhibit significant crazing shall be removed and replaced. During finishing operations, surfaces shall be checked with a 10 foot straightedge, applied in both directions at regular intervals while the concrete is still plastic, to detect high or low areas.

3.9.2 Rough Slab Finish

As a first finishing operation for unformed surfaces and as final finish for slabs to receive mortar setting beds, the surface shall receive a rough slab finish prepared as follows. The following areas at depressed slab at banked running track to receive sloped topping slab shall receive only a rough slab finish. The concrete shall be uniformly placed across the slab area, consolidated as previously specified, and then screeded with straightedge strikeoffs immediately after consolidation to bring the surface to the required finish level with no coarse aggregate visible. Side forms and screed rails shall be provided, rigidly supported, and set to exact line and grade. Allowable tolerances for finished surfaces apply only to the hardened concrete, not to forms or screed rails. Forms and screed rails shall be set true to line and grade. "Wet screeds" shall not be used.

3.9.3 Floated Finish

Slabs to receive more than a rough slab finish shall next be given a wood float finish. The following areas in areas to receive ceramic tile shall be given only a float finish. The screeding shall be followed immediately by darbying or bull floating before bleeding water is present, to bring the surface to a true, even plane. Then, after the concrete has stiffened so that it will withstand a man's weight without imprint of more than 1/4 inch and the water sheen has disappeared, it shall be floated to a true and even plane free of ridges. Floating shall be performed by use of suitable hand floats or power driven equipment. Sufficient pressure shall be used on the floats to bring a film of moisture to the surface. Hand floats shall be made of wood, magnesium, or aluminum. Concrete that exhibits stickiness shall be floated with a magnesium float. Care shall be taken to prevent over-finishing or incorporating water into the surface.

3.9.4 Troweled Finish

The following areas all interior slab areas not described above shall be given a trowel finish. After floating is complete and after the surface moisture has disappeared, unformed surfaces shall be steel-troweled to a smooth, even, dense finish, free from blemishes including trowel marks. In lieu of hand finishing, an approved power finishing machine may be used in accordance with the directions of the machine manufacturer. Additional trowelings shall be performed, either by hand or machine until the surface has been troweled 2 times, with waiting period between each. Care shall be taken to prevent blistering and if such occurs, troweling shall immediately be stopped and operations and surfaces corrected. A final hard steel troweling shall be done by hand, with the trowel tipped, and using hard pressure, when the surface is at a point that the trowel will produce a ringing sound. The finished surface shall be thoroughly consolidated and shall be essentially free of trowel marks and be uniform in texture and appearance. The concrete mixture used for troweled finished areas shall be adjusted, if necessary, in order to provide sufficient fines (cementitious material and fine sand) to finish properly.

3.10 CURING AND PROTECTION

3.10.1 General

Concrete shall be cured by an approved method for the period of time given below:

All concrete	7 days

Immediately after placement, concrete shall be protected from premature drying, extremes in temperatures, rapid temperature change, mechanical injury and damage from rain and flowing water for the duration of the curing period. Air and forms in contact with concrete shall be maintained at a temperature above 50 degrees F for the first 3 days and at a temperature above 32 degrees F for the remainder of the specified curing period. Exhaust fumes from combustion heating units shall be vented to the outside of the enclosure, and heaters and ducts shall be placed and directed so as not to cause areas of overheating and drying of concrete surfaces or to create fire hazards. Materials and equipment needed for adequate curing and protection shall be available and at the site prior to placing concrete. No fire or excessive heat, including welding, shall be permitted near or in direct contact with the concrete at any time. Except

as otherwise permitted by paragraph Membrane Forming Curing Compounds, moist curing shall be provided for any areas to receive floor hardener, any paint or other applied coating, or to which other concrete is to be bonded.

3.10.2 Moist Curing

Concrete to be moist-cured shall be maintained continuously wet for the entire curing period, commencing immediately after finishing. If water or curing materials used stain or discolor concrete surfaces which are to be permanently exposed, the concrete surfaces shall be cleaned as approved. When wooden forms are left in place during curing, they shall be kept wet at all times. If steel forms are used in hot weather, nonsupporting vertical forms shall be broken loose from the concrete soon after the concrete hardens and curing water continually applied in this void. If the forms are removed before the end of the curing period, curing shall be carried out as on unformed surfaces, using suitable materials. Surfaces shall be cured by ponding, by continuous sprinkling, by continuously saturated burlap or cotton mats, or by continuously saturated plastic coated burlap. Burlap and mats shall be clean and free from any contamination and shall be completely saturated before being placed on the concrete. The Contractor shall have an approved work system to ensure that moist curing is continuous 24 hours per day.

3.10.3 Membrane Forming Curing Compounds

Membrane forming curing compounds shall be used only on surfaces in the following areas, areas not receiving adhered flooring or areas not receiving a bonded topping for tile. Concrete in all other areas may be cured with a nonpigmented curing compound containing a fugitive dye in lieu of moist curing. Membrane curing shall not be used on surfaces that are to receive any subsequent treatment depending on adhesion or bonding to the concrete, including surfaces to which a smooth finish is to be applied or other concrete to be bonded. However, a styrene acrylate or chlorinated rubber compound meeting ASTM C 309, Class B requirements, may be used for surfaces which are to be painted or are to receive bituminous roofing or waterproofing, or floors that are to receive adhesive applications of resilient flooring. The curing compound selected shall be compatible with any subsequent paint, roofing, waterproofing or flooring specified. Membrane curing compound shall not be used on surfaces that are maintained at curing temperatures with free steam. Curing compound shall be applied to formed surfaces immediately after the forms are removed and prior to any patching or other surface treatment except the cleaning of loose sand, mortar, and debris from the surface. All surfaces shall be thoroughly moistened with water. Curing compound shall be applied to slab surfaces as soon as the bleeding water has disappeared, with the tops of joints being temporarily sealed to prevent entry of the compound and to prevent moisture loss during the curing period. The curing compound shall be applied in a two-coat continuous operation by approved motorized power-spraying equipment operating at a minimum pressure of 75 psi, at a uniform coverage of not more than 400 square feet per gallon for each coat, and the second coat shall be applied perpendicular to the first coat. Concrete surfaces which have been subjected to rainfall within 3 hours after curing compound has been applied shall be resprayed by the method and at the coverage specified. Surfaces on which clear compound is used shall be shaded from direct rays of the sun for the first 3 days. Surfaces coated with curing compound shall be kept free of foot and vehicular traffic, and from other sources of abrasion and contamination during the curing period.

3.10.4 Impervious Sheeting

The following concrete surfaces may be cured using impervious sheets: all floor areas. However, except for plastic coated burlap, impervious sheeting alone shall not be used for curing. Impervious-sheet curing shall only be used on horizontal or nearly horizontal surfaces. Surfaces shall be thoroughly wetted and be completely covered with the sheeting. Sheeting shall be at least 18 inches wider than the concrete surface to be covered. Covering shall be laid with light-colored side up. Covering shall be lapped not less than 12 inches and securely weighted down or shall be lapped not less than 4 inches and taped to form a continuous cover with completely closed joints. The sheet shall be weighted to prevent displacement so that it remains in contact with the concrete during the specified length of curing. Coverings shall be folded down over exposed edges of slabs and secured by approved means. Sheets shall be immediately repaired or replaced if tears or holes appear during the curing period.

3.10.5 Ponding or Immersion

Concrete shall be continually immersed throughout the curing period. Water shall not be more than 20 degrees F less than the temperature of the concrete.

3.10.6 Cold Weather Curing and Protection

When the daily ambient low temperature is less than 32 degrees F the temperature of the concrete shall be maintained above 40 degrees F for the first seven days after placing. During the period of protection removal, the air temperature adjacent to the concrete surfaces shall be controlled so that concrete near the surface will not be subjected to a temperature differential of more than 25 degrees F as determined by suitable temperature measuring devices furnished by the Contractor, as required, and installed adjacent to the concrete surface and 2 inches inside the surface of the concrete. The installation of the thermometers shall be made by the Contractor as directed.

3.11 SETTING BASE PLATES AND BEARING PLATES

After being properly positioned, column base plates, bearing plates for beams and similar structural members, and machinery and equipment base plates shall be set to the proper line and elevation with damp-pack bedding mortar, except where nonshrink grout is indicated. The thickness of the mortar or grout shall be as shown on plans, but not less than 3/4 inch. Concrete and metal surfaces in contact with grout shall be clean and free of oil and grease, and concrete surfaces in contact with grout shall be damp and free of laitance when grout is placed. Nonshrink grout shall be used for column base plates.

3.11.1 Damp-Pack Bedding Mortar

Damp-pack bedding mortar shall consist of 1 part cement and 2-1/2 parts fine aggregate having water content such that a mass of mortar tightly squeezed in the hand will retain its shape but will crumble when disturbed. The space between the top of the concrete and bottom of the bearing plate or base shall be packed with the bedding mortar by tamping or ramming with a bar or rod until it is completely filled.

3.11.2 Nonshrink Grout

Nonshrink grout shall be a ready-mixed non-metallic material requiring only the addition of water. Water content shall be the minimum that will provide a flowable mixture and completely fill the space to be grouted without segregation, bleeding, or reduction of strength.

3.11.2.1 Mixing and Placing of Nonshrink Grout

Mixing and placing shall be in conformance with the material manufacturer's instructions and as specified therein. Ingredients shall be thoroughly dry-mixed before adding water. After adding water, the batch shall be mixed for 3 minutes. Batches shall be of size to allow continuous placement of freshly mixed grout. Grout not used within 30 minutes after mixing shall be discarded. The space between the top of the concrete or machinery-bearing surface and the plate shall be filled solid with the grout. Forms shall be of wood or other equally suitable material for completely retaining the grout on all sides and on top and shall be removed after the grout has set. The placed grout shall be carefully worked by rodding or other means to eliminate voids; however, overworking and breakdown of the initial set shall be avoided. Grout shall not be retempered or subjected to vibration from any source. Where clearances are unusually small, placement shall be under pressure with a grout pump. Temperature of the grout, and of surfaces receiving the grout, shall be maintained at 65 to 85 degrees F until after setting.

3.12 TESTING AND INSPECTION FOR CONTRACTOR QUALITY CONTROL

The Contractor shall perform the inspection and tests described below and, based upon the results of these inspections and tests, shall take the action required and shall submit specified reports. When, in the opinion of the Contracting Officer, the concreting operation is out of control, concrete placement shall cease and the operation shall be corrected. The laboratory performing the tests shall be onsite and shall conform with ASTM C 1077. Materials may be subjected to check testing by the Government from samples obtained at the manufacturer, at transfer points, or at the project site. The Government will inspect the laboratory, equipment, and test procedures prior to start of concreting operations and at least once per month thereafter for conformance with ASTM C 1077.

3.12.1 Grading and Corrective Action

3.12.1.1 Fine Aggregate

At least once during each shift when the concrete plant is operating, there shall be one sieve analysis and fineness modulus determination in accordance with ASTM C 136 and COE CRD-C 104 for the fine aggregate or for each fine aggregate if it is batched in more than one size or classification. The location at which samples are taken may be selected by the Contractor as the most advantageous for control. However, the Contractor is responsible for delivering fine aggregate to the mixer within specification limits. When the amount passing on any sieve is outside the specification limits, the fine aggregate shall be immediately resampled and retested. If there is another failure on any sieve, the fact shall immediately reported to the Contracting Officer, concreting shall be stopped, and immediate steps taken to correct the grading.

3.12.1.2 Coarse Aggregate

At least once during each shift in which the concrete plant is operating, there shall be a sieve analysis in accordance with ASTM C 136 for each size of coarse aggregate. The location at which samples are taken may be selected by the Contractor as the most advantageous for production control. However, the Contractor shall be responsible for delivering the aggregate to the mixer within specification limits. A test record of samples of aggregate taken at the same locations shall show the results of the current test as well as the average results of the five most recent tests including the current test. The Contractor may adopt limits for control coarser than the specification limits for samples taken other than as delivered to the mixer to allow for degradation during handling. When the amount passing any sieve is outside the specification limits, the coarse aggregate shall be immediately resampled and retested. If the second sample fails on any sieve, that fact shall be reported to the Contracting Officer. Where two consecutive averages of 5 tests are outside specification limits, the operation shall be considered out of control and shall be reported to the Contracting Officer. Concreting shall be stopped and immediate steps shall be taken to correct the grading.

3.12.2 Quality of Aggregates

Thirty days prior to the start of concrete placement, the Contractor shall perform all tests for aggregate quality required by ASTM C 33. In addition, after the start of concrete placement, the Contractor shall perform tests for aggregate quality at least every three months, and when the source of aggregate or aggregate quality changes. Samples tested after the start of concrete placement shall be taken immediately prior to entering the concrete mixer.

3.12.3 Scales, Batching and Recording

The accuracy of the scales shall be checked by test weights prior to start of concrete operations and at least once every three months. Such tests shall also be made as directed whenever there are variations in properties of the fresh concrete that could result from batching errors. Once a week the accuracy of each batching and recording device shall be checked during a weighing operation by noting and recording the required weight, recorded weight, and the actual weight batched. At the same time, the Contractor shall test and ensure that the devices for dispensing admixtures are operating properly and accurately. When either the weighing accuracy or batching accuracy does not comply with specification requirements, the plant shall not be operated until necessary adjustments or repairs have been made. Discrepancies in recording accuracies shall be corrected immediately.

3.12.4 Batch-Plant Control

The measurement of concrete materials including cementitious materials, each size of aggregate, water, and admixtures shall be continuously controlled. The aggregate weights and amount of added water shall be adjusted as necessary to compensate for free moisture in the aggregates. The amount of air-entraining agent shall be adjusted to control air content within specified limits. A report shall be prepared indicating type and source of cement used, type and source of pozzolan or slag used, amount and source of admixtures used, aggregate source, the required aggregate and water weights per cubic yard, amount of water as free moisture in each size of aggregate, and the batch aggregate and water weights per cubic yard for

each class of concrete batched during each day's plant operation.

3.12.5 Concrete Mixture

a. Air Content Testing. Air content tests shall be made when test specimens are fabricated. In addition, at least two tests for air content shall be made on randomly selected batches of each separate concrete mixture produced during each 8-hour period of concrete production. Additional tests shall be made when excessive variation in workability is reported by the placing foreman or Government inspector. Tests shall be made in accordance with ASTM C 231 for normal weight concrete and ASTM C 173 for lightweight concrete. Test results shall be plotted on control charts which shall at all times be readily available to the Government and shall be submitted weekly. Copies of the current control charts shall be kept in the field by testing crews and results plotted as tests are made. When a single test result reaches either the upper or lower action limit, a second test shall immediately be made. The results of the two tests shall be averaged and this average used as the air content of the batch to plot on both the air content and the control chart for range, and for determining need for any remedial action. The result of each test, or average as noted in the previous sentence, shall be plotted on a separate control chart for each mixture on which an "average line" is set at the midpoint of the specified air content range from paragraph Air Entrainment. An upper warning limit and a lower warning limit line shall be set 1.0 percentage point above and below the average line, respectively. An upper action limit and a lower action limit line shall be set 1.5 percentage points above and below the average line, respectively. The range between each two consecutive tests shall be plotted on a secondary control chart for range where an upper warning limit is set at 2.0 percentage points and an upper action limit is set at 3.0 percentage points. Samples for air content may be taken at the mixer, however, the Contractor is responsible for delivering the concrete to the placement site at the stipulated air content. If the Contractor's materials or transportation methods cause air content loss between the mixer and the placement, correlation samples shall be taken at the placement site as required by the Contracting Officer, and the air content at the mixer controlled as directed.

b. Air Content Corrective Action. Whenever points on the control chart for percent air reach either warning limit, an adjustment shall immediately be made in the amount of air-entraining admixture batched. As soon as practical after each adjustment, another test shall be made to verify the result of the adjustment. Whenever a point on the secondary control chart for range reaches the warning limit, the admixture dispenser shall be recalibrated to ensure that it is operating accurately and with good reproducibility. Whenever a point on either control chart reaches an action limit line, the air content shall be considered out of control and the concreting operation shall immediately be halted until the air content is under control. Additional air content tests shall be made when concreting is restarted.

c. Slump Testing. In addition to slump tests which shall be made when test specimens are fabricated, at least four slump tests shall be made on randomly selected batches in accordance with ASTM

C 143/C 143M for each separate concrete mixture produced during each 8-hour or less period of concrete production each day. Also, additional tests shall be made when excessive variation in workability is reported by the placing foreman or Government inspector. Test results shall be plotted on control charts which shall at all times be readily available to the Government and shall be submitted weekly. Copies of the current control charts shall be kept in the field by testing crews and results plotted as tests are made. When a single slump test reaches or goes beyond either the upper or lower action limit, a second test shall immediately be made. The results of the two tests shall be averaged and this average used as the slump of the batch to plot on both the control charts for slump and the chart for range, and for determining need for any remedial action. Limits shall be set on separate control charts for slump for each type of mixture. The upper warning limit shall be set at 1/2 inch below the maximum allowable slump specified in paragraph Slump in PART 1 for each type of concrete and an upper action limit line and lower action limit line shall be set at the maximum and minimum allowable slumps, respectively, as specified in the same paragraph. The range between each consecutive slump test for each type of mixture shall be plotted on a single control chart for range on which an upper action limit is set at 2 inches. Samples for slump shall be taken at the mixer. However, the Contractor is responsible for delivering the concrete to the placement site at the stipulated slump. If the Contractor's materials or transportation methods cause slump loss between the mixer and the placement, correlation samples shall be taken at the placement site as required by the Contracting Officer, and the slump at the mixer controlled as directed.

d. Slump Corrective Action. Whenever points on the control charts for slump reach the upper warning limit, an adjustment shall immediately be made in the batch weights of water and fine aggregate. The adjustments are to be made so that the total water content does not exceed that amount allowed by the maximum w/c ratio specified, based on aggregates which are in a saturated surface dry condition. When a single slump reaches the upper or lower action limit, no further concrete shall be delivered to the placing site until proper adjustments have been made. Immediately after each adjustment, another test shall be made to verify the correctness of the adjustment. Whenever two consecutive individual slump tests, made during a period when there was no adjustment of batch weights, produce a point on the control chart for range at or above the upper action limit, the concreting operation shall immediately be halted, and the Contractor shall take appropriate steps to bring the slump under control. Additional slump tests shall be made as directed.

e. Temperature. The temperature of the concrete shall be measured when compressive strength specimens are fabricated. Measurement shall be in accordance with ASTM C 1064/C 1064M. The temperature shall be reported along with the compressive strength data.

f. Strength Specimens. At least one set of test specimens shall be made, for compressive or flexural strength as appropriate, on each different concrete mixture placed during the day for each 500 cubic yards or portion thereof of that concrete mixture placed each day. Additional sets of test specimens shall be made, as

directed by the Contracting Officer, when the mixture proportions are changed or when low strengths have been detected. A truly random (not haphazard) sampling plan shall be developed by the Contractor and approved by the Contracting Officer prior to the start of construction. The plan shall assure that sampling is done in a completely random and unbiased manner. A set of test specimens for concrete with a 28-day specified strength per paragraph Strength Requirements in PART 1 shall consist of four specimens, two to be tested at 7 days and two at 28 days. Test specimens shall be molded and cured in accordance with ASTM C 31/C 31M and tested in accordance with ASTM C 39/C 39M for test cylinders and ASTM C 78 for test beams. Results of all strength tests shall be reported immediately to the Contracting Officer. Quality control charts shall be kept for individual strength "tests", ("test" as defined in paragraph Strength Requirements in PART 1) moving average of last 3 "tests" for strength, and moving average for range for the last 3 "tests" for each mixture. The charts shall be similar to those found in ACI 214.3R.

3.12.6 Inspection Before Placing

Foundations, construction joints, forms, and embedded items shall be inspected by the Contractor in sufficient time prior to each concrete placement in order to certify to the Contracting Officer that they are ready to receive concrete. The results of each inspection shall be reported in writing.

3.12.7 Placing

The placing foreman shall supervise placing operations, shall determine that the correct quality of concrete or grout is placed in each location as specified and as directed by the Contracting Officer, and shall be responsible for measuring and recording concrete temperatures and ambient temperature hourly during placing operations, weather conditions, time of placement, volume placed, and method of placement. The placing foreman shall not permit batching and placing to begin until it has been verified that an adequate number of vibrators in working order and with competent operators are available. Placing shall not be continued if any pile of concrete is inadequately consolidated. If any batch of concrete fails to meet the temperature requirements, immediate steps shall be taken to improve temperature controls.

3.12.8 Vibrators

The frequency and amplitude of each vibrator shall be determined in accordance with COE CRD-C 521 prior to initial use and at least once a month when concrete is being placed. Additional tests shall be made as directed when a vibrator does not appear to be adequately consolidating the concrete. The frequency shall be determined while the vibrator is operating in concrete with the tachometer being held against the upper end of the vibrator head while almost submerged and just before the vibrator is withdrawn from the concrete. The amplitude shall be determined with the head vibrating in air. Two measurements shall be taken, one near the tip and another near the upper end of the vibrator head, and these results averaged. The make, model, type, and size of the vibrator and frequency and amplitude results shall be reported in writing. Any vibrator not meeting the requirements of paragraph Consolidation, shall be immediately removed from service and repaired or replaced.

3.12.9 Curing Inspection

a. Moist Curing Inspections. At least once each shift, and not less than twice per day on both work and non-work days, an inspection shall be made of all areas subject to moist curing. The surface moisture condition shall be noted and recorded.

b. Moist Curing Corrective Action. When a daily inspection report lists an area of inadequate curing, immediate corrective action shall be taken, and the required curing period for those areas shall be extended by 1 day.

c. Membrane Curing Inspection. No curing compound shall be applied until the Contractor has verified that the compound is properly mixed and ready for spraying. At the end of each operation, the Contractor shall estimate the quantity of compound used by measurement of the container and the area of concrete surface covered, shall compute the rate of coverage in square feet per gallon, and shall note whether or not coverage is uniform.

d. Membrane Curing Corrective Action. When the coverage rate of the curing compound is less than that specified or when the coverage is not uniform, the entire surface shall be sprayed again.

e. Sheet Curing Inspection. At least once each shift and once per day on non-work days, an inspection shall be made of all areas being cured using impervious sheets. The condition of the covering and the tightness of the laps and tapes shall be noted and recorded.

f. Sheet Curing Corrective Action. When a daily inspection report lists any tears, holes, or laps or joints that are not completely closed, the tears and holes shall promptly be repaired or the sheets replaced, the joints closed, and the required curing period for those areas shall be extended by 1 day.

3.12.10 Cold-Weather Protection

At least once each shift and once per day on non-work days, an inspection shall be made of all areas subject to cold-weather protection. Any deficiencies shall be noted, corrected, and reported.

3.12.11 Mixer Uniformity

a. Stationary Mixers. Prior to the start of concrete placing and once every 6 months when concrete is being placed, or once for every 75,000 cubic yards of concrete placed, whichever results in the shortest time interval, uniformity of concrete mixing shall be determined in accordance with ASTM C 94/C 94M.

b. Truck Mixers. Prior to the start of concrete placing and at least once every 6 months when concrete is being placed, uniformity of concrete mixing shall be determined in accordance with ASTM C 94/C 94M. The truck mixers shall be selected randomly for testing. When satisfactory performance is found in one truck mixer, the performance of mixers of substantially the same design and condition of the blades may be regarded as satisfactory.

c. Mixer Uniformity Corrective Action. When a mixer fails to meet

mixer uniformity requirements, either the mixing time shall be increased, batching sequence changed, batch size reduced, or adjustments shall be made to the mixer until compliance is achieved.

3.12.12 Reports

All results of tests or inspections conducted shall be reported informally as they are completed and in writing daily. A weekly report shall be prepared for the updating of control charts covering the entire period from the start of the construction season through the current week. During periods of cold-weather protection, reports of pertinent temperatures shall be made daily. These requirements do not relieve the Contractor of the obligation to report certain failures immediately as required in preceding paragraphs. Such reports of failures and the action taken shall be confirmed in writing in the routine reports. The Contracting Officer has the right to examine all contractor quality control records.

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SECTION 04200

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PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ACI INTERNATIONAL (ACI)

ACI 530/530.1	(2000) Building Code Requirements for Masonry Structures
ACI SP-66	(1994) ACI Detailing Manual

ASTM INTERNATIONAL (ASTM)

ASTM A 82	(2001) Steel Wire, Plain, for Concrete Reinforcement
ASTM A 153/A 153M	(2001a) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 615/A 615M	(2001b) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 641/A 641M	(1998) Zinc-Coated (Galvanized) Carbon Steel Wire
ASTM C 62	(2001) Building Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C 67	(2002c) Sampling and Testing Brick and Structural Clay Tile
ASTM C 836	(2000) High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use With Separate Wearing Course
ASTM C 90	(2002) Loadbearing Concrete Masonry Units
ASTM C 91	(2001) Masonry Cement
ASTM C 94/C 94M	(2000e2) Ready-Mixed Concrete
ASTM C 129	(2001) Nonloadbearing Concrete Masonry Units
ASTM C 140	(2002a) Sampling and Testing Concrete

	Masonry Units and Related Units
ASTM C 144	(2002) Aggregate for Masonry Mortar
ASTM C 150	(2002a) Portland Cement
ASTM C 207	(1991; R 1997) Hydrated Lime for Masonry Purposes
ASTM C 216	(2002) Facing Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C 270	(2002) Mortar for Unit Masonry
ASTM C 476	(2002) Grout for Masonry
ASTM C 494/C 494M	(1999ae1) Chemical Admixtures for Concrete
ASTM C 578	(2001) Rigid, Cellular Polystyrene Thermal Insulation
ASTM C 641	(1998e1) Staining Materials in Lightweight Concrete Aggregates
ASTM C 780	(2002) Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
ASTM C 1019	(2002) Sampling and Testing Grout
ASTM C 1072	(2000a) Measurement of Masonry Flexural Bond Strength
ASTM C 1142	(1995; R 2001) Extended Life Mortar for Unit Masonry
ASTM D 781	(1973) Test Method for Puncture Resistance and Stiffness of Paperboard, Corrugated and Solid Fiberboard
ASTM D 1004	(1994a) Initial Tear Resistance of Plastic Film and Sheeting
ASTM D 1876	(2000E1) Test Method for Peel Resistance of Adhesives
ASTM D 1938	(1994) Tear Propagation Resistance of Plastic Film and Thin Sheeting by a Single Tear Method
ASTM D 1970	(2001) Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection
ASTM D 2000	(2001) Rubber Products in Automotive Applications
ASTM D 2240	(2002a) Rubber Property - Durometer Hardness

ASTM D 2287	(1996; R 2001) Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
ASTM D 412	(1998a) Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension
ASTM D 570	(1998) Water Absorption of Plastics
ASTM D 903	(1998) Peel or Stripping Strength of Adhesive Bonds
ASTM E 119	(2000a) Fire Tests of Building Construction and Materials
ASTM E 154	(1999) Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover
ASTM E 283	(1991; R 1999) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM E 330	(2002) Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference
ASTM E 96	(2000e1) Water Vapor Transmission of Materials

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Structural Masonry; G-AE

Drawings including plans, elevations, and details of wall reinforcement; details of reinforcing bars at corners and wall intersections; offsets; tops, bottoms, and ends of walls; control and expansion joints; lintels; and wall openings. Bar splice locations shall be shown. Bent bars shall be identified on a bending diagram and shall be referenced and located on the drawings. Wall dimensions, bar clearances, and wall openings greater than one masonry unit in area shall be shown. No approval will be given to the shop drawings until the Contractor certifies

that all openings, including those for mechanical and electrical service, are shown. If, during construction, additional masonry openings are required, the approved shop drawings shall be resubmitted with the additional openings shown along with the proposed changes. Location of these additional openings shall be clearly highlighted. The minimum scale for wall elevations shall be 1/4 inch per foot. Reinforcement bending details shall conform to the requirements of ACI SP-66.

SD-03 Product Data

Clay or Shale Brick; G-AE

Insulation; G-AE
Flashing; G-AE

Manufacturer's descriptive data.

Cold Weather Installation

Cold weather construction procedures.

SD-04 Samples

Concrete Masonry Units (CMU)

Cast Stone Items; G-AE
Clay or Shale Brick; G-AE

Color samples of three stretcher units and one unit for each type of special shape. Units shall show the full range of color and texture.

Anchors, Ties, and Bar Positioners

Two of each type used.

Expansion-Joint Materials

One piece of each type used.

Joint Reinforcement

One piece of each type used, including corner and wall intersection pieces, showing at least two cross wires.

Insulation; G-AO

One piece of board type insulation, not less than 16 by 24 inches in size, containing the label indicating the rated permeance and R-values.

Portable Panel; G-AE

One panel of clay or shale brick, 2 by 2 feet, containing approximately 24 brick facings to establish range of color and texture.

SD-05 Design Data

Pre-mixed Mortar; G-AE
Unit Strength Method; G-AE

Pre-mixed mortar composition. Calculations and certifications of masonry unit and mortar strength.

SD-06 Test Reports

Efflorescence Test
Field Testing of Mortar
Field Testing of Grout
Prism tests
Masonry Cement
Fire-rated CMU

Test reports from an approved independent laboratory. Test reports on a previously tested material shall be certified as the same as that proposed for use in this project.

Special Inspection

Copies of masonry inspector reports.

SD-07 Certificates

Clay or Shale Brick
Cast Stone Items

Concrete Masonry Units (CMU)
Control Joint Keys
Anchors, Ties, and Bar Positioners
Expansion-Joint Materials
Joint Reinforcement
Reinforcing Steel Bars and Rods
Masonry Cement

Insulation
Precast Concrete Items
Admixtures for Masonry Mortar
Admixtures for Grout

Certificates of compliance stating that the materials meet the specified requirements.

SD-08 Manufacturer's Instructions

Masonry Cement

When masonry cement is used, submit the manufacturer's printed instructions on proportions of water and aggregates and on mixing to obtain the type of mortar required.

1.3 SAMPLE MASONRY PANELS

After material samples are approved and prior to starting masonry work, a portable panel of clay or shale brick and sample masonry panels shall be constructed for each type and color of masonry required. At least 48 hours

prior to constructing the sample panel or panels, the Contractor shall submit written notification to the Contracting Officer's Representative. Sample panels shall not be built in, or as part of the structure, but shall be located where directed.

1.3.1 Configuration

Panels shall be L-shaped or otherwise configured to represent all of the wall elements. Panels shall be of the size necessary to demonstrate the acceptable level of workmanship for each type of masonry represented on the project. The minimum size of a straight panel or a leg of an L-shaped panel shall be 8 feet long by 6 feet high.

1.3.2 Composition

Panels shall show full color range, texture, and bond pattern of the masonry work. The Contractor's method for mortar joint tooling; grouting of reinforced vertical cores, collar joints, bond beams, and lintels; positioning, securing, and lapping of reinforcing steel; positioning and lapping of joint reinforcement (including prefabricated corners); and cleaning of masonry work shall be demonstrated during the construction of the panels. Installation or application procedures for anchors, wall ties, CMU control joints, brick expansion joints, insulation, flashing, brick soldier courses and weep holes shall be shown in the sample panels. The panels shall contain a masonry bonded corner that includes a bond beam corner. Panels shall show installation of electrical boxes and conduit. Panels that represent reinforced masonry shall contain a 2 by 2 foot opening placed at least 2 feet above the panel base and 2 feet away from all free edges, corners, and control joints. Required reinforcing shall be provided around this opening as well as at wall corners and control joints.

1.3.3 Construction Method

Where anchored veneer walls are required, the Contractor shall demonstrate and receive approval for the method of construction; i.e., either bring up the two wythes together or separately, with the insulation and appropriate ties placed within the specified tolerances across the cavity. Temporary provisions shall be demonstrated to preclude mortar or grout droppings in the cavity and to provide a clear open air space of the dimensions shown on the drawings. Where masonry is to be grouted, the Contractor shall demonstrate and receive approval on the method that will be used to bring up the masonry wythes; support the reinforcing bars; and grout cells, bond beams, lintels, and collar joints using the requirements specified herein. If sealer is specified to be applied to the masonry units, sealer shall be applied to the sample panels. Panels shall be built on a properly designed concrete foundation.

1.3.4 Usage

The completed panels shall be used as the standard of workmanship for the type of masonry represented. Masonry work shall not commence until the sample panel for that type of masonry construction has been completed and approved. Panels shall be protected from the weather and construction operations until the masonry work has been completed and approved. After completion of the work, the sample panels, including all foundation concrete, shall become the property of the Contractor and shall be removed from the construction site.

1.4 DELIVERY, HANDLING, AND STORAGE

Materials shall be delivered, handled, stored, and protected to avoid chipping, breakage, and contact with soil or contaminating material.

1.4.1 Masonry Units

Concrete masonry units shall be covered or protected from inclement weather. Store Type II, concrete masonry units at the site for a minimum of 28 days for air cured units, 10 days for atmospheric steam or water cured units, and 3 days for units cured with steam at a pressure of 120 to 150 psi and at a temperature of 350 to 365 degrees F for at least 5 hours. Protect moisture controlled units (Type I) from rain and ground water.

1.4.2 Reinforcement, Anchors, and Ties

Steel reinforcing bars, coated anchors, ties, and joint reinforcement shall be stored above the ground. Steel reinforcing bars and uncoated ties shall be free of loose mill scale and rust.

1.4.3 Cementitious Materials, Sand and Aggregates

Cementitious and other packaged materials shall be delivered in unopened containers, plainly marked and labeled with manufacturers' names and brands. Cementitious material shall be stored in dry, weathertight enclosures or be completely covered. Cement shall be handled in a manner that will prevent the inclusion of foreign materials and damage by water or dampness. Sand and aggregates shall be stored in a manner to prevent contamination or segregation.

1.5 STRUCTURAL MASONRY

1.5.1 Special Inspection

A qualified masonry inspector approved by the Contracting Officer shall perform inspection of the masonry work. Minimum qualifications for the masonry inspector shall be 5 years of reinforced masonry inspection experience or acceptance by a State, municipality, or other governmental body having a program of examining and certifying inspectors for reinforced masonry construction. The masonry inspector shall be present during preparation of masonry prisms, sampling and placing of masonry units, placement of reinforcement (including placement of dowels in footings and foundation walls), inspection of grout space, immediately prior to closing of cleanouts, and during grouting operations. The masonry inspector shall assure Contractor compliance with the drawings and specifications. The masonry inspector shall keep a complete record of all inspections and shall submit daily written reports to the Quality Control Supervisory Representative reporting the quality of masonry construction.

1.5.2 Unit Strength Method

Compute compressive strength of masonry system "Unit Strength Method," ACI 530/530.1. Submit calculations and certifications of unit and mortar strength.

1.6 QUALITY ASSURANCE

1.6.1 Appearance

Bricks shall be manufactured at one time and from the same batch. Blend all brick to produce a uniform appearance when installed. An observable "banding" or "layering" of colors or textures caused by improperly mixed brick is unacceptable.

1.6.2 Testing

Masonry strength shall be determined in accordance with ACI 530/530.1; submit test reports on three prisms as specified in ACI 530/530.1. The cost of testing shall be paid by the Contractor.

1.6.3 Spare Vibrator

Maintain at least one spare vibrator on site at all times.

1.6.4 Bracing and Scaffolding

Provide bracing and scaffolding necessary for masonry work. Design bracing to resist wind pressure as required by local code.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

The source of materials which will affect the appearance of the finished work shall not be changed after the work has started except with Contracting Officer's approval.

2.2 CLAY OR SHALE BRICK

Color range and texture of clay or shale brick shall be as indicated and shall conform to the approved sample. Brick shall conform to ASTM C 62; Grade SW shall be used for brick in contact with earth or grade and for all exterior work and for all nonvertical surfaces. Average dimensions of brick shall be 3-5/8 inches thick, 2-1/4 inches high, and 8 inches long (standard) or 4 inches thick, 2-2/3 inches high, and 8 inches long (nominal), subject to the tolerances specified in ASTM C 62. Brick shall be tested for efflorescence. Clay or shale brick units shall be delivered factory-blended to provide a uniform appearance and color range in the completed wall.

2.2.1 Solid Clay or Shale Brick

Solid clay or shale brick shall conform to ASTM C 216, Type FBS. Brick size shall be modular and the nominal size of the brick used shall be 3-5/8 inches thick, 2-1/4 inches high, and 8 inches long (nominal). Colors and types shall be as specified in Section 09915 COLOR SCHEDULE.

2.3 CONCRETE MASONRY UNITS (CMU)

Cement shall have a low alkali content and be of one brand. Units shall be of modular dimensions and air, water, or steam cured. Exposed surfaces of units shall be smooth and of uniform texture.

a. Hollow Load-Bearing Units: ASTM C 90, Type I or II, made with normal weight aggregate. Provide load-bearing units for exterior walls, foundation walls, load-bearing walls, and shear walls.

b. Hollow Non-Load-Bearing Units: ASTM C 129, Type I or II, made with normal weight aggregate. Load-bearing units may be provided in lieu of non-load-bearing units.

2.3.1 Aggregates

Lightweight aggregates and blends of lightweight and heavier aggregates in proportions used in producing the units, shall comply with the following requirements when tested for stain-producing iron compounds in accordance with ASTM C 641: by visual classification method, the iron stain deposited on the filter paper shall not exceed the "light stain" classification.

2.3.2 Kinds and Shapes

Units shall be modular in size and shall include closer, jamb, header, lintel, and bond beam units and special shapes and sizes to complete the work as indicated. In exposed interior masonry surfaces, units having a bullnose shall be used for vertical external corners except at door, window, and louver jambs. Radius of the bullnose shall be 1 inch. Units used in exposed masonry surfaces in any one building shall have a uniform fine to medium texture and a uniform color.

2.3.3 Fire-Rated CMU

Concrete masonry units used in fire-rated construction shown on the drawings shall be of minimum equivalent thickness for the fire rating indicated and the corresponding type of aggregates indicated in TABLE I. Units containing more than one of the aggregates listed in TABLE I will be rated on the aggregate requiring the greater minimum equivalent thickness to produce the required fire rating. Construction shall conform to ASTM E 119.

TABLE I

FIRE-RATED CONCRETE MASONRY UNITS

See note (a) below

Aggregate Type	Minimum equivalent thickness inches for fire rating of: 4 hours	3 hours	2 hours
Pumice	4.7	4.0	3.0
Expanded slag	5.0	4.2	3.3
Expanded clay, shale, or slate	5.7	4.8	3.7
Limestone, scoria, cinders or unexpanded slag	5.9	5.0	4.0

TABLE I

FIRE-RATED CONCRETE MASONRY UNITS

	See note (a) below		
Calcareous gravel	6.2	5.3	4.2
Siliceous gravel	6.7	5.7	4.5

(a) Minimum equivalent thickness shall equal net volume as determined in conformance with ASTM C 140 divided by the product of the actual length and height of the face shell of the unit in inches. Where walls are to receive plaster or be faced with brick, or otherwise form an assembly; the thickness of plaster or brick or other material in the assembly will be included in determining the equivalent thickness.

2.4 PRECAST CONCRETE ITEMS

Splashblocks shall be factory-made units from a plant regularly engaged in producing precast concrete units. Unless otherwise indicated, concrete shall be 4,000 psi minimum conforming to Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE using 1/2 inch to No. 4 nominal-size coarse aggregate, and minimum reinforcement shall be the reinforcement required for handling of the units. Clearance of 3/4 inch shall be maintained between reinforcement and faces of units. Unless precast-concrete items have been subjected during manufacture to saturated-steam pressure of at least 120 psi for at least 5 hours, the items, after casting, shall be either damp-cured for 24 hours or steam-cured and shall then be aged under cover for 28 days or longer. Cast-concrete members weighing over 80 pounds shall have built-in loops of galvanized wire or other approved provisions for lifting and anchoring. Exposed-to-view surfaces shall be free of surface voids, spalls, cracks, and chipped or broken edges. Precast units exposed-to-view shall be of uniform appearance and color. Unless otherwise specified, units shall have a smooth dense finish. Prior to use, each item shall be wetted and inspected for crazing. Items showing evidence of dusting, spalling, crazing, or having surfaces treated with a protective coating will be rejected.

2.4.1 Splash Blocks

Splash blocks shall be as detailed. Reinforcement shall be the manufacturer's standard.

2.5 CAST STONE ITEMS

Sills shall be factory-made units from a plant regularly engaged in producing cast stone units. Unless otherwise indicated, units shall be 6,500 psi minimum and maximum absorption of 5 percent. Minimum reinforcement shall be the reinforcement required for handling of the units. Clearance of 3/4 inch shall be maintained between reinforcement and faces of units. Unless cast stone items have been subjected during manufacture to saturated-steam pressure of at least 120 psi for at least 5 hours, the items, after casting, shall be either damp-cured for 24 hours or steam-cured and shall then be aged under cover for 28 days or longer. Exposed-to-view surfaces shall be free of surface voids, spalls, cracks, and chipped or broken edges. Precast units exposed-to-view shall be of uniform appearance and color as specified in Section 09915 COLOR SCHEDULE.

Unless otherwise specified, units shall have a smooth dense finish. Prior to use, each item shall be wetted and inspected for crazing. Items showing evidence of dusting, spalling, crazing, or having surfaces treated with a protective coating will be rejected.

2.6 MORTAR FOR STRUCTURAL MASONRY

ASTM C 270, Type S. Strength (f'm) as indicated. Test in accordance with ASTM C 780. Use Type II portland cementI, II. Do not use admixtures containing chlorides. When structural reinforcement is incorporated, maximum air-content shall be 12 percent in cement-lime mortar and 18 percent in masonry cement mortar.

2.7 MASONRY MORTAR

Mortar Type S shall conform to the proportion specification of ASTM C 270 except Type S cement-lime mortar proportions shall be 1 part cement, 1/2 part lime and 4-1/2 parts aggregate. Type S mortar shall be used for non-load-bearing, non-shear-wall interior masonry and for remaining masonry work; except where higher compressive strength is indicated on structural drawings. When masonry cement ASTM C 91 is used the maximum air content shall be limited to 12 percent and performance equal to cement-lime mortar shall be verified. Verification of masonry cement performance shall be based on ASTM C 780 and ASTM C 1072. Cement shall have a low alkali content and be of one brand. Aggregates shall be from one source.

2.7.1 Admixtures for Masonry Mortar

In cold weather, a non-chloride based accelerating admixture may be used subject to approval. Accelerating admixture shall be non-corrosive, shall contain less than 0.2 percent chlorides, and shall conform to ASTM C 494/C 494M, Type C.

2.7.2 Hydrated Lime and Alternates

Hydrated lime shall conform to ASTM C 207, Type S. Lime alternates which have a current ICBO, ICBO UBC, Evaluation Report number whose findings state it may be used as an alternate to lime for Type S mortar will be deemed acceptable provided the user follows the manufacturer's proportions and mixing instructions as set forth in ICBO report.

2.7.3 Cement

Portland cement shall conform to ASTM C 150, Type I. Masonry cement shall conform to ASTM C 91, Type S. Containers shall bear complete instructions for proportioning and mixing to obtain the required types of mortar.

2.7.4 Pre-Mixed Mortar

Pre-mixed mortar shall conform to ASTM C 1142, Type RS.

2.7.5 Sand and Water

Sand shall conform to ASTM C 144. Water shall be clean, potable, and free from substances which could adversely affect the mortar.

2.8 GROUT AND READY-MIXED GROUT

Grout shall conform to ASTM C 476, coarse. Cement used in grout shall have

a low alkali content. Grout slump shall be between 8 and 10 inches. Minimum grout strength shall be 2000 psi in 28 days, as tested by ASTM C 1019. Grout shall be used subject to the limitations of Table III. Proportions shall not be changed and materials with different physical or chemical characteristics shall not be used in grout for the work unless additional evidence is furnished that the grout meets the specified requirements. Ready-Mixed grout shall conform to ASTM C 94/C 94M.

2.8.1 Admixtures for Grout

In cold weather, a non-chloride based accelerating admixture may be used subject to approval; accelerating admixture shall be non-corrosive, shall contain less than 0.2 percent chlorides, and shall conform to ASTM C 494/C 494M, Type C. In general, air-entrainment, anti-freeze or chloride admixtures shall not be used except as approved by the Contracting Officer.

2.8.2 Grout Barriers

Grout barriers for vertical cores shall consist of fine mesh wire, fiberglass, or expanded metal.

2.9 ANCHORS, TIES, AND BAR POSITIONERS

Anchors and ties shall be fabricated without drips or crimps and shall be zinc-coated in accordance with ASTM A 153/A 153M, Class B-2. Steel wire used for anchors and ties shall be fabricated from steel wire conforming to ASTM A 82. Wire ties or anchors in exterior walls shall conform to ASTM A 641/A 641M. Joint reinforcement in interior walls, and in exterior or interior walls exposed to moist environment shall conform to ASTM A 641/A 641M; coordinate with paragraph JOINT REINFORCEMENT below. Anchors and ties shall be sized to provide a minimum of 5/8 inch mortar cover from either face.

2.9.1 Wall Ties

Wall ties shall be rectangular-shaped or Z-shaped fabricated of 3/16 inch diameter zinc-coated steel wire. Rectangular wall ties shall be no less than 2 inches wide. Wall ties shall be of a continuous type conforming to paragraph JOINT REINFORCEMENT where ever possible. Adjustable type wall ties, if approved for use, shall consist of two essentially U-shaped elements fabricated of 3/16 inch diameter zinc-coated steel wire. Adjustable ties shall be of the double pintle to eye type and shall allow a maximum of 1/2 inch eccentricity between each element of the tie. Play between pintle and eye opening shall be not more than 1/16 inch. The pintle and eye elements shall be formed so that both can be in the same plane.

2.9.2 Adjustable Anchors

Adjustable anchors shall be 3/16 inch diameter steel wire, triangular-shaped. Anchors attached to steel shall be 5/16 inch diameter steel bars placed to provide 1/16 inch play between flexible anchors and structural steel members. Spacers shall be welded to rods and columns. Equivalent welded-on steel anchor rods or shapes standard with the flexible-anchor manufacturer may be furnished when approved. Welds shall be cleaned and given one coat of zinc-rich touch up paint.

2.9.3 Bar Positioners

Bar positioners, used to prevent displacement of reinforcing bars during the course of construction, shall be factory fabricated from 9 gauge steel wire or equivalent, and coated with a hot-dip galvanized finish. Not more than one wire shall cross the cell.

2.10 JOINT REINFORCEMENT

Joint reinforcement shall be factory fabricated from steel wire conforming to ASTM A 82, welded construction. Tack welding will not be acceptable in reinforcement used for wall ties. Wire shall have zinc coating conforming to ASTM A 153/A 153M, Class B-2. All wires shall be a minimum of 9 gauge. Reinforcement shall be ladder type design, having one longitudinal wire in the mortar bed of each face shell for hollow units and one wire for solid units. Joint reinforcement shall be placed a minimum of 5/8 inch cover from either face. The distance between crosswires shall not exceed 16 inches. Joint reinforcement for straight runs shall be furnished in flat sections not less than 10 feet long. Joint reinforcement shall be provided with factory formed corners and intersections. Joint reinforcement shall be furnished with adjustable wall tie features for attachment of veneer wythes.

2.11 REINFORCING STEEL BARS AND RODS

Reinforcing steel bars and rods shall conform to ASTM A 615/A 615M, Grade 60.

2.12 CONTROL JOINT KEYS

Control joint keys shall be a factory fabricated solid section of natural or synthetic rubber (or combination thereof) conforming to ASTM D 2000 or polyvinyl chloride conforming to ASTM D 2287. The material shall be resistant to oils and solvents. The control joint key shall be provided with a solid shear section not less than 5/8 inch thick and 3/8 inch thick flanges, with a tolerance of plus or minus 1/16 inch. The control joint key shall fit neatly, but without forcing, in masonry unit jamb sash grooves. The control joint key shall be flexible at a temperature of minus 30 degrees F after five hours exposure, and shall have a durometer hardness of not less than 70 when tested in accordance with ASTM D 2240.

2.13 INSULATION

2.13.1 Rigid Board-Type Insulation

Rigid board-type insulation shall be extruded polystyrene. Polystyrene shall conform to ASTM C 578. The insulation shall be a standard product and shall be marked with not less than the manufacturer's trademark or name, the specification number, the permeance and R-values.

2.13.1.1 Insulation Thickness and Air Space

The cavity space shall allow for a maximum insulation thickness of 3 inches, and a minimum air space of 1-3/4 inches.

2.13.1.2 Aged R-Value

The insulation shall provide a minimum aged R-value of 15 for the overall thickness. The aged R-value shall be determined at 75 degrees F in

accordance with the appropriate referenced specification. The stated R-value of the insulation shall be certified by an independent testing laboratory or certified by an independent Registered Professional Engineer if tests are conducted in the manufacturer's laboratory.

2.13.1.3 Recovered Material

Contractor shall comply with EPA requirements in accordance with Section 01670 RECYCLED / RECOVERD MATERIALS.

2.13.2 Insulation Adhesive

Insulation adhesive shall be specifically prepared to adhere the insulation to the masonry and, where applicable, to the thru-wall flashing. The adhesive shall not deleteriously affect the insulation, and shall have a record of satisfactory and proven performance for the conditions under which to be used.

2.14 CAVITY DRAINAGE NET

Cavity drainage net shall be purpose manufactured 90% open mesh, trapezoidal shaped, sized for 1-3/4 inches wide cavity, high density polyethylene material.

2.15 EXPANSION-JOINT MATERIALS

Backer rod and sealant shall be adequate to accommodate joint compression equal to 50 percent of the width of the joint. The backer rod shall be compressible rod stock of bi-cellular material or other flexible, nonabsorptive material as recommended by the sealant manufacturer. Sealant shall conform to Section 07920 JOINT SEALANTS.

2.16 FLASHING

Flashing shall be as specified here and in Section 07600 FLASHING AND SHEET METAL. Provide rubberized membrane flashing, 40 mil total thickness self-adhesive, cold applied tape consisting of 32 mils of rubberized asphalt integrally bonded to a 8 mil high density, cross laminated polyethylene film. Provide primer, mastic and liquid membrane as recommended by flashing manufacturer. Metal drip edge shall be stainless steel 0.010 inches thick, nominally 1-3/8 inches wide with 3/8 inch folded angled drip edge, either hemmed or finished.

2.16.1 Rubberized Membrane Flashing Physical Properties

Property	Typical Value	Test Method
Low temperature flexibility	Unaffected at -45^0 F	ASTM D 1970
Tensile strength, membrane	1200 psi minimum	ASTM D 412, Die C Mod
Elongation, ultimate failure of rubberized asphalt	200% minimum	ASTM D 412
Lap adhesion at minimum application temperature	60 lbs/ft width	ASTM D 1876 Modified
Adhesion to concrete at minimum application temperature	60 lbs/ft width	ASTM D 903
Puncture resistance, membrane	40 lbs minimum MD	ASTM D 781
	80 lbs minimum MD	ASTM E 154
Tear resistance, irritation	13 lbs minimum MD	ASTM D 1004

Tear resistance, propagation	9 lbs minimum MD	ASTM D 1938
Permeance	0.05 perms maximum	ASTM E 96 Method B
Water absorption	0.1% maximum	ASTM D 570

2.17 RUBBERIZED WALL MEMBRANE

Cold-applied composite sheet consisting of rubberized asphalt and cross-laminated high density polyethylene film intended for use as a waterproofing membrane for air and vapor barrier application. Not less than 40 mils minimum thickness is required.

2.17.1 Rubberized Wall Membrane Physical Properties Physical Properties

Property	Typical Value	Test Method
Minimum tensile strength, membranes	400 psi	ASTM D 412 Die C Modified
Minimum tensile strength, film	5000 psi	ASTM D 412 Die C Modified
Minimum elongation, to failure of rubberized asphalt	200%	ASTM D 412 Die C Modified
Pliability, at 180° bend over 1 in. mandrel	Pass at -45°F	ASTM D 1970
Crack cycling, 1/8 in. at -25° F	Unaffected	ASTM C 836
Minumum puncture resistance membrane	40 lbs.	ASTM E 154
Lap peel adhesion at minimum application temp	6.3 lbs/in.	ASTM D 1876 Modified
Maximum permeance to water vapor transmission	0.05 perms/(Pa.s.m^2	ASTM E 96 Method B
Air permeance of in-place membrane[1]	4x10^{-6} cf/min/ft^2	ASTM E 283
Air permeance of in-place membrane[2]	No change in air permeance value	ASTM E 330
Water absorption (weight gain at 24 hours)	0.1%	ASTM D 570

Footnotes:

1. Air permeance measured at a apressure differential of 1/64 inches Hg.
2. Air permeance measured at a pressure differential of 1/64 inches Hg after wall being subjected to a negative 57/64 in. Hg pressure difference of 10 seconds.

PART 3 EXECUTION

3.1 PREPARATION

Prior to start of work, masonry inspector shall verify the applicable conditions as set forth in ACI 530/530.1, inspection. The Contracting Officer will serve as inspector or will select a masonry inspector.

3.1.1 Hot Weather Installation

The following precautions shall be taken if masonry is erected when the ambient air temperature is more than 95 degrees F in the shade and the

relative humidity is less than 50 percent or the ambient air temperature exceeds 90 degrees F and the wind velocity is more than 8 mph. All masonry materials shall be shaded from direct sunlight; mortar beds shall be spread no more than 4 feet ahead of masonry; masonry units shall be set within one minute of spreading mortar; and after erection, masonry shall be protected from direct exposure to wind and sun for 48 hours.

3.1.2 Cold Weather Installation

Before erecting masonry when ambient temperature or mean daily air temperature falls below 40 degrees F or temperature of masonry units is below 40 degrees F, a written statement of proposed cold weather construction procedures shall be submitted for approval. The following precautions shall be taken during all cold weather erection.

3.1.2.1 Protection

Ice or snow formed on the masonry bed shall be thawed by the application of heat. Heat shall be applied carefully until the top surface of the masonry is dry to the touch. Sections of masonry deemed frozen and damaged shall be removed before continuing construction of those sections.

a. Air Temperature 40 to 32 Degrees F. Sand or mixing water shall be heated to produce mortar temperatures between 40 and 120 degrees F.

b. Air Temperature 32 to 25 Degrees F. Sand and mixing water shall be heated to produce mortar temperatures between 40 and 120 degrees F. Temperature of mortar on boards shall be maintained above freezing.

c. Air Temperature 25 to 20 Degrees F. Sand and mixing water shall be heated to provide mortar temperatures between 40 and 120 degrees F. Temperature of mortar on boards shall be maintained above freezing. Sources of heat shall be used on both sides of walls under construction. Windbreaks shall be employed when wind is in excess of 15 mph.

d. Air Temperature 20 Degrees F and below. Sand and mixing water shall be heated to provide mortar temperatures between 40 and 120 degrees F. Enclosure and auxiliary heat shall be provided to maintain air temperature above 32 degrees F. Temperature of units when laid shall not be less than 20 degrees F.

3.1.2.2 Completed Masonry and Masonry Not Being Worked On

a. Mean daily air temperature 40 to 32 degrees F. Masonry shall be protected from rain or snow for 24 hours by covering with weather-resistive membrane.

b. Mean daily air temperature 32 to 25 degrees F. Masonry shall be completely covered with weather-resistant membrane for 24 hours.

c. Mean Daily Air Temperature 25 to 20 degrees F. Masonry shall be completely covered with insulating blankets or equally protected for 24 hours.

d. Mean Daily Temperature 20 degrees F and Below. Masonry temperature shall be maintained above 32 degrees F for 24 hours by enclosure and supplementary heat, by electric heating blankets,

infrared heat lamps, or other approved methods.

3.1.3 Stains

Potect exposed surfaces from mortar and other stains. When mortar joints are tooled, remove mortar from exposed surfaces with fiber brushes and wooden paddles. Protect base of walls from splash stains by covering adjacent ground with sand, sawdust, or polyethylene.

3.1.4 Loads

Do not apply uniform loads for at least 12 hours or concentrated loads for at least 72 hours after masonry is constructed. Provide temporary bracing as required.

3.1.5 Surfaces

Surfaces on which masonry is to be placed shall be cleaned of laitance, dust, dirt, oil, organic matter, or other foreign materials and shall be slightly roughened to provide a surface texture with a depth of at least 1/8 inch. Sandblasting shall be used, if necessary, to remove laitance from pores and to expose the aggregate.

3.2 LAYING MASONRY UNITS

Coordinate masonry work with the work of other trades to accommodate built-in items and to avoid cutting and patching. Masonry units shall be laid in running bond pattern unless indicated otherwise. Facing courses shall be level with back-up courses, unless the use of adjustable ties has been approved in which case the tolerances shall be plus or minus 1/2 inch. Each unit shall be adjusted to its final position while mortar is still soft and plastic. Units that have been disturbed after the mortar has stiffened shall be removed, cleaned, and relaid with fresh mortar. Air spaces, cavities, chases, expansion joints, and spaces to be grouted shall be kept free from mortar and other debris. Units used in exposed masonry surfaces shall be selected from those having the least amount of chipped edges or other imperfections detracting from the appearance of the finished work. Vertical joints shall be kept plumb. Units being laid and surfaces to receive units shall be free of water film and frost. Solid units shall be laid in a nonfurrowed full bed of mortar. Mortar for veneer wythes shall be beveled and sloped toward the center of the wythe from the cavity side. Units shall be shoved into place so that the vertical joints are tight. Vertical joints of brick and the vertical face shells of concrete masonry units, except where indicated at control, expansion, and isolation joints, shall be completely filled with mortar. Mortar will be permitted to protrude up to 1/2 inch into the space or cells to be grouted. Means shall be provided to prevent mortar from dropping into the space below. In double wythe construction, the inner wythe may be brought up not more than 16 inches ahead of the outer wythe. Collar joints shall be filled with mortar or grout during the laying of the facing wythe, and filling shall not lag the laying of the facing wythe by more than 8 inches.

3.2.1 Forms and Shores

Provide bracing and scaffolding as required. Design bracing to resist wind pressure as required by local codes. Forms and shores shall be sufficiently rigid to prevent deflections which may result in cracking or other damage to supported masonry and sufficiently tight to prevent leakage of mortar and grout. Supporting forms and shores shall not be removed in

less than 10 days.

3.2.2 Reinforced Concrete Masonry Units Walls

Where vertical reinforcement occurs, fill cores solid with grout. Lay units in such a manner as to preserve the unobstructed vertical continuity of cores to be filled. Embed the adjacent webs in mortar to prevent leakage of grout. Remove mortar fins protruding from joints before placing grout. Minimum clear dimensions of vertical cores shall be 2 by 3 inches. Position reinforcing accurately as indicated before placing grout. As masonry work progresses, secure vertical reinforcing in place at vertical intervals not to exceed 160 bar diameters. Use puddling rod or vibrator to consolidate the grout. Minimum clear distance between masonry and vertical reinforcement shall be not less than 1/2 inch. Unless indicated or specified otherwise, form splices by lapping bars not less than 48 bar diameters and wire tying them together.

3.2.3 Concrete Masonry Units

Units in starting courses on solid foundation walls, lintels, and beams, and where cells are to be filled with grout shall be full bedded in mortar under both face shells and webs. Other units shall be full bedded under both face shells. Head joints shall be filled solidly with mortar for a distance in from the face of the unit not less than the thickness of the face shell. Jamb units shall be of the shapes and sizes to conform with wall units. Solid units may be incorporated in the masonry work where necessary to fill out at corners, gable slopes, and elsewhere as approved.

3.2.4 Clay or Shale Brick Units

Brick facing shall be laid with the better face exposed. Brick shall be laid in running bond with each course bonded at corners, unless otherwise indicated. Molded brick shall be laid with the frog side down. Brick that is cored, recessed, or has other deformations may be used except where deformations will be exposed to view.

3.2.4.1 Wetting of Units

Wetting of clay, shale brick, or hollow brick units having an initial rate of absorption of more than 1 gram per minute per square inch of bed surface shall be in conformance with ASTM C 67. The method of wetting shall ensure that each unit is nearly saturated but surface dry when laid. Test clay or shale brick daily on the job, prior to laying, as follows: Using a wax pencil, draw a circle the size of a quarter on five randomly selected bricks. Apply 20 drops of water with a medicine dropper to the surface within the circle on each brick. If the average time that the water is completely absorbed in the five bricks is less than 1-1/2 minutes, wet bricks represented by the five bricks tested.

3.2.4.2 Solid Units

Bed, head, and collar joints shall be completely filled with mortar.

3.2.4.3 Cavity Walls

Provide a continuous cavity as indicated. Securely tie the two wythes together with horizontal joint reinforcement. Bevel mortar beds away from cavity to prevent projection into cavity when bricks are shoved in place. Keep cavities clear and clean of mortar droppings. Cavity face of interior

wythe shall receive rubberized wall membrane air barrier.

3.2.5 Tolerances

Masonry shall be laid plumb, true to line, with courses level. Bond pattern shall be kept plumb throughout. Corners shall be square unless noted otherwise. Masonry shall be laid within the following tolerances (plus or minus unless otherwise noted):

TABLE II

TOLERANCES

Variation from the plumb in the lines and surfaces of columns, walls and arises	
In adjacent masonry units	1/8 inch
In 10 feet	1/4 inch
In 20 feet	3/8 inch
In 40 feet or more	1/2 inch
Variations from the plumb for external corners, expansion joints, and other conspicuous lines	
In 20 feet	1/4 inch
In 40 feet or more	1/2 inch
Variations from the level for exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines	
In 20 feet	1/4 inch
In 40 feet or more	1/2 inch
Variation from level for bed joints and top surfaces of bearing walls	
In 10 feet	1/4 inch
In 40 feet or more	1/2 inch
Variations from horizontal lines	
In 10 feet	1/4 inch
In 20 feet	3/8 inch
In 40 feet or more	1/2 inch
Variations in cross sectional dimensions of columns and in thickness of walls	
Minus	1/4 inch
Plus	1/2 inch

3.2.6 Cutting and Fitting

Full units of the proper size shall be used wherever possible, in lieu of cut units. Cutting and fitting, including that required to accommodate the work of others, shall be done by masonry mechanics using power masonry saws. Concrete masonry units may be wet or dry cut. Wet cut units, before being placed in the work, shall be dried to the same surface-dry appearance as uncut units being laid in the wall. Cut edges shall be clean, true and sharp. Openings in the masonry shall be made carefully so that wall plates, cover plates or escutcheons required by the installation will completely conceal the openings and will have bottoms parallel with the masonry bed joints. Reinforced masonry lintels shall be provided above openings over 12 inches wide for pipes, ducts, cable trays, and other wall penetrations, unless steel sleeves are used.

3.2.7 Jointing

Joints shall be tooled when the mortar is thumbprint hard. Horizontal joints shall be tooled last. Joints shall be brushed to remove all loose and excess mortar. Mortar joints shall be finished as follows:

3.2.7.1 Flush Joints

Joints in concealed masonry surfaces and joints at electrical outlet boxes in wet areas shall be flush cut. Flush cut joints shall be made by cutting off the mortar flush with the face of the wall. Joints in unparged masonry walls below grade shall be pointed tight. Flush joints for architectural units, such as fluted units, shall completely fill both the head and bed joints.

3.2.7.2 Tooled Joints

Joints in exposed exterior and interior masonry surfaces shall be tooled slightly concave. Joints shall be tooled with a jointer slightly larger than the joint width so that complete contact is made along the edges of the unit. Tooling shall be performed so that the mortar is compressed and the joint surface is sealed. Jointer of sufficient length shall be used to obtain a straight and true mortar joint.

3.2.7.3 Door and Window Frame Joints

On the exposed interior side of exterior frames, joints between frames and abutting masonry walls shall be raked to a depth of 3/8 inch. On the exterior side of exterior frames, joints between frames and abutting masonry walls shall be raked to a depth of 3/8 inch.

3.2.8 Joint Widths

Joint widths shall be as follows:

3.2.8.1 Concrete Masonry Units

Concrete masonry units shall have 3/8 inch joints.

3.2.8.2 Brick

Brick joint widths shall be the difference between the actual and nominal dimensions of the brick in either height or length. Brick expansion joint widths shall be as shown.

3.2.9 Embedded Items

Spaces around built-in items shall be filled with mortar. Openings around flush-mount electrical outlet boxes in wet locations shall be pointed with mortar. Anchors, ties, wall plugs, accessories, flashing, pipe sleeves and other items required to be built-in shall be embedded as the masonry work progresses. Anchors, ties and joint reinforcement shall be fully embedded in the mortar. Cells receiving anchor bolts and cells of the first course below bearing plates shall be filled with grout.

3.2.10 Unfinished Work

Unfinished work shall be stepped back for joining with new work. Toothing may be resorted to only when specifically approved. Loose mortar shall be removed and the exposed joints shall be thoroughly cleaned before laying new work.

3.2.11 Masonry Wall Intersections

Each course shall be masonry bonded at corners and elsewhere as shown. Masonry walls shall be anchored or tied together at corners and intersections with bond beam reinforcement and prefabricated corner or tee pieces of joint reinforcement as shown.

3.3 ANCHORED VENEER CONSTRUCTION

The inner and outer wythes shall be completely separated by a continuous airspace as shown on the drawings. Both the inner and the outer wythes shall be laid up together except when adjustable joint reinforcement assemblies are approved for use. When both wythes are not brought up together, through-wall flashings shall be protected from damage until they are fully enclosed in the wall. The airspace between the wythes shall be kept clear and free of mortar droppings by temporary wood strips laid on the wall ties and carefully lifted out before placing the next row of ties. A coarse gravel or drainage material shall be placed behind the weep holes in the cavity to a minimum depth of 4 inches of coarse aggregate or 10 inches of drainage material to keep mortar droppings from plugging the weep holes.

3.4 WEEP HOLES

Wherever through-wall flashing occurs, provide weep holes to drain flashing to exterior. Weep holes shall be provided not more than 24 inches on centers in mortar joints of the exterior wythe above wall flashing, over foundations, bond beams, and any other horizontal interruptions of the cavity. Weep holes shall be formed by placing short lengths of well-greased No. 10, 5/16 inch nominal diameter, braided cotton sash cord in the mortar. Other approved methods may be used for providing weep holes. Weep holes shall be kept free of mortar and other obstructions.Weep cords shall extend beyond the veneer exterior surface 1/2 inch and shall extend up within the cavity space a minimum dimension of 20 inches. Top end of weep cord shall be securely held in place to maintain vertical placement.

3.5 COMPOSITE WALLS

Masonry wythes shall be tied together with joint reinforcement. The facing wythe shall be anchored or tied to the backup at a maximum spacing of 16

inches on center vertically and 24 inches on center horizontally. Ties shall not extend through control joints. Collar joints between masonry facing and masonry backup shall be filled solidly with grout.

3.6 CAVITY DRAINAGE NET INSTALLATION

Install in cavities at base of wall, above lintels and at other locations in same as through-wall flashing and weep holes with bottom strip resting continuously on through-wall flashing. Use multiple layers as necessary to fill cavity completely with mesh touching both outer wyhte of masonry and inner face of cavity insulation. Align trapezoidal shapes of drainage in multiple layers.

3.7 RUBBERIZED WALL MEMBRANE INSTALLATION

Fully bond to substrate to achieve a waterproof, air tight barrier. Substrate surface shall be smooth, clean, dry and free of voids, spalled areas, loose aggregate, loose nails, sharp protrusions or other matter that will hinder the adhesion or regularity of the installation. Prepare surface with conditioner or primer as recommended by manufacturer. Apply mastic for sealing patches, terminations, and at brick ties and similar penetrations in accordance with manufacturer's instructions. Coordinate application with installation of brick ties and flashing. Apply wall membranes horizontally to primed blockwork with projecting masonry ties, beginning at the base of each wall with subsequent sheets overlapping sheet below minimum 2 inches. Cut the membrane at the location of the tie wires and lay sheets in place in accordance with manufacturer's printed instructions. End laps shall be a minimum of 4 inches. Roll or firmly press to adhere membrane to substrate, Apply mastic to seal around tie wire projections; flash other projections with a second ply of membrane and mastic. Finish exposed, terminated edges of membrane with a troweled bead of mastic. Apply mastic along top edge of membrane at end of each work day. Install membrane where indicated on drawings to achieve a complete air barrier at masonry cavity walls and metal panel rain screen walls.

3.8 MORTAR

Mortar shall be mixed in a mechanically operated mortar mixer for at least 3 minutes, but not more than 5 minutes. Measurement of ingredients for mortar shall be by volume. Ingredients not in containers, such as sand, shall be accurately measured by the use of measuring boxes. Water shall be mixed with the dry ingredients in sufficient amount to provide a workable mixture which will adhere to the vertical surfaces of masonry units. Mortar that has stiffened because of loss of water through evaporation shall be retempered by adding water to restore the proper consistency and workability. Mortar that has reached its initial set or that has not been used within 2-1/2 hours after mixing shall be discarded.

3.9 REINFORCING STEEL

Reinforcement shall be cleaned of loose, flaky rust, scale, grease, mortar, grout, or other coating which might destroy or reduce its bond prior to placing grout. Bars with kinks or bends not shown on the drawings shall not be used. Reinforcement shall be placed prior to grouting. Unless otherwise indicated, vertical wall reinforcement shall extend to within 2 inches of tops of walls.

3.9.1 Positioning Bars

Vertical bars shall be accurately placed within the cells at the positions indicated on the drawings. A minimum clearance of 1/2 inch shall be maintained between the bars and masonry units. Minimum clearance between parallel bars shall be one diameter of the reinforcement. Vertical reinforcing may be held in place using bar positioners located near the ends of each bar and at intermediate intervals of not more than 192 diameters of the reinforcement. Column and pilaster ties shall be wired in position around the vertical steel. Ties shall be in contact with the vertical reinforcement and shall not be placed in horizontal bed joints.

3.9.2 Splices

Bars shall be lapped a minimum of 48 diameters of the reinforcement. Welded or mechanical connections shall develop at least 125 percent of the specified yield strength of the reinforcement.

3.10 JOINT REINFORCEMENT INSTALLATION

Joint reinforcement shall be installed at 16 inches on center or as indicated. Reinforcement shall be lapped not less than 6 inches. Prefabricated sections shall be installed at corners and wall intersections. The longitudinal wires of joint reinforcement shall be placed to provide not less than 5/8 inch cover to either face of the unit.

3.11 PLACING GROUT

Cells containing reinforcing bars shall be filled with grout. Hollow masonry units in walls or partitions supporting plumbing, heating, or other mechanical fixtures, voids at door and window jambs, and other indicated spaces shall be filled solid with grout. Cells under lintel bearings on each side of openings shall be filled solid with grout for full height of openings. Walls below grade, lintels, and bond beams shall be filled solid with grout. Units other than open end units may require grouting each course to preclude voids in the units. Grout not in place within 1-1/2 hours after water is first added to the batch shall be discarded. Sufficient time shall be allowed between grout lifts to preclude displacement or cracking of face shells of masonry units. If blowouts, flowouts, misalignment, or cracking of face shells should occur during construction, the wall shall be torn down and rebuilt.

3.11.1 Vertical Grout Barriers for Fully Grouted Walls

Grout barriers shall be provided not more than 30 feet apart, or as required, to limit the horizontal flow of grout for each pour.

3.11.2 Horizontal Grout Barriers

Grout barriers shall be embedded in mortar below cells of hollow units receiving grout.

3.11.3 Cleanouts

3.11.3.1 Cleanouts for Hollow Unit Masonry Construction

Cleanout holes shall be provided at the bottom of every pour in cores containing vertical reinforcement when the height of the grout pour exceeds 5 feet. Where all cells are to be grouted, cleanout courses shall be

constructed using bond beam units in an inverted position to permit cleaning of all cells. Cleanout holes shall be provided at a maximum spacing of 32 inches where all cells are to be filled with grout. A new series of cleanouts shall be established if grouting operations are stopped for more than 4 hours. Cleanouts shall not be less than 3 by 4 inch openings cut from one face shell. Manufacturer's standard cutout units may be used at the Contractor's option. Cleanout holes shall not be closed until masonry work, reinforcement, and final cleaning of the grout spaces have been completed and inspected. For walls which will be exposed to view, cleanout holes shall be closed in an approved manner to match surrounding masonry.

3.11.4 Grouting Equipment

3.11.4.1 Grout Pumps

Pumping through aluminum tubes will not be permitted. Pumps shall be operated to produce a continuous stream of grout without air pockets, segregation, or contamination. Upon completion of each day's pumping, waste materials and debris shall be removed from the equipment, and disposed of outside the masonry.

3.11.4.2 Vibrators

Internal vibrators shall maintain a speed of not less than 5,000 impulses per minute when submerged in the grout. At least one spare vibrator shall be maintained at the site at all times. Vibrators shall be applied at uniformly spaced points not further apart than the visible effectiveness of the machine. Duration of vibration shall be limited to time necessary to produce satisfactory consolidation without causing segregation.

3.11.5 Grout Placement

Masonry shall be laid to the top of a pour before placing grout. Grout shall not be placed in hollow unit masonry until mortar joints have set for at least 24 hours. Grout shall be placed using a hand bucket, concrete hopper, or grout pump to completely fill the grout spaces without segregation of the aggregates. Vibrators shall not be inserted into lower pours that are in a semi-solidified state. The height of grout pours and type of grout used shall be limited by the dimensions of grout spaces as indicated in Table III. Low-lift grout methods may be used on pours up to and including 5 feet in height. High-lift grout methods shall be used on pours exceeding 5 feet in height.

3.11.5.1 Low-Lift Method

Grout shall be placed at a rate that will not cause displacement of the masonry due to hydrostatic pressure of the grout. Mortar protruding more than 1/2 inch into the grout space shall be removed before beginning the grouting operation. Grout pours 12 inches or less in height shall be consolidated by mechanical vibration or by puddling. Grout pours over 12 inches in height shall be consolidated by mechanical vibration and reconsolidated by mechanical vibration after initial water loss and settlement has occurred. Vibrators shall not be inserted into lower pours that are in a semi-solidified state. Low-lift grout shall be used subject to the limitations of Table III.

3.11.5.2 High-Lift Method

Mortar droppings shall be cleaned from the bottom of the grout space and from reinforcing steel. Mortar protruding more than 1/4 inch into the grout space shall be removed by dislodging the projections with a rod or stick as the work progresses. Reinforcing, bolts, and embedded connections shall be rigidly held in position before grouting is started. CMU units shall not be pre-wetted. Grout, from the mixer to the point of deposit in the grout space shall be placed as rapidly as practical by pumping and placing methods which will prevent segregation of the mix and cause a minimum of grout splatter on reinforcing and masonry surfaces not being immediately encased in the grout lift. The individual lifts of grout shall be limited to 4 feet in height. The first lift of grout shall be placed to a uniform height within the pour section and vibrated thoroughly to fill all voids. This first vibration shall follow immediately behind the pouring of the grout using an approved mechanical vibrator. After a waiting period sufficient to permit the grout to become plastic, but before it has taken any set, the succeeding lift shall be poured and vibrated 12 to 18 inches into the preceding lift. If the placing of the succeeding lift is going to be delayed beyond the period of workability of the preceding, each lift shall be reconsolidated by reworking with a second vibrator as soon as the grout has taken its settlement shrinkage. The waiting, pouring, and reconsolidation steps shall be repeated until the top of the pour is reached. The top lift shall be reconsolidated after the required waiting period. The high-lift grouting of any section of wall between vertical grout barriers shall be completed to the top of a pour in one working day unless a new series of cleanout holes is established and the resulting horizontal construction joint cleaned. High-lift grout shall be used subject to the limitations in Table III.

TABLE III

POUR HEIGHT AND TYPE OF GROUT FOR VARIOUS GROUT SPACE DIMENSIONS

Maximum Grout Pour Height (feet) (4)	Grout Type	Grouting Procedure	Minimum Dimensions of the Total Clear Areas Within Grout Spaces and Cells (in.) (1,2) Multiwythe Masonry (3)	Hollow-unit Masonry
1	Fine	Low Lift	3/4	1-1/2 x 2
5	Fine	Low Lift	2	2 x 3
8	Fine	High Lift	2	2 x 3
12	Fine	High Lift	2-1/2	2-1/2 x 3
24	Fine	High Lift	3	3 x 3
1	Coarse	Low Lift	1-1/2	1-1/2 x 3
5	Coarse	Low Lift	2	2-1/2 x 3
8	Coarse	High Lift	2	3 x 3
12	Coarse	High Lift	2-1/2	3 x 3
24	Coarse	High Lift	3	3 x 4

Notes:

(1) The actual grout space or cell dimension must be larger than the sum of the following items:
a) The required minimum dimensions of total clear areas given in the table above;
b) The width of any mortar projections within the space;

c) The horizontal projections of the diameters of the horizontal reinforcing bars within a cross section of the grout space or cell.

(2) The minimum dimensions of the total clear areas shall be made up of one or more open areas, with at least one area being 3/4 inch or greater in width.

(3) For grouting spaces between masonry wythes.

(4) Where only cells of hollow masonry units containing reinforcement are grouted, the maximum height of the pour shall not exceed the distance between horizontal bond beams.

3.12 BOND BEAMS

Bond beams shall be filled with grout and reinforced as indicated on the drawings. Grout barriers shall be installed under bond beam units to retain the grout as required. Reinforcement shall be continuous, including around corners, except through control joints or expansion joints, unless otherwise indicated on the drawings. Where splices are required for continuity, reinforcement shall be lapped 48 bar diameters. A minimum clearance of 1/2 inch shall be maintained between reinforcement and interior faces of units.

3.13 CONTROL JOINTS

Control joints shall be provided as indicated and shall be constructed by using sash jamb units with control joint key in accordance with the details shown on the drawings. Sash jamb units shall have a 3/4 by 3/4 inch groove near the center at end of each unit. The vertical mortar joint at control joint locations shall be continuous, including through all bond beams. This shall be accomplished by utilizing half blocks in alternating courses on each side of the joint. The control joint key shall be interrupted in courses containing continuous bond beam steel. In single wythe exterior masonry walls, the exterior control joints shall be raked to a depth of 3/4 inch; backer rod and sealant shall be installed in accordance with Section 07920 JOINT SEALANTS. Exposed interior control joints shall be raked to a depth of 1/4 inch. Concealed control joints shall be flush cut.

3.14 BRICK EXPANSION JOINTS

Brick expansion joints shall be provided and constructed as shown on the drawings. Joints shall be kept free of mortar and other debris.

3.15 SHELF ANGLES

Shelf angles shall be adjusted as required to keep the masonry level and at the proper elevation. Shelf angles shall be galvanized. Shelf angles shall be provided in sections not longer than 10 feet and installed with a 1/4 inch gap between sections. Shelf angles shall be mitered and welded at building corners with each angle not shorter than 4 feet, unless limited by wall configuration.

3.16 LINTELS

3.16.1 Masonry Lintels

Masonry lintels shall be constructed with lintel units filled solid with grout in all courses and reinforced with a minimum of two No. 4 bars in the

bottom course unless otherwise indicated on the drawings. Lintel reinforcement shall extend beyond each side of masonry opening 40 bar diameters or 24 inches, whichever is greater. Reinforcing bars shall be supported in place prior to grouting and shall be located 1/2 inch above the bottom inside surface of the lintel unit.

3.16.2 Steel Lintels

Steel lintels shall be as shown on the drawings. Lintels shall be set in a full bed of mortar with faces plumb and true. Steel lintels shall have a minimum bearing length of 8 inches unless otherwise indicated on the drawings.

3.17 ANCHORAGE TO STRUCTURAL STEEL

Masonry shall be anchored to vertical structural steel framing with adjustable steel wire anchors spaced not over 16 inches on centers vertically, and if applicable, not over 24 inches on centers horizontally.

3.18 INSULATION

Anchored veneer walls shall be insulated, where shown, by installing board-type insulation on the cavity side of the inner wythe. Board type insulation shall be applied directly to the masonry or thru-wall flashing with adhesive. Insulation shall be neatly fitted between obstructions without impaling of insulation on ties or anchors. The insulation shall be applied in parallel courses with vertical joints breaking midway over the course below and shall be applied in moderate contact with adjoining units without forcing, and shall be cut to fit neatly against adjoining surfaces.

3.19 SPLASH BLOCKS

Splash blocks shall be located as shown.

3.20 CAST STONE ITEMS

Cast stone sills shall be built into the masonry veneer where indicated.

3.21 POINTING AND CLEANING

After mortar joints have attained their initial set, but prior to hardening, mortar and grout daubs or splashings shall be completely removed from masonry-unit surfaces that will be exposed or painted. Before completion of the work, defects in joints of masonry to be exposed or painted shall be raked out as necessary, filled with mortar, and tooled to match existing joints. Immediately after grout work is completed, scum and stains which have percolated through the masonry work shall be removed using a high pressure stream of water and a stiff bristled brush. Masonry surfaces shall not be cleaned, other than removing excess surface mortar, until mortar in joints has hardened. Masonry surfaces shall be left clean, free of mortar daubs, dirt, stain, and discoloration, including scum from cleaning operations, and with tight mortar joints throughout. Metal tools and metal brushes shall not be used for cleaning.

3.21.1 Concrete Masonry Unit Surfaces

Exposed concrete masonry unit surfaces shall be dry-brushed at the end of each day's work and after any required pointing, using stiff-fiber bristled brushes.

3.21.2 Clay or Shale Brick Surfaces

Exposed clay or shale brick masonry surfaces shall be cleaned as necessary to obtain surfaces free of stain, dirt, mortar and grout daubs, efflorescence, and discoloration or scum from cleaning operations. After cleaning, the sample panel of similar material shall be examined for discoloration or stain as a result of cleaning. If the sample panel is discolored or stained, the method of cleaning shall be changed to assure that the masonry surfaces in the structure will not be adversely affected. The exposed masonry surfaces shall be water-soaked and then cleaned with a solution proportioned 1/2 cup trisodium phosphate and 1/2 cup laundry detergent to one gallon of water or cleaned with a proprietary masonry cleaning agent specifically recommended for the color and texture by the clay products manufacturer. The solution shall be applied with stiff fiber brushes, followed immediately by thorough rinsing with clean water. Proprietary cleaning agents shall be used in conformance with the cleaning product manufacturer's printed recommendations. Efflorescence shall be removed in conformance with the brick manufacturer's recommendations.

3.22 BEARING PLATES

Bearing plates for beams, joists, joist girders and similar structural members shall be set to the proper line and elevation with damp-pack bedding mortar, except where non-shrink grout is indicated. Bedding mortar and non-shrink grout shall be as specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE.

3.23 PROTECTION

Facing materials shall be protected against staining. Top of walls shall be covered with nonstaining waterproof covering or membrane when work is not in progress. Covering of the top of the unfinished walls shall continue until the wall is waterproofed with a complete roof or parapet system. Covering shall extend a minimum of 2 feet down on each side of the wall and shall be held securely in place. Before starting or resuming, top surface of masonry in place shall be cleaned of loose mortar and foreign material.

3.24 TEST REPORTS

3.24.1 Field Testing of Mortar

At least three specimens of mortar shall be taken each day. A layer of mortar 1/2 to 5/8 inch thick shall be spread on the masonry units and allowed to stand for one minute. The specimens shall then be prepared and tested for compressive strength in accordance with ASTM C 780.

3.24.2 Field Testing of Grout

Field sampling and testing of grout shall be in accordance with the applicable provisions of ASTM C 1019. A minimum of three specimens of grout per grout pour shall be sampled and tested. Each specimen shall have a minimum ultimate compressive strength of 2000 psi at 28 days.

3.24.3 Efflorescence Test

Brick which will be exposed to weathering shall be tested for efflorescence. Tests shall be scheduled far enough in advance of starting

masonry work to permit retesting if necessary. Sampling and testing shall conform to the applicable provisions of ASTM C 67. Units meeting the definition of "effloresced" will be subject to rejection.

3.24.4 Prism Tests

At least one prism test sample shall be made for each 5,000 square feet of wall but not less than three such samples shall be made for any building. Three prisms shall be used in each sample. Prisms shall be tested in accordance with ACI 530/530.1. Seven-day tests may be used provided the relationship between the 7- and 28-day strengths of the masonry is established by the tests of the materials used. Compressive strength shall not be less than 1500 psi at 28 days. If the compressive strength of any prism falls below the specified value by more than 500 psi, steps shall be taken to assure that the load-carrying capacity of the structure is not jeopardized. If the likelihood of low-strength masonry is confirmed and computations indicate that the load-carrying capacity may have been significantly reduced, tests of cores drilled, or prisms sawed, from the area in question may be required. In such case, three specimens shall be taken for each prism test more than 500 psi below the specified value. Masonry in the area in question shall be considered structurally adequate if the average compressive strength of three specimens is equal to at least 85 percent of the specified value, and if the compressive strength of no single specimen is less than 75 percent of the specified value. Additional testing of specimens extracted from locations represented by erratic core or prism strength test results shall be permitted.

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SECTION 05090A

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SECTION 05090A

WELDING, STRUCTURAL
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PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 335	(1989) Structural Steel Buildings Allowable Stress Design and Plastic Design

AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

ASNT RP SNT-TC-1A	(2001) Recommended Practice

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4	(1998) Standard Symbols for Welding, Brazing and Nondestructive Examination
AWS A3.0	(2001) Standard Welding Terms and Definitions
AWS D1.1/D1.1M	(2002) Structural Welding Code - Steel
AWS Z49.1	(1999) Safety in Welding, Cutting and Allied Processes

1.2 DEFINITIONS

Definitions of welding terms shall be in accordance with AWS A3.0.

1.3 GENERAL REQUIREMENTS

The design of welded connections shall conform to AISC 335 unless otherwise indicated or specified. Material with welds will not be accepted unless the welding is specified or indicated on the drawings or otherwise approved. Welding shall be as specified in this section, except where additional requirements are shown on the drawings or are specified in other sections. Welding shall not be started until welding procedures, inspectors, nondestructive testing personnel, welders, welding operators, and tackers have been qualified and the submittals approved by the Contracting Officer. Qualification testing shall be performed at or near the work site. Each Contractor performing welding shall maintain records of the test results obtained in welding procedure, welder, welding operator, and tacker performance qualifications.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Welding Procedure Qualifications; G-AE
Welder, Welding Operator, and Tacker Qualification
Inspector Qualification
Previous Qualifications
Prequalified Procedures

Copies of the welding procedure specifications; the procedure qualification test records; and the welder, welding operator, or tacker qualification test records.

SD-06 Test Reports

Quality Control

A quality assurance plan and records of tests and inspections.

1.5 WELDING PROCEDURE QUALIFICATIONS

Except for prequalified (per AWS D1.1/D1.1M) and previously qualified procedures, each Contractor performing welding shall record in detail and shall qualify the welding procedure specification for any welding procedure followed in the fabrication of weldments. Qualification of welding procedures shall conform to AWS D1.1/D1.1M and to the specifications in this section. Copies of the welding procedure specification and the results of the procedure qualification test for each type of welding which requires procedure qualification shall be submitted for approval. Approval of any procedure, however, will not relieve the Contractor of the sole responsibility for producing a finished structure meeting all the requirements of these specifications. This information shall be submitted on the forms in Appendix E of AWS D1.1/D1.1M. Welding procedure specifications shall be individually identified and shall be referenced on the detail drawings and erection drawings, or shall be suitably keyed to the contract drawings. In case of conflict between this specification and AWS D1.1/D1.1M, this specification governs.

1.5.1 Previous Qualifications

Welding procedures previously qualified by test may be accepted for this contract without requalification if the following conditions are met:

a. Testing was performed by an approved testing laboratory, technical consultant, or the Contractor's approved quality control organization.

b. The qualified welding procedure conforms to the requirements of this specification and is applicable to welding conditions encountered under this contract.

c. The welder, welding operator, and tacker qualification tests

conform to the requirements of this specification and are applicable to welding conditions encountered under this contract.

1.5.2 Prequalified Procedures

Welding procedures which are considered prequalified as specified in AWS D1.1/D1.1M will be accepted without further qualification. The Contractor shall submit for approval a listing or an annotated drawing to indicate the joints not prequalified. Procedure qualification shall be required for these joints.

1.5.3 Retests

If welding procedure fails to meet the requirements of AWS D1.1/D1.1M, the procedure specification shall be revised and requalified, or at the Contractor's option, welding procedure may be retested in accordance with AWS D1.1/D1.1M. If the welding procedure is qualified through retesting, all test results, including those of test welds that failed to meet the requirements, shall be submitted with the welding procedure.

1.6 WELDER, WELDING OPERATOR, AND TACKER QUALIFICATION

Each welder, welding operator, and tacker assigned to work on this contract shall be qualified in accordance with the applicable requirements of AWS D1.1/D1.1M and as specified in this section. Welders, welding operators, and tackers who make acceptable procedure qualification test welds will be considered qualified for the welding procedure used.

1.6.1 Previous Personnel Qualifications

At the discretion of the Contracting Officer, welders, welding operators, and tackers qualified by test within the previous 6 months may be accepted for this contract without requalification if all the following conditions are met:

a. Copies of the welding procedure specifications, the procedure qualification test records, and the welder, welding operator, and tacker qualification test records are submitted and approved in accordance with the specified requirements for detail drawings.

b. Testing was performed by an approved testing laboratory, technical consultant, or the Contractor's approved quality control organization.

c. The previously qualified welding procedure conforms to the requirements of this specification and is applicable to welding conditions encountered under this contract.

d. The welder, welding operator, and tacker qualification tests conform to the requirements of this specification and are applicable to welding conditions encountered under this contract.

1.6.2 Certificates

Before assigning any welder, welding operator, or tacker to work under this contract, the Contractor shall submit the names of the welders, welding operators, and tackers to be employed, and certification that each individual is qualified as specified. The certification shall state the type of welding and positions for which the welder, welding operator, or tacker is qualified, the code and procedure under which the individual is

qualified, the date qualified, and the name of the firm and person certifying the qualification tests. The certification shall be kept on file, and 3 copies shall be furnished. The certification shall be kept current for the duration of the contract.

1.6.3 Renewal of Qualification

Requalification of a welder or welding operator shall be required under any of the following conditions:

a. It has been more than 6 months since the welder or welding operator has used the specific welding process for which he is qualified.

b. There is specific reason to question the welder or welding operator's ability to make welds that meet the requirements of these specifications.

c. The welder or welding operator was qualified by an employer other than those firms performing work under this contract, and a qualification test has not been taken within the past 12 months. Records showing periods of employment, name of employer where welder, or welding operator, was last employed, and the process for which qualified shall be submitted as evidence of conformance.

d. A tacker who passes the qualification test shall be considered eligible to perform tack welding indefinitely in the positions and with the processes for which he is qualified, unless there is some specific reason to question the tacker's ability. In such a case, the tacker shall be required to pass the prescribed tack welding test.

1.7 INSPECTOR QUALIFICATION

Inspector qualifications shall be in accordance with AWS D1.1/D1.1M. Nondestructive testing personnel shall be qualified in accordance with the requirements of ASNT RP SNT-TC-1A for Levels I or II in the applicable nondestructive testing method. The inspector may be supported by assistant welding inspectors who are not qualified to ASNT RP SNT-TC-1A, and assistant inspectors may perform specific inspection functions under the supervision of the qualified inspector.

1.8 SYMBOLS

Symbols shall be in accordance with AWS A2.4, unless otherwise indicated.

1.9 SAFETY

Safety precautions during welding shall conform to AWS Z49.1.

PART 2 PRODUCTS

2.1 WELDING EQUIPMENT AND MATERIALS

All welding equipment, electrodes, welding wire, and fluxes shall be capable of producing satisfactory welds when used by a qualified welder or welding operator performing qualified welding procedures. All welding equipment and materials shall comply with the applicable requirements of AWS D1.1/D1.1M.

PART 3 EXECUTION

3.1 WELDING OPERATIONS

3.1.1 Requirements

Workmanship and techniques for welded construction shall conform to the requirements of AWS D1.1/D1.1M and AISC 335. When AWS D1.1/D1.1M and the AISC 335 specification conflict, the requirements of AWS D1.1/D1.1M shall govern.

3.1.2 Identification

Welds shall be identified in one of the following ways:

a. Written records shall be submitted to indicate the location of welds made by each welder, welding operator, or tacker.

b. Each welder, welding operator, or tacker shall be assigned a number, letter, or symbol to identify welds made by that individual. The Contracting Officer may require welders, welding operators, and tackers to apply their symbol next to the weld by means of rubber stamp, felt-tipped marker with waterproof ink, or other methods that do not cause an indentation in the metal. For seam welds, the identification mark shall be adjacent to the weld at 3 foot intervals. Identification with die stamps or electric etchers shall not be allowed.

3.2 QUALITY CONTROL

Testing shall be done by an approved inspection or testing laboratory or technical consultant; or if approved, the Contractor's inspection and testing personnel may be used instead of the commercial inspection or testing laboratory or technical consultant. The Contractor shall perform visual ultrasonic, inspection to determine conformance with paragraph STANDARDS OF ACCEPTANCE. Procedures and techniques for inspection shall be in accordance with applicable requirements of AWS D1.1/D1.1M, except that in radiographic inspection only film types designated as "fine grain," or "extra fine," shall be employed.

3.3 STANDARDS OF ACCEPTANCE

Dimensional tolerances for welded construction, details of welds, and quality of welds shall be in accordance with the applicable requirements of AWS D1.1/D1.1M and the contract drawings. Nondestructive testing shall be by visual inspection ultrasonic methods. The minimum extent of nondestructive testing shall be random 15 percent of welds or joints, as indicated on the drawings.

3.3.1 Nondestructive Examination

The welding shall be subject to inspection and tests in the mill, shop, and field. Inspection and tests in the mill or shop will not relieve the Contractor of the responsibility to furnish weldments of satisfactory quality. When materials or workmanship do not conform to the specification requirements, the Government reserves the right to reject material or workmanship or both at any time before final acceptance of the structure containing the weldment.

3.3.2 Destructive Tests

When metallographic specimens are removed from any part of a structure, the Contractor shall make repairs. The Contractor shall employ qualified welders or welding operators, and shall use the proper joints and welding procedures, including peening or heat treatment if required, to develop the full strength of the members and joints cut and to relieve residual stress.

3.4 GOVERNMENT INSPECTION AND TESTING

In addition to the inspection and tests performed by the Contractor for quality control, the Government will perform inspection and testing for acceptance to the extent determined by the Contracting Officer. The costs of such inspection and testing will be borne by the Contractor if unsatisfactory welds are discovered, or by the Government if the welds are satisfactory. The work may be performed by the Government's own forces or under a separate contract for inspection and testing. The Government reserves the right to perform supplemental nondestructive and destructive tests to determine compliance with paragraph STANDARDS OF ACCEPTANCE.

3.5 CORRECTIONS AND REPAIRS

When inspection or testing indicates defects in the weld joints, the welds shall be repaired using a qualified welder or welding operator as applicable. Corrections shall be in accordance with the requirements of AWS D1.1/D1.1M and the specifications. Defects shall be repaired in accordance with the approved procedures. Defects discovered between passes shall be repaired before additional weld material is deposited. Wherever a defect is removed and repair by welding is not required, the affected area shall be blended into the surrounding surface to eliminate sharp notches, crevices, or corners. After a defect is thought to have been removed, and before rewelding, the area shall be examined by suitable methods to ensure that the defect has been eliminated. Repair welds shall meet the inspection requirements for the original welds. Any indication of a defect shall be regarded as a defect, unless reevaluation by nondestructive methods or by surface conditioning shows that no unacceptable defect is present.

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SECTION 05120

STRUCTURAL STEEL
08/03

PART 4 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC FCD	(1995a) Quality Certification Program Description
AISC 810	(1997) Erection Bracing of Low-Rise Structural Steel Frames
AISC 316	(1989) ASD Manual of Steel Construction
AISC 317	(1992; Errata 1994) Connections
AISC 326	(2002) Detailing for Steel Construction
AISC 303	(2000) Steel Buildings and Bridges
AISC 348	(2000) Structural Joints Using ASTM A325 or A490 Bolts
AISC 335	(1989) Structural Steel Buildings Allowable Stress Design and Plastic Design
AISC S340	(1992) Metric Properties of Structural Shapes with Dimensions According to ASTM A6M

ASTM INTERNATIONAL (ASTM)

ASTM A 36/A 36M	(2001) Carbon Structural Steel
ASTM A 307	(2002) Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 325	(2002) Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A 490	(2002) Heat-Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength
ASTM A 500	(2001a) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

ASTM A 563	(2000) Carbon and Alloy Steel Nuts
ASTM A 992/A 992M	(2002) Structural Steel Shapes
ASTM C 827	(2001; Rev A) Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures
ASTM C 1107	(2002) Packaged Dry, Hydraulic-Cement Grout(Nonshrink)
ASTM F 436	(2002) Hardened Steel Washers
ASTM F 844	(2000) Washers, Steel, Plain (Flat), Unhardened for General Use

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4	(1998) Standard Symbols for Welding, Brazing and Nondestructive Examination
AWS D1.1/D1.1M	(2002) Structural Welding Code - Steel

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 3	(1982; R 2000) Power Tool Cleaning
SSPC SP 6	(2000) Commercial Blast Cleaning
SSPC Paint 25	(1997; R 2000) Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand Cleaned Steel, Type I and Type II
SSPC PA 1	(2000) Shop, Field, and Maintenance Painting
SSPC PS 13.01	(1982; R 2000) Epoxy-Polyamide Painting System

1.2 SYSTEM DESCRIPTION

Provide the structural steel system, including shop primer complete and ready for use. Structural steel systems including design, materials, installation, workmanship, fabrication, assembly, erection, inspection, quality control, and testing shall be provided in accordance with AISC 316 and AISC 317 except as modified in this contract.

1.3 MODIFICATIONS TO REFERENCES

In AISC 316, AISC 317, AISC 335, AISC 303, AISC 348, and AISC S340, except as modified in this section, shall be considered a part of AISC 316 and AISC 317 and is referred to in this section as AISC 316 and AISC 317.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as

otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Erection Plan, including description of temporary supports; G-AE

Fabrication drawings including description of connections; G-AE

SD-03 Product Data

Shop primer

Load indicator bolts

Include test report for Class B primer.

SD-06 Test Reports

Class B coating

Bolts, nuts, and washers

Supply the certified manufacturer's mill reports which clearly show the applicable ASTM mechanical and chemical requirements together with the actual test results for the supplied fasteners.

SD-07 Certificates

Steel

Bolts, nuts, and washers

Shop primer

Welding electrodes and rods

Nonshrink grout

Welding procedures and qualifications

1.5 QUALITY ASSURANCE

1.5.1 Drawing Requirements

Submit fabrication drawings for approval prior to fabrication. Prepare in accordance with AISC 326, AISC 316 and AISC 317. Drawings shall not be reproductions of contract drawings. Include complete information for the fabrication and erection of the structure's components, including the location, type, and size of bolts, welds, member sizes and lengths, connection details, blocks, copes, and cuts. Use AWS A2.4 standard welding symbols. Shoring and temporary bracing shall be designed and sealed by a registered professional engineer and submitted for record purposes, with calculations, as part of the drawings.

1.5.2 Certifications

1.5.2.1 Erection Plan

Submit for record purposes. Indicate the sequence of erection, temporary shoring and bracing, and a detailed sequence of welding, including each welding procedure required.

1.5.2.2 Welding Procedures and Qualifications

Prior to welding, submit certification for each welder stating the type of welding and positions qualified for, the code and procedure qualified under, date qualified, and the firm and individual certifying the qualification tests. If the qualification date of the welding operator is more than one-year old, the welding operator's qualification certificate shall be accompanied by a current certificate by the welder attesting to the fact that he has been engaged in welding since the date of certification, with no break in welding service greater than 6 months.

PART 2 PRODUCTS

2.1 STEEL

2.1.1 Structural Steel

ASTM A 36/A 36M.

2.1.2 High-Strength Structural Steel

2.1.2.1 Low-Alloy Steel

ASTM A 992/A 992M Grade 50.

2.1.3 Structural Shapes for Use in Building Framing

Wide flange shapes, ASTM A 992/A 992M.

2.1.4 Structural Steel Tubing

ASTM A 500, Grade B 46 KSI.

2.2 BOLTS, NUTS, AND WASHERS

Provide the following unless indicated otherwise.

2.2.1 High-Strength Structural Steel and Structural Steel Tubing

2.2.1.1 Bolts

ASTM A 325, Type 1 ASTM A 490, Type 1 or 2.

2.2.1.2 Nuts

ASTM A 563, Grade and Style as specified in the applicable ASTM bolt standard.

2.2.1.3 Washers

ASTM F 436, plain carbon steel.

2.2.2 Foundation Anchorage

2.2.2.1 Bolts

ASTM A 307.

2.2.2.2 Nuts

ASTM A 563, Grade A, hex style.

2.2.2.3 Washers

ASTM F 844.

2.2.3 Load Indicator Bolts

ASTM A 325, Type 1; with a manufactured notch between the bolt tip and threads. The bolt shall be designed to react to the opposing rotational torques applied by the installation wrench, with the bolt tip automatically shearing off when the proper tension is obtained.

2.3 STRUCTURAL STEEL ACCESSORIES

2.3.1 Welding Electrodes and Rods

AWS D1.1/D1.1M.

2.3.2 Nonshrink Grout

ASTM C 1107, with no ASTM C 827 shrinkage. Grout shall be nonmetallic.

2.3.3 Welded Shear Stud Connectors

AWS D1.1/D1.1M.

2.4 SHOP PRIMER

SSPC Paint 25, (alkyd primer) or SSPC PS 13.01 epoxy-polyamide, green primer (Form 150) type 1, except provide a Class B coating in accordance with AISC 316 and AISC 317 for slip critical joints. Primer shall conform to Federal, State, and local VOC regulations. If flash rusting occurs, re-clean the surface prior to application of primer.

2.5 FABRICATION

2.5.1 Markings

Prior to erection, members shall be identified by a painted erection mark. Connecting parts assembled in the shop for reaming holes in field connections shall be match marked with scratch and notch marks. Do not locate erection markings on areas to be welded. Do not locate match markings in areas that will decrease member strength or cause stress concentrations.

2.5.2 Shop Primer

Shop prime structural steel, except as modified herein, in accordance with SSPC PA 1. Do not prime steel surfaces embedded in concrete, surfaces designed as part of a composite steel concrete section, or surfaces within 0.5 inch of the toe of the welds prior to welding (except surfaces on which metal decking is to be welded). Slip critical surfaces shall be primed with a Class B coating. Prior to assembly, prime surfaces which will be concealed or inaccessible after assembly. Do not apply primer in foggy or rainy weather; when the ambient temperature is below 45 degrees F or over 95 degrees F; or when the primer may be exposed to temperatures below 40 degrees F within 48 hours after application, unless approved otherwise by the Contracting Officer.

2.5.2.1 Cleaning

SSPC SP 6, except steel exposed in spaces above ceilings, attic spaces, furred spaces, and chases that will be hidden to view in finished construction may be cleaned to SSPC SP 3 when recommended by the shop primer manufacturer. Maintain steel surfaces free from rust, dirt, oil, grease, and other contaminants through final assembly.

2.5.2.2 Primer

Apply primer to a minimum dry film thickness of 2.0 mil except provide the Class B coating for slip critical joints in accordance with the coating manufacturer's recommendations. Repair damaged primed surfaces with an additional coat of primer.

PART 3 EXECUTION

3.1 FABRICATION

Fabrication shall be in accordance with the applicable provisions of AISC 316. Fabrication and assembly shall be done in the shop to the greatest extent possible. Structural steelwork, except surfaces of steel to be encased in concrete, surfaces to be field welded, surfaces to be fireproofed, and contact surfaces of friction-type high-strength bolted connections shall be prepared for painting in accordance with endorsement "P" of AISC FCD and primed with the specified paint.

3.2 INSTALLATION

3.3 ERECTION

a. For low-rise structural steel buildings (60 feet tall or less and a maximum of 2 stories), the erection plan shall conform to AISC 303 and the structure shall be erected in accordance withAISC 810.

Provide for drainage in structural steel. After final positioning of steel members, provide full bearing under base plates and bearing plates using nonshrink grout. Place nonshrink grout in accordance with the manufacturer's instructions.

3.3.1 STORAGE

Material shall be stored out of contact with the ground in such manner and location as will minimize deterioration.

3.4 CONNECTIONS

Except as modified in this section, connections not detailed shall be designed in accordance with AISC 335. Build connections into existing work. Do not tighten anchor bolts set in concrete with impact torque wrenches. Punch, subpunch and ream, or drill bolt holes. Bolts, nuts, and washers shall be clean of dirt and rust, and lubricated immediately prior to installation.

3.4.1 Common Grade Bolts

ASTM A 307 bolts shall be tightened to a "snug tight" fit. "Snug tight" is the tightness that exists when plies in a joint are in firm contact. If firm contact of joint plies cannot be obtained with a few impacts of an impact wrench, or the full effort of a man using a spud wrench, contact the Contracting Officer for further instructions.

3.4.2 High-Strength Bolts

ASTM A 325 and ASTM A 490 bolts shall be fully tensioned to 70 percent of their minimum tensile strength. Provide load indicator bolts in all bolted connections. Direct tension indicator tightening, or installation of alternate design fasteners, shall be the only acceptable tightening methods. Bolts shall be installed in connection holes and initially brought to a snug tight fit. After the initial tightening procedure, bolts shall then be fully tensioned, progressing from the most rigid part of a connection to the free edges.

3.5 WELDING

AWS D1.1/D1.1M. Grind exposed welds smooth as indicated. Provide AWS D1.1/D1.1M qualified welders, welding operators, and tackers.

The contractor shall develop and submit the Welding Procedure Specifications (WPS) for all welding, including welding done using prequalified procedures. Prequalified procedures may be submitted for information only; however, procedures that are not prequalified shall be submitted for approval.

3.5.1 Removal of Temporary Welds, Run-Off Plates, and Backing Strips

Remove only from finished areas.

3.6 SHOP PRIMER REPAIR

Repair shop primer in accordance with the paint manufacturer's recommendation for surfaces damaged by handling, transporting, cutting, welding, or bolting.

3.6.1 Field Priming

Field priming of steel exposed to the weather, or located in building areas without HVAC for control of relative humidity. After erection, the field bolt heads and nuts, field welds, and any abrasions in the shop coat shall

be cleaned and primed with paint of the same quality as that used for the shop coat.

3.7 FIELD QUALITY CONTROL

Perform field tests, and provide labor, equipment, and incidentals required for testing. The Contracting Officer shall be notified in writing of defective welds, bolts, nuts, and washers within 7 working days of the date of weld inspection.

3.7.1 Welds

3.7.1.1 Visual Inspection

AWS D1.1/D1.1M. Furnish the services of AWS-certified welding inspectors for fabrication and erection inspection and testing and verification inspections. Welding inspectors shall visually inspect and mark welds, including fillet weld end returns.

3.7.1.2 Nondestructive Testing

AWS D1.1/D1.1M. Test locations shall be selected by the Contracting Officer. If more than 20 percent of welds made by a welder contain defects identified by testing, then all welds made by that welder shall be tested by radiographic or ultrasonic testing, as approved by the Contracting Officer. When all welds made by an individual welder are required to be tested, magnetic particle testing shall be used only in areas inaccessible to either radiographic or ultrasonic testing. Retest defective areas after repair.

a. Testing frequency: Provide the following types and number of tests:

Test Type	Number of Tests
Radiographic	30
Ultrasonic	50
Magnetic Particle	20
Dye Penetrant	

3.7.2 High-Strength Bolts

3.7.2.1 Testing Bolt, Nut, and Washer Assemblies

Test a minimum of 3 bolt, nut, and washer assemblies from each mill certificate batch in a tension measuring device at the job site prior to the beginning of bolting start-up. Demonstrate that the bolts and nuts, when used together, can develop tension not less than the provisions specified in AISC 348, Table 4, depending on bolt size and grade. The bolt tension shall be developed by tightening the nut. A representative of the manufacturer or supplier shall be present to ensure that the fasteners are properly used, and to demonstrate that the fastener assemblies supplied satisfy the specified requirements.

3.7.2.2 Inspection

Inspection procedures shall be in accordance with AISC 348, Section 9. Confirm and report to the Contracting Officer that the materials meet the project specification and that they are properly stored. Confirm that the faying surfaces have been properly prepared before the connections are assembled. Observe the specified job site testing and calibration, and confirm that the procedure to be used provides the required tension. Monitor the work to ensure the testing procedures are routinely followed on joints that are specified to be fully tensioned.

3.7.2.3 Testing

The Government has the option to perform nondestructive tests on 5 percent of the installed bolts to verify compliance with pre-load bolt tension requirements. The nondestructive testing will be done in-place using an ultrasonic measuring device or any other device capable of determining in-place pre-load bolt tension. The test locations shall be selected by the Contracting Officer. If more than 10 percent of the bolts tested contain defects identified by testing, then all bolts used from the batch from which the tested bolts were taken, shall be tested. Retest new bolts after installation.

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12/02

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SECTION 05210A

STEEL JOISTS
12/02

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

STEEL JOIST INSTITUTE (SJI)

SJI Specs & Tables	(August 2002) Standard Specifications and Load Tables for Steel Joists and Joist Girders

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Steel Joists; G-AE

Detail drawings shall include fabrication and erection details, specifications for shop painting, and identification markings of joists.

SD-07 Certificates

Steel Joists

Certificates stating that the steel joists have been designed and manufactured in accordance with SJI Specs & Tables. Complete engineering design computations may be submitted in lieu of the certification.

1.3 GENERAL REQUIREMENTS

Steel joists are designated on the drawings in accordance with the standard designations of the Steel Joist Institute. Joists of other standard designations or joists with properties other than those shown may be substituted for the joists designated provided the structural properties are equal to or greater than those of the joists shown and provided all other specified requirements are met.

1.4 DELIVERY AND STORAGE

Materials shall be delivered to the site in undamaged condition and stored off the ground in a well drained location, protected from damage, and easily accessible for inspection and handling.

PART 2 PRODUCTS

2.1 OPEN WEB STEEL JOISTS

Open web steel joists shall conform to SJI Specs & Tables, K-Series. Joists shall be designed to support the loads given in the standard load tables of SJI Specs & Tables.

2.2 LONGSPAN STEEL JOISTS

Longspan steel joists shall conform to SJI Specs & Tables, LH-Series. Joists designated LH shall be designed to support the loads given in the applicable standard load tables of SJI Specs & Tables.

2.3 ACCESSORIES AND FITTINGS

Accessories and fittings, including end supports and bridging, shall be in accordance with the standard specifications under which the members were designed.

2.4 SHOP PAINTING

Joists and accessories shall be shop painted with a rust-inhibiting primer paint. For joists which will be finish painted under Section 09900 PAINTING, GENERAL, the primer paint shall be limited to a primer which is compatible with the specified finish paint.

PART 3 EXECUTION

3.1 ERECTION

Installation of joists shall be in accordance with the standard specification under which the member was produced. Joists shall be handled in a manner to avoid damage. Damaged joists shall be removed from the site, except when field repair is approved and such repairs are satisfactorily made in accordance with the manufacturer's recommendations. Joists shall be accurately set, and end anchorage shall be in accordance with the standard specification under which the joists were produced. For spans over 40 ft through 60 ft one row of bridging nearest midspan shall be bolted diagonal bridging; for spans over 60 ft bolted diagonal bridging shall be used instead of welded horizontal bridging. Joist bridging and anchoring shall be secured in place prior to the application of any construction loads. Any temporary loads shall be distributed so that the carrying capacity of any joist is not exceeded. Loads shall not be applied to bridging during construction or in the completed work. Abraded, corroded, and field welded areas shall be cleaned and touched up with the same type of paint used in the shop painting.

3.2 BEARING PLATES

Bearing plates shall be provided with full bearing after the supporting members have been plumbed and properly positioned, but prior to placing superimposed loads. The area under the plate shall be damp-packed solidly with bedding mortar, except where nonshrink grout is indicated on the

drawings. Bedding mortar and grout shall be as specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE.

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SECTION 05310

STEEL DECKS
10/03

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 335	(1989) Structural Steel Buildings Allowable Stress Design and Plastic Design

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI SG-973	(1996) Cold-Formed Steel Design Manual

ASTM INTERNATIONAL (ASTM)

ASTM A 1008/A 1008M	(2002e1) Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
ASTM A 108	(1999) Steel Bars, Carbon, Cold-Finished, Standard Quality
ASTM A 653/A 653M	(2002a) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 780	(2001) Repair of Damaged and Uncoated Areas of Hot-Dipped Galvanized Coatings
ASTM A 792/A 792M	(2002) Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
ASTM A 924/A 924M	(1999) General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM C 423	(2002) Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2002) Structural Welding Code - Steel
AWS D1.3	(1998) Structural Welding Code - Sheet Steel

FM GLOBAL (FM)

FM DS 1-28	(2002) Design Wind Loads

STEEL DECK INSTITUTE (SDI)

SDI 30	(2001) Design Manual for Composite Decks, Form Decks, and Roof Decks
SDI DDM02	(1991) Diaphragm Design Manual
SDI DDP	(1987; R 2000) Deck Damages and Penetration
SDI MOC1	(1992) Manual of Construction with Steel Deck

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 20	(2002) Zinc-Rich Coating (Type I - "Inorganic" and Type II - "Organic")

UNDERWRITERS LABORATORIES (UL)

UL 580	(1994; Rev thru Feb 1998) Tests for Uplift Resistance of Roof Assemblies

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-310-01	(2000) Load Assumptions for Buildings

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fabrication Drawings; G-AE

SD-03 Product Data

Deck Units; G-AE

Sound Absorbing Material

Accessories

SD-05 Design Data

Deck Units; G-AE

Submit manufacturer's design calculations, or applicable published literature for the structural properties of the proposed deck units.

SD-07 Certificates

Deck Units

Accessories

Qualification of Welders

Wind Storm Resistance

1.3 QUALITY ASSURANCE

1.3.1 Deck Units

Deck units and accessories shall be products of a manufacturer regularly engaged in manufacture of steel decking. Provide a 2 sq ft. sample of decking material and each accessory to be used. Provide a sample of acoustical material to be used. Provide manufacturer's certificates attesting that the decking material meets the specified requirements.

1.3.2 Certification of Piston Tool Operator

Manufacturer's certificate attesting that the operators are authorized to use the low velocity piston tool.

1.3.3 Qualification of Welders

Provide welder qualification procedures, welder qualifications, and duration of qualification period in accordance with AWS D1.1/D1.1M and AWS D1.3.

1.3.4 Regulatory Requirements

1.3.4.1 Wind Storm Resistance

The roof construction assembly shall be capable of withstanding an uplift pressure of 60 pounds per square foot when tested in accordance with the uplift pressure test described in the FM DS 1-28 or as described in UL 580 and in general compliance with UFC 3-310-01.

1.3.5 Fabrication Drawings

Show type and location of units, location and sequence of connections, bearing on supports, methods of anchoring, attachment of accessories, adjusting plate details, size and location of holes to be cut and reinforcement to be provided, the manufacturer's erection instructions and other pertinent details.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver deck units to the site in a dry and undamaged condition. Store and handle steel deck in a manner to protect it from corrosion, deformation, and other types of damage. Do not use decking for storage or as working platform until units have been fastened into position. Exercise care not

to damage material or overload decking during construction. The maximum uniform distributed storage load shall not exceed the design live load. Stack decking on platforms or pallets and cover with weathertight ventilated covering. Elevate one end during storage to provide drainage. Maintain deck finish at all times to prevent formation of rust. Repair deck finish using touch-up paint. Replace damaged material.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Steel Sheet

Flat rolled carbon steel sheets of structural quality, thickness not less than indicated before coating, meeting the requirements of AISI SG-973, except as modified herein. For acoustical steel deck units, provide perforated sheets with 5/32 inch diameter holes staggered 3/8 inch on-centers.

2.1.2 Steel Coating

ASTM A 924/A 924M designation G90 galvanized. Apply coating to both sides of sheet.

2.1.3 Sound Absorbing Material

Provide glass fiber in roll or premolded form for acoustical noncellular steel roof deck in accordance with the manufacturer's standards.

2.2 ACCESSORIES

Provide accessories of same material as deck, unless specified otherwise. Provide manufacturer's standard type accessories, as specified.

2.2.1 Adjusting Plates

Provide adjusting plates, or segments of deck units, of same thickness and configuration as deck units in locations too narrow to accommodate full size units. Provide factory cut plates of predetermined size where possible.

2.2.2 End Closures

Fabricated of sheet metal by the deck manufacturer. Provide end closures minimum 0.028 inch thick to close open ends at exposed edges of floors,end walls, and openings through deck.

2.2.3 Closure Plates for Composite Deck

The concrete shall be supported and retained at each floor level. Provide edge closures at all edges of the slab of sufficient strength and stiffness to support the wet concrete. Metal closures shall be provided for all openings in composite steel deck 1/4 inch and over.

2.2.4 Sheet Metal Collar

Where deck is cut for passage of pipes, ducts, columns, etc., and deck is to remain exposed, provide a neatly cut sheet metal collar to cover edges of deck. Do not cut deck until after installation of supplemental supports.

2.2.5 Cover Plates

Sheet metal to close panel edge and end conditions, and where panels change direction or butt. Polyethylene-coated, self-adhesive, 2 inch wide joint tape may be provided in lieu of cover plates on flat-surfaced decking butt joints.

2.2.6 Sump Pans

Sump pans shall be provided for roof drains and shall be minimum 0.075 inch thick steel. Sump pans shall be shaped to meet roof slope by the supplier or by a sheet metal specialist. Bearing flanges of sump pans shall overlap steel deck a minimum of 3 inches. Opening in bottom of pan shall be shaped, sized, and reinforced to receive roof drain.

2.2.7 Column Closures

Sheet metal, minimum 0.0358 inch thick or metal rib lath.

2.2.8 Shear Connectors

Shear connectors shall be headed stud type, ASTM A 108, Grade 1015 or 1020, cold finished carbon steel with dimensions complying with AISC 335.

2.2.9 Miscellaneous Accessories
The manufacturer's standard accessories shall be furnished as necessary to complete the deck installation. Metal accessories shall be of the same material as the deck.

2.3 FABRICATION

2.3.1 Deck Units

Deck units shall conform to SDI 30. Form decking and accessories shall conform to ASTM A 653/A 653M, SQ, Grade 230, Grade 33; ASTM A 1008/A 1008M Coated Carbon Steel Sheets, Grade C, 228 mPa, 33, 000 psi minimum yield strength; or ASTM A 792/A 792M Coated Steel Sheets, Grade 33. Panels of maximum possible lengths shall be used to minimize end laps. Deck units shall be fabricated in lengths to span 3 or more supports with flush, telescoped, or nested 2 inchlaps at ends, and interlocking, or nested side laps, unless otherwise indicated. Deck with cross-sectional configuration differing from the units indicated may be used, provided that the properties of the proposed units, determined in accordance with AISI SG-973, are equal to or greater than the properties of the units indicated and that the material will fit the space provided without requiring revisions to adjacent materials or systems.

2.3.2 Roof Deck

Deck used in conjunction with insulation and built-up roofing shall conform to ASTM A 792/A 792M or ASTM A 1008/A 1008M. Roof deck units shall be fabricated of the steel design thickness required by the design drawings and shall be shop painted.

2.3.3 Composite Deck

Composite deck assembly shall conform to ASTM A 653/A 653M or ASTM A 1008/A

1008M. Deck used as the tension reinforcing in composite deck shall be fabricated if 0.0358 inch design thickness or thicker steel. The steel design thickness required by the design drawings. Zinc-coat in conformance with ASTM A 653/A 653M, G60 coating class.

In addition to resisting shear, devices shall provide resistance to vertical separation between the steel deck and the concrete. Provide one of the following types of shear devices:

a. Mechanically fixed shear devices such as embossments, holes, or welded buttons.

b. Mechanically fixed shear devices such as inverted, triangular-shaped ribs.

2.3.4 Acoustical Steel Deck

Provide a Noise Reduction Coefficient (NRC) rating of not less than 0.70, when tested in accordance with ASTM C 423, Standard Mounting No. 6. Sound absorbing materials shall be either glass fiber in roll or premolded form for acoustical steel deck in accordance with manufacturer's standards. The Contractor shall comply with EPA requirements in accordance with Section 01670 RECYCLED / RECOVERED MATERIALS.

2.3.5 Shop Priming

Shop prime accessories and underside of deck at the factory after coating. Clean surfaces in accordance with the manufacturer's standard procedure followed by a spray, dip or roller coat of rust-inhibitive primer, oven cured.

2.3.6 Touch-Up Paint

Touch-up paint for shop-painted units shall be of the same type used for the shop painting, and touch-up paint for zinc-coated units shall be an approved galvanizing repair paint with a high-zinc dust content . Welds shall be touched-up with paint conforming to SSPC Paint 20 in accordance with ASTM A 780. Finish of deck units and accessories shall be maintained by using touch-up paint whenever necessary to prevent the formation of rust.

PART 3 EXECUTION

3.1 EXAMINATION

Prior to installation of decking units and accessories, examine worksite to verify that as-built structure will permit installation of decking system without modification.

3.2 INSTALLATION

Install steel deck units in accordance with SDI 30 approved shop drawings. Place units on structural supports, properly adjusted, leveled, and aligned at right angles to supports before permanently securing in place. Damaged deck and accessories including material which is permanently stained or contaminated, deformed, or with burned holes shall not be installed. Extend deck units over three or more supports unless absolutely impractical. Report inaccuracies in alignment or leveling to the Contracting Officer and make necessary corrections before permanently

anchoring deck units. Locate deck ends over supports only. Ends of floor deck shall be butted. Do not use unanchored deck units as a work or storage platform. Do not fill unanchored deck with concrete. Permanently anchor units placed by the end of each working day. Do not support suspended ceilings, light fixtures, ducts, utilities, or other loads by steel deck unless indicated. Loads shall be distributed by appropriate means to prevent damage.

3.2.1 Attachment

Immediately after placement and alignment, and after correcting inaccuracies, permanently fasten steel deck units to structural supports and to adjacent deck units by welding with normal5/8 inch diameter puddle welds as indicated on the design drawings and in accordance with manufacturer's recommended procedure and SDI 30. Clamp or weight deck units to provide firm contact between deck units and structural supports while performing welding. Attachment of adjacent deck units by button-punching is prohibited.

3.2.1.1 Welding

Perform welding in accordance with AWS D1.3 using methods and electrodes recommended by the manufacturers of the base metal alloys being used. Ensure only operators previously qualified by tests prescribed in AWS D1.1/D1.1M and AWS D1.3 make welds. Immediately recertify, or replace with qualified welders, welders that have passed qualification tests but are producing unsatisfactory welding. Location, size, and spacing of fastening shall be as indicated. Welding washers shall not be used at the connections of the deck to supports. Welding washers shall not be used at sidelaps. Holes and similar defects will not be acceptable. Deck ends shall be lapped 2 inches. All partial or segments of deck units shall be attached to structural supports in accordance with Section 2.5 of SDI DDM02. Shear connectors shall be attached as shown and shall be welded as per AWS D1.1/D1.1M through the steel deck to the steel member. Immediately clean welds by chipping and wire brushing. Heavily coat welds, cut edges and damaged portions of shop painted finish with the manufacturer's standard touch-up paint.

3.2.2 Openings

All holes and openings required shall be cut or drilled holes and be coordinated with the drawings, specifications, and other trades. Frame and reinforce openings through the deck in conformance with SDI DDP. Holes and openings 6 to 12 inches across shall be reinforced by 0.0474 inch thick steel sheet at least 12 inches wider and longer than the opening and be fastened to the steel deck at each corner of the sheet and at a maximum of 6 inches on center. Holes and openings larger than 12 inches shall be reinforced by steel channels or angles installed perpendicular to the steel joists and supported by the adjacent steel joists. Steel channels or angles shall be installed perpendicular to the deck ribs and shall be fastened to the channels or angles perpendicular to the steel joists. Deck manufacturer shall approve holes or openings larger than 6 inches in diameter prior to drilling or cutting.

3.2.3 Deck Damage

SDI MOC1, for repair of deck damage.

3.2.4 Accessory Installation

3.2.4.1 Adjusting Plates

Install as shown on shop drawings.

3.2.4.2 End Closures

Provide end closure to close open ends of cells at columns, walls, and openings in deck.

3.2.4.3 Column Closures

Provide for spaces between floor decking and columns which penetrate the deck. Field cut closure plate to fit column in the field and tack weld to decking and columns.

3.2.5 Sound Absorbing Material

Install sound absorbing glass fiber roll or premolded form, neatly in voids between perforated webs of acoustical noncellular steel deck. Keep sound absorbing material dry before, during and after installation.

3.2.6 Concrete Work

Prior to placement of concrete, inspect installed decking to ensure that there has been no permanent deflection or other damage to decking. Replace decking which has been damaged or permanently deflected as approved by the Contracting Officer. Place concrete on metal deck in accordance with Construction Practice of SDI 30. Concrete fill over metal deck is specified in Section 03300, "Cast-In-Place Structural Concrete."

3.3 FIELD QUALITY CONTROL

3.3.1 Decks Not Receiving Concrete

Inspect the decking top surface for distortion after installation. For roof decks not receiving concrete, verify distortion by placing a straight edge across three adjacent top flanges. The maximum allowable gap between the straight edge and the top flanges is 1/16 inch; when gap is more than 1/16 inch, provide corrective measures or replacement. Reinspect decking after performing corrective measures or replacement.

-- End of Section --

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SECTION 05400

COLD-FORMED METAL FRAMING

10/03

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SECTION 05400

COLD-FORMED METAL FRAMING
10/03

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI SG-973	(1996) Cold-Formed Steel Design Manual
AISI SG02-1	(2001) Design of Cold-Formed Steel Structural Members

ASTM INTERNATIONAL (ASTM)

ASTM A 123/A 123M	(2002) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(2001a) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 653/A 653M	(2002a) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B 633	(1998e1) Electrodeposited Coatings of Zinc on Iron and Steel
ASTM C 955	(2001) Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases

AMERICAN WELDING SOCIETY (AWS)

AWS D1.3	(1998) Structural Welding Code - Sheet Steel

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE J78	(1998) Steel Self Drilling Tapping Screws

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS TT-P-664	(Rev. D) Primer Coating, Alkyd, Corrosion-Inhibiting, Lead and Chromate Free, VOC-Compliant

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Framing Components;

a. Cross sections, plans, and/or elevations showing component types and locations for each framing application; including shop coatings and material thicknesses for each framing component.

b. Connection details showing fastener type, quantity, location, and other information to assure proper installation.

c. Drawings depicting panel configuration, dimensions, components, locations, and construction sequence if the Contractor elects to install prefabricated/prefinished frames.

SD-03 Product Data

Steel studs,joists, tracks, bracing, bridging and accessories

SD-05 Design Data

Metal framing calculations; G-AE

SD-07 Certificates

Welds

Certified copies of welder qualifications test records showing qualification in accordance with AWS D1.3.

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver materials to job site and store in adequately ventilated, dry locations. Storage area shall permit easy access for inspection and handling. If necessary to store materials outside, stack off the ground, support on a level platform, and protect from the weather as approved. Handle materials to prevent damage. Finish of the framing members shall be maintained at all times, using an approved high zinc dust content, galvanizing repair paint whenever necessary to prevent the formation of rust. Replace damaged items with new, as directed by the Contracting Officer.

1.4 MAXIMUM DEFLECTION

a. Exterior Studs:

Deflection Criteria	Exterior Finish
L/240 or L/360	Synthetic Plaster, Metal Panels
L/360	Cement Plaster, Wood Veneer
L/600	Brick Veneer, Stone Panels

Wall deflections shall be computed on the basis that studs withstand all lateral forces independent of any composite action from sheathing materials. Studs abutting windows or louvers shall also be designed not to exceed 1/4 inch maximum deflection.

1.5 QUALITY ASSURANCE

1.5.1 Drawing Requirements

Submit framing components to show sizes, thicknesses, layout, material designations, methods of installation, and accessories.

1.5.2 Design Data Required

Submit metal framing calculations to verify sizes, gages, and spacing of members and connections. Show methods and practices used in installation.

PART 2 PRODUCTS

2.1 STEEL STUDS, JOISTS, TRACKS, BRACING, BRIDGING AND ACCESSORIES

Framing components shall comply with ASTM C 955 and the following.

2.1.1 Studs and Joists of 16 Gage (0.0598 Inch) and Heavier

Galvanized steel, ASTM A 653/A 653M, SS Grade 50, G60.

2.1.2 Studs and Joists of 18 Gage (0.0478 Inch) and Lighter

Studs and Joists of 18 Gage (0.0478 Inch) and Lighter, Track, and Accessories (All Gages): Galvanized steel, ASTM A 653/A 653M, SS, Grade 50 33,000 psi G60.

2.1.3 Sizes, Gages, Section Modulus, and Other Structural Properties

Size and gage as indicated. Steel stud deflection shall be limited to L/600 for exterior wall brick veneer construction.

2.2 MARKINGS

Studs and track shall have product markings stamped on the web of the section. The markings shall be repeated throughout the length of the member at a maximum spacing of 4 feet on center and shall be legible and easily read. The product marking shall include the following:

a. An ICBO number.

b. Manufacturer's identification.

c. Minimum delivered uncoated steel thickness.

d. Protective coating designator.

e. Minimum yield strength.

2.3 CONNECTIONS

Screws for steel-to-steel connections shall be self-drilling tapping in compliance with SAE J78 of the type, size, and location as shown on the drawings. Electroplated screws shall have a Type II coating in accordance with ASTM B 633. Screws, bolts, and anchors shall be hot-dipped galvanized in accordance with ASTM A 123/A 123M or ASTM A 153/A 153M as appropriate. Screws bolts, and anchors shall be hot dipped galvanized in accordance with ASTM A 123/A 123M or ASTM A 153/A 153M as appropriate.

2.4 PAINT

Ungalvanized steel, if used, shall be thoroughly cleaned, phosphate treated, and coated with corrosion-inhibiting primer, FS TT-P-664.

2.5 PLASTIC GROMMETS

Supply plastic grommets, recommended by stud manufacturer, to protect electrical wires. Prevent metal to metal contact for plumbing pipes.

PART 3 EXECUTION

3.1 FASTENING

Fasten framing members together by welding or by using self-drilling or self-tapping screws. Electrodes and screw connections shall be as required and indicated in the design calculations.

3.1.1 Welds

All welding shall be performed in accordance with AWS D1.3, as modified by AISI SG02-1. All welders, welding operations, and welding procedures shall be qualified according to AWS D1.3. All welds shall be cleaned and coated with rust inhibitive galvanizing paint. Do not field weld materials lighter than 18 gage.

3.1.2 Screws

Screws shall be self-drilling self-tapping type, size, and location shown on the drawings. Screw penetration through joined materials shall not be less than three exposed threads. Minimum spacings and edge distances for screws shall be as specified in AISI SG02-1. Screws covered by sheathing materials shall have low profile heads.

3.1.3 Anchors

Anchors shall be of the type, size, and location shown on the drawings.

3.2 INSTALLATION

3.2.1 Tracks

Provide accurately aligned runners at top and bottom of partitions. Anchor tracks as indicated in design calculations. Butt weld joints in tracks or splice with stud inserts. Fasteners shall be at least 3 inches from the

edge of concrete slabs.

3.2.2 Studs

Cut studs square and set with firm bearing against webs of top and bottom tracks. Position studs vertically in tracks and space as indicated in design. Do not splice studs. Provide at least two studs at jambs of doors and other openings 2 feet wide or larger. Provide jack studs over openings, as necessary, to maintain indicated stud spacing. Provide tripled studs at corners, positioned to receive interior and exterior finishes. Fasten studs to top and bottom tracks by welding or screwing both flanges to the tracks. Framed wall openings shall include headers and supporting components as shown on the drawings. Headers shall be installed in all openings that are larger than the stud spacing in a wall. In curtain wall construction, provide for vertical movement where studs connect to the structural frame. Provide horizontal bracing in accordance with the design calculations and AISI SG-973, consisting of, as a minimum, runner channel cut to fit between and welded to the studs or hot- or cold-rolled steel channels inserted through cutouts in web of each stud and secured to studs with welded clip angles. Bracing shall be not less than the following:

LOAD	HEIGHT	BRACING
Wind load only	Up to 10 feet	One row at mid-height
	Over 10 feet	Rows 5'-0" o.c. maximum
Axial load	Up to 10 feet	Two rows at 1/3 points
	Over 10 feet	Rows 3'-4" o.c. maximum

3.2.3 Joists and Trusses

Locate each joist or truss directly above a stud. Provide doubled joists under parallel partitions wherever partition length exceeds 1/2 of joist span. Joists shall have at least 2.50 inches of bearing on steel, 4 inches on masonry, and shall be reinforced over bearings where required to prevent web crippling. Splice joists over bearings only. Lap and weld splices as indicated. Provide manufacturer's standard bridging which shall not be less than the following:

CLEAR SPAN	BRIDGING
Up to 14 feet	One row near center
14 to 20 feet	Two rows at 1/3 points
20 to 26 feet	Three rows at 1/4 points
26 to 32 feet	Four rows at 1/5 points

Temporary bracing shall be provided and remain in place until work is permanently stabilized.

3.2.4 Erection Tolerances

a. Framing members which will be covered by finishes such as wallboard, plaster, or ceramic tile set in a mortar setting bed, shall be within the following limits:

(1) Layout of walls and partitions: 1/4 inch from intended position;

(2) Plates and runners: 1/4 inch in 8 feet from a straight line;

(3) Studs: 1/4 inch in 8 feet out of plumb, not cumulative; and

(4) Face of framing members: 1/4 inch in 8 feet from a true plane.

b. Framing members which will be covered by ceramic tile set in dry-set mortar, latex-portland cement mortar, or organic adhesive shall be within the following limits:

(1) Layout of walls and partitions: 1/4 inch from intended position;

(2) Plates and runners: 1/8 inch in 8 feet from a straight line;

(3) Studs: 1/8 inch in 8 feet out of plumb, not cumulative; and

(4) Face of framing members: 1/8 inch in 8 feet from a true plane.

3.2.5 Special Inspection and Testing for Seismic-Resisting Systems

Special inspections and testing for seismic-resisting systems and components shall be done in accordance with Section 01452A SPECIAL INSPECTION FOR SEISMIC-RESISTING SYSTEMS.

-- End of Section --

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SECTION 05500A

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SECTION 05500A

MISCELLANEOUS METAL
01/02

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A 1011	(2000) Hot-Rolled, Carbon, Structural High-Strength Low-Alloy and High-Strength Low-Alloy Steel, Sheet and Strip with Improved Formability
ASTM A 123/A 123M	(2002) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 36/A 36M	(2001) Carbon Structural Steel
ASTM A 500	(2001a) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 53/A 53M	(2002) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 653/A 653M	(2002a) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 924/A 924M	(1999) General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM E 814	(2002) Fire Tests of Through-Penetration Fire Stops

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2002) Structural Welding Code - Steel

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 10	(1998; Errata 10-98-1) Portable Fire Extinguishers

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation;

submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Miscellaneous Metal Items; G-AO.

Detail drawings indicating material thickness, type, grade, and class; dimensions; and construction details. Drawings shall include catalog cuts, erection details, manufacturer's descriptive data and installation instructions, and templates. Detail drawings for the following items: access doors and panels, pipe guards, handrails and guardrails, miscellaneous frames, steel stairs and fire extinguisher cabinets.

SD-04 Samples

Miscellaneous Metal Items

Samples of the following items: access panels. Samples shall be full size, taken from manufacturer's stock, and shall be complete as required for installation in the structure. Samples may be installed in the work, provided each sample is clearly identified and its location recorded.

1.3 GENERAL REQUIREMENTS

The Contractor shall verify all measurements and shall take all field measurements necessary before fabrication. Welding to or on structural steel shall be in accordance with AWS D1.1/D1.1M. Items specified to be galvanized, when practicable and not indicated otherwise, shall be hot-dip galvanized after fabrication. Galvanizing shall be in accordance with ASTM A 123/A 123M, ASTM A 653/A 653M, or ASTM A 924/A 924M, as applicable. Galvanize exterior items. Exposed fastenings shall be compatible materials, shall generally match in color and finish, and shall harmonize with the material to which fastenings are applied. Materials and parts necessary to complete each item, even though such work is not definitely shown or specified, shall be included. Poor matching of holes for fasteners shall be cause for rejection. Fastenings shall be concealed where practicable. Thickness of metal and details of assembly and supports shall provide strength and stiffness. Joints exposed to the weather shall be formed to exclude water.

1.4 DISSIMILAR MATERIALS

Where dissimilar metals are in contact, or where aluminum is in contact with concrete, mortar, masonry, wet or pressure-treated wood, or absorptive materials subject to wetting, the surfaces shall be protected with a coat of bituminous paint or asphalt varnish.

1.5 WORKMANSHIP

Miscellaneous metalwork shall be well formed to shape and size, with sharp lines and angles and true curves. Drilling and punching shall produce clean true lines and surfaces. Welding shall be continuous along the entire area of contact except where tack welding is permitted. Exposed connections of work in place shall not be tack welded. Exposed welds shall

be ground smooth. Exposed surfaces of work in place shall have a smooth finish, and unless otherwise approved, exposed riveting shall be flush. Where tight fits are required, joints shall be milled. Corner joints shall be coped or mitered, well formed, and in true alignment. Work shall be accurately set to established lines and elevations and securely fastened in place. Installation shall be in accordance with manufacturer's installation instructions and approved drawings, cuts, and details.

1.6 ANCHORAGE

Anchorage shall be provided where necessary for fastening miscellaneous metal items securely in place. Anchorage not otherwise specified or indicated shall include slotted inserts made to engage with the anchors, expansion shields, and power-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine and carriage bolts for steel; and lag bolts and screws for wood.

1.7 SHOP PAINTING

Surfaces of ferrous metal except galvanized surfaces, shall be cleaned and shop coated with the manufacturer's standard protective coating unless otherwise specified. Surfaces of items to be embedded in concrete shall not be painted. Items to be finish painted shall be prepared according to manufacturer's recommendations or as specified.

PART 2 PRODUCTS

2.1 ACCESS DOORS AND PANELS

Doors and panels shall be flush type unless otherwise indicated. Frames for access doors shall be fabricated of not lighter than 16 gauge steel with welded joints and finished with anchorage for securing into construction. Access doors shall be a minimum of 14 by 20 inches and of not lighter than 14 gauge steel, with stiffened edges, complete with attachments. Access doors shall be hinged to frame and provided with a flush face, screw driver operated latch. Access doors in fire-rated walls and ceilings shall be of equivalent fire ratings. Exposed metal surfaces shall have a shop applied prime coat.

2.2 PIPE GUARDS

Pipe guards shall be heavy duty steel pipe conforming to ASTM A 53/A 53M, Type E or S, weight STD, finished as specified in Section 09915 COLOR SCHEDULE.

2.3 FLOOR PLATES

Floor plates shall be 1/4 inch thick, pattern indicated.

2.4 HANDRAILS AND GUARDRAILS

Handrails shall be designed to resist a concentrated load of 200 pounds in any direction at any point of the top of the rail or 50 pounds per foot applied horizontally to top of the rail, whichever is more severe. Fabricate handrails and railing systems as indicated on the drawings to comply with design requirements, material type and size, post spacings and anchorage.

2.4.1 Steel Handrails, Including Carbon Steel Inserts

Steel handrails, including inserts in concrete, shall be steel pipe conforming to ASTM A 53/A 53M or structural tubing conforming to ASTM A 500, Grade A or B of equivalent strength. Steel railings shall be 1-1/2 or 2 inch nominal size as indicated on drawings. Railings shall be shop painted. Pipe collars shall be steel.

a. Joint posts, rail, and corners shall be fabricated by one of the following methods:

(1) Mitered and welded joints by fitting post to top rail and intermediate rail to post, mitering corners, groove welding joints, and grinding smooth. Railing splices shall be butted and reinforced by a tight fitting interior sleeve not less than 6 inches long.

(2) Railings may be bent at corners in lieu of jointing, provided bends are made in suitable jigs and the pipe is not crushed.

2.4.2 Perforated Metal Infill

Perforated metal infill shall be steel sheet conforming to ASTM A 1011, Grade 36, 16 gage material. Perforations shall be 1/2 inch round staggered 11/16 inch on center.

2.5 MISCELLANEOUS

Miscellaneous plates and shapes for items that do not form a part of the structural steel framework, such as lintels, sill angles, miscellaneous mountings, and frames, shall be provided to complete the work.

2.6 STEEL STAIRS

Steel stairs shall be complete with structural or formed channel stringers, metal pan cement-filled treads, landings, columns, handrails, and necessary bolts and other fastenings as indicated. Structural steel shall conform to ASTM A 36/A 36M. Stairs and accessories shall be shop primed. Risers on stairs with metal pan treads shall be deformed to form a sanitary cove to retain the tread concrete.

2.7 FIRE EXTINGUISHER CABINETS

Cabinets to be located in fire-rated walls shall be fire-rated type, fabricated in accordance with ASTM E 814, and shall be listed by an approved testing agency for 1- and 2-hour combustible and non-combustible wall systems. The testing agency's seal shall be affixed to each fire-rated cabinet. Cabinets shall be of the recessed type suitable for 10 pound extinguishers. Box and trim shall be of heavy gage stainless steel. Door shall be a rigid frame with full length piano type hinge and double strength (DSA) glass panel. Door and panel shall have the manufacturer's standard #4 stainless steel finish inside and out.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

All items shall be installed at the locations shown and according to the manufacturer's recommendations. Items listed below require additional procedures as specified.

3.2 REMOVABLE ACCESS PANELS

A removable access panel not less than 12 by 12 inches shall be installed directly below each valve, flow indicator, damper, or air splitter that is located above the ceiling, other than an acoustical ceiling, and that would otherwise not be accessible.

3.3 INSTALLATION OF PIPE GUARDS

Pipe guards shall be set vertically in concrete piers. Piers shall be constructed of, and the hollow cores of the pipe filled with, concrete specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE.

3.4 ATTACHMENT OF HANDRAILS

Brackets shall be installed where indicated. Splices, where required, shall be made at expansion joints.

3.4.1 Installation of Steel Handrails

Installation shall be as indicataed on drawings, including in pipe sleeves embedded in concrete and filled with molten lead or sulphur with anchorage covered with standard pipe collar pinned to post.; by means of pipe sleeves secured to wood with screws or masonry with expansion shields and bolts or toggle bolts. Rail ends shall be secured by steel pipe flanges anchored by expansion shields and bolts. or through-bolted to a back plate or by 1/4 inch lag bolts to studs or solid backing.

3.5 INSTALLATION OF FIRE EXTINGUISHER CABINETS

Metal fire extinguisher cabinets shall be furnished and installed in accordance with NFPA 10 where shown on the drawings or specified.

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SECTION 06100A

ROUGH CARPENTRY
02/02

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN FOREST & PAPER ASSOCIATION (AF&PA)

AF&PA T101	(1991; Supple 1993; Addenda Apr 1997; Supple T02) National Design Specification for Wood Construction
AF&PA T10	(2001) Wood Frame Construction Manual for One- and Two-Family Dwellings

AMERICAN INSTITUTE OF TIMBER CONSTRUCTION (AITC)

AITC 111	(1979) Recommended Practice for Protection of Structural Glued Laminated Timber During Transit, Storage and Erection

ASTM INTERNATIONAL (ASTM)

ASTM A 307	(2002) Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM C 518	(1998) Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
ASTM C 578	(2001) Rigid, Cellular Polystyrene Thermal Insulation
ASTM C 665	(2001e1) Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
ASTM D 2898	(1994; R 1999) Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing
ASTM E 154	(1999) Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover
ASTM E 96	(2000e1) Water Vapor Transmission of Materials
ASTM F 547	(1977; R 1995) Definitions of Terms

	Relating to Nails for Use with Wood and Wood-Based Materials

AMERICAN WOOD-PRESERVERS' ASSOCIATION (AWPA)

AWPA C2	(2001) Lumber, Timber, Bridge Ties and Mine Ties - Preservative Treatment by Pressure Processes
AWPA C20	(1999) Structural Lumber Fire-Retardant Pressure Treatment
AWPA C27	(1999) Plywood - Fire-Retardant Pressure Treatment
AWPA C9	(1997) Plywood - Preservative Treatment by Pressure Processes
AWPA M4	(2001) Standard for the Care of Preservative-Treated Wood Products
AWPA P5	(2000) Standards for Waterborne Preservatives

APA - THE ENGINEERED WOOD ASSOCIATION (APA)

APA EWS R540C	(1996) Builder Tips Proper Storage and Handling of Glulam Beams
APA E445S	(2001; R 2002) Performance Standards and Policies for Structural-Use Panels (APA PRP-108)

FM GLOBAL (FM)

FM DS 1-49	(2000) Perimeter Flashing

NATIONAL HARDWOOD LUMBER ASSOCIATION (NHLA)

NHLA Rules	(1994) Rules for the Measurement & Inspection of Hardwood & Cypress

NORTHEASTERN LUMBER MANUFACTURERS ASSOCIATION (NELMA)

NELMA Grading Rules	(1997) Standard Grading Rules for Northeastern Lumber

REDWOOD INSPECTION SERVICE (RIS)

RIS Grade Use	(1997) Grades of California Redwood Lumber

SOUTHERN CYPRESS MANUFACTURERS ASSOCIATION (SCMA)

SCMA Spec	(1986; Supple No. 1, Aug 1993) Standard Specifications for Grades of Southern Cypress

SOUTHERN PINE INSPECTION BUREAU (SPIB)

SPIB 1003	(1994; Supple 8 thru 11) Standard Grading Rules for Southern Pine Lumber

U.S. DEPARTMENT OF COMMERCE (DOC)

PS1	(1995) Construction and Industrial Plywood (APA V995)
PS2	(1993) Wood-Base Structural-Use Panels

WEST COAST LUMBER INSPECTION BUREAU (WCLIB)

WCLIB 17	(1996; Supp. VII & VIII) Standard Grading and Dressing Rules for Douglas Fir, Western Hemlock, Western Red Cedar, White Fir, Sitka Spruce Lumber

WESTERN WOOD PRODUCTS ASSOCIATION (WWPA)

WWPA G-5	(1999) Western Lumber Grading Rules 95

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Nailers and Nailing Strips; G-AO

Drawings of field erection details, including materials and methods of fastening nailers in conformance with Factory Mutual wind uplift rated systems specified in other Sections of these specifications.

SD-07 Certificates

Grading and Marking

Manufacturer's certificates (approved by an American Lumber Standards approved agency) attesting that lumber and material not normally grade marked meet the specified requirements. Certificate of Inspection for grade marked material by an American Lumber Standards Committee (ALSC) recognized inspection agency prior to shipment.

Insulation

Certificate attesting that the glass and mineral fiber, insulation furnished for the project contains recovered material, and showing an estimated percent of such recovered material.

1.3 DELIVERY AND STORAGE

Materials shall be delivered to the site in undamaged condition, stored off ground in fully covered, well ventilated areas, and protected from extreme changes in temperature and humidity. Laminated timber shall be handled and stored in accordance with AITC 111 or APA EWS R540C.

PART 2 PRODUCTS

2.1 LUMBER AND SHEATHING

2.1.1 Grading and Marking

2.1.1.1 Lumber Products

Solid sawn and finger-jointed lumber shall bear an authorized gradestamp or grademark recognized by ALSC, or an ALSC recognized certification stamp, mark, or hammerbrand. Surfaces that are to be exposed to view shall not bear grademarks, stamps, or any type of identifying mark. Hammer marking will be permitted on timbers when all surfaces will be exposed to view.

2.1.1.2 Plywood and Other Sheathing Products

Materials shall bear the grademark or other identifying marks indicating grades of material and rules or standards under which produced, including requirements for qualifications and authority of the inspection organization. Except for plywood and wood structural panels, bundle marking will be permitted in lieu of marking each individual piece. Surfaces that are to be exposed to view shall not bear grademarks or other types of identifying marks.

2.1.2 Sizes

Lumber and material sizes shall conform to requirements of the rules or standards under which produced. Unless otherwise specified, lumber shall be surfaced on four sides. Unless otherwise specified, sizes indicated are nominal sizes, and actual sizes shall be within manufacturing tolerances allowed by the standard under which the product is produced.

2.1.3 Treatment

Exposed areas of treated wood that are cut or drilled after treatment shall receive a field treatment in accordance with AWPA M4. Items of all-heart material of cedar, cypress, or redwood will not require preservative treatment, except when in direct contact with soil. Except as specified for all-heart material of the previously mentioned species, the following items shall be treated:

a. Wood members in contact with or within 18 inches of soil.

b. Wood members in contact with water.

c. Wood members exposed to the weather and those used in roofing systems.

d. Wood members set into concrete regardless of location.

e. Wood members in contact with concrete that is in contact with soil

or water or that is exposed to weather.

2.1.3.1 Lumber and Timbers

Lumber and timbers shall be treated in accordance with AWPA C2 with waterborne preservatives listed in AWPA P5 to a retention level as follows:

a. 0.25 pcf intended for above ground use.

b. 0.40 pcf intended for ground contact and fresh water use.

2.1.3.2 Plywood

Plywood shall be treated in accordance with AWPA C9 with waterborne preservatives listed in AWPA P5 to a retention level as follows:

a. 0.25 pcf intended for above ground use.

b. 0.40 pcf intended for ground contact and fresh water use.

2.1.4 Moisture Content

At the time lumber and other materials are delivered and when installed in the work their moisture content shall be as follows:

a. Treated and Untreated Lumber Except Roof Planking: 4 inches or less, nominal thickness, 19 percent maximum. 5 inches or more, nominal thickness, 23 percent maximum in a 3 inch perimeter of the timber cross-section.

b. Materials Other Than Lumber: In accordance with standard under which product is produced.

2.1.5 Fire-Retardant Treatment

Fire-retardant treated wood shall be pressure treated in accordance with AWPA C20 for lumber and AWPA C27 for plywood. Material use shall be defined in AWPA C20 and AWPA C27 for Interior Type A and Exterior Type. Treatment and performance inspection shall be by an independent and qualified testing agency that establishes performance ratings. Each piece or bundle of treated material shall bear identification of the testing agency to indicate performance in accordance with such rating. Treated materials to be exposed to rain wetting shall be subjected to an accelerated weathering technique in accordance with ASTM D 2898 prior to being tested for compliance with AWPA C20 or AWPA C27. Items to be treated include: wood blocking in interior partitions.

2.1.6 Sheathing

Sheathing shall be gypsum board or plywood for wall sheathing.

2.1.6.1 Gypsum Sheathing Board

Glass mat gypsum sheathing is specified in Section 09250 GYPSUM BOARD.

2.1.6.2 Plywood

Plywood shall conform to PS1, APA E445S or PS2, Grade C-D or sheathing

grade with exterior glue. Sheathing for roof and walls without corner bracing of framing shall have a span rating of 16/0 or greater for supports 16 inches on center and a span rating of 24/0 or greater for supports 24 inches on center.

2.1.7 Miscellaneous Wood Members

2.1.7.1 Nonstress Graded Members

Members shall include furring and nailing strips. Members shall be in accordance with TABLE I for the species used. Sizes shall be as follows unless otherwise shown:

Member	Size (inch)
Furring	1 x 3.
Nailing strips	1 x 3 or 1 x 4 when used as interior finish, otherwise 2 inch stock.

2.1.7.2 Blocking

Blocking shall be standard or number 2 grade.

2.1.7.3 Rough Bucks and Frames

Rough bucks and frames shall be straight standard or number 2 grade.

2.2 ACCESSORIES AND NAILS

Markings shall identify both the strength grade and the manufacturer. Accessories and nails shall conform to the following:

2.2.1 Anchor Bolts

ASTM A 307, size as indicated, complete with nuts and washers.

2.2.2 Bolts: Lag, Toggle, and Miscellaneous Bolts and Screws

Type, size, and finish best suited for intended use. Finish options include zinc compounds, cadmium, and aluminum paint impregnated finishes.

2.2.3 Clip Angles

Steel, 3/16 inch thick, size best suited for intended use; or zinc-coated steel or iron commercial clips designed for connecting wood members.

2.2.4 Expansion Shields

Type and size best suited for intended use.

2.2.5 Nails and Staples

ASTM F 547, size and type best suited for purpose; staples shall be as recommended by the manufacturer of the materials to be joined. For

sheathing and subflooring, length of nails shall be sufficient to extend 1 inch into supports. In general, 8-penny or larger nails shall be used for nailing through 1 inch thick lumber and for toe nailing 2 inch thick lumber; 16-penny or larger nails shall be used for nailing through 2 inch thick lumber. Nails used with treated lumber and sheathing shall be galvanized. Nailing shall be in accordance with the recommended nailing schedule contained in AF&PA T10. Where detailed nailing requirements are not specified, nail size and spacing shall be sufficient to develop an adequate strength for the connection. The connection's strength shall be verified against the nail capacity tables in AF&PA T101. Reasonable judgement backed by experience shall ensure that the designed connection will not cause the wood to split. If a load situation exceeds a reasonable limit for nails, a specialized connector shall be used.

2.3 INSULATION

Thermal resistance of insulation shall be not less than the R-values shown. R-values shall be determined at 75 degrees F in accordance with ASTM C 518. Contractor shall comply with EPA requirements in conformance with Section 01670 RECYCLED / RECOVERED MATERIALS. Insulation shall be the standard product of a manufacturer and factory marked or identified with manufacturer's name or trademark and R-value. Identification shall be on individual pieces or individual packages. Materials containing more than one percent asbestos will not be allowed.

2.3.1 Batt or Blanket

2.3.1.1 Glass Fiber Batts and Rolls

Glass fiber batts and rolls shall conform to ASTM C 665, Type I unfaced insulation or Type II kraft faced insulation.

2.3.1.2 Mineral Fiber Batt

Mineral fiber batt shall conform to ASTM C 665, Type I unfaced insulation or Type II kraft faced insulation, Class C.

2.3.2 Sill Sealer

Mineral wool, 1 inch thick and compressible to 1/32 inch, width of sill, designed to perform as an air, dirt, and insect seal in conformance with ASTM C 665, Type I.

2.3.3 Rigid Insulation

2.3.3.1 Polystyrene Board

Polystyrene board shall be extruded and conform to ASTM C 578, Type IV.

2.4 VAPOR RETARDER

Vapor retarder shall be polyethylene sheeting conforming to ASTM E 154 or other equivalent material. Vapor retarder shall have a maximum vapor permeance rating of 0.5 perms as determined in accordance with ASTM E 96, unless otherwise specified.

PART 3 EXECUTION

3.1 INSTALLATION OF SHEATHING

3.1.1 Gypsum Board

Sheathing shall be applied as specified in Section 09250 GYPSUM BOARD in accordance with the manufacturer's approved instructions. Sheets 2 feet wide shall be applied horizontally with tongued edge up, with vertical joints over supports, and with vertical joints staggered. Sheets 4 feet wide shall be applied vertically, extended over top and bottom plates, and with all vertical and horizontal joints over supports.

3.1.2 Plywood

Sheathing shall be applied with edges 1/8 inch apart at side and end joints, and nailed at supported edges at 6 inches on center and at intermediate supports 12 inches on center unless otherwise shown. Nailing of edges shall be 3/8 inch from the edges. Wall sheathing shall extend over top and bottom plates, and if applied horizontally the vertical joints shall be made over supports and staggered.

3.2 INSTALLATION OF MISCELLANEOUS WOOD MEMBERS

3.2.1 Blocking

Blocking shall be provided as necessary for application of sheathing, wallboard, and other materials or building items. Blocking shall be cut to fit between framing members and rigidly fixed thereto.

3.2.2 Nailers and Nailing Strips

Nailers and nailing strips shall be provided as necessary for the attachment of finish materials. Stacked nailers shall be assembled with spikes or nails spaced not more than 18 inches on center and staggered. Beginning and ending nails shall not be more than 6 inches for nailer end. Ends of stacked nailers shall be offset approximately 12 inches in long runs and alternated at corners. Anchors shall extend through the entire thickness of the nailer. Nailers and nailer installation for Factory Mutual wind uplift rated roof systems specified in other Sections of these specifications shall conform to the recommendations contained in FM DS 1-49.

3.2.3 Furring Strips

Furring strips shall be provided at the locations shown. Furring strips shall be installed at 16 inches on center unless otherwise shown, run in lengths as long as practicable, butt jointed and rigidly secured in place.

3.2.4 Rough Bucks and Frames

Rough bucks shall be set straight, true, and plumb, and secured with anchors near top and bottom of each wood member and at intermediate intervals of not more than 3 feet. Anchors for concrete shall be expansion bolts, and anchors for masonry shall be 3/16 x 1-1/4 inch steel straps extending not less than 8 inches into the masonry and turned down 2 inches into the masonry.

3.3 INSTALLATION OF INSULATION

Insulation shall be installed after construction has advanced to a point that the installed insulation will not be damaged by remaining work. For thermal insulation the actual installed thickness shall provide the R-values shown. For acoustical insulation the installed thickness shall be as shown. Insulation shall be installed on the weather side of such items as electrical boxes and water lines. Unless otherwise specified, installation shall be in accordance with the manufacturer's recommendation.

3.4 INSTALLATION OF VAPOR RETARDER

Vapor retarder shall be applied to provide a continuous barrier at window and door frames, and at all penetrations such as electrical outlets and switches, plumbing connections, and utility service penetrations. Joints in the vapor retarder shall be lapped and sealed according to the manufacturer's recommendations.

3.5 TABLES

TABLE I. SPECIES AND GRADE

Wall Sheathing, Furring

Grading Rules	Species	Const Standard	No. 2 Comm	No. 2 Board Comm	No. 3 Comm
NHLA Rules					
	Cypress			X	
NELMA Grading Rules					
	Northern White Cedar				X
	Eastern White Pine	X			
	Northern Pine	X			
	Balsam Fir				X
	Eastern Hemlock-Tamarack				X
RIS Grade Use					
	Redwood		X		
SCMA Spec					
	Cypress			X	
SPIB 1003					
	Southern Pine		X		
WCLIB 17					
	Douglas Fir-Larch	X			
	Hem-Fir	X			
	Sitka Spruce	X			
	Mountain Hemlock	X			
	Western Cedar	X			
WWPA G-5					
	Douglas Fir-Larch	X			
	Hem-Fir	X			
	Idaho White Pine	X			
	Lodgepole Pine			X	
	Ponderosa Pine			X	
	Sugar Pine			X	
	Englemann Spruce			X	
	Douglas Fir South			X	
	Mountain Hemlock			X	
	Subalpine Fir			X	
	Western Cedar			X	

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SECTION 06200A

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SECTION 06200A

FINISH CARPENTRY
11/01

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ARCHITECTURAL WOODWORK INSTITUTE (AWI)

AWI Qual Stds (1999) AWI Quality Standards

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Finish Carpentry; G-AE

Drawings showing special mill and woodwork items. Drawings shall indicate materials and details of construction and of fastening methods installation.

SD-04 Samples

Moldings and Interior Trim; G-AE

Samples shall be of sufficient size to show color ranges of the material proposed to be used. Submit samples with finish specified.

1.3 DELIVERY AND STORAGE

Materials shall be delivered to the site in undamaged condition, stored off ground in fully covered, well-ventilated areas, and protected from extreme changes in temperature and humidity.

PART 2 PRODUCTS

2.1 FINISH CARPENTRY

2.1.1 Grading and Marking

Materials shall bear the grademark, stamp or other identifying marks indicating grades of material and rules or standards under which produced. Such identifying marks on a material shall be in accordance with the rule or standard under which the material is produced, including requirements for qualifications and authority of the inspection organization, usage of authorized identification, and information included in the identification. Surfaces that are to be architecturally exposed to view shall not bear grademarks, stamps, or other types of identifying marks.

2.1.2 Moldings and Interior Trim

Moldings and trim shall be select Mahagony without sapwood, AWI Grade I. Sizes and profiles shall be as indicated.

2.1.3 Finish

Moldings and interior trim shall be field finished in accordance with Section 09900 PAINTS AND COATINGS.

PART 3 EXECUTION

3.1 MOLDING AND INTERIOR TRIM

Install in accordance with AWI Qual Stds, premium grade, Section 300 Standing and Running Trim. Molding and interior trim shall be installed straight, plumb, level and with closely fitted joints. Exposed surfaces shall be machine sanded at the mill. Molded work shall be coped at returns and interior angles and mitered at external corners. Intersections of flatwork shall be shouldered to ease any inherent changes in plane. Trim shall be provided in greatest lengths practicle. Blind nailing shall be used to the extent practicable, and face nailing shall be set and stopped with a nonstaining putty to match the finish applied. Screws shall be used for attachment to metal; setting and stopping of screws shall be of the same quality as required where nails are used.

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SECTION 06410A

LAMINATE CLAD ARCHITECTURAL CASEWORK
11/01

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A161.2	(1998) Decorative Laminate Countertops, Performance Standards for Fabricated High Pressure
ANSI A208.1	(1999) Particleboard
ANSI A208.2	(2002) Medium Density Fiberboard (MDF) For Interior Applications

ASTM INTERNATIONAL (ASTM)

ASTM D 1037	(1999) Evaluating Properties of Wood-Base Fiber and Particle Panel Materials
ASTM F 547	(1977; R 1995) Definitions of Terms Relating to Nails for Use with Wood and Wood-Based Materials

ARCHITECTURAL WOODWORK INSTITUTE (AWI)

AWI Qual Stds	(1999) AWI Quality Standards

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

BHMA A156.9	(1994) Cabinet Hardware

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA LD 3	(1995) High-Pressure Decorative Laminates
NEMA LD 3.1	(1995) Performance, Application, Fabrication, and Installation of High-Pressure Decorative Laminates

WINDOW AND DOOR MANUFACTURERS ASSOCIATION (WDMA)

WDMA I.S. 1-A	(1997) Architectural Wood Flush Doors

1.2 GENERAL DESCRIPTION

Work in this section includes laminate clad custom casework and cabinets as

shown on the drawings and as described in this specification. This Section includes high-pressure laminate surfacing and cabinet hardware. The Contractor shall comply with EPA requirements in accordance with Section 01670 RECYCLED / RECOVERED MATERIALS. All exposed and semi-exposed surfaces, whose finish is not otherwise noted on the drawings or finish schedule, shall be sanded smooth and shall receive a clear finish of polyurethane.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. All items designated with a "G", including product literature, calculations, component data, certificates, diagrams, drawings, and samples shall be submitted concurrently in one complete system submittal. Omission of any required submittal item from the package shall be sufficient cause for disapproval of the entire submittal. Unless otherwise indicated in the submittal review commentary, disapproval of any item within the package shall require a re-submittal of the entire system package, in which all deficiencies shall be corrected. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES.

SD-02 Shop Drawings

Shop Drawings; G-AE
Installation; G-AO

Shop drawings showing all fabricated casework items in plan view, elevations and cross-sections to accurately indicate materials used, details of construction, dimensions, methods of fastening and erection, and installation methods proposed. Shop drawing casework items shall be clearly cross-referenced to casework items located on the project drawings. Shop drawings shall include a color schedule of all casework items to include all countertop, exposed, and semi-exposed cabinet finishes to include finish material manufacturer, pattern, and color.

SD-03 Product Data

Wood Materials
Wood Finishes

Descriptive data which provides narrative written verification of all types of construction materials and finishes, methods of construction, etc. not clearly illustrated on the submitted shop drawings. Data shall provide written verification of conformance with AWI Qual Stds for the quality indicated to include materials, tolerances, and types of construction. Both the manufacturer of materials and the fabricator shall submit available literature which describes re-cycled product content, operations and processes in place that support efficient use of natural resources, energy efficiency, emissions of ozone depleting chemicals, management of water and operational waste, indoor environmental quality, and other production techniques supporting sustainable design and products.

SD-04 Samples

Plastic Laminates; G-AE

Three samples minimum of each plastic laminate pattern and color. Samples shall be a minimum of 5 by 7 inches in size.

Cabinet Hardware; G-AE

One sample of each cabinet hardware item specified to include hinges, pulls, and drawer glides.

Wood Veneer; G-AE

Three samples minimum of each species and factory finish of veneer on actual substrate.

SD-07 Certificates

Quality Assurance; G-AO
Laminate Clad Casework; G-AO

A quality control statement which illustrates compliance with and understanding of AWI Qual Stds requirements, in general, and the specific AWI Qual Stds requirements provided in this specification. The quality control statement shall also certify a minimum of ten years contractor's experience in laminate clad casework fabrication and construction. The quality control statement shall provide a list of a minimum of five successfully completed projects of a similar scope, size, and complexity.

1.4 QUALITY ASSURANCE

Unless otherwise noted on the drawings, all materials, construction methods, and fabrication shall conform to and comply with the custom grade quality standards as outlined in AWI Qual Stds, Section 400G and Section 400B for laminate clad cabinets. These standards shall apply in lieu of omissions or specific requirements in this specification. Contractors and their personnel engaged in the work shall be able to demonstrate successful experience with work of comparable extent, complexity and quality to that shown and specified. Contractor must demonstrate knowledge and understanding of AWI Qual Stds requirements for the quality grade indicated.

1.5 DELIVERY AND STORAGE

Casework shall be delivered assembled to the fullest extent possible. All units shall be delivered to the site in undamaged condition, stored off the ground in fully enclosed areas, and protected from damage. The storage area shall be well ventilated and not subject to extreme changes in temperature or humidity.

1.6 SEQUENCING AND SCHEDULING

Work shall be coordinated with other trades. Units shall not be installed in any room or space until painting, and ceiling installation are complete within the room where the units are located. Floor cabinets shall be installed before finished flooring materials are installed.

1.7 PROJECT/SITE CONDITIONS

Field measurements shall be verified as indicated in the shop drawings

before fabrication.

PART 2 PRODUCTS

2.1 WOOD MATERIALS

2.1.1 Lumber

All framing lumber shall be kiln-dried Grade III to dimensions as shown on the drawings. Frame front, where indicated on the drawings, shall be nominal 3/4 inch hardwood.

2.1.2 Panel Products

2.1.2.1 Custom Manufactured Wood Veneer Plywood

Face veneer species and cut as selected in Section 09915 COLOR SCHEDULE, U.S. Commercial Standard CS36 for AWI custom grade, three ply. Panels shall be slip matched and balanced with veneer grain direction as indicated on drawings. Nominal thickness of plywood panels shall be as indicated on the drawings.

2.1.2.2 Particleboard

All particleboard shall be industrial grade, medium density (40 to 50 pounds per cubic foot), 3/4 inch thick. A moisture-resistant particleboard in grade Type 2-M-2 or 2-M-3 shall be used as the substrate for plastic laminate covered countertops and backsplashes and other areas subjected to moisture. Particleboard shall meet the minimum standards listed in ASTM D 1037 and ANSI A208.1.

2.1.2.3 Medium Density Fiberboard

Medium density fiberboard (MDF) shall be an acceptable panel substrate where noted on the drawings. Medium density fiberboard shall meet the minimum standards listed in ANSI A208.2.

2.2 SOLID POLYMER MATERIAL

Solid surfacing casework components shall conform to the requirements of Section 06650 SOLID POLYMER FABRICATIONS.

2.3 HIGH PRESSURE DECORATIVE LAMINATE (HPDL)

All plastic laminates shall meet the requirements of NEMA LD 3 and ANSI A161.2 for high-pressure decorative laminates. Design, colors, surface finish and texture, and locations shall be as indicated on the drawings and in Section 09915 COLOR SCHEDULE. Plastic laminate types and nominal minimum thicknesses for casework components shall be as indicated in the following paragraphs.

2.3.1 Horizontal General Purpose Standard (HGS) Grade

Horizontal general purpose standard grade plastic laminate shall be 0.048 inches (plus or minus 0.005 inches) in thickness. This laminate grade is intended for horizontal surfaces where postforming is not required.

2.3.2 Vertical General Purpose Standard (VGS) Grade

Vertical general purpose standard grade plastic laminate shall be 0.028 inches (plus or minus 0.004 inches) in thickness. This laminate grade is intended for exposed exterior vertical surfaces of casework components where postforming is not required.

2.3.3 Horizontal General Purpose Postformable (HGP) Grade

Horizontal general purpose postformable grade plastic laminate shall be 0.042 inches (plus or minus 0.005 inches) in thickness. This laminate grade is intended for horizontal surfaces where post forming is required.

2.3.4 Cabinet Liner Standard (CLS) Grade

Cabinet liner standard grade plastic laminate shall be 0.020 inches in thickness. This laminate grade is intended for light duty semi-exposed interior surfaces of casework components.

2.3.5 Backing Sheet (BK) Grade

Undecorated backing sheet grade laminate is formulated specifically to be used on the backside of plastic laminated panel substrates to enhance dimensional stability of the substrate. Backing sheet thickness shall be 0.020 inches. Backing sheets shall be provided for all laminated casework components where plastic laminate finish is applied to only one surface of the component substrate.

2.4 THERMOSET DECORATIVE OVERLAYS (MELAMINE)

Thermoset decorative overlays (melamine panels) shall be used for casework cabinet interior, drawer interior and all semi-exposed surfaces.

2.5 EDGE BANDING

Edge banding for casework doors and drawer fronts shall be PVC vinyl and shall be 0.020 inch thick. Material width shall be 15/16 inches. Color and pattern shall match exposed door and drawer front laminate pattern and color.

2.6 CABINET HARDWARE

All hardware shall conform to BHMA A156.9, unless otherwise noted, and shall consist of the following components:

a. Door Hinges: self-closing type, BHMA No. B01602.

b. Cabinet Pulls: Back mounted solid brass, satin chromium plated, 3-1/2 inch length wire pull, 5/16 inch diameter type, BHMA No. B02011.

c. Drawer Slide: Side mounted type, BHMA No. B05091 with full extension and a minimum 100 pound load capacity, black zinc finish. Slides shall include positive stop to avoid accidental drawer removal.

d. Adjustable Shelf Support System: Multiple holes with metal pin supports.

2.7 FASTENERS

Nails, screws, and other suitable fasteners shall be the size and type best suited for the purpose and shall conform to ASTM F 547 where applicable.

2.8 ADHESIVES, CAULKS, AND SEALANTS

2.8.1 Adhesives

Adhesives shall be of a formula and type recommended by AWI. Adhesives shall be selected for their ability to provide a durable, permanent bond and shall take into consideration such factors as materials to be bonded, expansion and contraction, bond strength, fire rating, and moisture resistance. Adhesives shall meet local regulations regarding VOC emissions and off-gassing.

2.8.1.1 Wood Joinery

Adhesives used to bond wood members shall be a Type II for interior use . Adhesives shall withstand a bond test as described in WDMA I.S. 1-A.

2.8.1.2 Laminate Adhesive

Adhesive used to join high-pressure decorative laminate to wood shall be an adhesive consistant with AWI and laminate manufacturer's recommendations. PVC edgebanding shall be adhered using a polymer-based hot melt glue.

2.8.2 Caulk

Caulk used to fill voids and joints between laminated components and between laminated components and adjacent surfaces shall be clear, 100 percent silicone.

2.8.3 Sealant

Sealant shall be of a type and composition recommended by the substrate manufacturer to provide a moisture barrier at sink cutouts and all other locations where unfinished substrate edges may be subjected to moisture.

2.9 WOOD FINISHES

Provide shop-finished wood panels as follows: AWI Qual Stds Section 1500, specification for System No. 4 Conversion varnish alkyd urea or System No. 5 Vinyl catalyzed. The coating shall be AWI Qual Stds, premium, medium rubbed sheen, open grain effect. Match wood door fnish as specified in Section 08210 WOOD DOORS.

2.10 ACCCESSORIES

2.10.1 Grommets

Grommets shall be metal material for cutouts with a diameter of 2 inches. Locations shall be as indicated on the drawings.

2.11 FABRICATION

Fabrication and assembly of components shall be accomplished at the shop to the maximum extent possible. Construction and fabrication of cabinets and their components shall meet or exceed the requirements for AWI custom grade

unless otherwise indicated in this specification. Cabinet style, in accordance with AWI Qual Stds, Section 400-G descriptions, shall be flush overlay.

2.11.1 Base and Wall Cabinet Case Body

Fabricate in accordance with the custom grade quality standards as outlined in AWI Qual Stds.

2.11.2 Cabinet Floor Base

Fabricate in accordance with the custom grade quality standards as outlined in AWI Qual Stds.

2.11.3 Cabinet Door and Drawer Fronts

Door and drawer fronts shall be fabricated from 3/4 inch medium density particleboard or 3/4 inch medium density fiberboard (MDF. All door and drawer front edges shall be surfaced with PVC edgebanding, color and pattern to match exterior face laminate as indicated in Section 09915 COLOR SCHEDULE.

2.11.4 Drawer Assembly

Fabricate in accordance with the custom grade quality standards as outlined in AWI Qual Stds.

2.11.5 Cabinet Shelving

Shelving shall be fabricated from 3/4 inch medium density particleboard or 3/4 inch medium density fiberboard (MDF. All shelving top and bottom surfaces shall be finished with thermoset decorative overlay (melamine). Shelf edges shall be finished in a PVC edgebanding.

2.11.5.1 Shelf Support System

The shelf support system shall be:

a. Pin Hole Method. Holes shall be drilled on the interior surface of the cabinet side walls. Holes shall be evenly spaced in two vertical columns The holes in each column shall be spaced at 1 inch increments starting 6 inches from the cabinet interior bottom and extending to within 6 inches of the top interior surface of the cabinet. Holes shall be drilled to provide a level, stable surface when the shelf is resting on the shelf pins. Hole diameter shall be coordinated with pin insert size to provide a firm, tight fit.

2.11.6 Wall-mounted Shelving

Shelving shall be fabricated from 3/4 inch medium density particleboard or 3/4 inch medium density fiberboard (MDF). All shelving top and bottom surfaces shall be finished with HDPL plastic laminate. Shelf edges shall be finished in a PVC edgebanding.

2.11.6.1 Shelf Support System

The shelf support system shall be adjustable, metal shelf standards on brackets for wall mounting. Brackets shall be load rated at 540 to 1,060 pounds, and include a cam lock lever to secure bracket in place. Provide end, center and front rests as applicable to the installation. Standards,

brackets and accessories shall be electro zinc-plated 12 gage steel.

2.11.7 Laminate Clad Countertops

Laminate countertop substrate shall be constructed of 3/4 inch medium density fiberboard (MDF). The substrate shall be moisture-resistant where countertops receive sinks, lavatories, or are subjected to liquids. All substrates shall have sink cutout edges sealed with appropriate sealant against moisture. No joints shall occur at any cutouts. A balanced backer sheet is required.

2.11.7.1 Edge Style

Front and exposed side countertop edges shall be in shapes and to dimensions as shown on the drawings. The countertop edge material shall be one of the following as indicated on drawings.

post formed plastic laminate. Laminate edge shall be integral with countertop surface. Shape and profile shall be bullnose and to dimensions as indicated on the drawings.

b. Plastic laminate Self Edge. Flat, 90 degree "self " edge. Edge must be applied before top. Laminate edge shall overlap countertop laminate and shall be eased to eliminate sharp corners.

2.11.7.2 Laminate Clad Splashes

Countertop splash substrate shall be 3/4 inch MDF fiberboard. Laminate clad backsplash shall be integral with countertop, coved to radius and to dimensions as indicated on the drawings. Side splashes shall be straight profile and provided loose, to be installed at the time of countertop installation. Back and side splash laminate pattern and color shall match the adjacent countertop laminate.

2.11.8 Laminate Application

Laminate application to substrates shall follow the recommended procedures and instructions of the laminate manufacturer and NEMA LD 3.1, using tools and devices specifically designed for laminate fabrication and application. Provide a balanced backer sheet (Grade BK) wherever only one surface of the component substrate requires a plastic laminate finish. Apply required grade of laminate in full uninterrupted sheets consistent with manufactured sizes using one piece for full length only, using adhesives specified herein or as recommended by the manufacturer. Fit corners and joints hairline. All laminate edges shall be machined flush, filed, sanded, or buffed to remove machine marks and eased (sharp corners removed). Clean up at easing shall be such that no overlap of the member eased is visible. Fabrication shall conform to NEMA LD 3.1 and ANSI A161.2. Laminate types and grades for component surfaces shall be as follows unless otherwise indicated on the drawings:

a. Base/Wall Cabinet Case Body.

1) Exterior (exposed) surfaces to include exposed and semi-exposed face frame surfaces: HPDL Grade VGS.

2) Interior (semi-exposed) surfaces to include interior back wall, bottom, and side walls: Thermoset Decorative Overlay (melamine).

b. Adjustable Shelving.

1) Top and bottom surfaces: Thermoset Decorative Overlay (melamine).

2) All edges: PVC edgebanding.

c. Door, Drawer Fronts, Access Panels.

1) Exterior (exposed) and interior (semi-exposed) faces: HPDL Grade VGS

2) Edges: PVC edgebanding.

d. Drawer Assembly.

All interior and exterior surfaces: Thermoset Decorative Overlay (melamine).

e. Countertops and Splashes.

1) All exposed and semi-exposed surfaces: HPDL Grade HGS

2.11.8.1 Tolerances

Flushness, flatness, and joint tolerances of laminated surfaces shall meet the AWI Qual Stds custom grade requirements.

2.11.9 Wood Paneling at Transaction Counter

Install sequence matched, factory curved custom manufactured flush paneling in accordance with AWI Qual Stds custom grade requirements.

2.11.10 Finishing

2.11.10.1 Filling

No fasteners shall be exposed on laminated surfaces.

2.11.10.2 Coatings

Types, method of application and location of casework finishes shall be in accordance with the drawings, Section 09900 PAINTS AND COATINGS. All cabinet reveals shall be painted.

PART 3 EXECUTION

3.1 INSTALLATION

Installation shall comply with applicable requirements for AWI Qual Stds custom quality standards. Countertops and fabricated assemblies shall be installed level, plumb, and true to line, in locations shown on the drawings. Cabinets and other laminate clad casework assemblies shall be attached and anchored securely to the floor and walls with mechanical fasteners that are appropriate for the wall and floor construction.

3.1.1 Anchoring Systems

3.1.1.1 Floor

Base cabinets shall utilize a floor anchoring system . Anchoring and mechanical fasteners shall not be visible from the finished side of the casework assembly. Cabinet assemblies shall be attached to anchored bases without visible fasteners . Where assembly abutts a wall surface, anchoring shall include a minimum 1/2 inch thick lumber or panel product hanging strip, minimum 2-1/2 inch width; securely attached to the top of the wall side of the cabinet back.

3.1.1.2 Wall

Cabinet to be wall mounted shall utilize minimum 1/2 inch thick lumber or panel product hanging strips, minimum 2-1/2 inch width; securely attached to the wall side of the cabinet back, both top and bottom.

3.1.2 Countertops

Countertops shall be installed in locations as indicated on the drawings. Countertops shall be fastened to supporting casework structure with mechanical fasteners, hidden from view. All joints formed by the countertop or countertop splash and adjacent wall surfaces shall be filled with a clear silicone caulk.

3.1.2.1 Loose Splashes

Loose side splashes shall be adhered to both the countertop surface perimeter and the adjacent wall surface with adhesives appropriate for the type of materials to be adhered. Joints between the countertop surface and splash shall be filled with clear silicone caulk in a smooth consistent concave bead. Bead size shall be the minimum necessary to fill the joint and any surrounding voids or cracks.

3.1.3 Hardware

Casework hardware shall be installed in types and locations as indicated on the drawings. Where fully concealed European-style hinges are specified to be used with particleboard or fiberboard doors, the use of plastic or synthetic insertion dowels shall be used to receive 3/16 inch "Euroscrews". The use of wood screws without insertion dowels is prohibited.

3.1.4 Doors, Drawers and Removable Panels

The fitting of doors, drawers and removable panels shall be accomplished within target fitting tolerances for gaps and flushness in accordance with AWI Qual Stds custom grade requirements.

3.1.5 Wall-mounted Shelving

Install shelving on adjustable metal shelf standards and brackets. Fix brackets to solid blocking partitions. Brackets and standard shall be positioned and spaced on the walls to provide a stable shelf surface that eliminates tipping when shelf front is weighted. Standards shall be installed and adjusted vertically to provide a level, stable shelf surface.

3.1.6 Plumbing Fixtures

Sinks, sink hardware, and other plumbing fixtures shall be installed in locations as indicated on the drawings and in accordance with Section 15400A PLUMBING, GENERAL PURPOSE.

-- End of Section --

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DIVISION 06 - WOOD AND PLASTICS

SECTION 06650

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10/03

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SECTION 06650

SOLID POLYMER (SOLID SURFACING) FABRICATIONS
10/03

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A108.1	(1999) Installation of Ceramic Tile; including A108.1A-C, 108.4-.13, 118.1-.10, A136.1
ANSI Z124.3	(1995) Plastic Lavatories
ANSI Z124.6	(1997) Plastic Sinks

ASTM INTERNATIONAL (ASTM)

ASTM D 570	(1998) Water Absorption of Plastics
ASTM D 638	(2002) Tensile Properties of Plastics
ASTM D 696	(1998) Coefficient of Linear Thermal Expansion of Plastics Between Minus 30 degrees C and 30 degrees C With a Vitreous Silica Dilatometer
ASTM D 2583	(1995; R 2001e1) Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor
ASTM E 84	(2001) Surface Burning Characteristics of Building Materials
ASTM G 21	(1996; R 2002) Determining Resistance of Synthetic Polymeric Materials to Fungi

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA LD 3	(1995) High-Pressure Decorative Laminates

1.2 GENERAL DESCRIPTION

Work in this section includes transaction top, vanity tops and window stools and other items utilizing solid polymer (solid surfacing) fabrication as shown on the drawings and as described in this specification.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Shop Drawings; G-AE
Installation; G-AO

Shop Drawings indicating locations, dimensions, component sizes, fabrication and joint details, attachment provisions, installation details, and coordination requirements with adjacent work.

SD-03 Product Data

Solid polymer material
Qualifications
Fabrications

Product data indicating product description, fabrication information, and compliance with specified performance requirements for solid polymer, joint adhesive, and sealants. Both the manufacturer of materials and the fabricator shall submit a detailed description of operations and processes in place that support efficient use of natural resources, energy efficiency, emissions of ozone depleting chemicals, management of water and operational waste, indoor environmental quality, and other production techniques supporting sustainable design and products.

SD-04 Samples

Material; G-AE

A minimum 4 by 4 inch sample of each color and pattern for approval. Samples shall indicate full range of color and pattern variation. Approved samples shall be retained as a standard for this work.

Transaction Top and Vanity Tops; G-AO

A minimum 1 foot wide by 6 inch deep, full size sample for each type of top shown on the project drawings. The sample shall include the edge profile and backsplash as detailed on the project drawings. Solid polymer material shall be of a pattern and color as indicated on the drawings. Sample shall include at least one seam. Approved sample shall be retained as standard for this work.

SD-06 Test Reports

Solid polymer material

Test report results from an independent testing laboratory attesting that the submitted solid polymer material meets or exceeds each of the specified performance requirements.

SD-07 Certificates

Fabrications
Qualifications

Solid polymer manufacturer's certification attesting to fabricator qualification approval.

SD-10 Operation and Maintenance Data

Clean-up

A minimum of six copies of maintenance data indicating manufacturer's care, repair and cleaning instructions. Maintenance video shall be provided,if available. Maintenance kit for matte finishes shall be submitted.

1.4 DELIVERY, STORAGE AND HANDLING

Materials shall not be delivered to project site until areas are ready for installation. Materials shall be stored indoors and adequate precautions taken to prevent damage to finished surfaces. Protective coverings shall be provided to prevent physical damage or staining following installation, for duration of project.

1.5 WARRANTY

Manufacturer's warranty of ten years against defects in materials, excluding damages caused by physical or chemical abuse or excessive heat, shall be provided. Warranty shall provide for material and labor for replacement or repair of defective material for a period of ten years after component installation.

1.6 QUALIFICATIONS

To insure warranty coverage, solid polymer fabricators shall be certified to fabricate by the solid polymer material manufacturer being utilized. All fabrications shall be marked with the fabricator's certification label affixed in an inconspicuous location. Fabricators shall have a minimum of 5 years of experience working with solid polymer materials.

PART 2 PRODUCTS

2.1 MATERIAL

Solid polymer material shall be a homogeneous filled solid polymer; not coated, laminated or of a composite construction; meeting ANSI Z124.3 and ANSI Z124.6 requirements. Material shall have minimum physical and performance properties specified. Superficial damage to a depth of 0.01 inch shall be repairable by sanding or polishing. Material thickness shall be as indicated on the drawings. In no case shall material be less than 1/4 inch in thickness.

2.1.1 Cast,100 Percent Acrylic Polymer Solid Surfacing Material

Cast, 100 percent acrylic solid polymer material shall be composed of acrylic polymer, mineral fillers, and pigments and shall meet the following

minimum performance requirements:

PROPERTY	REQUIREMENT (min. or max.)	TEST PROCEDURE
Tensile Strength	5800 psi (min.)	ASTM D 638
Hardness	52-Barcol Impressor (min.)	ASTM D 2583
Thermal Expansion	.000023 in/in/F (max.)	ASTM D 696
Boiling water Surface Resistance	No Change	NEMA LD 3-3.05
High Temperature Resistance	No Change	NEMA LD 3-3.06
Impact Resistance (Ball drop)		NEMA LD 3-303
1/2" sheet	140", 1/2 lb ball, no failure	
3/4" sheet	200", 1/2 lb ball, no failure	
Mold & Mildew Growth	No growth	ASTM G 21
Bacteria Growth	No Growth	ASTM G 21
Liquid Absorption (Weight in 24 hrs.)	0.1% max.	ASTM D 570
Flammability		ASTM E 84
Flame Spread	25 max.	
Smoke Developed	30 max	

2.1.2 Material Patterns and Colors

Patterns and colors for all solid polymer components and fabrications shall be those indicated on the project color schedule and in Section 09915 COLOR SCHEDULE. Pattern and color shall occur, and shall be consistent in appearance, throughout the entire depth (thickness) of the solid polymer material.

2.1.3 Surface Finish

Exposed finished surfaces and edges shall receive a uniform appearance. Exposed surface finish shall be matte; gloss rating of 5-20.

2.2 ACCESSORY PRODUCTS

Accessory products, as specified below, shall be manufactured by the solid polymer manufacturer or shall be products approved by the solid polymer

manufacturer for use with the solid polymer materials being specified.

2.2.1 Seam Adhesive

Seam adhesive shall be a two-part adhesive kit to create permanent, inconspicuous, non-porous, hard seams and joints by chemical bond between solid polymer materials and components to create a monolithic appearance of the fabrication. Adhesive shall be approved by the solid polymer manufacturer. Adhesive shall be color-matched to the surfaces being bonded where solid-colored, solid polymer materials are being bonded together. The seam adhesive shall be clear or color matched where particulate patterned, solid polymer materials are being bonded together.

2.2.2 Panel Adhesive

Panel adhesive shall be neoprene based panel adhesive meeting ANSI A108.1, Underwriter's Laboratories (UL) listed. This adhesive shall be used to bond solid polymer components to adjacent and underlying substrates.

2.2.3 Silicone Sealant

Sealant shall be a mildew-resistant, FDA and UL listed silicone sealant or caulk in a clear formulation. The silicone sealant shall be approved for use by the solid polymer manufacturer. Sealant shall be used to seal all expansion joints between solid polymer components and all joints between solid polymer components and other adjacent surfaces such as walls, floors, and plumbing fixtures.

2.3 FABRICATIONS

Components shall be factory or shop fabricated to the greatest extent practical to sizes and shapes indicated, in accordance with approved Shop Drawings and manufacturer's requirements. Factory cutouts shall be provided for sinks, lavatories, and plumbing fixtures where indicated on the drawings. Contours and radii shall be routed to template, with edges smooth. Defective and inaccurate work will be rejected.

2.3.1 Joints and Seams

Joints and seams shall be formed between solid polymer components using manufacturer's approved seam adhesive. Joints shall be inconspicuous in appearance and without voids to create a monolithic appearance.

2.3.2 Edge Finishing

Rout and finish component edges to a smooth, uniform appearance and finish. Edge shapes and treatments, including any inserts, shall be as detailed on the drawings. Rout all cutouts, then sand all edges smooth. Repair or reject defective or inaccurate work.

2.3.3 Counter and Vanity Top Splashes

Backsplashes and end splashes shall be fabricated from 1/2 inch thick solid surfacing material and shall be provided to dimensions and shapes as indicated on the drawings. Backsplashes and end splashes shall be provided at locations indicated on the drawings. Backsplashes shall be shop fabricated and be permanently attached.

2.3.3.1 Permanently Attached Backsplash

Permanently attached backsplashes shall be attached straight with seam adhesive to form a 90 degree transition.

2.3.3.2 End Splashes

End splashes shall be provided loose for installation at the jobsite after horizontal surfaces to which they are to be attached have been installed.

2.3.4 Window Stools

Window stools shall be fabricated from 1/2 inch thick solid surfacing, solid polymer material. Dimensions, edge shape, and other details shall be as indicated on the drawings.

2.3.5 Transaction Top and Vanity Tops

All solid surfacing, solid polymer counter top and vanity top components shall be fabricated from 3/4 inch thick material. Edge details, dimensions, locations, and quantities shall be as indicated on the Drawings. Vanity tops shall be complete with 4 inch high permanently attached, 90 degree transition backsplash and loose endsplashes. Attach 2 inch wide reinforcing strip of polymer material under each horizontal counter top seam.

2.3.5.1 Vanity Tops With Bowls

A. Vitreous China Bowl

Countertops with vitreous china bowls shall include cutouts to template as furnished by the sink manufacturer. Manufacturer's standard sink mounting hardware for vitreous china rimless installation shall be provided. Seam between sink and counter top shall be sealed with silicone sealant. Sink, faucet, and plumbing requirements shall be in accordance with Section 15400A PLUMBING,GENERAL PURPOSE.

PART 3 EXECUTION

3.1 COORDINATION

In most instances, installation of solid polymer fabricated components and assemblies will require strong, correctly located structural support provided by other trades. To provide a stable, sound, secure installation, close coordination is required between the solid polymer fabricator/installer and other trades to insure that necessary structural wall support, vanity and transaction top structural support, proper clearances, and other supporting components are provided for the installation of tops and all other solid polymer fabrications to the degree and extent recommended by the solid polymer manufacturer. Contractor shall appropriate staging areas for solid polymer fabrications.

3.2 INSTALLATION

3.2.1 Components

All components and fabricated units shall be installed plumb, level, and rigid. Field joints between solid polymer components to provide a

monolithic appearance shall be made using solid polymer manufacturer's approved seam adhesives, with joints inconspicuous in the finished work. Metal or vitreous china sinks and lavatory bowls shall be attached to counter tops using solid polymer manufacturer's recommended clear silicone sealant and mounting hardware. Plumbing connections to sinks and lavatories shall be made in accordance with Section 15400A PLUMBING, GENERAL PURPOSE.

3.2.1.1 Loose Counter Top Splashes

Loose splashes shall be mounted in locations as noted on the drawings. Loose splashes shall be adhered to the counter top with a color matched silicone sealant when the solid polymer components are solid colors. Adhesion of particulate patterned solid polymer splashes to counter tops shall utilize a clear silicone sealant.

3.2.2 Silicone Sealant

A clear, silicone sealant or caulk shall be used to seal all expansion joints between solid polymer components and all joints between solid polymer components and other adjacent surfaces such as walls, floors, ceiling, and plumbing fixtures. Sealant bead shall be smooth and uniform in appearance and shall be the minimum size necessary to bridge any gaps between the solid surfacing material and the adjacent surface. Bead shall be continuous and run the entire length of the joint being sealed.

3.2.3 Plumbing

Plumbing connections to sinks and lavatories shall be made in accordance with Section 15400A PLUMBING, GENERAL PURPOSE.

3.3 CLEAN-UP

Components shall be cleaned after installation and covered to protect against damage during completion of the remaining project items. Components damaged after installation by other trades will be repaired or replaced at the General Contractor's cost. Component supplier will provide a repair/replace cost estimate to the General Contractor who shall approve estimate before repairs are made. The Contractor shall submit maintenance data as specified in the Submittals paragraph, under SD-10.

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SECTION 07112N

BITUMINOUS DAMPPROOFING

09/99

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SECTION 07112N

BITUMINOUS DAMPPROOFING
09/99

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C 208	(1995; R 2001) Cellulosic Fiber Insulating Board
ASTM C 728	(1997) Perlite Thermal Insulation Board
ASTM D 4263	(1983; R 1999) Indicating Moisture in Concrete by the Plastic Sheet Method
ASTM D 4479	(1993) Asphalt Roof Coatings - Asbestos Free

1.2 DELIVERY AND STORAGE

Deliver materials in sealed containers bearing manufacturer's original labels. Labels shall include date of manufacture, contents of each container, performance standards that apply to the contents and recommended shelf life.

PART 2 PRODUCTS

2.1 FIBROUS ASPHALT PRIMER

Matrial recommended by dampproofing materials manufacturer.

2.2 FIBROUS ASPHALT

ASTM D 4479, Type I for horizontal surfaces and vertical surfaces where approved by manufacturer, Type II for vertical surfaces.

2.3 SURFACE PROTECTION

2.3.1 Protection Board

Wood Fiber Board, ASTM C 208, or Perlite Board, ASTM C 728.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Remove or cut form ties and repair all surface defects as required in Section 03300, "Cast-In-place Structural Concrete." Clean concrete and

masonry surfaces to receive dampproofing of foreign matter and loose particles. Apply dampproofing to clean dry surfaces. Moisture test in accordance with ASTM D 4263. If test indicates moisture, allow a minimum of 7 additional days after test completion for curing. If moisture still exists, redo test until substrate is dry.

3.2 APPLICATION

Prime surfaces to receive asphaltic dampproofing only when requried by dampproofing materials manufacturer. When priming coat is required, apply dampproofing after priming coat is dry, but prior to any deterioration of primed surface, and when ambient temperature is above 40 degrees F.

3.2.1 Surface Priming

When priming coat is required prime surfaces to receive fibrous asphalt dampproofing with material recommended by dampproofing materials manufacturer. Apply primer when ambient temperature is above 40 degrees F and at rate recommended by dampproofing materials manufacturer, fully covering entire surface to be dampproofed.

3.2.2 Cold-Application Method

Apply two coats of fibrous asphalt to surfaces to be dampproofed. Apply each coat uniformly using not less than one gallon fibrous asphalt per 50 square feet unless recommended otherwise by dampproofing materials manufacturer. Apply first coat by brush or spray to provide full bond with surface. Brush or spray second coat over thoroughly dry first coat unless recommended otherwise by dampproofing materials manufacturer. Provide finished surface that is of uniform thickness and impervious to moisture. Provide coatings of minimum 1.6 mm thickness unless recommended otherwise by dampproofing materials manufacturer. Recoat porous areas.

3.3 PROTECTIVE COVERING

Protect dampproofed surfaces against which backfill will be placed with 1/2 inch thick wood fiberboard or perlite board.

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SECTION 07131

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03/02

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SECTION 07131

ELASTOMERIC SHEET WATERPROOFING
03/02

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D 4551	(1996; R 2001) Poly(Vinyl Chloride) (PVC) Plastic Flexible Concealed Water-Containment Membrane

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures:"

SD-03 Product Data

Elastomeric waterproofing sheet material G-AE

Primers, adhesives, and mastics

SD-04 Samples

Corner and field condition

SD-06 Test Reports

Elastomeric waterproofing sheet material

Certify compliance with performance requirements specified herein.

SD-08 Manufacturer's Instructions

Submit Manufacturer's material safety data sheets for primers, adhesives and mastics.

1.3 QUALITY ASSURANCE

1.3.1 Shop Drawing Requirements

Include description and physical properties; termination details; application details; recommendations regarding shelf life, application procedures; requirements for protective covering; and precautions for flammability and toxicity.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver and store materials out of the weather, in manufacturer's original packaging with brand name and product identification clearly marked. Do not permit uncertified materials in the work area.

1.5 ENVIRONMENTAL CONDITIONS

Do not apply waterproofing when there is surface moisture, or visible dampness on the surface to receive waterproofing and when ambient and surface temperatures are 40 degrees F or below.

PART 2 PRODUCTS

2.1 MATERIALS

Provide elastomeric waterproofing sheet material and related primers, adhesives, and mastics as specified herein. Ensure compatibility of waterproofing materials within a specific type, with each other, and with the materials on which they will be applied. Materials shall conform to the applicable performance requirements cited below when tested in accordance with the referenced ASTM publications.

2.2 THERMOPLASTIC MEMBRANE: POLYVINYL CHLORIDE (PVC)

Polyvinyl chloride (PVC) flexible sheets manufactured from 100 percent virgin polyvinyl cloride resin, not less than 40 mils minimum thickness. Treated with biocides which prevent growth of mold, mildew and fungus.

2.2.1 Thermoplastic Membrane Performance Requirements

a. Overall thickness: .040 inches min.; and meets requirements of ASTM D 4551.

2.2.2 Adhesives

a. Adhesive for thermoplastic flashings as recommended by sheet manufacturer.

b. Solvent cement for welding thermoplastic flashings as recommended by sheet manufacturer.

2.2.3 Accessories

a. Securement Strip: 14 gauge stainless steel metal bar, 1 inch wide, pre-punched 1 inch on center for securement.

PART 3 EXECUTION

3.1 VERIFICATION OF CONDITIONS

Before starting the work, verify that surfaces to be waterproofed are in satisfactory condition. Notify the Contracting Officer of defects or conditions that will prevent a satisfactory application. Do not start application until defects and conditions have been corrected.

3.2 SURFACE PREPARATION

Ensure surfaces to be treated are clean, dry, smooth, and free from deleterious materials and projections. Sweep surfaces to be covered before applying waterproofing to remove dust and foreign matter. Cure concrete by a method compatible with the waterproofing system.

3.3 APPLICATION

Follow manufacturer's printed installation instructions. When using solvent welding liquid, avoid prolonged contact with skin and breathing of vapor. Provide adequate ventilation. Carry waterproofing of horizontal surfaces up abutting vertical surfaces as indicated and adhere solid to the substrate. Avoid wrinkles and buckles in applying membrane. Unroll membrane and allow to remain flat for at least one-half hour before application. Install membrane over dry, sloped subfloor. Where membrane on horizontal surfaces are to receive fill, apply adhesive in accordance with manufacturer's instructions. Where metal studs are present, attach membrane at the height of at least 3 inches above the highest flood level of the shower area, attaching metal securement strip. Pull membrane tight without stretching. As soon as adhesive is fully set and dry, recheck lap splices. Where openings or fishmouths appear, reseal and reroll lap splices.

3.3.1 Thermoplastic Membrane (PVC)

Deck shall be clean, smooth and dry without surface irregularities. Adjacent sheets shall be welded in accordance with manufacturer's instructions. Lap area shall be a minimum of 4 inches wide when solvent-welded but not less than recommended by the manufacturer. Overlaps shall be with the flow of water. Join cemented surfaces and use a weighted, smooth flooring roller to facilitate bonding.

3.4 DRAIN INSTALLATION

Coordinate membrane and floor drain installation. Seal membrane with the appropriate sealant or mastic flashing component to drain flange in accordance with sheet manufacturer's instructions.

3.5 FIELD QUALITY CONTROL

Notify the Contracting Officer one day prior to date of performing tests. Before concealment, place test plug in drain below the level of the weep holes and cover elastomeric waterproofing to top of membrane dam with ponded water for 24 hours. Do not add water after start of 24 hour period. Carefully measure water level at beginning and end of 24 hour period. If water level falls, remove water and inspect waterproofing membrane. Make repairs or replacement as directed, and repeat test. Do not proceed with work that conceals membrane waterproofing before receiving approval and acceptance of Contracting Officer.

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SECTION 07220

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02/03

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SECTION 07220

ROOF AND DECK INSULATION
02/03

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C 208	(1995; R 2001) Cellulosic Fiber Insulating Board
ASTM C 728	(1997) Perlite Thermal Insulation Board
ASTM C 1177/C 1177M	(2001) Glass Mat Gypsum Substrate for Use as Sheathing
ASTM C 1289	(2002) Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
ASTM D 312	(2000) Asphalt Used in Roofing
ASTM D 4586	(2000) Asphalt Roof Cement, Asbestos Free
ASTM E 84	(2001) Surface Burning Characteristics of Building Materials

FM GLOBAL (FM)

FM AS 4470	(1986; R 1992) Class I Roof Covers
FM P7825	(2001) Approval Guide
FM P7825c	(2001) Approval Guide Building Materials
FM P9513	(1996) Loss Prevention Data for Roofing Contractors.

UNDERWRITERS LABORATORIES (UL)

UL Bld Mat Dir	(2003) Building Materials Directory

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Tapered roof insulation system; G-AE

Taper cants and crickets

Show a complete description of the procedures for the installation of each phase of the system indicating the type of materials, thicknesses, identity codes, sequence of laying insulation, location of ridges and valleys, special methods for cutting and fitting of insulation, and special precautions. The drawings shall be based on field measurements.

SD-03 Product Data

Fasteners and Asphalt; G-AO

Insulation; G-AE

Include minimum thickness of insulation for steel decks and fastener pattern for insulation on steel decks.

SD-06 Test Reports

Flame spread and smoke developed ratings

Submit in accordance with ASTM E 84.

SD-07 Certificates

Installer qualifications

SD-08 Manufacturer's Instructions

Nails and fasteners

Roof insulation, including field of roof and perimeter attachment requirements.

1.3 MANUFACTURER'S CERTIFICATE

Submit certificate from the insulation manufacturer attesting that the installer has the proper qualifications for installing tapered roof insulation systems.

Certificate attesting that the expanded perlite or polyisocyanurate insulation contains recovered material and showing estimated percent of recovered material. Certificates of compliance for felt materials.

1.4 QUALITY ASSURANCE

1.4.1 Insulation on Combustible Steel Decks

Roof insulation shall have a flame spread rating not greater than 75 and a smoke developed rating not greater than 150, exclusive of covering, when tested in accordance with ASTM E 84. Insulation bearing the UL label and

listed in the UL Bld Mat Dir as meeting the flame spread and smoke developed ratings will be accepted in lieu of copies of test reports. Compliance with flame spread and smoke developed ratings will not be required when insulation has been tested as part of a roof construction assembly of the type used for this project and the construction is listed as fire-classified in the UL Bld Mat Dir or listed as Class I roof deck construction in the FM P7825. Insulation tested as part of a roof construction assembly shall bear UL or FM labels attesting to the ratings specified herein.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

Deliver materials to site in manufacturer's unopened and undamaged standard commercial containers bearing the following legible information:

a. Name of manufacturer;

b. Brand designation;

c. Specification number, type, and class, as applicable, where materials are covered by a referenced specification; and

d. Asphalt's flashpoint (FP), equiviscous temperature (EVT), and finished blowing temperature (FBT).

Deliver materials in sufficient quantity to allow continuity of the work.

1.5.2 Storage and Handling

Store and handle materials in a manner to protect from damage, exposure to open flame or other ignition sources, and from wetting, condensation or moisture absorption. Store in an enclosed building or trailer that provides a dry, adequately ventilated environment. Replace damaged material with new material.

1.6 ENVIRONMENTAL CONDITIONS

Do not install roof insulation during inclement weather or when air temperature is below 40 degrees F and interior humidity is 45 percent or greater, or when there is visible ice, frost, or moisture on the roof deck.

1.7 PROTECTION OF PROPERTY

Provide protection as specified in Section 07511 BUILT-UP ASPHALT ROOFING

1.7.1 Special Protection

Provide special protection approved by the insulation manufacturer, or avoid heavy traffic on completed work when ambient temperature is above 80 degrees F.

1.7.2 Drippage of Bitumen

Seal joints in and at edges of deck as necessary to prevent drippage of asphalt into building or down exterior walls.

PART 2 PRODUCTS

2.1 INSULATION

2.1.1 Insulation Types

Roof insulation shall be one or an assembly of a maximum of three of the following materials and compatible with attachment methods for the specified insulation and roof membrane:

a. Expanded Perlite Board: ASTM C 728. Minimum 1 inch thick when both top and bottom surfaces will be in contact with asphalt.

b. Polyisocyanurate Board: ASTM C 1289 Type II, fibrous felt or glass mat membrane both sides, except minimum compressive strength shall be 20 pounds per square inch (psi).

c. Wood Fiberboard: ASTM C 208, high density, except 4 by 4 feet maximum board size.

ASTM C 208 Type II, Grade 1, roof insulating board, treated with sizing, wax or bituminous impregnation. Bituminous impregnation shall be limited to 4 percent by weight when used over steel decks. Maximum board size: 4 feet by 4 feet.

2.1.2 Recovered Materials

Provide thermal insulation materials containing recycled materials to the extent practical. The required minimum recycled material content for the listed materials are:

Perlite Composition Board:	23 percent postconsumer paper
Wood Fiberboard	5 percent recovered material

2.1.3 Insulation Thickness

As necessary to provide a thermal resistance (R value) of 22 or more for average thickness of tapered system. Thickness shall be based on the "R" value for aged insulation. Insulation over steel decks shall satisfy both specified R value and minimum thickness for width of rib opening recommended in insulation manufacturer's published literature.

2.1.4 Tapered Roof Insulation

One layer of the tapered roof insulation assembly shall be factory tapered to a slope of not less than 1/4 inch per foot. Provide starter and filler blocks as required to provide the total thickness of insulation necessary to meet the specified slope and thermal conductance. Mitered joints shall be factory fabricated and shall consist of two diagonally cut boards or one board shaped to provide the required slopes. Identify each piece of tapered insulation board by color or other identity coding system, allowing the identification of different sizes of tapered insulation board required to complete the roof insulation system.

2.1.5 Cants and Tapered Edge Strips

Provide preformed cants and tapered edge strips of the same material as the roof insulation; or, when roof insulation material is unavailable, provide pressure-preservative treated wood, wood fiberboard, or rigid perlite board cants and edge strips as recommended by the roofing manufacturer, unless otherwise indicated. Face of cant strips shall have incline of 45 degrees and vertical height of 4 inches. Taper edge strips at a rate of one to 1 1/2 inch per foot down to approximately 1/8 inch thick.

2.2 PROTECTION BOARD

For use as a protection board for hot-moppedroofing membrane over roof insulation.

2.2.1 Glass Mat Gypsum Roof Board

ASTM C 1177/C 1177M, 0 Flame Spread and 0 Smoke Developed when tested in accordance with ASTM E 84, 500 psi, Class A, non-combustible, 1/2 inch thick, 4 by 8 feet board size.

2.3 BITUMENS

2.3.1 Asphalt

ASTM D 312, Type III or IV. Asphalt flash point, finished blowing temperature, and equiviscous temperature (EVT) for mop and for mechanical spreader application shall be indicated on bills of lading or on individual containers.

2.3.2 Asphalt Roof Cement

ASTM D 4586, Type I for horizontal surfaces and for surfaces sloped from 0 to 3 inches per foot, Type II for vertical and surfaces sloped more than 3 inches per foot.

2.4 FASTENERS

Flush-driven through flat round or hexagonal steel or plastic plates. Steel plates shall be zinc-coated, flat round not less than 1 3/8 inch diameter or hexagonal not less than 28 gage. Plastic plates shall be high-density, molded thermoplastic with smooth top surface, reinforcing ribs and not less than 3 inches in diameter. Fastener head shall recess fully into the plastic plate after it is driven. Plates shall be formed to prevent dishing. Do not use bell-or cup-shaped plates. Fasteners shall conform to insulation manufacturer's recommendations, except that holding power, when driven, shall be not less than 40 pounds each in steel deck. Fasteners for steel decks shall conform to FM P7825c for Class I roof deck construction, and shall be spaced to withstand an uplift pressure of 90 pounds per square foot.

2.4.1 Fasteners for Steel Decks

Approved hardened penetrating fasteners or screws conforming to FM AS 4470 and listed in FM P7825c for Class I roof deck construction. Quantity and placement to withstand a minimum uplift pressure of 90 psf conforming to FM P7825.

PART 3 EXECUTION

3.1 EXAMINATION AND PREPARATION

3.1.1 Surface Inspection

Surfaces shall be clean, smooth, and dry. Check roof deck surfaces, including surfaces sloped to roof drains and outlets, for defects before starting work. The Contractor shall inspect and approve the surfaces immediately before starting installation. Prior to installing insulation, perform the following:

Examine steel decks to ensure that panels are properly secured to structural members and to each other and that surfaces of top flanges are flat or slightly convex.

3.1.2 Surface Preparation

Correct defects and inaccuracies in roof deck surface to eliminate poor drainage and hollow or low spots and perform the following:

a. Install wood nailers the same thickness as insulation at eaves, edges, curbs, walls, and roof openings for securing cant strips, gravel stops, and flashing flanges.

b. Cover steel decks with a layer of insulation board of sufficient thickness to span the width of a deck rib opening, and conforming to fire safety requirements. Secure with piercing or self-drilling, self-tapping fasteners of quantity and placement conforming to FM P7825. Insulation joints parallel to ribs of deck shall occur on solid bearing surfaces only, not over open ribs.

3.2 INSULATION INSTALLATION

Apply insulation in a minimum of two layers with staggered joints when total required thickness of insulation exceeds 1/2 inch. Lay insulation so that continuous longitudinal joints are parallel to ribs of deck and occur on solid bearing surfaces only, and end joints of each course are staggered with those of adjoining courses. When using multiple layers of insulation, joints of each succeeding layer shall be parallel and offset in both directions with respect to layer below. Keep insulation 1/2 inch clear of vertical surfaces penetrating and projecting from roof surface.

3.2.1 Installation Using Asphalt on Steel Decks

Secure first layer of insulation to deck with piercing or self-drilling, self-tapping fasteners. Engage fasteners by driving them through insulation into top flange of steel deck. Use driving method prescribed by fastener manufacturer. Insulation joints parallel to ribs of deck shall occur on solid bearing surfaces only, not over open ribs. Secure succeeding layers with solid asphalt moppings. Apply asphalt at a nominal rate of 30 pounds per square. Where insulation is applied over steel deck, long edge joints shall continuously bear on surfaces of the steel deck. Insulation which can be readily lifted after installation is not considered to be adequately secured. Insulation shall be applied so that all roof insulation applied each day is waterproofed the same day. Phased

construction will not be permitted.

3.2.2 Special Precautions for Installation of Foam Insulation

3.2.2.1 Polyisocyanurate Insulation

Where polyisocyanurate foam board insulation is provided, install 1 inch thick minimum wood fiberboard, glass mat gypsum roof board, or 1 inch thick minimum expanded perlite board insulation over top surface of foam board insulation. Stagger joints of insulation with respect to foam board insulation below.

3.2.3 Cant Strips

Where indicated, provide cant strips at intersections of roof with walls, parapets, and curbs extending above roof. Wood cant strips shall bear on and be anchored to wood blocking. Fit cant strips flush against vertical surfaces. Where possible, nail cant strips to adjoining surfaces. Where cant strips are installed against non-nailable materials, install in heavy mopping of asphalt.

3.2.4 Tapered Edge Strips

Where indicated, provide edge strips in the right angle formed by junction of roof and wood nailing strips that extend above level of roof. Install edge strips flush against vertical surfaces of wood nailing strips. Where possible, nail edge strips to adjoining surfaces. Where installed against non-nailable materials, install in heavy mopping of asphalt.

3.3 PROTECTION

3.3.1 Protection of Applied Insulation

Completely cover each day's installation of insulation with the finished roofing specified in Section 07511 BUILT-UP ASPHALT ROOFING on same day. Do not permit phased construction. Protect open spaces between insulation and parapets or other walls and spaces at curbs, scuttles, and expansion joints, until permanent roofing and flashing are applied. Do not permit storing, walking, wheeling, or trucking directly on insulation or on roofed surfaces. Provide smooth, clean board or plank walkways, runways, and platforms near supports, as necessary, to distribute weight to conform to indicated live load limits of roof construction. Exposed edges of the insulation shall be protected by cutoffs at the end of each work day or whenever precipitation is imminent. Cutoffs shall be 2 layers of bituminous-saturated felt set in plastic bituminous cement or hot asphalt, or EPDM membrane set in roof cement or hot asphalt. Fill all profile voids in cut-offs to prevent entrapping of moisture into the area below the membrane. Cutoffs shall be removed when work is resumed.

3.3.2 Damaged Work and Materials

Restore work and materials that become damaged during construction to original condition or replace with new materials.

3.4 INSPECTION

The Contractor shall establish and maintain an inspection procedure to assure compliance of the installed roof insulation with the contract requirements. Any work found not to be in compliance with the contract

shall be promptly removed and replaced or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

a. Observation of environmental conditions; number and skill level of insulation workers; start and end time of work.

b. Verification of certification, listing or label compliance with FM P9513.

c. Verification of proper storage and handling of insulation and vapor retarder materials before, during, and after installation.

d. Inspection of mechanical fasteners; type, number, length, and spacing.

e. Coordination with other materials, cants, sleepers, and nailing strips.

f. Inspection of insulation joint orientation and laps between layers, joint width and bearing of edges of insulation on deck.

g. Installation of cutoffs and proper joining of work on subsequent days.

h. Continuation of complete roofing system installation to cover insulation installed same day.

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SECTION 07410

COMPOSITE ALUMINUM WALL PANEL SYSTEM

PART 1 GENERAL

1.1 REFERENCE

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM B 209	(2002a) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 221	(2002) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM C 578	(2001) Rigid, Cellular Polystyrene Thermal Insulation
ASTM D 1037	(1999) Evaluating Properties of Wood-Base Fiber and Particle Panel Materials
ASTM D 1781	(1976 R 1986) Climbing Drum Peel Test for Adhesives
ASTM E 84	(2001) Surface Burning Characteristics of Building Materials
ASTM E 108	(1990) Fire Tests for Roof Coverings
ASTM E 283	(1991; R 1999) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM E 330	(2002) Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference
ASTM E 331	(2000) Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference

1.2 SYSTEM DESCRIPTION

Aluminum faced composite panels with a panel mounting system that includes anchorages, shims, furring, fasteners, gaskets and sealants, related flashing, adapters and masking for a complete and watertight installation.

System shall include roof edge and similar border and filler items as integral components of the panel system.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having an "G" designation are for information only or as othaerwise designated. When used, a designation following the "G" designation identifies the office that will reviw the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Materials; G-AE

Submit shop drawings showing adaption of the manufacturer's system to the project; include typical unit elevations at 1/2" scale and details at 3" scale, or full scale, to show dimensioning, member profiles, anchorage's system and interface with building construction. Show clearly where and how the manufacturer's system deviates from contract drawings and these specifications.

SD-03 Product Data

Materials; G-AE

Submit manufacturer's specifications for materials and fabrication of panel system.

Insulation

The manufactuarer's descriptive data shall be submitted for each type and thickness of insulation used. This data shall include a facsimile of the label the manufacturer shall apply to the insulation for shipping to the site. This label shall include a clearly marked indication of the R-value of each board thickness.

SD-04 Samples

Materials; G-AE

Submit a sample of panel system with specified finish, complete with factory applied edge treatment. Fabricate into units showing the following:

Prime members
Joinery
Anchorage
Profiles
Intersections

SD-06 Test Reports

System Performance Requirements

Certified test reports showing compliance with test methods indicated.

1.4 QUALITY ASSURANCE

1.4.1 System Characteristics

Plans, elevations, details, characteristics and other requirements indicated are based upon standards by one manufacturer. It is intended that other manufacturers may be acceptable, provided their details and characteristics comply with the requirements of size and profiles, and material/performance standards as indicated and as follows:

1.4.2 Appearance

System must not generally have any visible fasteners, telegraphing of fasteners or assembly on the panel faces or any other compromise of a neat, flat, fastener free panel and joint appearance.

1.4.3 Composition

System must be essentially the same composition and identically the finish of that specified.

1.4.4 Manufacturer's Qualifications

Manufacturer's of components of the panel system shall have not less than five years experience in the manufacture of each component.

1.4.5 Installer Qualifications

Panel system Fabricator/Installer shall have a minimum of five years experience in the fabrication and erection of panel systems similar to systems required for this project. Fabricator/Installer must be acceptable to the Panel Manufacturer and provide certification of same.

1.5 SYSTEM PERFORMANCE REQUIREMENTS

1.5.1 Testing

Where manufacturer's systems and components have been tested in accordance with tests specified under this Article, provide certification by manufacturer showing compliance with requirements. Otherwise, perform tests through a laboratory approved by the government and provide certified test results. Test results shall meet or exceed indicated standards.

1.5.2 Wind Resistance

Provide manufacturer's system which has been designed and tested in accordance with ASTM E 330 to withstand flexural, shear and torsional stresses for the following positive and negative wind pressures acting normal to the plane of the wall. Design shall be based on the building code but in no case less than 40 pounds per square foot positive and negative.

1.5.3 Deflections and Thermal Movement

Provide manufacturer's products and system which are capable of withstanding building movements and weather exposures including wind loading, and which are capable of performing within the following limitations:

a. Normal to the Plane of the Wall: Deflection of perimeter framing member shall not exceed 1/175 of span of 3/4", whichever is less.

b. At connection points of framing members to anchors, anchor deflection in any direction shall not exceed 1/16". Where connection points are not clearly defined, maximum anchor deflection shall not exceed 1/16".

c. Thermal Movements: Make allowances for free vertical and horizontal thermal movements due to the contraction and expansion of component parts. For an ambient temperature range from plus 20 degrees F to plus 180 degrees F, buckling, opening of joints, undue stress on fasteners, failure of sealants or any other detrimental effect due to the thermal movement of component parts will not be permitted. Fabrication, assembly and erection procedure shall take into account the ambient temperature range at the time of the respective operation.

1.5.4 Leakage Resistance

Provide the manufacturer's system that has been tested to demonstrate permanent resistance to leakages as follows:

a. Air Leakage: At 1.56 psf, not more than 0.1 cfm per sq ft of wall area when tested in accordance with ASTM E 283.

b. Water Penetration: Water penetration in this specification is defined as the appearance of uncontrolled water in the wall. Provision shall be made in the design to drain to the exterior face of the wall any leakage of water occurring at joints and/or any condensation taking place within the construction. No water infiltration under static pressure with ASTM E 331 at a differential of 20 percent of design loading, 6.24 psf minimum.

1.5.5 Structural Performance

Shall be tested in accordance with ASTM E 330 at design pressure. No permanent deformation or failures of structural members shall occur.

1.5.6 Panel Flatness Criteria

Maximum 1/32" in 2"-0" on panel in any direction for assembled units (non-accumulative).

1.5.7 Bond Integrity

When tested in accordance with ASTM D 1781 -76 for bond integrity, simulating resistance to delamination:

Bond Strength: 220 psi minimum
Peel Strength: 26 in. lbs./in., minimum
Shall have successfully passed 6 each ASTM D 1037 weather cycling tests.
Shall have no change in bond performance after 8 hours of submersion in boiling water.

1.5.8 Fire Performance Characteristics

Wall panel system shall comply with requirements for finished panel

performance as established by Section 1407 of the International Building Code (IBC) for non-load bearing, non-combustible wall construction. Finish panel system shall have surface burning characteristics of a flame spread rating of 25 or less and a smoke developed rating of 450 or less when tested in accordance with ASTM E 84; system evaluated and passed the UBC 26-9, intermediate scale multi-story test (ISMA) for flammability characteristics of exterior non-load bearing wall panel disassembles.

1.6 DELIVERY AND STORAGE

Deliver fabricated units and components parts identified per erection drawings. Protect surfaces from damage during shipping and erection. Inspect work for damage upon delivery. No damaged material shall be erected. Coordinate with Contractor for storage space at the site.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Composite Panels

Provide aluminum faced composite panel material as follows:

a. Core: Thermoplastic material which in composite assembly meets performance characteristics specified and code requirements as set forth in the BOCA Basic/National Building Code for Class 2A Construction.

b. Face Sheets: .020 inch thick aluminum 3003 alloy, coil coated with specified anodized finish and chemically bonded in a continuous process to core material to meet performance requirements. No glued or laminated materials allowed.

c. Thickness: 4 millimeters as indicated.

2.1.2 Panel Mounting System

Provide members such as extrusions, formed members, sheet and plate, of the alloy, temper and thickness recommended by the manufacturer to comply with the requirements of ASTM B 221 for extrusions and ASTM B 209 for sheet or plate. System to be rout and return wet seal system.

2.1.3 Flashing and Sealants

Fabricate flashing (where indicated) from .062 inch thick aluminum sheet. Where exposed to view, with anodized finish to match adjacent panel system. Provide lap strip under flashing at abutted conditions with lapped surface sealed with a full bed of non-hardening sealant. Provide sealants and/or gaskets as detailed or specified to meet performance requirements.

2.1.4 Furring and Fasteners

Hat type furring channels where indicated of size and thickness as determined by the panel manufacturer for indicated applications. Aluminum, non-magnetic stainless steel or other materials warranted by manufacturer to be non-corrosive and compatible with aluminum panel system.

2.2 FABRICATION

Fabricate panel system to dimensions, sizes and profiles indicated on the drawings based on an assumed design temperature of 70 degrees F. Allow for ambient temperature range of time of fabrication and erection. Where possible, check actual field dimensions in construction work by accurate field measurement before fabrication, and show recorded measurements on final shop drawings. However, coordinate fabrication schedule with construction progress to avoid delay of work. Where necessary, proceed with fabrication without field dimensions and coordinate installation tolerances to ensure proper fit of all system components. Shop fabricate units ready for erection. Fabricate panel sections with envelope pan corners with metal backup plates and sealant inside corner folds.At three-sided corner panels, heat weld compound corners with polyethylene rod, reinforce, and provide hair line joints. Locate weep holes at underside of panels at 24 inches on center with weep hole near every vertical joint. Cover holes on inside panel face with aluminum 18 x 14 mesh screen glued to panel. Protect panels with removable plastic film applied during production.

2.3 FINISHES

For all exposed Panel System components and accessories, provide electrolytically deposited color-anodized finish, designation AA-M10-C22-A44, Architectural Class I, 0.7 mil or thicker, on the metal faced panels. For color refer to Section 09915 COLOR SCHEDULE.

2.4 INSULATION

2.4.1 Rigid Board-Type Insulation

Rigid board-type insulation shall be extruded polystyrene. Polystyrene shall conform to ASTM C 578. The insulation shall be a standard product and shall be marked with not less than the manufacturer's trademark or name, the specifiction number, the permeance and R-values.

2.4.1.1 Aged R-Value

The aged R-value shall be determined at 75 degrees F in accordance with the appropriate referenced specification. The stated R-value of the insulation shall be certified by an independent testing laboratory or certified by an independent Registered Professional Engineer if tests are conducted in the manufacturer's laboratory.

2.4.1.2 Insulation Thickness

The insulation thickness shall be as shown on the drawings.

2.4.2 Insulation Adhesive

Insulation adhesive shall be specifically prepared to adhere the insulation to the sheathing. The adhesive shall not deleteriously affect the insulation, and shall have a record of satisfactory and proven performance for the conditions under which to be used.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Preparation

Examine supporting structure and conditions under which the work is to be erected, and notify the Contractor in writing of conditions detrimental to proper and timely completion of the work. Do not proceed with erection until unsatisfactory conditions have been corrected.

3.2 GENERAL

Do not install component parts which are observed to be defective, including warped, bowed, dented, abraided and broken members. Do not cut, trim, weld, or braze component parts during erection in a manner which would damage finish, decrease strength, or result in a visual imperfection or a failure in performance. Return component parts which require alteration to shop for refabrication, if possible, or for replacement by new parts.

3.2.1 Metal Separation

Apply a coat of bituminous paint, concealed, on one or both surfaces wherever dissimilar metals would otherwise be in contact. Use gasketed fasteners where needed to eliminate the possibility of corrosive or electrolytic action between metals.

3.2.2 Anchorage

Anchor component parts of the system securely in place, providing for necessary thermal and structural movement. Provide pressure-treated solid wood blocking behind aluminum panels where needed or indicated.

3.2.3 Tolerances and Shimming

Provide adjustment within system to accommodate variations of existing structure. Deviation from established vertical, horizontal or designed position must not exceed 1/8" per 12' of length of any member or 1/4" in any total run in any line. All shimming required to meet installation tolerances shall be provided and installed by composite aluminum wall panel installer.

3.2.4 Insulation

Composite aluminum wall panel system shall be insulated, where shown, by installing board-type insulation. Board type insulation shall be applied directly to the sheathing with adhesive. Insulation shall be neatly fitted between obstructions without impaling of insulation on anchors. The insulation shall be applied in parallel courses with vertical joints breaking midway over the course below and shall be applied in moderate contact with adjoining units without forcing, and shall be cut to fit neatly against adjoining surfaces.

3.2.5 Color Grain

The color grain in the anodized finish shall run in the same direction on all composite metal panels used on the project.

3.2.6 CLEANING

Clean aluminum surfaces promptly after installation, exercising care to avoid damage to protective coatings and finishes. Remove excess sealants, dirt and other substances. Remove protective film after installation is complete. It is the responsibility of the Contractor to initiate and maintain protections and other precautions required to ensure that panel system will be without damage or deterioration (other than normal weathering) at time of final acceptance.

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SECTION 07410N

METAL WALL AND SOFFIT PANELS
09/99

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7	(2002) Minimum Design Loads for Buildings and Other Structures

ASTM INTERNATIONAL (ASTM)

ASTM A 653/A 653M	(2002a) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 924/A 924M	(1999) General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM B 117	(1997) Operating Salt Spray (Fog) Apparatus
ASTM D 522	(1993a; R 2001) Mandrel Bend Test of Attached Organic Coatings
ASTM D 523	(1989; R 1999) Specular Gloss
ASTM D 714	(2002) Evaluating Degree of Blistering of Paints
ASTM D 822	(2001) Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings
ASTM D 968	(1993) Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM D 1654	(1992; R 2000) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D 2244	(2002) Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates
ASTM D 2247	(2002) Testing Water Resistance of Coatings in 100% Relative Humidity

ASTM D 2794	(1993; R 1999el) Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
ASTM D 3359	(2002) Measuring Adhesion by Tape Test
ASTM D 4214	(1998) Evaluating the Degree of Chalking of Exterior Paint Films
ASTM E 1592	(2001) Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference
ASTM E 283	(1991; R 1999) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM E 331	(2000) Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
ASTM E 84	(2001) Surface Burning Characteristics of Building Materials

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA Arch. Manual	(1993; Errata; Addenda Oct 1997; 4th Printing 1999) Architectural Sheet Metal Manual

1.2 DEFINITIONS

1.2.1 Corrugated Sheet

Metal sheet with finish coating system which is bent into standard corrugated shapes by roll-forming.

1.2.2 Finish Coating System

Factory-applied, organic coating system which is applied over sheet.

1.2.3 Flat Metal Sheet

Relatively thin, rectangular in cross-section and form, protected from corrosion by metallic coating bonded to base metal (with exception of aluminum alloy 3004), produced in commercial sizes, and usually furnished in coiled lengths for further processing.

1.2.4 Panel

One of series of standard-sized units produced by factory cutting of longer lengths of corrugated sheet, ready for installation as preformed metal roofing or siding.

1.2.5 Edge Creepage

Measurement of expected performance at conditions of field cut panel edges, drilled hole edges or site scratches of protective coating through handling or tool misusage.

1.2.6 Preformed

Roll formed, in the field or factory, to the manufacturer's approved configuration prior to installation.

1.2.7 System

The composite assembly of all components of the roof or wall system; including insulation, flashings, fasteners, other accessories, sealants, and transitions at roof and/or wall penetrating elements; necessary for a watertight installation.

1.3 PERFORMANCE REQUIREMENT

1.3.1 Deflection

When subjected to full design loads, steel soffit panels shall not deflect more than 1/180 of panels' clear span.

1.3.2 Wind Uplift

The structural performance test methods and requirements of the soffit systems and attachments shall be in accordance with ASTM E 1592.

Soffit systems and attachments shall resist wind loads shown on drawings as determined by ASCE 7, in pounds per square foot, with a factor of safety appropriate for the material holding the anchor.

1.3.3 Formability Test

When subjected to testing in accordance with ASTM D 522 Method B, 1/8 inch diameter mandrel, the coating film shall show no evidence of cracking to the naked eye.

1.3.4 Accelerated Weathering, Chalking Resistance and Color Change

A sample of the sheets shall be tested in accordance with ASTM D 822 for 2000 total hours. The coating shall withstand the weathering test without objectionable chalking, color change, or loss of adhesion of the protective coating, or corrosion of the base metal. Protective coating with no removal of finish after 1/16 inch cross-hatching to bare metal, to impact limits or point of metal rupture, when tested in accordance with ASTM D 3359, Test Method B. Following the accelerated weathering test, the coating shall have a chalk rating not less than No. 8 in accordance with ASTM D 4214 test procedures, and the color change shall not exceed 5 CIE or Hunter Lab color difference (delta E) units in accordance with ASTM D 2244. For sheets required to have a low gloss finish, the chalk rating shall be not less than No. 6 and the color difference shall be not greater than 7 units.

1.3.5 Specular Gloss

Finished surfaces exposed on building exterior shall have maximum specular gloss value of 10 or less, at angle of 85 degrees when measured in

accordance with ASTM D 523.

1.3.6 Salt Spray Test

Withstand a salt spray test for a minimum of 1000 hours in accordance with ASTM B 117, including the scribe requirement in the test. Immediately upon removal of the panel from the test, coating shall receive a rating of 10, no blisters in field as determined by ASTM D 714; and an average rating of 6, 1/8 inch failure at scribe, as determined by ASTM D 1654. Rating Schedule No. 1.

1.3.7 Impact Resistance

Factory-painted sheet shall withstand direct and reverse impact in accordance with ASTM D 2794 0.500 inch diameter hemispherical head indenter, equal to 1.5 times the metal thickness in mills, expressed in inch-pounds, with no cracking.

1.3.8 Abrasion Resistance Test

When subjected to the falling sand test in accordance with ASTM D 968, coating system shall withstand minimum of 50 liters of sand per mil of coating thickness before appearance of base metal.

1.3.9 Humidity Test

When subjected to humidity cabinet test in accordance with ASTM D 2247 for 1,000 hours, factory-finished, organic-coated panel shall show no signs of blistering, cracking, creepage, or corrosion with no loss of adhesion.

1.3.10 Insulated Wall Panel Performance

Insulated wall panels shall also comply with the following:

1.3.10.1 Air Infiltration

Air infiltration shall not exceed .03 cfm per square foot when tested at a static pressure of 1.56 psf per ASTM E 283-73.

1.3.10.2 Water Penetration

There shall be no uncontrolled water penetration at a static pressure of 10 psf when tested per ASTM E 331-70.

1.3.10.3 Surface Burning Characteristics

Foam core and interior surface of the complete panel system shall demonstrate compliance with the following criteria for surface burning characteristics per UL Standard 723 (ASTM E 84): Flame spread - 25 or less, Smoke developed - 450 or less.

1.4 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-02 Shop Drawings

Panels; G-AE

Fasteners; G-AE

Supports; G-AE

Flashing; G-AE

Closures; G-AE

In addition to the manufacturer's printed installation instruction manual and standard details, submit drawings to supplement the instructions and details. Drawings shall be thorough and show typical and special conditions including flashings, materials and thickness, dimensions, fixing lines, anchoring methods, sealant locations, sealant tape locations, fastener layout, sizes, and spacing, terminations, penetrations, attachments, and provisions for thermal movement. Details of installation shall be in accordance with the manufacturer's standard instructions and details or the SMACNA Arch. Manual. Prior to submitting shop drawings, have drawings reviewed and approved by the manufacturer's technical engineering department.

SD-03 Product Data

Panels; G-AE

Accessories

Fasteners

Sample warranty certificate

Submit catalog cuts, technical data sheets, and descriptive literature.

SD-04 Samples

Panels; G-AE

Submit one sample of each color and panel type indicated.

SD-06 Test Reports

Formability test

Accelerated Weathering, Chalking Resistance and Color Change

Specular gloss

Salt spray test

Abrasion resistance test

Humidity test

Wind uplift

Submit reports performed by independent qualified testing

laboratories.

SD-07 Certificates

Qualification of installer

Certify that the installer meets requirements specified under paragraph entitled "Qualification of Installer," and include the soffit system manufacturer's written approval of the installer.

1.5 QUALITY ASSURANCE

1.5.1 Manufacturer's Technical Representative

The representative shall have authorization from manufacturer to approve field changes and be thoroughly familiar with the products and with installations in the geographical area where construction will take place.

The representative shall be available to perform field inspections and attend meetings as required herein and as requested by the Contracting Officer.

1.5.2 Qualification of Installer

The roofing system installer shall be factory-trained and approved by the soffit system manufacturer to install the system.

1.6 DELIVERY, STORAGE, AND HANDLING

Carefully deliver, store, and handle panels and other manufactured products. Stack materials stored on site on platforms or pallets, and cover with tarpaulins or other weathertight covering. Do not use plastic which may cause sweating or condensation. Store panels so that water which may have accumulated during transit or storage, drains off. Do not store panels in contact with materials that might cause staining. Inspect panels upon arrival at jobsite; if wet, remove moisture, and restack and protect panels until used.

1.7 Warranty

A manufacturer's 20 year exterior material finish warranty on the factory colored finish warranting that the finish, under normal atmospheric conditions at the site, will not crack, peel, or delaminate; chalk in excess of a numerical rating of eight, as determined by ASTM D 4214 test procedures; or change color in excess of five CIE or Hunter Lab color difference (delta E) units in accordance with ASTM D 2244. Liability under this warranty is exclusively limited to refinishing with an air-drying version of the specified finish or replacing the defective coated material.

PART 2 PRODUCTS

2.1 SIDING AND SOFFIT PANELS

Wall and Soffit panels shall be steel and shall have a factory color finish meeting the specified requirements. Wall panels indicated to match existing shall have configurations for overlapping adjacent sheets. Insulated wall panels shall have interlocking ribs for securing adjacent sheets.Wall covering indicated to match existing shall be fastened to

framework using exposed fasteners. Insulated wall panels shall be fastened to framework using concealed fasteners. Length of sheets shall be sufficient to cover the entire height of any unbroken wall surface when such dimension is 30 feet, or less. Soffit panels shall have interlocking side seams for securing adjacent sheets. Length of sheets shall be sufficient to cover the entire length of any unbroken soffit surface. Design provisions shall be made for expansion and contraction. Thickness of sheet for panels shall be not less than specified. Where gages are specified, gages are subject to normal manufacturing tolerances.

2.1.1 Coated Steel Panels

2.1.1.1 Shape

Panels indicated to match existing shall be standard corrugated type having pitch and depth to match existing siding. Insulated wall panels shall be t ype having cross-sectional profile and depth as indicated. Soffit panels shall be 12 inches wide. Panels for Soffit shall have a 1 inch deep profile.

2.1.1.2 Material and Coating

Form sheets from steel conforming to ASTM A 653/A 653M, Structural Grade 40, galvanized coating conforming to ASTM A 924/A 924M, Class G-90.

2.1.1.3 Gage

22 U.S. Standard Gage for wall panels indicated to match existing andminimum 22 U.S. Standard Gage for soffit panels, but in no case lighter than required to meet maximum deflection requirements specified. 26 U.S. Standard Gage for interior and exterior surfaces of insulated wall panels, but in no case lighter than required to meet maximum deflection requirements specified.

2.1.1.4 Factory Color Finish

Provide factory applied, baked coating to the exterior and interior of metal roof and wall panels and metal accessories. Provide exterior finish top coat of 70 percent polyvinylidene fluoride resin with nominal 0.8 mil dry film thickness. Provide exterior primer standard with panel manufacturer with not less than 0.2 mil dry film thickness. Interior finish shall consist of 0.2 mil dry film thick prime coat. Provide exterior coating meeting the test requirements specified. Tests shall have been performed on the same factory finish and thickness provided.

2.1.2 Insulated Wall Panels

Steel faced, pre-finished, foamed in place composite wall panel with double interlocking side joints, integral factory-applied vapor seal and concealed structural fastening. Panels shall be 36 inches in width, 2 inches thick with a minimum R-value of 15. Exterior skin shall be non-directionally embossed and planked or striated. Core shall be urethane modified isocyanate. Strippable plastic film shall be used to protect the exterior finish.

2.1.3 Accessories

Provide sheet metal flashings, trim moldings, closure strips, caps, and other preformed metal panel accessories, of same material and finish as

panels, except accessories that are concealed after installation, and are zinc-coated steel may be provided unfinished. Provide metal thickness not less than that of panels. Provide molded closure strips of closed-cell or solid-cell synthetic rubber, neoprene, or polyvinyl chloride premolded to match configurations of preformed metal panels.

2.1.4 Fasteners

Provide fasteners for attaching panels to structural supports and to adjoining panels as approved and in accordance with printed manufacturer's recommendations; unless specified otherwise, fasteners shall be any of the following: self-tapping screws, bolts and nuts and self-locking rivets, self-locking bolts, end-welded studs, bolted or riveted studs, and stem rivets held by aluminum straps. Provide fastening system to withstand design loads indicated. Fasteners shall be Series 305 stainless steel, cadmium plated steel, or zinc cast-head for steel panels. Fasteners, except those having integral hexagonal washer heads, shall have composite metal and neoprene washers. Provide fasteners having integral hexagonal washer heads with polychloroprene washers. Heads of screws or bolts exposed on exterior face of factory-finished wall shall be nylon headed to match color of panel.

2.1.4.1 Screws

Not less than No. 14 diameter self-tapping type or self-drilling and self-tapping type.

2.1.4.2 Stud Welding

Provide shouldered type studs with minimum shank diameter of 3/16 inch and with cap or nut for holding preformed metal panels against shoulder.

2.1.4.3 Powder-Actuated Fasteners

Provide type to be fastened with powder-actuated tools and with shank diameter of adequate size to support loads imposed. Provide 1/2 inch minimum shank length for fastening panels to steel and one inch for fastening panels to concrete.

2.1.4.4 Blind Rivets

Stainless steel with nominal 3/16 inch diameter shank. Provide thread-stem-type rivets for other than fastening of trim. Close rivets with hollow stems.

2.1.4.5 Bolts

Minimum 1/4 inch diameter, shouldered or plain shank nuts.

2.1.5 Joint-Sealing Material

Compressible adhesive-cohesive butyl polyisobutylene rubber tape.

PART 3 EXECUTION

3.1 INSTALLATION

In accordance with manufacturer's approved installation instructions, and approved drawings, except as specified otherwise. Install panels in full

and firm contact with each other at side and end laps. Where panels are cut in field or where factory-applied coating is damaged and necessary repairs have been made with material of same type and color as finish coating, obtain approval of the Contracting Officer before installation. Correct defects in materials. Remove defective materials which cannot be corrected, and provide non-defective materials. Provide molded closure strips where indicated and whenever panels terminate with open ends after installation.

3.1.1 Wall Panels

Apply panels with longitudinal configurations in vertical position. Provide panels in full wall heights from base to eave with no horizontal joints except at junctions of door frames, window frames, louver panels, and similar locations. Seal side and end laps with joint-sealing material. Flash seal walls at base and at top, around windows, door frames, framed louvers, and other similar openings. Place closures, flashing, and sealing materials to achieve complete water tightness. Flashing is not required where approved interlocking, concealed-type side joints with concealed fasteners for wall panels. Side laps shall be standard overlap or interlocking ribs as indicated. Remove strippable plastic film as work progresses.

3.1.2 Soffit Panels

Apply soffit panels with longitudinal configurations in the direction indicated on the drawings. Provide soffit panels in full lengths from face of building wall to face of fascia, with no transverse joints. Seal side and end laps with joint-sealing material. Provide closure strips, flashing, and sealing material to achieve complete weathertightness.

3.1.3 Flashings

Provide flashings, related closures, and accessories provided with preformed metal panels where indicated to provide watertight installation. Install flashing, related closure, and accessories not indicated in accordance with panel manufacturer's printed instructions and details or approved shop drawings. Installation shall allow for expansion and contraction of flashing.

3.1.4 Fastener Installation

Provide fastener spacings in accordance with manufacturer's recommendations to withstand design loads indicated. Install fasteners in straight lines within tolerance of 1/2 inch in length of bay. Drive exposed, penetrating-type fasteners normal to surface and to uniform depth to seat washers with gaskets. Drive so as not to damage factory-applied coating. Exercise extreme care when drilling pilot hole for fastenings to keep drills perpendicular and centered. After drilling, remove metal filings and burrs from holes prior to installing fasteners and washers. Torque used when applying fasteners shall not exceed that recommended by manufacturer. Remove panels damaged by over-torqued fastenings, and provide new panels.

3.2 CLEANING

Clean exposed sheet metal work at completion of installation. Remove metal shavings, filings, nails, bolts, and wires. Remove grease and oil films, excess sealants, handling marks, contamination from steel wool, fittings

and drilling debris and scrub the work clean. Exposed metal surfaces shall be free of dents, creases, waves, scratch marks, solder or weld marks, and damage to the finish coating.

3.3 MANUFACTURER'S FIELD INSPECTION

Manufacturer's technical representative shall visit the site as necessary during the installation process to assure panels, flashings, and other system components are being installed in a satisfactory manner.

-- End of Section --

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SECTION 07416A

STRUCTURAL STANDING SEAM METAL ROOF (SSSMR) SYSTEM
11/01

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI SG-973	(1996) Cold-Formed Steel Design Manual

ASTM INTERNATIONAL (ASTM)

ASTM A 792/A 792M	(2002) Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
ASTM B 117	(1997) Operating Salt Spray (Fog) Apparatus
ASTM C 1289	(2002) Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
ASTM C 518	(1998) Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
ASTM C 665	(2001e1) Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
ASTM D 1308	(1987; R 1998) Effect of Household Chemicals on Clear and Pigmented Organic Finishes
ASTM D 1654	(1992; R 2000) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D 1970	(2001) Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection
ASTM D 2244	(2002) Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates
ASTM D 2247	(2002) Testing Water Resistance of Coatings in 100% Relative Humidity

ASTM D 2794	(1993; R 1999el) Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
ASTM D 3359	(2002) Measuring Adhesion by Tape Test
ASTM D 412	(1998a) Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension
ASTM D 4214	(1998) Evaluating the Degree of Chalking of Exterior Paint Films
ASTM D 4397	(1996) Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications
ASTM D 522	(1993a; R 2001) Mandrel Bend Test of Attached Organic Coatings
ASTM D 523	(1989; R 1999) Specular Gloss
ASTM D 714	(2002) Evaluating Degree of Blistering of Paints
ASTM D 822	(2001) Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings
ASTM D 903	(1998) Peel or Stripping Strength of Adhesive Bonds
ASTM D 968	(1993) Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM E 1592	(2001) Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference
ASTM E 84	(2001) Surface Burning Characteristics of Building Materials
ASTM E 96	(2000e1) Water Vapor Transmission of Materials

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7	(2002) Minimum Design Loads for Buildings and Other Structures

1.2 GENERAL REQUIREMENTS

The Contractor shall furnish a commercially available roofing system which satisfies all requirements contained herein and has been verified by load testing and independent design analysis to meet the specified design requirements.

1.2.1 Structural Standing Seam Metal Roof (SSSMR) System

The SSSMR system covered under this specification shall include the entire roofing system; the standing seam metal roof panels, fasteners, connectors, roof securement components, and assemblies tested and approved in accordance with ASTM E 1592. In addition, the system shall consist of panel finishes, slip sheet, insulation, vapor retarder, snow guards, all accessories, components, and trim and all connections with roof panels. This includes roof penetration items such as vents; ; eaves, ridge, hip, valley, rake, gable, wall, or other roof system flashings installed and any other components specified within this contract to provide a weathertight roof system.

1.2.2 Manufacturer Qualifications

The SSSMR system shall be the product of a manufacturer who has been in the practice of manufacturing and designing SSSMR systems for a period of not less than 3 years and has been involved in at least five projects similar in size and complexity to this project.

1.2.3 Installer Qualifications

The installer shall be certified by the SSSMR system manufacturer to have experience in installing at least three projects that are of comparable size, scope and complexity as this project for the particular roof system furnished. The installer may be either employed by the manufacturer or be an independent installer.

1.3 DESIGN REQUIREMENTS

The design of the SSSMR system shall be provided by the Contractor as a complete system. Members and connections not indicated on the drawings shall be designed by the Contractor. Roof panels, components, transitions, accessories, and assemblies shall be supplied by the same roofing system manufacturer.

1.3.1 Design Criteria

Design criteria shall be in accordance with ASCE 7.

1.3.2 Dead Loads

The dead load shall be the weight of the SSSMR system. Collateral loads such as sprinklers, mechanical and electrical systems, and ceilings shall not be attached to the panels.

1.3.3 Live Loads

1.3.3.1 Concentrated Loads

The panels and anchor clips shall be capable of supporting a 300 pound concentrated load. The concentrated load shall be applied at the panel midspan and will be resisted by a single standing seam metal roof panel assumed to be acting as a beam. The undeformed shape of the panel shall be used to determine the section properties.

1.3.3.2 Uniform Loads

The panels and concealed anchor clips shall be capable of supporting the

live loads which shall be the roof snow load.

1.3.4 Roof Snow Loads

The design roof snow loads shall be as shown on the contract drawings.

1.3.5 Wind Loads

The design wind uplift pressure for the roof system shall be as shown on the contract drawings. The design uplift force for each connection assembly shall be that pressure given for the area under consideration, multiplied by the tributary load area of the connection assembly. The safety factor listed below shall be applied to the design force and compared against the ultimate capacity. Prying shall be considered when figuring fastener design loads.

a. Single fastener in each connection.....3.0

b. Two or more fasteners in each connection...2.25

1.3.6 Thermal Loads

Roof panels shall be free to move in response to the expansion and contraction forces resulting from a total temperature range of 220 degrees F during the life of the structure.

1.3.7 Framing Members Supporting the SSSMR System

Any additions/revisions to framing members supporting the SSSMR system to accommodate the manufacturer/fabricator's design shall be the Contractor's responsibility and shall be submitted for review and approval. New or revised framing members and their connections shall be designed in accordance with AISI Cold-Formed Manual. Maximum deflection under applied live load, snow, or wind load shall not exceed 1/180 of the span length.

1.3.8 Roof Panels Design

Steel panels shall be designed in accordance with AISI SG-973. The structural section properties used in the design of the panels shall be determined using the unloaded shape of the roof panels. The calculated panel deflection from concentrated loads shall not exceed 1/180 of the span length. The calculated panel deflection under applied live load, snow, or wind load shall not exceed 1/180 times the span length. Deflections shall be based on panels being continuous across three or more supports. Deflection shall be calculated and measured along the major ribs of the panels.

1.3.9 Accessories and Their Fasteners

Accessories and their fasteners shall be capable of resisting the specified design wind uplift forces and shall allow for thermal movement of the roof panel system. Exposed fasteners shall not restrict free movement of the roof panel system resulting from thermal forces. There shall be a minimum of two fasteners per clip. Single fasteners with a minimum diameter of 3/8 inch will be allowed when the supporting structural members are prepunched or predrilled.

1.4 PERFORMANCE REQUIREMENTS

The SSSMR shall be tested for wind uplift resistance in accordance with ASTM E 1592; SSSMR systems previously tested and approved by the Corps of Engineers' STANDARD TEST METHOD FOR STRUCTURAL PERFORMANCE OF SSMRS BY UNIFORM STATIC AIR PRESSURE DIFFERENCE may be acceptable. Two tests shall be performed. Test 1 shall simulate the edge condition with one end having crosswise restraint and other end free of crosswise restraint. The maximum span length for the edge condition shall be 30 inches. Test 2 shall simulate the interior condition with both ends free of crosswise restraint. The maximum span length for the interior condition shall be 5.0 feet. External reinforcement, such as clamps on the ribs, shall not be installed to improve uplift resistance. Bolts through seams shall not be installed.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Structural Standing Seam Metal Roof (SSSMR) System; G-AE.

Metal roofing drawings and specifications and erection drawings; shop coating and finishing specifications; and other data as necessary to clearly describe design, materials, sizes, layouts, standing seam configuration, construction details, provisions for thermal movement, line of panel fixity, fastener sizes and spacings, sealants and erection procedures. Drawings shall reflect the intent of the architectural detailing using the manufacturer's proprietary products and fabricated items as required. The SSSMR system shop drawings shall be provided by the metal roofing manufacturer.

SD-03 Product Data

Design Analysis; G-AE.

Design analysis signed by a Registered Professional Engineer employed by the SSSMR manufacturer. The design analysis shall include a list of the design loads, and complete calculations for the support system (when provided by the Contractor), roofing system and its components; valley designs, calculations, screw pullout test results, and shall indicate how expected thermal movements are accommodated. Snow guard manufacturer to verify number of rows of bars needed at locations shown on drawings.

Qualifications

Qualifications of the manufacturer and installer.

Quality Assurance Plan

Contractor shall include a Quality Assurance Plan for SSSMR that includes a checklist of points to be observed, prior to start of roofing work.

SD-04 Samples

Accessories;G-AE.

One sample of each type of flashing, trim, closure, thermal spacer block, cap and similar items. Size shall be sufficient to show construction and configuration.

Roof Panels;G-AE.

One piece of each type to be used, 9 inches long, full width.

Factory Color FinishG-AE.

Three 3 by 5 inches samples of each type and color.

Fasteners

Two samples of each type to be used, with statement regarding intended use. If so requested, random samples of bolts, nuts, and washers as delivered to the job site shall be taken in the presence of the Contracting Officer and provided to the Contracting Officer for testing to establish compliance with specified requirements.

Insulation; G-AE.

One piece, 12 by 12 inches, of each type and thickness to be used, with a label indicating the rated permeance (if faced) and R-values. The flame spread, and smoke developed rating shall be shown on the label or provided in a letter of certification.

Gaskets and Insulating Compounds

Two samples of each type to be used and descriptive data.

Sealant

One sample, approximately 1 pound, and descriptive data.

Concealed Anchor Clips; G-AE.

Two samples of each type used.

Subpurlins; G-AE.

One piece, 9 inches long.

EPDM Rubber Boots; G-AE.

One piece of each type.

SD-06 Test Reports

Test Report for Uplift Resistance of the SSSMR; G-AE

The report shall include the following information:

a. Details of the SSSMR system showing the roof panel cross-section with dimensions and thickness.

b. Details of the anchor clip, dimensions, and thickness.

c. Type of fasteners, size, and the number required for each connection.

d. Purlins/subpurlins size and spacing used in the test.

e. Description of the seaming operation including equipment used.

f. Maximum allowable uplift pressures. These pressures are determined from the ultimate load divided by a factor of safety equal to 1.65.

g. Any additional information required to identify the SSSMR system tested.

h. Signature and seal of an independent registered engineer who witnessed the test.

SD-07 Certificates

Structural Standing Seam Metal Roof (SSSMR) System

a. Certification that the actual thickness of uncoated sheets used in SSSMRS components including roofing panels, subpurlins, and concealed anchor clips complies with specified requirements.

b. Certification that materials used in the installation are mill certified.

c. Previous certification of SSSMR system tested under the Corps of Engineers' Standard Test Method in lieu of ASTM E 1592 testing.

d. Certification that the sheets to be furnished are produced under a continuing quality control program and that a representative sample consisting of not less than three pieces has been tested and has met the quality standards specified for factory color finish.

e. Certification of installer. Installer certification shall be furnished.

f. Warranty certificate. At the completion of the project the Contractor shall furnish signed copies of the 5-year Warranty for Structural Standing Seam Metal Roof (SSSMR) System, a sample copy of which is attached to this section, and the 20-year Manufacturer's Material Warranties, and the manufacturer's 20-year system weathertightness warranty.

1.6 DELIVERY AND STORAGE

Materials shall be delivered to the site in a dry and undamaged condition

and stored out of contact with the ground. Materials shall be covered with weathertight coverings and kept dry. Storage conditions shall provide good air circulation and protection from surface staining.

1.7 WARRANTIES

The SSSMR system shall be warranted as outlined below. Any emergency temporary repairs conducted by the owner shall not negate the warranties.

1.7.1 Contractor's Weathertightness Warranty

The SSSMR system shall be warranted by the Contractor on a no penal sum basis for a period of five years against material and workmanship deficiencies; system deterioration caused by exposure to the elements and/or inadequate resistance to specified service design loads, water leaks, and wind uplift damage. The SSSMR system covered under this warranty shall include the entire roofing system including, but not limited to, the standing seam metal roof panels, fasteners, connectors, roof securement components, and assemblies tested and approved in accordance with ASTM E 1592. In addition, the system shall consist of panel finishes, slip sheet, insulation, vapor retarder, all accessories, components, and trim and all connections with roof panels. This includes roof penetration items such as vents; eaves, ridge, hip, valley, rake, gable, wall, or other roof system flashings installed and any other components specified within this contract to provide a weathertight roof system; and items specified in other sections of these specifications that are part of the SSSMR system. All material and workmanship deficiencies, system deterioration caused by exposure to the elements and/or inadequate resistance to specified design loads, water leaks and wind uplift damage shall be repaired as approved by the Contracting Officer. See the attached Contractor's required warranty for issue resolution of warrantable defects. This warranty shall warrant and cover the entire cost of repair or replacement, including all material, labor, and related markups. The Contractor shall supplement this warranty with written warranties from the installer and system manufacturer, which shall be submitted along with Contractor's warranty; however, the Contractor shall be ultimately responsible for this warranty. The Contractor's written warranty shall be as outlined in attached WARRANTY FOR STRUCTURAL STANDING SEAM METAL ROOF (SSSMR) SYSTEM, and shall start upon final acceptance of the facility. It is required that the Contractor provide a separate bond in an amount equal to the installed total roofing system cost in favor of the owner (Government) covering the Contractor's warranty responsibilities effective throughout the five year Contractor's warranty period for the entire SSSMR system as outlined above.

1.7.2 Manufacturer's Material Warranties.

The Contractor shall furnish, in writing, the following manufacturer's material warranties which cover all SSSMR system components such as roof panels, anchor clips and fasteners, flashing, accessories, and trim, fabricated from coil material:

a. A manufacturer's 20 year material warranty warranting that the aluminum-zinc alloy coated steel or aluminum-coated steel as specified herein will not rupture, structurally fail, fracture, deteriorate, or become perforated under normal design atmospheric conditions and service design loads. Liability under this warranty shall be limited exclusively to the cost of either repairing or replacing nonconforming, ruptured, perforated, or structurally failed coil material.

b. A manufacturer's 20 year exterior material finish warranty on the factory colored finish warranting that the finish, under normal atmospheric conditions at the site, will not crack, peel, or delaminate; chalk in excess of a numerical rating of eight, as determined by ASTM D 4214 test procedures; or change color in excess of five CIE or Hunter Lab color difference (delta E) units in accordance with ASTM D 2244. Liability under this warranty is exclusively limited to refinishing with an air-drying version of the specified finish or replacing the defective coated material.

c. A roofing system manufacturer's 20 year, non-prorated, system weathertightness warranty.

1.8 COORDINATION MEETING

A coordination meeting shall be held 30 days prior to the first submittal, for mutual understanding of the Structural Standing Seam Metal Roof (SSSMR) System contract requirements. This meeting shall take place at the building site and shall include representatives from the Contractor, the roof system manufacturer, the roofing supplier, the erector, the SSSMR design engineer of record, and the Contracting Officer. All items required by paragraph SUBMITTALS shall be discussed, including applicable standard manufacturer shop drawings, and the approval process. The Contractor shall coordinate time and arrangements for the meeting.

1.9 QUALITY ASSURANCE PLAN

Contractor shall include a Quality Assurance Plan that includes a checklist of points to be observed, prior to start of roof work.

PART 2 PRODUCTS

2.1 ROOF PANELS

Panels shall be steel and shall have a factory color finish. Length of sheets shall be sufficient to cover the entire length of any unbroken roof slope for slope lengths that do not exceed 30 feet. When length of run exceeds 30 feet and panel laps are provided, each sheet in the run shall extend over three or more supports. Sheets longer than 100 feet may be furnished if approved by the Contracting Officer. Width of sheets shall provide not more than 24 inches of coverage in place. SSSMR system shall have standing seams rolled during installation by an electrically driven seaming machine. Height of standing seams shall be not less than 2 inches for rolled seams.

2.1.1 Steel Panels

Steel panels shall be aluminum-zinc alloy coated steel conforming to ASTM A 792/A 792M, AZ 50 coating. Zinc-aluminum alloy coated panels shall be 0.023 inch thick minimum. Panels shall be within 95 percent of reported tested thickness as noted in wind uplift resistance testing required in paragraph PERFORMANCE REQUIREMENTS. Panels that have become wet during shipment and have started to oxidize shall be rejected.

2.2 CONCEALED ANCHOR CLIPS

Concealed anchor clips shall be the same as the tested roofing system. Clip bases shall have factory punched or drilled holes for attachment. Clips shall be made from multiple pieces with the allowance for the total thermal movement required to take place within the clip. Single piece

clips may be acceptable when the manufacturer can substantiate that the system can accommodate the thermal cyclic movement under sustained live or snow loads.

2.3 ACCESSORIES

Flashing, trim, metal closure strips, caps and similar metal accessories shall be the manufacturer's standard products. Exposed metal accessories shall be finished to match the panels furnished. Molded closure strips shall be closed-cell or solid-cell synthetic rubber or neoprene, or polyvinyl chloride premolded to match configuration of the panels and shall not absorb or retain water. The use of a continuous angle butted to the panel ends to form a closure will not be allowed.

2.4 FASTENERS

Fasteners for steel roof panels shall be zinc-coated steel, corrosion resisting steel, or nylon capped steel, type and size specified below or as otherwise approved for the applicable requirements. Fasteners for structural connections shall provide both tensile and shear ultimate strengths of not less than 750 pounds per fastener. Fasteners for accessories shall be the manufacturer's standard. Exposed roof fasteners shall be sealed or have sealed washers on the exterior side of the roof to waterproof the fastener penetration. Washer material shall be compatible with the roofing; have a minimum diameter of 3/8 inch for structural connections; and gasketed portion of fasteners or washers shall be neoprene or other equally durable elastomeric material approximately 1/8 inch thick. Exposed fasteners for factory color finished panels shall be factory finished to match the color of the panels.

2.4.1 Screws

Screws for attaching anchor devices shall be not less than No. 14. Actual screw pull out test results shall be performed for the actual material gage and yield strength of the structural purlins or subpurlins to which the clip is to be anchored/attached. Other screws shall be as recommended by the manufacturer to meet the strength design requirements of the panels.

2.4.2 Bolts

Bolts shall be not less than 1/4 inch diameter, shouldered or plain shank as required, with locking washers and nuts.

2.4.3 Structural Blind Fasteners

Blind screw-type expandable fasteners shall be not less than 1/4 inch diameter. Blind (pop) rivets shall be not less than 9/32 inch minimum diameter.

2.5 SUBPURLINS

Cold formed supporting structural members/subpurlins shall have a minimum thickness of 0.059 inches and a minimum tensile yield strength of 50000 psi. Hot rolled structural members shall have a minimum thickness of 0.25 inches and a minimum tensile yield strength of 36000 psi. Subpurlins shall be shop painted.

2.6 FACTORY COLOR FINISH

Panels shall have a factory applied polyvinylidene fluoride finish on the exposed side. The exterior finish shall consist of a baked-on topcoat with an appropriate prime coat. Color shall match the color indicated in Section 09915 COLOR SCHEDULE. The exterior coating shall be a nominal 1 mil thickness consisting of a topcoat of not less than 0.7 mil dry film thickness and the paint manufacturer's recommended primer of not less than 0.2 mil thickness. The interior color finish shall consist of a 0.2 mil thick prime coat. The exterior color finish shall meet the test requirements specified below.

2.6.1 Salt Spray Test

A sample of the sheets shall withstand a cyclic corrosion test for a minimum of 1000 hours in accordance with ASTM B 117, including the scribe requirement in the test. Immediately upon removal of the panel from the test, the coating shall receive a rating of not less than 10, no blistering, as determined by ASTM D 714; and a rating of 10, no blistering or cracking, as determined by ASTM D 1654.

2.6.2 Formability Test

When subjected to testing in accordance with ASTM D 522 Method B, 1/8 inch diameter mandrel, the coating film shall show no evidence of cracking to the naked eye.

2.6.3 Accelerated Weathering, Chalking Resistance and Color Change

A sample of the sheets shall be tested in accordance with ASTM D 822for 2000 total hours. The coating shall withstand the weathering test without objectionable chalking, color change, or loss of adhesion of the protective coating, or corrosion of the base metal. Protective coating with no removal of finish after 1/16 inch cross-hatching to bare metal, to impact limits or point of metal rupture, when tested in accordance with ASTM D 3359, Test Method B. Following the accelerated weathering test, the coating shall have a chalk rating not less than No. 8 in accordance with ASTM D 4214 test procedures, and the color change shall not exceed 5 CIE or Hunter Lab color difference (delta E) units in accordance with ASTM D 2244. For sheets required to have a low gloss finish, the chalk rating shall be not less than No. 6 and the color difference shall be not greater than 7 units.

2.6.4 Humidity Test

When subjected to a humidity cabinet test in accordance with ASTM D 2247 for 2000 hours, a scored panel shall show no signs of blistering, cracking, creepage or corrosion.

2.6.5 Impact Resistance

Factory-painted sheet shall withstand direct and reverse impact in accordance with ASTM D 2794 0.500 inch diameter hemispherical head indenter, equal to 1.5 times the metal thickness in mils, expressed in inch-pounds, with no cracking.

2.6.6 Abrasion Resistance Test

When subjected to the falling sand test in accordance with ASTM D 968, Method A, the coating system shall withstand a minimum of 50 liters of sand

before the appearance of the base metal. The term "appearance of base metal" refers to the metallic coating on steel or the aluminum base metal.

2.6.7 Specular Gloss

Finished roof surfaces shall have a specular gloss value of 10 or less at an angle of 85 degrees when measured in accordance with ASTM D 523.

2.6.8 Pollution Resistance

Coating shall show no visual effects when covered spot tested in a 10 percent hydrochloric acid solution for 24 hours in accordance with ASTM D 1308.

2.7 INSULATION

Thermal resistance of insulation shall be not less than the R-values shown on the contract drawings. R-values of polyisocyanurate board insulation shall be determined at a mean temperature of 75 degrees F in accordance with ASTM C 518. Insulation shall be a standard product with the insulation manufacturer, factory marked or identified with insulation manufacturer's name or trademark and R-value. Identification shall be on individual pieces or individual packages. Insulation, including facings, shall have a flame spread not in excess of 25 and a smoke developed rating not in excess of 50 when tested in accordance with ASTM E 84. The stated R-value of the insulation shall be certified by an independent Registered Professional Engineer if tests are conducted in the insulation manufacturer's laboratory.

2.7.1 Polyisocyanurate Rigid Board Insulation for Use Above a Roof Deck

Polyisocyanurate insulation shall conform to ASTM C 1289, Type II. For polyisocyanurate , the maximum design R-value per 1 inch of insulation used shall be 7.2. Facings shall be non-asphaltic, glass fiber reinforced.

2.7.2 Blanket Insulation

Blanket insulation shall conform to ASTM C 665, Type I. Insulation placed between the steel studs shall be batt or blanket type mineral wool.

2.8 SEALANT

Sealants shall be elastomeric type containing no oil or asphalt. Exposed sealant shall be colored to match the applicable building color and shall cure to a rubberlike consistency. Sealant placed in the roof panel standing seam ribs shall be provided in accordance with the manufacturer's recommendations.

2.9 GASKETS AND INSULATING COMPOUNDS

Gaskets and insulating compounds shall be nonabsorptive and suitable for insulating contact points of incompatible materials. Insulating compounds shall be nonrunning after drying.

2.10 VAPOR RETARDER

2.10.1 Vapor Retarders Separate from Insulation

Vapor retarder material shall be polyethylene sheeting conforming to ASTM D

4397. A single ply of 10 mil polyethylene sheet; or, at the Contractor's option, a double ply of 6 mil polyethylene sheet shall be used. A fully compatible polyethylene tape which has equal or better water vapor control characteristics than the vapor retarder material shall be provided. A cloth industrial duct tape in a utility grade shall also be provided to use as needed to protect the vapor retarder from puncturing.

2.10.2 Slip Sheet for Use With Blanket Insulation

Slip sheet for use with vapor retarder shall be a 5 lb. per 100 square feet rosin-sized, unsaturated building paper.

2.11 EPDM RUBBER BOOTS

Flashing devices around pipe penetrations shall be flexible, one-piece devices molded from weather-resistant EPDM rubber. Rubber boot material shall be as recommended by the manufacturer. The boots shall have base rings made of aluminum or corrosion resisting steel that conform to the contours of the roof panel to form a weather-tight seal.

2.12 COMPOSITE, SELF ADHERING MEMBRANE SHEETING

Cold applied composite sheet consisting of rubberized asphalt and cross-laminated high density polyethylene film intended for use as underlayment for metal roof and wall panels. Not less than 40 mils minimum thickness is required.

2.12.1 Composite, Self Adhering Sheeting Performance Requirements

a. Tensile Strength, ASTM D 412, Die C: 250 psi minimum;
b. Ultimate Elongation, ASTM D 412, Die C: 200 percent mnimum;
c. Water Vapor Transmission, ASTM E 96: 0.05 perm maximum;
d. Low Temperature Flexibility, ASTM D 1970: Unaffected at -20 degrees F;
f. Adhesion to Plywood, ASTM D 903: 3 pounds per inch width.

2.13 SNOW GUARDS

Snow guards shall be the standard product of a manufacturer who has been in the practice of manuacturing snow guard systems for a period of not less than 3 years. The system shall consist of a 12 gauge stainless steel clamp which holds a 16 gauge 1 inch by 1 inch galvanized steel tube painted to match the roof. Clamps shall be designed to attach to the standing seams with stainless steel screws. Provide ice-stopper shapes designed to hang from the bar in the center of the panel.

PART 3 EXECUTION

3.1 INSTALLATION

Installation shall be in accordance with the manufacturer's erection instructions and drawings. Dissimilar materials which are not compatible when contacting each other shall be insulated by means of gaskets or insulating compounds. Molded closure strips shall be installed wherever roofing sheets terminate in open-end configurations, exclusive of flashings. The closure strip installation shall be weather-tight and sealed. Screws shall be installed with a clutching screw gun, to assure screws are not stripped. Field test shall be conducted on each gun prior to starting installation and periodically thereafter to assure it is

adjusted properly to install particular type and size of screw as recommended by manufacturer's literature. Improper or mislocated drill holes shall be plugged with an oversize screw fastener and gasketed washer; however, sheets with an excess of such holes or with such holes in critical locations shall not be used. Exposed surfaces and edges shall be kept clean and free from sealant, metal cuttings, hazardous burrs, and other foreign material. Stained, discolored, or damaged sheets shall be removed from the site.

3.1.1 Field Forming of Panels for Unique Area

When roofing panels are formed from factory-color-finished steel coils at the project site, the same care and quality control measures that are taken in shop forming of roofing panels shall be observed. Rollformer shall be operated by the metal roofing manufacturer's representative. In cold weather conditions, preheating of the steel coils to be field formed shall be performed as necessary just prior to the rolling operations.

3.1.2 Subpurlins

Unless otherwise shown, subpurlins shall be anchored to the purlins or other structural framing members with bolts or screws. Attachment to the substrate (when provided) or to the panels is not permitted. The subpurlin spacing shall not exceed 30 inches on centers at the corner, edge and ridge zones, and 5 foot maximum on centers for the remainder of the roof. Corner, edge, and ridge zones are as defined in ASCE 7.

3.1.3 Roof Panel Installation

Roof panels shall be installed with the standing seams in the direction of the roof slope. The side seam connections for installed panels shall be completed at the end of each day's work. Method of applying joint sealant shall conform to the manufacturer's recommendation to achieve a complete weather-tight installation. End laps of panels shall be provided in accordance with the manufacturer's instructions. Closures, flashings, EPDM rubber boots, and related accessories shall be installed according to the manufacturer's drawings. Fasteners shall not puncture roofing sheets except as provided for in the manufacturer's instructions for erection and installation. Expansion joints for the standing seam roof system shall be installed at locations indicated on the contract drawings and other locations indicated on the manufacturer's drawings.

3.1.4 Concealed Anchor Clips

Concealed anchor clips shall be fastened directly to the structural framing members. Attachment to the substrate (when provided) or to the metal deck is not permitted. The maximum distance, parallel to the seams, between clips shall be 30 inches on center at the corner, edge, and ridge zones, and 5 feet maximum on centers for the remainder of the roof.

3.2 INSULATION INSTALLATION

Insulation shall be continuous over entire roof surface. Where expansion joints, terminations, and other connections are made, the cavity shall be filled with batt insulation with vapor retarder providing equivalent R-value and perm rating as remaining insulation. Insulation shall be installed as indicated and in accordance with manufacturer's instructions.

3.2.1 Board Insulation with Blanket Insulation

Rigid board insulation shall be laid in close contact. Board shall be attached to the metal roof deck with bearing plates and fasteners, as recommended by the insulation manufacturer, so that the insulation joints are held tight against each other, and shall have a minimum of 1 fastener per 4 square feet. Layout and joint pattern of insulation and fasteners shall be indicated on the shop drawings. Install insulation in two layers with joints in the second layer offset from joints in the first layer. A layer of blanket insulation shall be placed over the rigid board insulation to be compressed against the underside of the metal roofing to reduce thermal bridging, dampen noise, and prevent roofing flutter. This layer of blanket insulation shall be compressed a minimum of 50 percent.

3.3 PROTECTION OF VAPOR RETARDER FROM ROOF DECK

A cloth industrial duct tape shall be applied over the seams of metal roof decks, at penetration edges, and at surface areas exhibiting sharp burrs or similar protrusions. For other types of roof decks, cloth industrial duct tape shall be applied over irregularities which could potentially puncture polyethylene membrane.

3.4 VAPOR RETARDER INSTALLATION

3.4.1 Polyethylene Vapor Retarder

The polyethylene vapor retarder membrane shall be installed over the entire surface. A fully compatible polyethylene tape shall be used to seal the edges of the sheets to provide a vapor tight membrane. Sheet edges shall be lapped not less than 6 inches. Sufficient material shall be provided to avoid inducing stresses in the sheets due to stretching or binding. All tears or punctures that are visible in the finished surface at any time during the construction process shall be sealed with polyethylene tape.

3.5 SLIP SHEET INSTALLATION

A slip sheet shall be laid over the blanket insulation to prevent the insulation from adhering to the metal roofing.

3.6 COMPOSITE, SELF ADHERING MEMBRANE INSTALLATION

All side laps shall be minimum 3-1/2 inches and end laps shall be 6 inches. Laps shall be self adhesive mastic as per manufacturer's recommendation. Roll or firmly press to adhere membrane to substrate. Flash projections with a second ply of membrane for a distance of 6 inches from the projection. Finish exposed, terminated edges of membrane on sloped or vertical surfaces with a trowelled bead of mastic. Apply mastic around edgs of membrane and projections. Apply mastic at end of each work day. Install membrane where indicated on drawings.

3.7 CLEANING AND TOUCH-UP

Exposed SSSMR systems shall be cleaned at completion of installation. Debris that could cause discoloration and harm to the panels, flashings, closures and other accessories shall be removed. Grease and oil films, excess sealants, and handling marks shall be removed and the work shall be scrubbed clean. Exposed metal surfaces shall be free of dents, creases, waves, scratch marks, and solder or weld marks. Immediately upon detection, abraded or corroded spots on shop-painted surfaces shall be wire

brushed and touched up with the same material used for the shop coat. Factory color finished surfaces shall be touched up with the manufacturer's recommended touch up paint.

CONTRACTOR'S FIVE (5) YEAR NO PENAL SUM WARRANTY
FOR
STRUCTURAL STANDING SEAM METAL ROOF (SSSMR) SYSTEM

FACILITY DESCRIPTION_____

BUILDING NUMBER:_____

CORPS OF ENGINEERS CONTRACT NUMBER:_____

CONTRACTOR

CONTRACTOR:_____

ADDRESS:_____

POINT OF CONTACT:_____

TELEPHONE NUMBER:_____

OWNER

OWNER:_____

ADDRESS:_____

POINT OF CONTACT:_____

TELEPHONE NUMBER:_____

CONSTRUCTION AGENT

CONSTRUCTION AGENT:_____

ADDRESS:_____

POINT OF CONTACT:_____

TELEPHONE NUMBER:_____

CONTRACTOR'S FIVE (5) YEAR NO PENAL SUM WARRANTY
FOR
STRUCTURAL STANDING SEAM METAL ROOF (SSSMR) SYSTEM
(continued)

THE SSSMR SYSTEM INSTALLED ON THE ABOVE NAMED BUILDING IS WARRANTED BY _____ FOR A PERIOD OF FIVE (5) YEARS AGAINST WORKMANSHIP AND MATERIAL DEFICIENCES, WIND DAMAGE, STRUCTURAL FAILURE, AND LEAKAGE. THE SSSMR SYSTEM COVERED UNDER THIS WARRANTY SHALL INCLUDE, BUT SHALL NOT BE LIMITED TO, THE FOLLOWING: THE ENTIRE ROOFING SYSTEM, MANUFACTURER SUPPLIED FRAMING AND STRUCTURAL MEMBERS, METAL ROOF PANELS, FASTENERS, CONNECTORS, ROOF SECUREMENT COMPONENTS, AND ASSEMBLIES TESTED AND APPROVED IN ACCORDANCE WITH ASTM E 1592. IN ADDITION, THE SYSTEM PANEL FINISHES, SLIP SHEET, INSULATION, VAPOR RETARDER, ALL ACCESSORIES, COMPONENTS, AND TRIM AND ALL CONNECTIONS ARE INCLUDED. THIS INCLUDES ROOF PENETRATION ITEMS SUCH AS VENTS, CURBS, SKYLIGHTS; INTERIOR OR EXTERIOR GUTTERS AND DOWNSPOUTS; EAVES, RIDGE, HIP, VALLEY, RAKE, GABLE, WALL, OR OTHER ROOF SYSTEM FLASHINGS INSTALLED AND ANY OTHER COMPONENTS SPECIFIED WITHIN THIS CONTRACT TO PROVIDE A WEATHERTIGHT ROOF SYSTEM; AND ITEMS SPECIFIED IN OTHER SECTIONS OF THE SPECIFICATIONS THAT ARE PART OF THE SSSMR SYSTEM.

ALL MATERIAL DEFICIENCIES, WIND DAMAGE, STRUCTURAL FAILURE, AND LEAKAGE ASSOCIATED WITH THE SSSMR SYSTEM COVERED UNDER THIS WARRANTY SHALL BE REPAIRED AS APPROVED BY THE CONTRACTING OFFICER. THIS WARRANTY SHALL COVER THE ENTIRE COST OF REPAIR OR REPLACEMENT, INCLUDING ALL MATERIAL, LABOR, AND RELATED MARKUPS. THE ABOVE REFERENCED WARRANTY COMMENCED ON THE DATE OF FINAL ACCEPTANCE ON _____ AND WILL REMAIN IN EFFECT FOR STATED DURATION FROM THIS DATE.

SIGNED, DATED, AND NOTARIZED (BY COMPANY PRESIDENT)

_____

(Company President) (Date)

CONTRACTOR'S FIVE (5) YEAR NO PENAL SUM WARRANTY
FOR
STRUCTURAL STANDING SEAM METAL ROOF (SSSMR) SYSTEM
(continued)

THE CONTRACTOR SHALL SUPPLEMENT THIS WARRANTY WITH WRITTEN WARRANTIES FROM THE MANUFACTURER AND/OR INSTALLER OF THE SSSMR SYSTEM, WHICH SHALL BE SUBMITTED ALONG WITH THE CONTRACTOR'S WARRANTY. HOWEVER, THE CONTRACTOR WILL BE ULTIMATELY RESPONSIBLE FOR THIS WARRANTY AS OUTLINED IN THE SPECIFICATIONS AND AS INDICATED IN THIS WARRANTY EXAMPLE.

EXCLUSIONS FROM COVERAGE

1. NATURAL DISASTERS, ACTS OF GOD (LIGHTNING, FIRE, EXPLOSIONS, SUSTAINED WIND FORCES IN EXCESS OF THE DESIGN CRITERIA, EARTHQUAKES, AND HAIL).

2. ACTS OF NEGLIGENCE OR ABUSE OR MISUSE BY GOVERNMENT OR OTHER PERSONNEL, INCLUDING ACCIDENTS, VANDALISM, CIVIL DISOBEDIENCE, WAR, OR DAMAGE CAUSED BY FALLING OBJECTS.

3. DAMAGE BY STRUCTURAL FAILURE, SETTLEMENT, MOVEMENT, DISTORTION, WARPAGE, OR DISPLACEMENT OF THE BUILDING STRUCTURE OR ALTERATIONS MADE TO THE BUILDING.

4. CORROSION CAUSED BY EXPOSURE TO CORROSIVE CHEMICALS, ASH OR FUMES GENERATED OR RELEASED INSIDE OR OUTSIDE THE BUILDING FROM CHEMICAL PLANTS, FOUNDRIES, PLATING WORKS, KILNS, FERTILIZER FACTORIES, PAPER PLANTS, AND THE LIKE.

5. FAILURE OF ANY PART OF THE SSSMR SYSTEM DUE TO ACTIONS BY THE OWNER TO INHIBIT FREE DRAINAGE OF WATER FROM THE ROOF AND GUTTERS AND DOWNSPOUTS OR ALLOW PONDING WATER TO COLLECT ON THE ROOF SURFACE. CONTRACTOR'S DESIGN SHALL INSURE FREE DRAINAGE FROM THE ROOF AND NOT ALLOW PONDING WATER.

6. THIS WARRANTY APPLIES TO THE SSSMR SYSTEM. IT DOES NOT INCLUDE ANY CONSEQUENTIAL DAMAGE TO THE BUILDING INTERIOR OR CONTENTS WHICH IS COVERED BY THE WARRANTY OF CONSTRUCTION CLAUSE INCLUDED IN THIS CONTRACT.

7. THIS WARRANTY CANNOT BE TRANSFERRED TO ANOTHER OWNER WITHOUT WRITTEN CONSENT OF THE CONTRACTOR; AND THIS WARRANTY AND THE CONTRACT PROVISIONS WILL TAKE PRECEDENCE OVER ANY CONFLICTS WITH STATE STATUTES.

**

CONTRACTOR'S FIVE (5) YEAR NO PENAL SUM WARRANTY
FOR
STRUCTURAL STANDING SEAM METAL ROOF (SSSMR) SYSTEM
(continued)

**REPORTS OF LEAKS AND SSSMR SYSTEM DEFICIENCIES SHALL BE RESPONDED TO WITHIN 48 HOURS OF RECEIPT OF NOTICE, BY TELEPHONE OR IN WRITING, FROM EITHER THE OWNER OR CONTRACTING OFFICER. EMERGENCY REPAIRS TO PREVENT FURTHER ROOF LEAKS SHALL BE INITIATED IMMEDIATELY; A WRITTEN PLAN SHALL BE SUBMITTED FOR APPROVAL TO REPAIR OR REPLACE THIS SSSMR SYSTEM WITHIN SEVEN (7) CALENDAR DAYS. ACTUAL WORK FOR PERMANENT REPAIRS OR REPLACEMENT SHALL BE STARTED WITHIN 30 DAYS AFTER RECEIPT OF NOTICE, AND COMPLETED WITHIN A REASONABLE TIME FRAME. IF THE CONTRACTOR FAILS TO ADEQUATELY RESPOND TO THE WARRANTY PROVISIONS, AS STATED IN THE CONTRACT AND AS CONTAINED HEREIN, THE CONTRACTING OFFICER MAY HAVE THE SSSMR SYSTEM REPAIRED OR REPLACED BY OTHERS AND CHARGE THE COST TO THE CONTRACTOR.

IN THE EVENT THE CONTRACTOR DISPUTES THE EXISTENCE OF A WARRANTABLE DEFECT, THE CONTRACTOR MAY CHALLENGE THE OWNER'S DEMAND FOR REPAIRS AND/OR REPLACEMENT DIRECTED BY THE OWNER OR CONTRACTING OFFICER EITHER BY REQUESTING A CONTRACTING OFFICER'S DECISION UNDER THE CONTRACT DISPUTES ACT, OR BY REQUESTING THAT AN ARBITRATOR RESOLVE THE ISSUE. THE REQUEST FOR AN ARBITRATOR MUST BE MADE WITHIN 48 HOURS OF BEING NOTIFIED OF THE DISPUTED DEFECTS. UPON BEING INVOKED, THE PARTIES SHALL, WITHIN TEN (10) DAYS, JOINTLY REQUEST A LIST OF FIVE (5) ARBITRATORS FROM THE FEDERAL MEDIATION AND CONCILIATION SERVICE. THE PARTIES SHALL CONFER WITHIN TEN (10) DAYS AFTER RECEIPT OF THE LIST TO SEEK AGREEMENT ON AN ARBITRATOR. IF THE PARTIES CANNOT AGREE ON AN ARBITRATOR, THE CONTRACTING OFFICER AND THE PRESIDENT OF THE CONTRACTOR'S COMPANY WILL STRIKE ONE (1) NAME FROM THE LIST ALTERNATIVELY UNTIL ONE (1) NAME REMAINS. THE REMAINING PERSON SHALL BE THE DULY SELECTED ARBITRATOR. THE COSTS OF THE ARBITRATION, INCLUDING THE ARBITRATOR'S FEE AND EXPENSES, COURT REPORTER, COURTROOM OR SITE SELECTED, ETC., SHALL BE BORNE EQUALLY BETWEEN THE PARTIES. EITHER PARTY DESIRING A COPY OF THE TRANSCRIPT SHALL PAY FOR THE TRANSCRIPT. A HEARING WILL BE HELD AS SOON AS THE PARTIES CAN MUTUALLY AGREE. A WRITTEN ARBITRATOR'S DECISION WILL BE REQUESTED NOT LATER THAN 30 DAYS FOLLOWING THE HEARING. THE DECISION OF THE ARBITRATOR WILL NOT BE BINDING; HOWEVER, IT WILL BE ADMISSIBLE IN ANY SUBSEQUENT APPEAL UNDER THE CONTRACT DISPUTES ACT.

A FRAMED COPY OF THIS WARRANTY SHALL BE POSTED IN THE MECHANICAL ROOM OR OTHER APPROVED LOCATION DURING THE ENTIRE WARRANTY PERIOD.

-- End of Section --

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DIVISION 07 - THERMAL AND MOISTURE PROTECTION

SECTION 07511

BUILT-UP ASPHALT ROOFING

02/03

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SECTION 07511

BUILT-UP ASPHALT ROOFING
02/03

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C 208	(1995; R 2001) Cellulosic Fiber Insulating Board
ASTM C 1177/C 1177M	(2001) Glass Mat Gypsum Substrate for Use as Sheathing
ASTM D 41	(1994) Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D 312	(2000) Asphalt Used in Roofing
ASTM D 448	(1986; R 1998) Sizes of Aggregate for Road and Bridge Construction
ASTM D 1668	(1997a) Glass Fabrics (Woven and Treated) for Roofing and Waterproofing
ASTM D 1863	(1993; R 1996) Mineral Aggregate Used on Built-Up Roofs
ASTM D 1864	(1989; R 1999 e1) Moisture in Mineral Aggregate Used on Built-Up Roofs
ASTM D 2170	(1995) Kinematic Viscosity of Asphalts (Bitumens)
ASTM D 2178	(1997a) Asphalt Glass Felt Used in Roofing and Waterproofing
ASTM D 3617	(1983; R 1994 e1) Sampling and Analysis of New Built-Up Roof Membranes
ASTM D 4402	(1987; R 1995 e2) Viscosity Determinations of Unfilled Asphalts Using the Brookfield Thermosel Apparatus
ASTM D 4586	(2000) Asphalt Roof Cement, Asbestos Free

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation;

submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Asphalt; G-AO

Felts; G-AO

Fasteners

Primer

Asphalt roof cement

Walkway Materials

Inspection

The inspection procedure for roofing installation, prior to the start of roofing work.

Cants

Certificate attesting that the fiberboard furnished for the project contains recovered material, and showing an estimated percent of such recovered material.

Warranty certificate; G-AO

Submit roofing system manufacturer's warranty stamped "Sample" or "Facsimile."

SD-06 Test Reports

Samples of built-up roofing

Submit test results on roofing field samples as required, verifying composition of sample. Submit six copies of laboratory analysis within 30 calendar days after samples are taken. Submit reports in accordance with ASTM D 3617.

SD-07 Certificates

Bill of lading

Submit when labels of asphalt containers do not indicate the finished blowing temperature, flash point and equiviscous temperature.

Qualifications of applicator

Submit evidence of the roofing system manufacturer's approval.

SD-11 Closeout Submittals

Information card

For each roofing installation, submit typewritten card or photoengraved aluminum card containing the information listed on Form 1 located at the end of this section.

1.3 QUALITY ASSURANCE

1.3.1 Qualifications of Applicator

The roofing system applicator shall be approved, authorized, or licensed in writing by the roofing system manufacturer and shall have a minimum of 3 years experience as an approved, authorized, or licensed applicator with the manufacturer and be approved at a level capable of providing the specified warranty.

1.3.2 Preroofing Conference

After approval of submittals and before roofing and insulation work, including associated work, is performed, the Contracting Officer will hold a preroofing conference to review the following:

a. Drawings and specifications

b. Procedure for on site inspection and acceptance of roofing substrate and pertinent structural details relating to roofing system

c. Contractor's plan for coordination of work of the various trades involved in providing roofing system and other components secured to roofing

d. Safety requirements

The preroofing conference shall be attended by the Contractor and personnel directly responsible for the roofing and insulation installation, flashing and sheet metal work, mechanical work, and representative of the roofing materials manufacturer. Conflicts among those attending the preroofing conference shall be resolved and confirmed in writing before roofing work, including associated work, is begun.

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 Delivery

Deliver materials in manufacturers' original unopened containers and rolls with manufacturer's labels intact and legible. Mark and remove wet or damaged materials from site. Where materials are covered by a referenced specification, container shall bear specification number, type, and class, as applicable. Indicate on labels or bill of lading for roofing asphalt the asphalt type, finished blowing temperature (FBT), flash point (FP), and equiviscous temperature (EVT), that is, the temperature at which the viscosity is either 125 centistokes when tested in accordance with ASTM D 2170 or 75 centipoise when tested in accordance with ASTM D 4402. Deliver materials in sufficient quantity to allow work to proceed without

interruption.

1.4.2 Storage

Protect materials against moisture absorption. Store roll materials on end on clean raised platforms in dry locations in enclosed buildings or trailers with adequate ventilation. Do not store roll materials in buildings under construction until concrete, mortar, and plaster work are finished and dry. For a 24-hour period immediately prior to application, maintain roll materials at temperature above 50 degrees F. Aggregate shall be kept dry as defined by ASTM D 1863. Place only those materials to be used during one day's work on the roof at one time. Remove unused materials from the roof at the end of each day's work.

1.4.3 Handling

Select and operate material handling equipment so as not to damage applied roofing. Prevent damage to edges and ends of roll materials.

1.5 ENVIRONMENTAL CONDITIONS

Do not install roofing during precipitation, or fog, or when air temperature is below 40 degrees F, or when there is ice, frost, moisture or visible dampness on roof deck. Restriction on application of roofing materials below 40 degrees F may be waived if Contractor devises a means, satisfactory to Contracting Officer, of: (1) maintaining surrounding temperature above 40 degrees F; and (2) maintaining application temperature of heated materials without exceeding maximum specified heating temperature.

1.6 PROTECTION OF PROPERTY

1.6.1 Protective Coverings

Install protective coverings at paving and building walls adjacent to hoist and kettles prior to starting work. Lap protective coverings not less than 6 inches, secure against wind, and vent to prevent collection of moisture on covered surfaces. Keep protective coverings in place for duration of roofing work.

1.6.2 Flame-Heated Equipment

Do not place flame-heated equipment closer than 25 feet to buildings or combustible materials. Provide a minimum of two 20 pound ABC all-purpose type extinguishers at melting kettle and at area of hot material application.

1.7 WARRANTY

Furnish the roofing system manufacturer's warranty for the roofing system. The warranty period shall not be less than 5 years from the date the Government acceptance of the work. The warranty shall be issued directly to the Government and shall not be limited in dollar value. The warranty shall provide that if within the warranty period the built-up roofing system including membrane, flashing,insulation and accessories becomes nonwatertight, blisters or shows evidence of excessive weathering due to deterioration of the roofing system resulting from defective materials or workmanship, the repair or replacement of defective materials or workmanship shall be the responsibility of the manufacturer. While roofing is under warranty perform repairs that become necessary due to defective

materials or workmanship within 72 hours of notification, unless additional time is approved by the Contracting Officer. Failure to perform repairs within specified period of time will constitute grounds for the Government having repairs performed by others and cost billed to Contractor.

PART 2 PRODUCTS

2.1 ROOFING SYSTEM

Glass felt, asphalt bitumen, aggregate surfaced.

Substrate: Roof Insulation Components:	Quantity:
Felt:	
Ply Felt (GA)	4 Plies
Asphalt: (See a. below)	
Between Substrate and First Ply	20-35 lbs/100 sq. ft.
Between Each Ply	20-35 lbs/100 sq. ft.
Top Coat	55-70 lbs/100 sq. ft.
Surfacing:	
Gravel or Crushed Stone	400 lbs/100 sq. ft.
Other Aggregate	300 lbs/100 sq. ft.

a. Provide asphalt quantities within the indicated ranges, unless recommended otherwise in the roofing materials manufacturer's printed data.

2.2 MATERIALS

2.2.1 Asphalt

Roof Slope, in./ft.	Specification
1/4 to 1/2	ASTM D 312, Type II or III

2.2.2 Felts

For built-up roofing and flashing:

Designation	Use	Felt	Impregnant	Coating	Specification
GA	Ply Felt	Glass	Asphalt	None	ASTM D 2178, Type VI or IV
FF	Flashing	Glass	Asphalt	Asphalt	(See a.

Desig-nation	Use	Felt	Impregnant	Coating	Speci-fication
	Felt				below)

a. Provide flashing felt specifically prepared in the manufacturing process for use in two-ply base flashing construction of either: a single thickness of glass felt conforming to the properties listed in ASTM D 2178, for Type IV; or glass felt factory-laminated to a woven glass fiber scrim or cotton fabric; or styrene-butadiene-styrene (SBS) or a tactic polypropylene (APP) modified bitumen. Factory-coat each type of flashing construction on both sides with an asphaltic coating which includes a water-insoluble, fine mineral stabilizer and a fine mineral surfacing.

2.2.3 Primer

ASTM D 41 for asphalt roofing systems.

2.2.4 Asphalt Roof Cement

ASTM D 4586 for use with asphalt roofing systems, Type II for vertical surfaces and built-up bituminous flashings; Type I for horizontal surfaces.

2.2.5 Cants

Cants shall be made from treated wood or treated fiberboard not less than 3-1/2 inches high cut to reduce change in direction of the membrane to 45 degrees or less. Treated wood shall be of water-borne preservative-treated material as specified in Section 06100A "Rough Carpentry." Contractor shall comply with EPA requirements in accordance with Section 01670 "Recycled/Recovered Materials." Fiberboard shall conform to ASTM C 208 with a minimum recovered material content of 5percent, treated with sizing, wax or bituminous impregnation.

2.2.6 Aggregate for Surfacing Built-up Roofing

Water-worn gravel, crushed stone, or crushed slag, conforming to ASTM D 1863, or marble, expanded slag, or expanded shale, conforming to ASTM D 1863 except density not less than 55 pcf. Aggregate conforming to gradation sizes No. 6, No. 7, and No. 67 in conformance with ASTM D 448 is acceptable provided other requirements of ASTM D 1863 are met. 2 percent maximum moisture content as determined by ASTM D 1864. Aggregate shall be light colored and opaque. Limestone, volcanic rock, crushed shells, and cinders are not acceptable.

2.2.7 Fasteners

Provide nonferrous or galvanized fasteners, except where in contact with copper, aluminum, and stainless steel. Use hard copper fasteners in contact with copper; aluminum or stainless steel fasteners in contact with aluminum; and stainless steel fasteners in contact with stainless steel. For fastening only roofing felts, use fasteners driven through metal discs, or one-piece composite fasteners with heads not less than one inch in diameter or one inch square with rounded or 45-degree tapered corners.

2.2.7.1 Plywood Substrates and Nailers

Provide 11 gage annular threaded shank nails with 7/16 to 5/8 inch diameter heads; or one-piece composite nails with annular threaded shanks not less than 11 gage for securing felts and metal items. Fasteners shall be long enough to penetrate the nailer not less than one inch and plywood substrate 3/8 to 7/16 inch , when driven through the material to be fastened.

2.2.7.2 Metal Discs (Tin Caps)

Flat discs or caps of zinc-coated steel not lighter than 28 gage and not less than 1 3/8 inch in diameter. Form discs to prevent dishing. Do not use bell or cup-shaped caps. Omit disc when one-piece composite fasteners are used.

2.2.8 Walkway Materials

2.2.8.1 Modified Asphalt Preformed Pads

Provide walkway material specially manufactured for the purpose of protecting built-up asphalt roof membranes. Preformed, skid resistant board consisting of SBS modified asphalt, reinforcements and fillers with a ceramic granule surface. Nominal 32 inches square by 5/16 inch thick, 2 pounds per square foot.

2.2.9 Woven Glass Fabric

ASTM D 1668.

2.2.10 Insulation

Insulation shall be as specified in Section 07220, "Roof and Deck Insulation."

2.2.11 Glass Mat Gypsum Roof Board

Glass mat gypsum roof board shall be in accordance with ASTM C 1177/C 1177M, flame spread - 0, smoke developed - 0, 500 psi Class A non-combustible. The glass mat gypsum roof board shall be a minimum 1/4 inch thickness.

PART 3 EXECUTION

3.1 VERIFICATION OF CONDITIONS

Before applying roofing materials, ensure that the following exist:

a. Drains, curbs, cants, expansion joints perimeter walls, and roof penetrating components are in place.

b. Surfaces are rigid, dry, smooth, and free of cracks, holes, and sharp changes in elevation. Joints in substrate are sealed to prevent drippage of bitumen into building or down exterior walls. Surfaces shall be inspected and approved immediately before application of roofing and flashings. The roofing and flashings shall be applied to a smooth and firm surface free from ice, frost, visible moisture, dirt, projections, and foreign materials.

c. Plane of substrate does not vary more than 1/4 inch within an area 10 by 10 feet when checked with a 10-foot straight edge placed

anywhere on substrate.

d. Substrate is sloped as indicated to provide drainage.

e. Walls and vertical surfaces are constructed to receive counterflashing.

f. Treated wood nailers are in place on non-nailable surfaces, to permit nailing of base flashing at minimum height of 8 inches above finished roofing surface.

g. Treated wood nailers are fastened in place at eaves, gable ends, openings, and intersections with vertical surfaces for securing of felts, edging strips, gravel stops, and roof fixtures.

h. Cants are securely fastened in place in the angles formed by walls and other vertical surfaces. The angle of the cant is approximately 45 degrees and the height of the vertical leg is not less than nominal 4 inches. Cants are constructed of treated wood or wood fiberboard insulation. Cants shall be laid in a solid coat of asphalt cement just prior to laying the roofing plies. Cants shall be continuous, and shall be installed in lengths as long as practicable.

i. Plywood substrates are constructed of treated wood securely fastened to the framing members with exposed nail heads properly set. Warped and split sheets have been replaced. There are no cracks or end joints 1/4 inch in width or greater. Knot holes are covered with sheet metal and nailed in place. Joints in plywood substrates are taped with 2 inch wide masking tape to prevent air leakage from behind.

j. Insulation boards are installed smoothly and evenly, and are not broken, cracked, or curled. Insulation is being roofed over on the same day the insulation is installed.

3.2 PREPARATION

Coordinate work with other trades to ensure that components which are to be secured to or stripped into roofing system are available and that permanent flashings and counterflashings are installed as work progresses.

3.2.1 Insulation

Application of roofing shall immediately follow application of insulation as a continuous operation. Roofing operations shall be coordinated with insulation work so that all roof insulation applied each day is waterproofed the same day. Insulation is specified in Section 07220, "Roof and Deck Insulation."

3.2.2 Sheet Metalwork

Roofing operations shall be coordinated with sheet metalwork so that sheet metal items are installed to permit continuous roof surfacing operations the same day felts are installed. Sheet metalwork is specified in Section

07600, FLASHING AND SHEET METAL.

3.2.3 Priming of Surfaces

Prime surfaces at rate of 0.75 gallon per 100 square feet.

3.2.3.1 Priming of Metal Surfaces

Prime flanges of metal gravel stops, edging strips, flashing collars, roof drain flashing, and accessories before stripping into roofing system.

3.2.4 Heating of Asphalt

Break up solid asphalt on surface free of dirt and debris. Heat in kettle designed to prevent contact of flame with surfaces in contact with asphalt. Kettles shall have visible thermometer and thermostatic controls set to specified temperature limits. Keep controls in working order and calibrated. Use immersion thermometer, accurate within a tolerance of plus or minus 2 degrees F, for frequent checking of asphalt temperature. If temperature exceeds maximum specified, remove asphalt from site. If temperature of asphalt, at instant of application, is below minimum specified, take a field sample of affected roofing, analyze as specified, and replace with new material if deficiencies are disclosed. Cutting back, adulterating, or fluxing of asphalt are prohibited.

3.2.5 Environmental Conditions

Air temperature shall be above 40 degrees F and there shall be no visible ice, frost, or moisture on the roof deck at the time roofing is installed.

3.2.6 Mechanical Application Devices

Mechanical application devices shall be mounted on pneumatic-tired wheels, and shall be designed and maintained to operate without damaging the insulation, roofing membrane, or structural components.

3.3 APPLICATION

Apply roofing materials as specified or recommended by manufacturer's printed application instructions. Keep roofing materials dry before and during application. Phased construction is prohibited. Except for surfacing, complete application of roofing in a continuous operation. Begin and apply only as much roofing in one day as can be completed that same day. Maintain specified temperature for asphalt. Do not apply surfacing until the other roofing application procedures specified herein are completed.

3.3.1 Ply Felts

Apply ply felts shingle fashion in hot-moppings of asphalt. Apply felts in a continuous operation. Provide starter sheets of felt to maintain the specified number of plies throughout the roofing. Apply felts with side laps in accordance with the material manufacturer's printed instructions and in uniform alignment. Lap ends not less than 6 inches and stagger 36 inches minimum. The full 36 inch width of each ply shall be placed in hot bitumen immediately behind the applicator. A squeegee or broom or follow through tool shall be used to eliminate air pockets and obtain complete adhesion between plies. Bitumen shall be visible beyond all edges of each ply as it is being installed. Plies shall be laid free of wrinkles,

creases or fishmouths. Apply felts at right angles to roof slope so that direction of water flow is over and not against laps. Extend felts approximately 2 inches above top of cant strips at vertical surfaces and to top of cant strips elsewhere. Trim felts to a neat fit around vent pipes, roof drains, and other projections. Workers shall not walk on mopped surfaces when the bitumen is fluid.

3.3.1.1 Hot-Mopping of Ply Felts

Bond plies to each other and to the substrate with hot asphalt. Apply felts immediately following application of asphalt. Do not work ahead with asphalt. At the instant felts come into contact with asphalt, asphalt shall be completely fluid, with mop temperatures within specified EVT range. Apply asphalt uniformly in a full, continuous, firmly bonding film at the rate specified. As felts are rolled into the hot asphalt, immediately squeegee, roll or broom down to eliminate trapped air and to provide tight, smooth laminations without wrinkles, buckles, kinks, or fish mouths. The completed roofing system shall be free of pockets, felt delaminations, ridges, fishmouths, dry laps, or blisters. Do not lay felts dry, turn back laps for mopping between plies.

3.3.1.2 Temperature Limitations for Asphalt

Heat and apply asphalt at temperature specified below unless specified otherwise by the manufacturer. Use thermometer to check temperature during heating and application. Have kettle attended constantly during heating process to ensure specified temperatures are maintained. Do not heat asphalt above its finished blowing temperature (FBT). Do not heat asphalt to the flash point (FP). Apply asphalt and embed roofing felts when asphalt temperature is within plus or minus 25 degrees F of the equiviscous temperature (EVT). Before heating asphalt refer to manufacturer's label or bill of lading for the FBT, FP and EVT of the asphalt used. Equipment utilizing flame heat shall not be placed on the roof.

3.3.2 Flashing

Provide bituminous flashing in the angles formed where the roof deck abuts walls, curbs, ventilators, pipes, and other vertical surfaces, and where necessary to make work watertight. Install flashing after plies of felt have been applied but before surfacing is applied. Metal flashings are specified under Section 07600, "Flashing and Sheet Metal." Modified bituminous flashing may be used when it is specified in the roofing manufacturer's instructions.

3.3.2.1 Base Flashing

Modified Bitumen Base Flashing: Provide SBS or APP modified bitumen base flashing standard with the roofing system manufacturer in accordance with printed installation instructions and graphic details.

3.3.2.2 Strip Flashing

Set flanges of sheet metal work which are to be incorporated into roofing system into a uniform coating of asphalt roof cement not less than 1/16 inch thick applied over the ply felts. Strip-in with either two layers of ply felt or one layer of modified bitumen sheet cemented to the tops of the

flanges, roofing membrane, and to each other. Use coatings of asphalt roof cement not less than 1/16 inch thick for ply felt. Use hot steep asphalt for modified bitumen sheets. Extend felts 3 and 6 inches respectively, beyond flange edges and onto roof membrane. Coat finished felt strip flashing with asphalt roof cement not less than 1/8 inch thick.

3.3.2.3 Flashing at Roof Drain

Roof drains are specified under Section 15400APLUMBING, GENERAL PURPOSE. Flashings for roof drains are specified under Section 07600, "Flashing and Sheet Metal." Extend roofing plies to edge of drain bowl opening at roof drain deck flange. Neatly fit and press primed roof drain flashing into heavy coat of asphalt roof cement applied to top of roofing plies. Strip in and completely cover flashing with two layers of modified bitumen sheet, extending the sheets 4 and 6 inches, respectively, on the roofing beyond the edge of flashing. Cement the two layers to the metal flashing and to each other with hot asphalt. Securely clamp membrane, metal flashing, and strip flashing in the flashing clamping ring. Secure clamps so that strip flashing and metal flashing are free from wrinkles and folds. Trim membrane, flashing, and stripping flush with inside of clamping ring.

3.3.3 Valleys and Ridges

Felt plies shall continue across valleys and ridges and terminate approximately 12 inches from the valley or ridge. Exposed lap shall terminate on a line approximately 12 inches from, and parallel to the valley or ridge. Two plies of roofing felt 9 inch wide bottom ply, and 12 inch wide top ply, shall be successively mopped-in over each felt line of termination.

3.3.4 Protection of Applied Roofing

3.3.4.1 Protection Against Moisture Absorption

When precipitation is imminent and at the end of each day's work, protect applied felts as follows:

a. Water Cut-Offs: Apply water cut-offs consisting of two strips of ply felt applied to exposed edges of insulation. Where exposed edges of insulation cross flutes of steel deck, place pieces of insulation or wood, fit flush with the deck, into the flutes, and embed in roofing cement at edge of insulation. Extend the first strip 6 inches on roof deck, up vertical edge of insulation, and 6 inches on top of applied felts. The second strip shall lap first strip by 3 inches on each side. Apply the strips with asphalt roof cement to roof deck, applied felts, and to each other. Keep roof cement from edges of insulation. Before resuming application of insulation and roofing system, remove water cut-offs to expose edges of insulation so that new insulation butts properly against insulation already in place.

b. Temporary Flashing: Provide temporary flashing at drains, curbs, walls, and other penetrations and terminations of roofing felts until roofing membrane is complete, and permanent flashings are applied. Use one ply of felt applied in trowel coat of asphalt roof cement over primed surface. Finish with a surface coat of asphalt roof cement. Remove temporary flashing before applying permanent flashing.

3.3.4.2 Glaze Coat

Only valleys and low areas that may pond water shall receive glaze coating for fiber glass ply felts in asphalt bitumen systems when 5 days are required to finish the roofing.

3.3.4.3 Temporary Walkways, Runways, and Platforms

Storing, walking, wheeling, and trucking directly on applied roofing materials is prohibited. Provide temporary walkways, runways, and platforms of smooth clean boards or planks, as necessary, to avoid damage to applied roofing materials, and to distribute weight to conform to indicated live load limits of roof construction. Use rubber-tired equipment for roofing work.

3.3.5 Aggregate Surfacing

Provide aggregate surfacing materials after felt flashings, roof drain flashing, work of other trades, tests, repairs, and corrective action have been completed and approved. Embed aggregate surfacing in a flood coat of hot asphalt poured from a dipper or approved spreading device at a rate of 60 pounds per 100 square feet. Aggregate surfacing materials shall be spread on the hot bitumen at a rate of 400 pounds per square for gravel or 300 pounds per square for other approved surfacing aggregate. To aid in proper embedment, aggregate may be lightly rolled, provided that there is no damage to roofing membrane. Remove loose aggregate from roof.

3.3.6 Walkways

3.3.6.1 Modified Asphalt Pads

Provide modified asphalt pads for roof membrane protection where indicated on drawings. Make provision for roof drainage by leaving a minimum 1 inch open space in all directions between walkway boards. Prior to graveling, install pads in a full bed of Type III asphalt applied in accordance with manufacturer's instructions.

3.4 FIELD QUALITY CONTROL

Perform field tests in the presence of the Contracting Officer. Notify the Contracting Officer one day before performing tests.

3.4.1 Test for Surface Dryness

Before starting work on area to be roofed, perform test for surface dryness in accordance with the following:

a. Foaming: When poured on the surface to receive felts, one pint of asphalt heated in the range of 350 to 400 degrees F, shall not foam upon contact.

b. Strippability: After asphalt used in foaming test application has cooled to ambient temperature, test for adherence. If a portion of sample is readily stripped clean from surface, do not consider surface to be dry and do not start application. If rain occurs during application, stop work and do not resume until surface has been tested by method above and found dry.

3.4.2 Samples of Built-Up Roofing

After application of specified roofing felts and prior to applying surfacing, take field samples of built-up roofing in the presence of Contracting Officer. Take and test samples in accordance with ASTM D 3617 and at locations selected by the Contracting Officer immediately prior to cutting. Cut 4 inch by 40 inch samples across felt laps in a manner to expose the specified number of piles. The 4 inch edge shall coincide with an edge lap of felt and shall not be positioned over an end lap. The 4 by 40 inch samples shall be used for visual inspection. The Contracting Officer will inspect the samples for the specified number of plies, bond between plies, skips in interply moppings, uniform asphalt mopping, presence of excessive voids or large voids in the ply construction, presence of harmful foreign materials, visible presence of moisture in the sandwich and wet insulation. 12 by 12 inch cut samples shall be used to calculate bitumen quantities in accordance with ASTM D 3617 when necessary and directed by the Contracting Officer.
Do not proceed with surfacing until all deficiencies disclosed as a result of "cut tests" have been corrected and approved.

3.4.2.1 Number of Cut Tests

Take not less than 2 samples from each 100 squares of roofed area, and take at least one sample from each day's application, regardless of quantity applied. If samples show any deficiency, no matter how slight, take additional samples to determine extent of deficiency.

3.4.2.2 Sample Cutting Device

Provide a rectangular, 4 by 40 inch template and 12 by 12 inch template, of a type that will permit accurate cutting of samples with standard roofing knives. Keep cutting edge of knife clean by washing in solvent after each cut.

3.4.2.3 Patching Cut-Out Area

Immediately after inspection, replace cut-out sample. When sample is needed for laboratory analysis or other circumstance makes it unavailable, substitute a new section of equivalent size and structure. For non-nailable decks, replace sample in hot asphalt. For nailable decks, insert one ply of ply felt into opening from which sample was taken and sprinkle nail to hold in place; coat felt heavily with asphalt roof cement and press cutout sample firmly into asphalt roof cement. Cover area over replaced samples with four plies of ply felt, hot mopped in place with first ply overlapping cutout area 3 inches on all sides and each succeeding ply overlapping previous 3 inches on all sides.

3.4.3 Correction of Deficiencies

Where interply moppings are too light, apply additional 2 plies of felt in full moppings of asphalt. Apply with 4 inch side and end laps. Where free water, skips, excessive voids, dry laps, disbonding or any form of delamination are discovered between the plies, remove and rebuild affected area. Correction of inadequate number of plies, improper lap widths, or nonuniform or excessive asphalt mopping shall be as directed by the Contracting Officer. Where insulation is found to be wet, remove insulation and provide new built-up roofing and insulation.

3.4.4 Roof Drain Test

After roofing system is complete except for surfacing, perform the following test of roof drains and adjacent roofing for watertightness. Plug primary roof drains and fill with water to edge of drain sump for 24 hours. Do not plug secondary overflow drains. To ensure some drainage from roof, do not test all drains at same time. Measure water at beginning and end of the 24-hour period. When precipitation occurs during test period, repeat test. When water level falls, remove water, thoroughly dry, and inspect the installation. Repair or replace roofing at drain. Repeat test until there is no water leakage.

3.5 INSPECTION

The Contractor shall establish and maintain an inspection procedure to assure compliance of the installed roofing with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced or corrected in an approved manner. Inspection shall include, but not be limited to, the following:

a. Environmental conditions; number and skill level of roofing workers; start and end time of various tasks; condition of substrate.

b. Verification of compliance of materials before, during, and after installation.

c. Inspection of condition of equipment and accuracy of thermometers and metering devices.

d. Inspection of flashings, cants and curbs.

e. Inspection of membrane placement, including edge envelopes, widths of starter sheets, laps, proper use of squeegee, and mechanical fastening.

f. Inspection of application of bitumen, aggregate, and walkways.

g. Inspection of embedment of aggregate for required weight and coverage.

h. Cutout sampling and analysis as directed.

3.6 INFORMATION CARD

For each roof, provide a typewritten card, laminated in plastic for interior display, or a photoengraved 0.032 inch thick aluminum card for exterior display. Card shall be 8 1/2 by 11 inches minimum and contain the information listed on Form 1 located at end of this section. Install card near point of access to roof or where indicated. Send photostatic paper copy to Warren Fried 5CES/CECNA, 320 Peacekeeper Place, Minot AFB, ND 58705-5006.

FORM 1 - ROOFING SYSTEM DESCRIPTION

1. Location _____ 2. Bldg. Name _____

3. Bldg. No. _____ 4. Roof Area (SF) _____ 5. Contract No. _____

6. New Construction: ( ) Yes ( ) No 7. Deck Slope: _____

8. Type of Deck:
   ( ) Metal
   ( ) Cast-In-Place Concrete
   ( ) Precast/Prestressed Concrete
   ( ) Wood Plank or Plywood
   ( ) Other _____

9. Type of Insulation Board:
   ( ) Polyisocyanurate/Composite
   ( ) Polystyrene/Composite
   ( ) Perlite
   ( ) Other _____
   ( ) Polyisocyanurate Foam
   ( ) Polystyrene
   ( ) Mineral Fiber

10. Insulation Manufacturer: _____

11. Insulation Thickness: _____

12. Vapor Treatment: Total coverage ( ) Yes ( ) No
   ( ) No Vapor Retarder
   ( ) One Way Roof Vents
   ( ) Other _____
   ( ) Bituminous Vapor Retarder
   ( ) Laminated Kraft Paper

13. Vapor Treatment Manufacturer(s): _____

14. Roofing Type:
   ( ) Built-Up (Asphalt)
   ( ) Metal
   ( ) Shingles
   ( ) Other _____
   ( ) PIB
   ( ) Modified Bitumen
   ( ) CSPE
   ( ) TPA
   ( ) EPDM
   ( ) PVC

15. Roofing Manufacturer: _____

16. Roofing Installer/Warrantor: _____

17. Roofing Application Method:
   ( ) Bitumen
   ( ) Mechanically Fastened
   ( ) Mechanically Fastened/Fully Adhered
   ( ) Fully Adhered
   ( ) Torched
   ( ) Loose-Laid Ballasted
   ( ) Other _____

18. Warranty Period: From _____ To _____

19. Warranty Serial Number: _____

20. Date Roofing Completed: _____ 21. Inspector: _____

22. Prime Contractor Name/Address: _____

Signature: _____ Date: _____

INSTRUCTIONS FOR FORM 1 (Do Not Post)

1. Location: Name of activity as shown on contract.

2. Bldg. Name: As shown on contract or as provided by Contracting Officer.

3. Bldg. Number: As provided by Contracting Officer.

4. Roof Area: Area in square feet of roof for which deck insulation, membrane, etc. are the same. A separate form is required if any part of roof system is different over other areas of the roof.

5. Contract Number: As shown on the contract.

7. Show deck slope.

8. Deck: Check appropriate block.

9. Type of Insulation Board: Check appropriate block.

11. Show minimum thickness of installed insulation.

12. Vapor Treatment: Check appropriate blocks.

13. Show vapor treatment system manufacturer's name.

14. Roofing Type: Check appropriate block.

15. Show roofing manufacturer's name.

16. Roofing Installer's or Contractor's name.

17. Roofing Application Method: Check appropriate block.

18. Warranty Period: Insert start and end dates.

19. Warranty Serial Number: Insert serial number.

20. Show date roofing was accepted by the Contracting Officer. Warranty period begins on this date.

21. Show Government Inspector's name.

22. Prime Contractor Name/Address/Signature: Must be signed and dated by QC Representative or an official of Contracting firm.

-- End of Section --

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DIVISION 07 - THERMAL AND MOISTURE PROTECTION

SECTION 07600

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02/03

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SECTION 07600

FLASHING AND SHEET METAL
02/03

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A 653/A 653M	(2002a) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM D 41	(1994) Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D 226	(1997a) Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D 4586	(2000) Asphalt Roof Cement, Asbestos Free

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA Arch. Manual	(1993; Errata; Addenda Oct 1997; 4th Printing 1999) Architectural Sheet Metal Manual

1.2 General Requirements

Sheet metalwork shall be accomplished to form weathertight construction without waves, warps, buckles, fastening stresses or distortion, and shall allow for expansion and contraction. Cutting, fitting, drilling, and other operations in connection with sheet metal required to accommodate the work of other trades shall be performed by sheet metal mechanics. Application of bituminous strip flashing over various sheet metal items is covered in Section 07511 BUILT-UP ASPHALT ROOFING. Installation of sheet metal items used in conjunction with roofing shall be coordinated with roofing work to permit continuous roofing operations. Sheet metalwork pertaining to heating, ventilating, and air conditioning is specified in Section 15895 AIR SUPPLY DISTRIBUTION, VENTILATION AND EXHAUST SYSTEM.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Downspouts; G-AE
Flashing for roof drains

Base flashing

Counterflashing

Flashing at roof penetrations

Scuppers; G-AE
Copings; G-AE

Indicate thicknesses, dimensions, fastenings and anchoring methods, and other provisions necessary for thermal expansion and contraction. Scaled manufacturer's catalog data may be submitted for factory fabricated items.

SD-11 Closeout Submittals

Quality Control Plan

Submit for sheet metal work in accordance with paragraph entitled "Field Quality Control."

1.4 DELIVERY, HANDLING, AND STORAGE

Package and protect materials during shipment. Uncrate and inspect materials for damage, dampness, and wet-storage stains upon delivery to the job site. Remove from the site and replace damaged materials that cannot be restored to like-new condition. Handle sheet metal items to avoid damage to surfaces, edges, and ends. Store materials in dry, weather-tight, ventilated areas until immediately before installation.

PART 2 PRODUCTS

2.1 MATERIALS

Furnish sheet metal items in 8 to 10 foot lengths. Single pieces less than 8 feet long may be used to connect to factory-fabricated inside and outside corners, and at ends of runs. Factory fabricate corner pieces with minimum 12 inch legs. Provide accessories and other items essential to complete the sheet metal installation. These accessories shall be made of the same materials as the items to which they are applied. Fabricate sheet metal items of the materials specified below and to the gage, thickness, or weight shown in Table I at the end of this section. Sheet metal items shall have finish specified.

2.1.1 Exposed Sheet Metal Items

Shall be of the same material. The following items shall be considered as exposed sheet metal: metal copings, downspouts, metal base and counter flashings and related accessories.

2.1.2 Lead Sheet

Minimum weight 4 pounds per square foot.

2.1.3 Steel Sheet, Zinc-Coated (Galvanized)

ASTM A 653/A 653M.

2.1.3.1 Finish

Unless noted otherwise, exposed exterior items of zinc-coated steel sheet shall have a baked-on, factory-applied color coating of polyvinylidene fluoride or other equivalent fluorocarbon coating applied after metal substrates have been cleaned and pretreated. Finish coating dry-film thickness shall be 0.8 to 1.3 mils and color shall be as specified in Setion 09915 COLOR SCHEDULE.

2.1.4 Bituminous Plastic Cement

ASTM D 4586, Type I.

2.1.5 Building Paper

ASTM D 226 Type I.

2.1.6 Asphalt Primer

ASTM D 41.

2.1.7 Through-Wall Flashing

Through-wall flashing for masonry is specified in Section 04200MASONRY.

2.1.8 Fasteners

Use the same metal or a metal compatible with the item fastened. Use stainless steel fasteners to fasten dissimilar materials.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Through-Wall Flashing

Install self-adhering drip edge and through-wall rubberized membrane flashing according to manufacturer's published directions. Install through-wall flashing at steel lintels, steel angles, plate or beam masonry supports, window and louver heads and sills, as cavity base flashing and at other locations indicated on drawings. Adhere drip edge to steel angle lintels, cavity wall bases, or brick supports full width of support, lap ends 2 inches, project folded edge minimum 1/4 inch beyond face of wall. Extend flashing vertically on rubberized wall membrane surface minimum of 16 inches above horizontal portion. Finish exposed, terminated edges of membrane with troweled bead of mastic. Extend flashing horizontally through face wythe over drip edge to align with outside face of wall. Extend flashing full width of steel lintels and turn up to form minimum 8 inches high sealed dam at both ends of lintel, using folded corners or extra thickness of flashing at corners. If using pre-formed end dams, place at ends and adhere vertical and horizontal surfaces, then cover with flashing.

3.1.2 Workmanship

Make lines, arrises, and angles sharp and true. Free exposed surfaces from visible wave, warp, and buckle, and tool marks. Fold back exposed edges neatly to form a 1/2 inch hem on the concealed side. Make sheet metal exposed to the weather watertight with provisions for expansion and contraction.

Make surfaces to receive sheet metal plumb and true, clean, even, smooth, dry, and free of defects and projections which might affect the application. For installation of items not shown in detail or not covered by specifications conform to the applicable requirements of SMACNA Arch. Manual, Architectural Sheet Metal Manual. Provide sheet metal flashing in the angles formed where roof decks abut walls, curbs, ventilators, pipes, or other vertical surfaces and wherever indicated and necessary to make the work watertight. Join sheet metal items together as shown in Table II.

3.1.3 Nailing

Confine nailing of sheet metal generally to sheet metal having a maximum width of 18 inches. Confine nailing of flashing to one edge only. Space nails evenly not over 3 inches on centers and approximately 1/2 inch from edge unless otherwise specified or indicated. Face nailing will not be permitted. Where sheet metal is applied to other than wood surfaces, include in shop drawings, the locations for sleepers and nailing strips required to secure the work. Sleepers and nailing strips are specified in Section 06100A, "Rough Carpentry."

3.1.4 Cleats

Provide continuous cleats for sheet metal where specified or indicated. Unless otherwise specified, butt joints of cleats approximately 1/8 inch apart. Fabricate of the same material and thickness as the sheet metal being installed. Fasten cleats to supporting wood construction with nails evenly spaced not over 12 inches on center. Where the fastening is to be made to concrete or masonry, screws shall be used and shall be driven in expansion shields set in concrete or masonry.

3.1.5 Bolts, Rivets, and Screws

Install bolts, rivets, and screws where indicated or required. Provide compatible washers where required to protect surface of sheet metal and to provide a watertight connection.

3.1.6 Seams

Straight and uniform in width and height.

3.1.6.1 Flat-lock Seams

Finish not less than 3/4 inch wide.

3.1.6.2 Lap Seams

Finish soldered seams not less than one inch wide. Overlap seams not soldered, not less than 3 inches.

3.1.6.3 Flat Seams

Make seams in the direction of the flow.

3.1.7 Protection from Contact with Dissimilar Materials

3.1.7.1 Copper or Copper-bearing Alloys

Paint with heavy-bodied bituminous paint surfaces in contact with dissimilar metal, or separate the surfaces by means of moistureproof building felts.

3.1.7.2 Metal Surfaces

Paint surfaces in contact with mortar, concrete, or other masonry materials with alkali-resistant coatings such as heavy-bodied bituminous paint.

3.1.7.3 Wood or Other Absorptive Materials

Paint surfaces that may become repeatedly wet and in contact with metal with two coats of aluminum paint or a coat of heavy-bodied bituminous paint.

3.1.8 Expansion and Contraction

Provide expansion and contraction joints at not more than 32 foot intervals for aluminum and at not more than 40 foot intervals for other metals. Where the distance between the last expansion joint and the end of the continuous run is more than half the required interval, an additional joint shall be provided. Space joints evenly. Join extruded aluminum gravel stops and fascias by expansion and contraction joints spaced not more than 12 feet apart.

3.1.9 Base Flashing

Coordinate base flashing with roofing work.

3.1.10 Counterflashing

Except as otherwise indicated, provide counter flashing over base flashing. Install counter flashing as shown on the drawings and in accordance with SMACNA Arch. Manual. Counter flashing shall be factory formed to provide spring action against the base flashing.

3.1.11 Downspouts

Supports for downspouts shall be spaced as indicated. Types, shapes and sizes are indicated. Provide complete including elbows and offsets. Provide downspouts in approximately 10 foot lengths. Provide end joints to telescope not less than 1/2 inch and lock longitudinal joints. Keep downspouts not less than one inch away from walls. Fasten to the walls at top, bottom, and at an intermediate point not to exceed 5 feet on centers with leader straps. Form straps and fasteners of metal compatible with the downspouts.

3.1.11.1 Terminations

Provide downspouts terminating in splash blocks with elbow-type fittings. Concrete splash block is specified in Section 03300, "Cast-In-Place Structural Concrete." Provide splash pans as specified.

3.1.12 Flashing for Roof Drains

Roof drains are specified in Section: 15400APLUMBING, GENERAL PURPOSE. Provide a 30 inch square sheet indicated. Taper insulation to drain from 24 inches out. Set flashing on finished felts in a full bed of asphalt roof cement, ASTM D 4586. Apply strip flashing to the drain flashing in accordance with Section 07511 BUILT-UP ASPHALT ROOFING, , paragraph entitled "Flashing of Roof Drain". Heavily coat the drain flashing ring with asphalt roof cement. Clamp the roof membrane, flashing sheet, and stripping felt in the drain clamping ring. Secure clamps so that felts and drain flashing are free of wrinkles and folds.

3.1.13 Scuppers

Line interior of scupper openings with sheet metal. Extend the lining through and project outside of the wall to form a drip on the bottom edge and form to return not less than one inch against the face of the outside wall at the top and sides. Fold outside edges under 1/2 inch on all sides. Provide the perimeter of the lining approximately 1/2 inch less than the perimeter of the scupper. Join the top and sides of the lining on the roof deck side to a closure flange by a locked and soldered joint. Join the bottom edge by a locked and soldered joint to the closure flange, where required, form with a ridge to act as a gravel stop around the scupper inlet. Provide surfaces to receive the scupper lining and coat with bituminous plastic cement.

3.1.14 Flashing at Roof Penetrations

Provide metal flashing for all pipes, ducts, and conduits projecting through the roof surface. Power roof ventilators and gravity hoods are specified in Section 15895 AIR SUPPLY DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM.

3.1.15 Single Pipe Vents

See Table I, footnote (b). Set flange of sleeve in bituminous plastic cement and nail 3 inches on centers. Bend the top of sleeve over and extend down into the vent pipe a minimum of 2 inches. For long runs or long rises above the deck, where it is impractical to cover the vent pipe with lead, use a two-piece formed metal housing. Set metal housing with a metal sleeve having a 4 inch roof flange in bituminous plastic cement and nailed 3 inches on centers. Extend sleeve a minimum of 8 inches above the roof deck and lapped a minimum of 3 inches by a metal hood secured to the vent pipe by a draw band. Seal the area of hood in contact with vent pipe with an approved sealant. Sealants are covered under Section 07920, "Joint Sealants."

3.1.16 Copings

Provide coping using prefinished steel sheets 8 or 10 feet long . Terminate outer edges in edge strips. Install with sealed cover plate joints as indicated.

3.2 PAINTING

Field-paint sheet metal for separation of dissimilar materials.

3.3 CLEANING

Clean exposed sheet metal work at completion of installation. Remove grease and oil films, handling marks, contamination from steel wool, fittings and drilling debris, and scrub-clean. Free the exposed metal surfaces of dents, creases, waves, scratch marks, and solder or weld marks.

3.4 REPAIRS TO FINISH

Scratches, abrasions, and minor surface defects of finish may be repaired in accordance with the manufacturer's printed instructions and as approved. Repair damaged surfaces caused by scratches, blemishes, and variations of color and surface texture. Replace items which cannot be repaired.

3.5 FIELD QUALITY CONTROL

Establish and maintain a Quality Control Plan for sheet metal used in conjunction with roofing to assure compliance of the installed sheet metalwork with the contract requirements. Work not in compliance with the contract shall be promptly removed and replaced or corrected. Quality control shall include, but not be limited to, the following:

a. Observation of environmental conditions; number and skill level of sheet metal workers; condition of substrate.

b. Verification that specified material is provided and installed.

c. Inspection of sheet metalwork, for proper size(s) and thickness(es), fastening and joining, and proper installation.

3.5.1 Procedure

Submit for approval prior to start of roofing work. Include a checklist of points to be observed. Document the actual quality control observations and inspections. Furnish a copy of the documentation to the Contracting Officer at the end of each day.

TABLE I. SHEET METAL WEIGHTS, THICKNESSES, AND GAGES

Sheet Metal Items	Copper, Ounces Per Square Foot	U.S. Std. Steel,	Zinc-Coated Steel, Gage
Building Expansion Joints Cover.....	24		
Flashings:			
Base.....		24	
Cap (Counter-flashing)		24	
Roof drain.....	16(a)		
Pipe vent sleeve(b)			
Joint Cover plates...		24	

TABLE I. SHEET METAL WEIGHTS, THICKNESSES, AND GAGES

Sheet Metal Items	Copper, Ounces Per Square Foot	U.S. Std. Steel,	Zinc-Coated Gage
(See Table II)			

(a) May be lead weighing 4 pounds per square foot.

(b) 2.5 pound minimum lead sleeve with 4 inch flange. Where lead sleeve is impractical, refer to paragraph entitled "Single Pipe Vents" for optional material.

TABLE II. SHEET METAL JOINTS

Item Designation	TYPE OF JOINT: Zinc-Coated Steel	Remarks
Flashings		
Base	One inch 3 inch lap for expansion joint	

(a) Elastomeric flashing shall have 3 inch lap with manufacturer's recommended sealant.

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SECTION 07840

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06/03

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SECTION 07840

FIRESTOPPING
06/03

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM E 84	(2001) Surface Burning Characteristics of Building Materials
ASTM E 119	(2000a) Fire Tests of Building Construction and Materials
ASTM E 814	(2002) Fire Tests of Through-Penetration Fire Stops
ASTM E 1399	(1997; R 2000) Cyclic Movement and Measuring the Minimum and Maximum Joint Widths of Architectural Joint Systems
ASTM E 1966	(2001) Fire-Resistive Joint Systems

FM GLOBAL (FM)

FM P7825a	(2003) Approval Guide Fire Protection
FM Standard 4991	(2003) FM Contractor Approval Standard

UNDERWRITERS LABORATORIES (UL)

UL 723	(1996; Rev thru Sep 2001) Test for Surface Burning Characteristics of Building Materials
UL 1479	(1994; Rev thru Aug 2000) Fire Tests of Through-Penetration Firestops
UL 2079	(1998) Tests for Fire Resistance of Building Joint Systems
UL Fire Resist Dir	(2003) Fire Resistance Directory (Vol 1, 2A, 2B & 3)

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G"

designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Firestopping MaterialsG-RE.

Detail drawings including manufacturer's descriptive data, typical details conforming to UL Fire Resist Dir or other details certified by another nationally recognized testing laboratory, installation instructions or UL listing details for a firestopping assembly in lieu of fire-test data or report. For those firestop applications for which no UL tested system is available through a manufacturer, a manufacturer's engineering judgement, derived from similar UL system designs or other tests, shall be submitted for review and approval prior to installation. Submittal shall indicate the firestopping material to be provided for each type of application. When more than a total of 5 penetrations and/or construction joints are to receive firestopping, provide drawings that indicate location, "F" and "T" ratings, and type of application.

SD-07 Certificates

Firestopping Materials

Certificates attesting that firestopping material complies with the specified requirements. In lieu of certificates, drawings showing UL classified materials as part of a tested assembly may be provided. Drawings showing evidence of testing by an alternate nationally recognized independent laboratory may be substituted.

Installer Qualifications

Documentation of training and experience.

Inspection

Manufacturer's representative certification stating that firestopping work has been inspected and found to be applied according to the manufacturer's recommendations and the specified requirements.

1.3 GENERAL REQUIREMENTS

Firestopping shall consist of furnishing and installing tested and listed firestop systems, combination of materials, or devices to form an effective barrier against the spread of flame, smoke and gases, and maintain the integrity of fire resistance rated walls, partitions, floors, and ceiling-floor assemblies, including through-penetrations and construction joints and gaps. Through-penetrations include the annular space around pipes, tubes, conduit, wires, cables and vents. Construction joints include those used to accommodate expansion, contraction, wind, or seismic movement; firestopping material shall not interfere with the required movement of the joint. Gaps requiring firestopping include gaps between the curtain wall and the floor slab and between the top of the fire-rated walls and the roof or floor deck above.

1.4 DELIVERY AND STORAGE

Materials shall be delivered in the original unopened packages or containers showing name of the manufacturer and the brand name. Materials shall be stored off the ground and shall be protected from damage and exposure to elements. Damaged or deteriorated materials shall be removed from the site.

1.5 INSTALLER QUALIFICATIONS

The Contractor shall engage an experienced Installer who is:

a. FM Research approved in accordance with FM Standard 4991, or

b. Certified, licensed, or otherwise qualified by the firestopping manufacturer as having the necessary staff, training, and a minimum of 3 years experience in the installation of manufacturer's products per specified requirements. A manufacturer's willingness to sell its firestopping products to the Contractor or to an installer engaged by the Contractor does not in itself confer qualification on the buyer. The Installer shall have been trained by a direct representative of the manufacturer (not distributor or agent) in the proper selection and installation procedures.

1.6 COORDINATION

The specified work shall be coordinated with other trades. Firestopping materials, at penetrations of pipes and ducts, shall be applied prior to insulating, unless insulation meets requirements specified for firestopping. Firestopping materials at building joints and construction gaps shall be applied prior to completion of enclosing walls or assemblies.

PART 2 PRODUCTS

2.1 FIRESTOPPING MATERIALS

Firestopping materials shall consist of commercially manufactured, asbestos-free, containing no water soluble intumescent imgredients, noncombustible products FM P7825a approved for use with applicable construction and penetrating items, complying with the following minimum requirements:

2.1.1 Fire Hazard Classification

Material shall have a flame spread of 25 or less, and a smoke developed rating of 50 or less, when tested in accordance with ASTM E 84 or UL 723. Material shall be an approved firestopping material as listed in UL Fire Resist Dir or by a nationally recognized testing laboratory.

2.1.2 Toxicity

Material shall be nontoxic to humans at all stages of application or during fire conditions.

2.1.3 Fire Resistance Rating

Firestop systems shall be UL Fire Resist Dir listed or FM P7825a approved with "F" rating at least equal to fire-rating of fire wall or floor in

which penetraded openings are to be protected, except that "F" rating may be 3 hours in through-penetrations of 4 hour fire rated wall or floor. Firestop systems shall also have "T" rating where required.

2.1.3.1 Through-Penetrations

Firestopping materials for through-penetrations, as described in paragraph GENERAL REQUIREMENTS, shall provide "F" and "T" fire resistance ratings in accordance with ASTM E 814 or UL 1479. Fire resistance ratings shall be as follows:

a. Penetrations of Fire Resistance Rated Walls and Partitions: F Rating = Rating of wall or partition being penetrated.

2.1.3.2 Construction Joints and Gaps

Fire resistance ratings of construction joints, as described in paragraph GENERAL REQUIREMENTS, and gaps such as those between floor slabs or roof decks and curtain walls shall be the same as the construction in which they occur. Construction joints and gaps shall be provided with firestopping materials and systems that have been tested per ASTM E 119, ASTM E 1966 or UL 2079 to meet the required fire resistance rating. Systems installed at construction joints shall meet the cycling requirements of ASTM E 1399 or UL 2079.

PART 3 EXECUTION

3.1 PREPARATION

Areas to receive firestopping shall be free of dirt, grease, oil, or loose materials which may affect the fitting or fire resistance of the firestopping system. Surfaces shall be prepared as recommended by the manufacturer.

3.2 INSTALLATION

Firestopping material shall completely fill void spaces regardless of geometric configuration, subject to tolerance established by the manufacturer. Firestopping shall be installed in accordance with manufacturer's written instructions. Tested and listed firestop systems shall be provided in the following locations, except in floor slabs on grade:

a. Penetrations of duct, conduit, tubing, cable and pipe through fire-resistance rated walls and partitions.

b. Penetrations of vertical shafts such as pipe chases and utility chutes.

c. Gaps at perimeter of fire-resistance rated walls and partitions, such as between the top of the walls and the bottom of roof decks.

d. Construction joints in fire rated walls and partitions.

f. Other locations where required to maintain fire resistance rating of the construction.

3.2.1 Insulated Pipes and Ducts

Thermal insulation shall be cut and removed where pipes or ducts pass through firestopping, unless insulation meets requirements specified for firestopping. Thermal insulation shall be replaced with a material having equal thermal insulating and firestopping characteristics.

3.2.2 Fire Dampers

Fire dampers shall be installed and firestopped in accordance with Section 15895 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM.

3.2.3 Data and Communication Cabling

Cabling for data and communication applications shall be sealed with re-enterable firestopping products that do not cure over time. Firestopping shall be modular devices, containing built-in self-sealing intumescent inserts. Firestopping devices shall allow for cable moves, adds or changes without the need to remove or replace any firestop materials.

3.3 INSPECTION

For all projects,the firestopped areas shall not be covered or enclosed until inspection is complete and approved by the manufacturer's technical representative. The manufacturer's representative shall inspect the applications initially to ensure adequate preparations (clean surfaces suitable for application, etc.) and periodically during the work to assure that the completed work has been accomplished according to the manufacturer's written instructions and the specified requirements. The Contractor shall submit written reports indicating locations of and types of penetrations and types of firestopping used at each location; type shall be recorded by UL listed printed numbers.

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SECTION 07920

JOINT SEALANTS
10/03

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C 734	(2001) Low-Temperature Flexibility of Latex Sealants After Artificial Weathering
ASTM C 834	(2000e1) Latex Sealants
ASTM C 919	(2002) Use of Sealants in Acoustical Applications
ASTM C 920	(2002) Elastomeric Joint Sealants
ASTM C 1330	(1996) Standard Specification for Cylindrical Sealant Backing for Use With Cold Liquid-Applied Sealants
ASTM D 217	(1997) Cone Penetration of Lubricating Grease
ASTM E 84	(2001) Surface Burning Characteristics of Building Materials

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Sealants

Primers

Bond breakers

Backstops

Manufacturer's descriptive data including storage requirements, shelf life, curing time, instructions for mixing and application, and primer data (if required). A copy of the Material Safety Data

Sheet shall be provided for each solvent, primer or sealant material.

SD-04 Samples

Color Selection; G-AE

Contractor shall furnish color samples for each type of sealant.

SD-07 Certificates

Sealant

Certificates of compliance stating that the materials conform to the specified requirements.

1.3 ENVIRONMENTAL CONDITIONS

The ambient temperature shall be within the limits of 40 and 90 degrees F when sealant is applied.

1.4 DELIVERY AND STORAGE

Deliver materials to the job site in unopened manufacturers' external shipping containers, with brand names, date of manufacture, color, and material designation clearly marked thereon. Elastomeric sealant containers shall be labeled to identify type, class, grade, and use. Carefully handle and store materials to prevent inclusion of foreign materials or subjection to sustained temperatures exceeding 90 degrees F or less than 0 degrees F.

PART 2 PRODUCTS

2.1 SEALANTS

Provide sealant that has been tested and found suitable for the substrates to which it will be applied. Color selection shall be from manufacturer's standard selection unless otherwise noted.

2.1.1 Interior Sealant

ASTM C 834, ASTM C 920, Type S or M, Grade NS, Class 12.5 or 25, Use NT or ASTM C 919, as indicated. Location(s) and color(s) of sealant shall be as follows:

	LOCATION	COLOR
a.	Small static interior joints between walls or partitions and adjacent surfaces scheduled to be painted.	ASTM C 834 Color as selected
b.	Perimeter of frames at doors, windows, and access panels which adjoin exposed interior concrete and masonry surfaces.	ASTM C 920, Class 25 Color as selected
c.	Joints of interior masonry walls and partitions which adjoin columns, pilasters, concrete walls, and exterior walls unless otherwise detailed.	ASTM C 920, Class 25 Color as selected

	LOCATION	COLOR
d.	Joints between edge members for acoustical tile and adjoining vertical surfaces.	ASTM C 919 Gray
e.	Interior static joints, not otherwise indicated or specified, where small voids exist between materials specified to be painted.	ASTM C 834 Color as selected
f.	Joints between shower receptors and ceramic tile; joints formed where nonplaner tile surfaces meet.	ASTM C 920, Class 12.5 Sanitary Silicone
g.	Joints formed between tile floors and tile base cove; joints between tile and dissimilar materials; joints occuring where substrates change.	ASTM C 920, Class 12.5 Sanitary Silicone
h.	Behind escutcheon plates at valve pipe penetrations and showerheads in showers.	ASTM C 920, Class 12.5 Sanitary Silicone

2.1.2 Exterior Sealant

For joints in vertical surfaces, provide ASTM C 920, Type S or M, Grade NS, Class 25, Use NT. For joints in horizontal surfaces, provide ASTM C 920, Type S or M, Grade P, Class 25, Use T. Location(s) and color(s) of sealant shall be as follows:

	LOCATION	COLOR
a.	Joints and recesses formed where frames and subsills of windows, doors, louvers, and vents adjoin masonry, concrete, or metal frames. Use sealant at both exterior and interior surfaces of exterior wall penetrations.	As selected
b.	Joints between new and existing exterior masonry walls.	As selected
c.	Masonry joints where shelf angles occur.	As selected
d.	Expansion and control joints.	As selected
e.	Interior face of expansion joints in exterior concrete or masonry walls where metal expansion joint covers are not required.	As selected
f.	Voids where items pass through exterior walls.	As selected
g.	Metal-to-metal joints where sealant is indicated or specified.	As selected

LOCATION	COLOR
h. Joints between ends of gravel stops, fascias, copings, and adjacent walls.	As selected

2.1.3 Floor Joint Sealant

ASTM C 920, Type S or M, Grade P, Class 25, Use T. Location(s) and color(s) of sealant shall be as follows:

LOCATION	COLOR
a. Seats of metal thresholds for exterior doors.	Gray
b. Control and expansion joints in floors, slabs, ceramic tile, and walkways.	As selected

2.1.4 Acoustical Sealant

Rubber or polymer-based acoustical sealant conforming to ASTM C 919 shall have a flame spread of 25 or less and a smoke developed rating of 50 or less when tested in accordance with ASTM E 84. Acoustical sealant shall have a consistency of 250 to 310 when tested in accordance with ASTM D 217, and shall remain flexible and adhesive after 500 hours of accelerated weathering as specified in ASTM C 734, and shall be non-staining.

2.1.5 Preformed Sealant

Preformed sealant shall be polybutylene or isoprene-butylene based pressure sensitive weather resistant tape or bead sealant capable of sealing out moisture, air and dust when installed as recommended by the manufacturer. At temperatures from minus 30 to plus 160 degrees F, the sealant shall be non-bleeding and shall have no loss of adhesion.

2.2 PRIMERS

Provide a nonstaining, quick-drying type and consistency recommended by the sealant manufacturer for the particular application.

2.3 BOND BREAKERS

Provide the type and consistency recommended by the sealant manufacturer to prevent adhesion of the sealant to backing or to bottom of the joint.

2.4 BACKSTOPS

Provide bi-cellular material free from oil or other staining elements as recommended by sealant manufacturer. Backing shall be 25 to 33 percent oversize for closed cell material, unless otherwise indicated. Backstop material shall be compatible with sealant. Do not use oakum, and other types of absorptive materials as backstops.

2.4.1 Bi-cellular Material

Bi-cellular backing shall be ASTM C 1330, Type B round cross section.

2.5 CLEANING SOLVENTS

Provide type(s) recommended by the sealant manufacturer except for aluminum surfaces that will be in contact with sealant.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Surfaces shall be clean, dry to the touch, and free from dirt frost, moisture, grease, oil, wax, lacquer, paint, or other foreign matter that would tend to destroy or impair adhesion. Oil and grease shall be removed with solvent and surfaces shall be wiped dry with clean cloths. When resealing an existing joint, remove existing calk or sealant prior to applying new sealant. For surface types not listed below, the sealant manufacturer shall be contacted for specific recommendations.

3.1.1 Steel Surfaces

Remove loose mill scale by sandblasting or, if sandblasting is impractical or would damage finish work, scraping and wire brushing. Remove protective coatings by sandblasting or using a residue-free solvent.

3.1.2 Aluminum Surfaces

Remove temporary protective coatings from surfaces that will be in contact with sealant. When masking tape is used as a protective coating, remove tape and any residual adhesive just prior to sealant application. For removing protective coatings and final cleaning, use nonstaining solvents recommended by the manufacturer of the item(s) containing aluminum surfaces.

3.1.3 Concrete and Masonry Surfaces

Where surfaces have been treated with curing compounds, oil, or other such materials, the materials shall be removed by sandblasting or wire brushing. Laitance, efflorescence and loose mortar shall be removed from the joint cavity.

3.1.4 Wood Surfaces

Wood surfaces to be in contact with sealants shall be free of splinters and sawdust or other loose particles.

3.2 SEALANT PREPARATION

Do not add liquids, solvents, or powders to the sealant. Mix multicomponent elastomeric sealants in accordance with manufacturer's instructions.

3.3 APPLICATION

3.3.1 Joint Width-To-Depth Ratios

a. Acceptable Ratios:

JOINT WIDTH	JOINT DEPTH	
	Minimum	Maximum
For metal, glass, or other		

JOINT WIDTH	JOINT DEPTH Minimum	JOINT DEPTH Maximum
nonporous surfaces:		
1/4 inch (minimum)	1/4 inch	1/4 inch
over 1/4 inch	1/2 of width	Equal to width
For concrete or masonry:		
1/4 inch (minimum)	1/4 inch	1/4 inch
Over 1/4 inch to 1/2 inch	1/4 inch	Equal to width
Over 1/2 inch to 2 inches	1/2 inch	5/8 inch
Over 2 inches	(As recommended by sealant manufacturer)	

b. Unacceptable Ratios: Where joints of acceptable width-to-depth ratios have not been provided, clean out joints to acceptable depths and grind or cut to acceptable widths without damage to the adjoining work. Grinding shall not be required on metal surfaces.

3.3.2 Masking Tape

Masking tape may be placed on the finish surface on one or both sides of a joint cavity to protect adjacent finish surfaces from primer or sealant smears. Masking tape shall be removed within 10 minutes after joint has been filled and tooled.

3.3.3 Backstops

Install backstops dry and free of tears or holes. Tightly pack the back or bottom of joint cavities with backstop material to provide a joint of the depth specified. Install backstops in the following locations:

a. Where indicated.

b. Where backstop is not indicated but joint cavities exceed the acceptable maximum depths specified in paragraph entitled, "Joint Width-to-Depth Ratios."

3.3.4 Primer

Immediately prior to application of the sealant, clean out loose particles from joints. Where recommended by sealant manufacturer, apply primer to joints in concrete masonry units, wood, and other porous surfaces in accordance with sealant manufacturer's instructions. Do not apply primer to exposed finish surfaces.

3.3.5 Bond Breaker

Provide bond breakers to the back or bottom of joint cavities, as recommended by the sealant manufacturer for each type of joint and sealant used, to prevent sealant from adhering to these surfaces. Carefully apply the bond breaker to avoid contamination of adjoining surfaces or breaking bond with surfaces other than those covered by the bond breaker.

3.3.6 Sealants

Provide a sealant compatible with the material(s) to which it is applied. Do not use a sealant that has exceeded shelf life or has jelled and can not be discharged in a continuous flow from the gun. Apply the sealant in accordance with the manufacturer's instructions with a gun having a nozzle that fits the joint width. Force sealant into joints to fill the joints solidly without air pockets. Tool sealant after application to ensure adhesion. Sealant shall be uniformly smooth and free of wrinkles. Upon completion of sealant application, roughen partially filled or unfilled joints, apply sealant, and tool smooth as specified. Sealer shall be applied over the sealant when and as specified by the sealant manufacturer.

3.4 PROTECTION AND CLEANING

3.4.1 Protection

Protect areas adjacent to joints from sealant smears. Masking tape may be used for this purpose if removed 5 to 10 minutes after the joint is filled.

3.4.2 Final Cleaning

Upon completion of sealant application, remove remaining smears and stains and leave the work in a clean and neat condition.

a. Masonry and Other Porous Surfaces: Immediately scrape off fresh sealant that has been smeared on masonry and rub clean with a solvent as recommended by the sealant manufacturer. Allow excess sealant to cure for 24 hour then remove by wire brushing or sanding.

b. Metal and Other Non-Porous Surfaces: Remove excess sealant with a solvent-moistened cloth.

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SECTION 08110

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SECTION 08110

STEEL DOORS AND FRAMES

05/01

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A250.4	(1994) Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors and Hardware Reinforcings
ANSI A250.6	(1997) Hardware on Standard Steel Doors (Reinforcement - Application)
SDI A250.8	(1998) SDI-100 Recommended Specifications for Standard Steel Doors and Frames

ASTM INTERNATIONAL (ASTM)

ASTM A 591	(1998) Steel Sheet, Electrolytic Zinc-Coated, for Light
ASTM A 653/A 653M	(2002a) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 924/A 924M	(1999) General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

BHMA A115	(Set - Spec dates Vary) Steel Preparation Standards (Incl A115.1 (1990), A115.2 (1987), A115.4 (1994), A115.5 (1992), A115.6 (1993), A115.12 (1994), A115.13 (1991), A115.14 (1994), A115.15 (1994), A115.16 (1990), A115.17 (1994), A115.18 (1994)

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM HMMA HMM	(1992) Hollow Metal Manual

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80	(1999) Fire Doors and Fire Windows
NFPA 105	(1999) The Installation of Smoke-Control Door Assemblies
NFPA 252	(1999) Fire Tests of Door Assemblies

STEEL DOOR INSTITUTE (SDI)

SDI 105	(2001) Recommended Erection Instructions for Steel Frames
SDI 111-C	Recommended Louver Details for Standard Steel Doors
SDI 111-F	Recommended Existing Wall Anchors for Standard Steel Doors and Frames

UNDERWRITERS LABORATORIES (UL)

UL 10B	(1997) Fire Tests of Door Assemblies

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-02 Shop Drawings

Doors; G-AE

Frames; G-AE

Accessories; G-AE

Show elevations, construction details, metal gages, hardware provisions, method of glazing, and installation details.

Schedule of doors; G-AE

Schedule of frames; G-AE

Submit door and frame locations.

SD-03 Product Data

Doors; G-AE

Frames; G-AE

Accessories; G-AE

Submit manufacturer's descriptive literature for doors, frames, and accessories. Include data and details on door construction,

panel (internal) reinforcement, insulation, and door edge construction. When "custom hollow metal doors" are provided in lieu of "standard steel doors," provide additional details and data sufficient for comparison to SDI A250.8 requirements.

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver doors, frames, and accessories undamaged and with protective wrappings or packaging. Provide temporary steel spreaders securely fastened to the bottom of each welded frame. Store doors and frames on platforms under cover in clean, dry, ventilated, and accessible locations, with 1/4 inch airspace between doors. Remove damp or wet packaging immediately and wipe affected surfaces dry. Replace damaged materials with new.

PART 2 PRODUCTS

2.1 STANDARD STEEL DOORS

SDI A250.8, except as specified otherwise. Prepare doors to receive hardware specified in Section 08710, "Door Hardware." Undercut where indicated. Exterior doors shall have top edge closed flush and sealed to prevent water intrusion. Doors shall be 1 3/4 inches thick, unless otherwise indicated.

2.1.1 Classification - Level, Performance, Model

2.1.1.1 Heavy Duty Doors

SDI A250.8, Level 2, physical performance Level B, Model 1, with core construction as required by the manufacturer for interior doors, of size(s) and design(s) indicated. Where vertical stiffener cores are required, the space between the stiffeners shall be filled with mineral board insulation.

2.2 CUSTOM HOLLOW METAL DOORS

Provide custom hollow metal doors where nonstandard steel doors are indicated. At the Contractor's option, custom hollow metal doors may be provided in lieu of standard steel interior doors. Door size(s), design, materials, construction, gages, and finish shall be as specified for standard steel doors and shall comply with the requirement of NAAMM HMMA HMM. Fill all spaces in doors with insulation. Close top and bottom edges with steel channels not lighter than 16 gage. Prepare doors to receive hardware specified in Section 08710, "Door Hardware." Undercut doors where indicated. Doors shall be 1 3/4 inches thick, unless otherwise indicated.

2.3 INSULATED STEEL DOOR AND FRAME

Insulated steel doors shall have a core of polyurethane foam and an R factor of 10.0 or more (based on a k value of 0.16); face sheets, edges, and frames of galvanized steel not lighter than 16 gage, 16 gage, and 14 gage respectively. Doors and frames shall receive phosphate treatment and rust-inhibitive primer. Doors shall have been tested in accordance with ANSI A250.4 and shall have met the requirements for Level C. Prepare doors to receive hardware specified in Section 08710, "Door Hardware." Doors shall be 1 3/4 inches thick. Provide insulated steel doors and frames where shown.

2.4 ACCESSORIES

2.4.1 Louvers

2.4.1.1 Interior Louvers

SDI 111-C, Louvers shall be stationary type where scheduled. Detachable moldings on room or non security side of door; on security side of door, moldings to be integral part of louver. Form louver frames of 20 gage steel and louver blades of a minimum 24 gage.

2.4.2 Astragals

For pairs of exterior steel doors which will not have aluminum astragals or removable mullions, as specified in Section 08710, "Door Hardware," provide overlapping steel astragals with the doors. For interior pairs of fire rated and smoke control doors, provide stainless steel astragals complying with NFPA 80 for fire rated assemblies and NFPA 105 for smoke control assemblies.

2.4.3 Moldings

Provide moldings around glass of interior and exterior doors . Provide nonremovable moldings on outside of exterior doors and on corridor side of interior doors. Other moldings may be stationary or removable. Secure inside moldings to stationary moldings, or provide snap-on moldings. Muntins shall interlock at intersections and shall be fitted and welded to stationary moldings.

2.5 STANDARD STEEL FRAMES

SDI A250.8, except as otherwise specified. Form frames to sizes and shapes indicated, with welded corners. Provide steel frames for doors, transoms, sidelights, and interior glazed panels, unless otherwise indicated.

2.5.1 Welded Frames

Continuously weld frame faces at corner joints. Mechanically interlock or continuously weld stops and rabbets. Grind welds smooth.

2.5.2 Mullions and Transom Bars

Mullions and transom bars shall be closed or tubular construction and shall member with heads and jambs butt-welded thereto . Bottom of door mullions shall have adjustable floor anchors and spreader connections.

2.5.3 Stops and Beads

Form stops and beads from 20 gage steel. Provide for glazed and other openings in standard steel frames. Secure beads to frames with oval-head, countersunk Phillips self-tapping sheet metal screws or concealed clips and fasteners. Space fasteners approximately 12 to 16 inches on centers. Miter molded shapes at corners. Butt or miter square or rectangular beads at corners.

2.5.4 Anchors

Provide anchors to secure the frame to adjoining construction. Provide steel anchors, zinc-coated or painted with rust-inhibitive paint, not

lighter than 18 gage.

2.5.4.1 Wall Anchors

Provide at least three anchors for each jamb. For frames which are more than 7.5 feet in height, provide one additional anchor for each jamb for each additional 2.5 feet or fraction thereof.

a. Masonry: Provide anchors of corrugated or perforated steel straps or 3/16 inch diameter steel wire, adjustable or T-shaped;

b. Stud partitions: Weld or otherwise securely fasten anchors to backs of frames. Design anchors to be fastened to closed steel studs with sheet metal screws, and to open steel studs by wiring or welding;

c. Completed openings: Secure frames to previously placed concrete or masonry with expansion bolts in accordance with SDI 111-F.

2.5.4.2 Floor Anchors

Provide floor anchors drilled for 3/8 inch anchor bolts at bottom of each jamb member.

2.6 FIRE AND SMOKE DOORS AND FRAMES

NFPA 80 and NFPA 105 and this specification. The requirements of NFPA 80 and NFPA 105 shall take precedence over details indicated or specified.

2.6.1 Labels

Fire doors and frames shall bear the label of Underwriters Laboratories (UL), Factory Mutual Engineering and Research (FM), or Warnock Hersey International (WHI) attesting to the rating required. Testing shall be in accordance with NFPA 252 or UL 10B. Labels shall be metal with raised letters, and shall bear the name or file number of the door and frame manufacturer. Labels shall be permanently affixed at the factory to frames and to the hinge edge of the door. Door labels shall not be painted.

2.6.2 Oversized Doors

For fire doors and frames which exceed the size for which testing and labeling are available, furnish certificates stating that the doors and frames are identical in design, materials, and construction to a door which has been tested and meets the requirements for the class indicated.

2.6.3 Astragal on Fire and Smoke Doors

On pairs of labeled fire doors, conform to NFPA 80 and UL requirements. On smoke control doors, conform to NFPA 105.

2.7 WEATHERSTRIPPING

As specified in Section 08710, "Door Hardware."

2.8 HARDWARE PREPARATION

Provide minimum hardware reinforcing gages as specified in ANSI A250.6.

Drill and tap doors and frames to receive finish hardware. Prepare doors and frames for hardware in accordance with the applicable requirements of SDI A250.8 and ANSI A250.6. For additional requirements refer to BHMA A115. Drill and tap for surface-applied hardware at the project site. Build additional reinforcing for surface-applied hardware into the door at the factory. Locate hardware in accordance with the requirements of SDI A250.8, as applicable. Punch door frames, with the exception of frames that will have weatherstripping to receive a minimum of two rubber or vinyl door silencers on lock side of single doors and one silencer for each leaf at heads of double doors. Set lock strikes out to provide clearance for silencers.

2.9 FINISHES

2.9.1 Factory-Primed Finish

All surfaces of doors and frames shall be thoroughly cleaned, chemically treated and factory primed with a rust inhibiting coating as specified in SDI A250.8.

2.9.2 Hot-Dip Zinc-Coated and Factory-Primed Finish

Fabricate exterior doors and frames from hot dipped zinc coated steel, alloyed type, that complies with ASTM A 924/A 924M and ASTM A 653/A 653M. The Coating weight shall meet or exceed the minimum requirements for coatings having 0.4 ounces per square foot, total both sides, i.e., A40. Repair damaged zinc-coated surfaces by the application of zinc dust paint. Thoroughly clean and chemically treat to insure maximum paint adhesion. Factory prime as specified in SDI A250.8.

2.9.3 Electrolytic Zinc-Coated Anchors and Accessories

Provide electrolytically deposited zinc-coated steel in accordance with ASTM A 591, Commercial Quality, Coating Class A. Phosphate treat and factory prime zinc-coated surfaces as specified in SDI A250.8.

2.10 FABRICATION AND WORKMANSHIP

Finished doors and frames shall be strong and rigid, neat in appearance, and free from defects, waves, scratches, cuts, dents, ridges, holes, warp, and buckle. Molded members shall be clean cut, straight, and true, with joints coped or mitered, well formed, and in true alignment. Dress exposed welded and soldered joints smooth. Design door frame sections for use with the wall construction indicated. Corner joints shall be well formed and in true alignment. Conceal fastenings where practicable.

2.10.1 Grouted Frames

For frames to be installed in exterior walls and to be filled with mortar or grout, fill the stops with strips of rigid insulation to keep the grout out of the stops and to facilitate installation of stop-applied head and jamb seals.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Frames

Set frames in accordance with SDI 105. Plumb, align, and brace securely until permanent anchors are set. Anchor bottoms of frames with expansion bolts or powder-actuated fasteners. Build in or secure wall anchors to adjoining construction. Backfill frames in masonry partitions with mortar. When an additive is provided in the mortar, coat inside of frames with corrosion-inhibiting bituminous material. For frames in exterior walls, ensure that stops are filled with rigid insulation before grout is placed.

3.1.2 Doors

Hang doors in accordance with clearances specified in SDI A250.8. After erection and glazing, clean and adjust hardware.

3.1.3 Fire and Smoke Doors and Frames

Install fire doors and frames, including hardware, in accordance with NFPA 80. Install fire rated smoke doors and frames in accordance with NFPA 80 and NFPA 105.

3.2 PROTECTION

Protect doors and frames from damage. Repair damaged doors and frames prior to completion and acceptance of the project or replace with new, as directed. Wire brush rusted frames until rust is removed. Clean thoroughly. Apply an all-over coat of rust-inhibitive paint of the same type used for shop coat.

3.3 CLEANING

Upon completion, clean exposed surfaces of doors and frames thoroughly. Remove mastic smears and other unsightly marks.

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SECTION 08120

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09/99

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SECTION 08120

ALUMINUM DOORS AND FRAMES
09/99

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ALUMINUM ASSOCIATION (AA)

AA DAF-45	(1997) Designation System for Aluminum Finishes

ASTM INTERNATIONAL (ASTM)

ASTM A 36/A 36M	(2001) Carbon Structural Steel
ASTM B 209	(2002a) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 221	(2002) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM C 1184	(2000ae1) Structural Silicone Sealants
ASTM C 1401	(2002) Structural Sealant Glazing
ASTM E 283	(1991; R 1999) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM E 331	(2000) Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 4-010-01	(8 October 2003) Unified Faciliites Criteria DoD Mnimum Antiterrorism Standards for Buildings.

1.2 PERFORMANCE REQUIREMENTS

1.2.1 Aluminum Door System Design

Shapes and thicknesses of all framing members, fasteners and hardware shall comply with UFC 4-010-01.

1.2.1.1 Frame Member Design

Steel members shall be designed using ultimate yield stresses and aluminum members shall be designed on a 0.2% offset yield strength. Equivalent static design loads for the window and door members shall be 1 lb per square inch applied to the surface of the glazing and frame. Deformations shall not exceed 1/60th of the unsupported member lengths.

1.2.1.2 Glazing Frame Bite

The glazing shall have a minimum frame bite 3/8 inch for structurally glazed systems.

1.2.1.3 Connection Design

Equivalent static design loads for connections of the window or doorframe to the surrounding walls associated connections and glazing stop connections shall be 10.8 lbs per square inch for glazing panels with a vision area less than or equal to 10.8 square feet and 4.4 lbs per square inch or glazing panels with a vision area greater than 10.8 square feet but less than or equal to 32 square feet. Loads shall be applied to the surface of the glazing and frame. Connections and hardware may be designed on ultimate strength for steel and 0.2% offset yield strength for aluminum.

1.2.2 Air Infiltration

When tested in accordance with ASTM E 283, air infiltration shall not exceed 0.06 cubic feet per minute per square foot of fixed area at a test pressure of 6.24 pounds per square foot (50 mile per hour wind).

1.2.3 Water Penetration

When tested in accordance with ASTM E 331, there shall be no water penetration at a pressure of 8 pounds per square foot of fixed area.

1.3 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-02 Shop Drawings

Doors and frames; G-AE

Show elevations of each door type, size of doors and frames, metal gages, details of door and frame construction, methods of anchorage, glazing details, weatherstripping, provisions for and location of hardware, and details of installation.

SD-03 Product Data

Doors and Frames; G-AE

Manufacturer's descriptive data and catalog cuts including air-filtration data.

SD-07 Certificates

Aluminum Door System Design; G-AE

Certificates stating that the door system framing design complies with the requirements of UFC 4-010-01. Certification includes design calculations of door, framing and accessories; connection design; and glazing design to comply with specified loads.

SD-08 Manufacturer's Instructions

Doors and frames

Submit detail specifications and instructions for installation, adjustments, cleaning, and maintenance.

1.4 DELIVERY, STORAGE, AND HANDLING

Inspect materials delivered to the site for damage. Unload and store with minimum handling. Provide storage space in dry location with adequate ventilation, free from dust or water, and easily accessible for inspection and handling. Stack materials on nonabsorptive strips or wood platforms. Do not cover doors and frames with tarps, polyethylene film, or similar coverings. Protect finished surfaces during shipping and handling using manufacturer's standard method, except that no coatings or lacquers shall be applied to surfaces to which calking and glazing compounds must adhere.

PART 2 PRODUCTS

2.1 DOORS AND FRAMES

Swing-type aluminum doors and frames of size, design, and location indicated. Provide doors complete with frames, subframes, trim, and accessories.

2.2 MATERIALS

2.2.1 Anchors

Stainless steel or steel with hot-dipped galvanized finish.

2.2.2 Weatherstripping

Continuous wool pile, silicone treated, or type recommended by door manufacturer.

2.2.3 Aluminum Alloy for Doors and Frames

ASTM B 221, Alloy 6063-T5 for extrusions. ASTM B 209, alloy and temper best suited for aluminum sheets and strips.

2.2.4 Fasteners

Hard aluminum or stainless steel.

2.2.5 Structural Steel

ASTM A 36/A 36M.

2.2.6 Aluminum Paint

Type as recommended by aluminum door manufacturer.

2.3 FABRICATION

2.3.1 Aluminum Frames

Extruded aluminum shapes with contours approximately as indicated. Provide glazing accessories for frames accommodating structural silicone glazed fixed glass. Use countersunk stainless steel Phillips screws for exposed fastenings, and space not more than 12 inches o.c. Mill joints in frame members to a hairline fit, reinforce, and secure mechanically.

2.3.2 Aluminum Doors

Of type, size, and design indicated and not less than 1 3/4 inches thick. Minimum wall thickness, 0.125 inch, except beads and trim, 0.050 inch. Door sizes shown are nominal and shall include standard clearances as follows: 0.093 inch at hinge and lock stiles, 0.125 inch between meeting stiles, 0.125 inch at top rails, 0.187 inch between bottom and threshold, and 0.687 inch between bottom and floor. Bevel single-acting doors 0.063 or 0.125 inch at lock, hinge, and meeting stile edges.

2.3.2.1 Full Glazed Stile and Rail Doors

Doors shall have wide stiles and rails as indicated. Fabricate from extruded aluminum hollow seamless tubes or from a combination of open-shaped members interlocked or welded together. Fasten top and bottom rail together by means of welding or by 3/8 or 1/2 inch diameter cadmium-plated tensioned steel tie rods. Provide an adjustable mechanism of jack screws or other methods in the top rail to allow for minor clearance adjustments after installation. Install wet glazing system with ASTM C 1184 compliant silicone sealant. Color to match sealant color at glazed curtain wall.

2.3.3 Welding and Fastening

Where possible, locate welds on unexposed surfaces. Dress welds on exposed surfaces smoothly. Select welding rods, filler wire, and flux to produce a uniform texture and color in finished work. Remove flux and spatter from surfaces immediately after welding. Exposed screws or bolts will be permitted only in inconspicuous locations, and shall have countersunk heads. Weld concealed reinforcements for hardware in place.

2.3.4 Weatherstripping

Provide on stiles and rails of exterior doors. Fit into slots which are integral with doors or frames. Weatherstripping shall be replaceable without special tools, and adjustable at meeting rails of pairs of doors. Installation shall allow doors to swing freely and close positively. Air leakage of a single leaf weatherstripped door shall not exceed 1.25 cubic feet per minute of air per square foot of door area when tested in accordance with ASTM E 283.

2.3.5 Anchors

On the backs of subframes, provide anchors of the sizes and shapes indicated for securing subframes to adjacent construction. Anchor mullions at head and sill. Where indicated, reinforce vertical mullions with structural steel members of sufficient length to extend up to the overhead structural slab or framing and secure thereto. Place anchors near top and bottom of each jamb and at intermediate points not more than 25 inches apart.

2.3.6 Provisions for Hardware

Hardware is specified in Section 08710, "Door Hardware." Deliver hardware templates and hardware (except field-applied hardware) to the door manufacturer for use in fabrication of aluminum doors and frames. Cut, reinforce, drill, and tap doors and frames at the factory to receive template hardware. Provide doors to receive surface-applied hardware, except push plates and kick plates with reinforcing only; drill and tap in the field. Provide hardware reinforcements of stainless steel or steel with hot-dipped galvanized finish, and secure with stainless steel screws.

2.3.7 Provisions for Glazing

Provide manufactured metallic glazing beads and accessories to allow for structural silicone glazing. Design glazing beads to receive glass of thickness indicated or specified. Glazing is specified in Section 08800 GLAZING.

2.3.8 Finishes

Provide exposed aluminum surfaces with factory finish of anodic coating.

2.3.8.1 Anodic Coating

Clean exposed aluminum surfaces and provide an anodized finish conforming to AA DAF-45. Finish shall be electrolytically deposited color-anodized, designation AA-M10-C22-A44, Architectural Class I 0.7 mil or thicker.Color shall be Champagne .

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Door and Frame Installation

Plumb, square, level, and align frames and framing members to receive doors. Anchor frames to adjacent construction as indicated, in accordance with manufacturer's printed instructions and in conformance with UFC 4-010-01 criteria. Anchor bottom of each frame to rough floor construction with minimum 3/32 inch thick stainless steel angle clips secured to back of each jamb and to floor construction; use stainless steel bolts and expansion rivets for fastening clip anchors. Seal metal-to-metal joints between framing members as specified in Section 07920 JOINT SEALANTS. Hang doors to produce clearances specified in paragraph entitled "Aluminum Doors," of this section. After erection and glazing, adjust doors and hardware to operate properly.

3.1.2 Glazing Installation

Install glazing in a wet glazed system in compliance with ASTM C 1401 using

an ASTM C 1184 structural silicone sealant.

3.2 PROTECTION FROM DISSIMILAR MATERIALS

3.2.1 Dissimilar Metals

Where aluminum surfaces come in contact with metals other than stainless steel, zinc, or small areas of white bronze, protect from direct contact by one or a combination of the following methods:

a. Paint the dissimilar metal with one coat of heavy-bodied bituminous paint.

b. Apply a good quality elastomeric sealant between the aluminum and the dissimilar metal.

c. Paint the dissimilar metal with one coat of primer and one coat of aluminum paint.

d. Use a nonabsorptive tape or gasket in permanently dry locations.

3.2.2 Drainage from Dissimilar Metals

In locations where drainage from dissimilar metals has direct contact with aluminum, provide protective paint, to prevent aluminum discoloration.

3.2.3 Masonry and Concrete

Provide aluminum surfaces in contact with mortar, concrete, or other masonry materials with one coat of heavy-bodied bituminous paint.

3.2.4 Wood or Other Absorptive Materials

Provide aluminum surfaces in contact with absorptive materials subject to frequent moisture, and aluminum surfaces in contact with treated wood, with two coats of aluminum paint or one coat of heavy-bodied bituminous paint. In lieu of painting the aluminum, the Contractor shall have the option of painting the wood or other absorptive surface with two coats of aluminum paint and sealing the joints with elastomeric sealant.

3.3 CLEANING

Upon completion of installation, clean door and frame surfaces in accordance with door manufacturer's recommended procedure. Do not use abrasive, caustic, or acid cleaning agents.

3.4 PROTECTION

Protect doors and frames from damage and from contamination by other materials such as cement mortar. Prior to completion and acceptance of the work, restore damaged doors and frames to original condition, or replace with new ones.

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09/99

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SECTION 08210

WOOD DOORS
09/99

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM E 152	(1981; Rev. A) Fire Tests of Door Assemblies

ARCHITECTURAL WOODWORK INSTITUTE (AWI)

AWI Qual Stds	(1999) AWI Quality Standards

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80	(1999) Fire Doors and Fire Windows
NFPA 252	(1999) Fire Tests of Door Assemblies

WINDOW AND DOOR MANUFACTURERS ASSOCIATION (WDMA)

WDMA I.S. 1-A	(1997) Architectural Wood Flush Doors
WDMA TM-5	(1990) Split Resistance Test
WDMA TM-7	(1990) Cycle - Slam Test
WDMA TM-8	(1990) Hinge Loading Resistance Test

UNDERWRITERS LABORATORIES (UL)

UL 10B	(1997) Fire Tests of Door Assemblies

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-02 Shop Drawings

Doors; G-AE

Submit drawings or catalog data showing each type of door unit. Drawings and data shall indicate door type and construction, sizes, thickness, methods of assembly, and glazing.

SD-03 Product Data

Doors; G-AE

Accessories

Water-resistant sealer

Sample warranty

Fire resistance rating; G-AE

SD-04 Samples

Doors

Prior to the delivery of wood doors, submit a sample section of each type of door which shows the stile, rail, veneer, finish, and core construction.

Door finish colors; G-AE

Submit a minimum of three color selection samples .

SD-06 Test Reports

Split resistance

Cycle-slam

Hinge loading resistance

Submit split resistance test report for doors tested in accordance with WDMA TM-5, cycle-slam test report for doors tested in accordance with WDMA TM-7, and hinge loading resistance test report for doors tested in accordance with WDMA TM-8.

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver doors to the site in an undamaged condition and protect against damage and dampness. Stack doors flat under cover. Support on blocking, a minimum of 4 inches thick, located at each end and at the midpoint of the door. Store doors in a well-ventilated building so that they will not be exposed to excessive moisture, heat, dryness, direct sunlight, or extreme changes of temperature and humidity. Do not store in a building under construction until concrete, masonry work, and other wet activities are dry. Replace defective or damaged doors with new ones.

1.4 WARRANTY

Warranty shall warrant doors free of defects as set forth in the door manufacturer's standard door warranty.

PART 2 PRODUCTS

2.1 DOORS

Provide doors of the types, sizes, and designs indicated.

2.1.1 Flush Doors

Flush doors shall conform to WDMA I.S. 1-A. Hollow core doors shall have lock blocks and one inch minimum thickness hinge stile. Stile edge bands of doors to receive natural finish shall be hardwood, compatible with face veneer. Stile edge bands of doors to be painted shall be mill option specie. No visible finger joints will be accepted in stile edge bands. When used, locate finger-joints under hardware.

2.1.1.1 Interior Flush Doors

Provide particleboard core, Type II flush doors conforming to WDMA I.S. 1-A with faces of premium grade red oak. Hardwood veneers shall be plain sliced book matched.

2.1.2 Composite-Type Fire Doors

Doors specified or indicated to have a fire resistance rating shall conform to the requirements of UL 10B, ASTM E 152, or NFPA 252 for the class of door indicated. Affix a permanent metal label with raised or incised markings indicating testing agency's name and approved hourly fire rating to hinge edge of each door.

2.2 ACCESSORIES

2.2.1 Door Light Openings

Provide glazed openings with the manufacturer's standard wood moldings except that moldings for doors to receive natural finish shall be of the same specie and color as the face veneers. Moldings for flush doors shall be lip type. Provide glazed openings in fire-rated doors with fire rated frames. Glazing is specified in Section 08800, "Glazing."

2.2.2 Additional Hardware Reinforcement

Provide fire rated doors with hardware reinforcement blocking. Size of lock blocks shall be as required to secure the hardware specified. Top, bottom and intermediate rail blocks shall measure 5 inches minimum by full core width. Reinforcement blocking shall be in compliance with the manufacturer's labeling requirements and shall not be mineral material similar to the core.

2.3 FABRICATION

2.3.1 Marking

Each door shall bear a stamp, brand, or other identifying mark indicating quality and construction of the door.

2.3.2 Quality and Construction

Identify the standard on which the construction of the door was based.

2.3.3 Adhesives and Bonds

WDMA I.S. 1-A. Use Type II bond for interior doors. Adhesive for doors to receive a natural finish shall be nonstaining.

2.3.4 Prefitting

At the Contractor's option, doors may be provided factory pre-fit. Doors shall be sized and machined at the factory by the door manufacturer in accordance with the standards under which they are produced. The work shall include sizing, bevelling edges, mortising, and drilling for hardware and providing necessary beaded openings for glass. Provide the door manufacturer with the necessary hardware samples, and frame and hardware schedules as required to coordinate the work.

2.3.5 Finishes

2.3.5.1 Factory Finish

Provide doors finished at the factory by the door manufacturer as follows: AWI Qual Stds Section 1500, specification for System No. 4 Conversion varnish alkyd urea or System No. 5 Vinyl catalyzed. The coating shall be AWI Qual Stds premium, medium rubbed sheen, open grain effect. Use stain when required to produce the finish specified for color. Seal edges, cutouts, trim, and wood accessories, and apply two coats of finish compatible with the door face finish. Touch-up finishes that are scratched or marred, or where exposed fastener holes are filled, in accordance with the door manufacturer's instructions. Match color and sheen of factory finish using materials compatible for field application.

2.3.5.2 Color

Provide door finish colors as indicated.

2.3.6 Water-Resistant Sealer

Provide a water-resistant sealer compatible with the specified finish as approved and as recommended by the door manufacturer.

2.4 SOURCE QUALITY CONTROL

Stiles of "B" and "C" label fire doors utilizing standard mortise leaf hinges shall meet the following performance criteria:

a. Split resistance: Average of ten test samples shall be not less than 500 pounds load when tested in accordance with WDMA TM-5.

b. Cycle-slam: 200,000 cycles with no loose hinge screws or other visible signs of failure when tested in accordance with the requirements of WDMA TM-7.

c. Hinge loading resistance: Average of ten test samples shall be not less than 700 pounds load when tested for direct screw withdrawal in accordance with WDMA TM-8 using a No. 12, 1 1/4 inch long, steel, fully threaded wood screw. Drill 5/32 inch pilot hole, use 1 1/2 inch opening around screw for bearing surface, and engage screw full, except for last 1/8 inch. Do not use a steel plate to reinforce screw area.

PART 3 EXECUTION

3.1 INSTALLATION

Before installation, seal top and bottom edges of doors with the approved water-resistant sealer. Seal cuts made on the job immediately after cutting using approved water-resistant sealer. Fit, trim, and hang doors with a 1/16 inch minimum, 1/8 inch maximum clearance at sides and top, and a 3/16 inch minimum, 1/4 inch maximum clearance over thresholds. Provide 3/8 inch minimum, 7/16 inch maximum clearance at bottom where no threshold occurs. Bevel edges of doors at the rate of 1/8 inch in 2 inches. Door warp shall not exceed 1/4 inch when measured in accordance with WDMA I.S. 1-A.

3.1.1 Fire Doors

Install fire doors in accordance with NFPA 80. Do not paint over labels.

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OVERHEAD ROLLING DOORS

10/03

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SECTION 08330A

OVERHEAD ROLLING DOORS
10/03

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A 653/A 653M	(2002a) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM E 84	(2001) Surface Burning Characteristics of Building Materials
ASTM E 330	(2002) Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE Hdbk-IP	(2001) Fundamentals Handbook, IP Edition
ASHRAE Hdbk-SI	(2001) Fundamentals Handbook, SI Edition

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 2	(2000) Industrial Controls and Systems: Controllers, Contactors, and Overload Relays Rated 600 Volts
NEMA ICS 6	(1993; R 2001) Industrial Control and Systems: Enclosures
NEMA MG 1	(1998) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2002) National Electrical Code
NFPA 80	(1999) Fire Doors and Fire Windows

1.2 DESCRIPTION

Overhead rolling doors shall be spring counterbalanced, rolling type, with interlocking slats, complete with guides, fastenings, hood, brackets, and

operating mechanisms, and shall be designed for use on openings as indicated. Fire doors shall bear the Underwriters Laboratories, Warnock Hersey, Factory Mutual or other nationally recognized testing laboratory label for [Class [_____] rating.] [the rating listed on the drawings.] Each door shall be provided with a permanent label showing the manufacturer's name and address and the model/serial number of the door. Doors in excess of the labelled size shall be deemed oversize and shall be provided with a listing agency oversize label, or a listing agency oversize certificate, or a certificate signed by an official of the manufacturing company certifying that the door and operator have been designed to meet the specified requirements.

1.2.1 Wind Load Requirements

Doors and components shall be designed to withstand the minimum design wind load of [20 psf] [[_____] psf.] Doors shall be constructed to sustain a superimposed load, both inward and outward, equal to 1-1/2 times the minimum design wind load. [Calculations shall be provided that prove the door design meets the design windload requirements.] [Test data showing compliance with design windload requirements for the specific door design tested in accordance with the uniform static air pressure difference test procedures of ASTM E 330 shall be provided.] Recovery shall be at least 3/4 of the maximum deflection within 24 hours after the test load is removed. Sound engineering principles may be used to interpolate or extrapolate test results to door sizes not specifically tested

1.2.2 Operational Cycle Life

All portions of the door and door operating mechanism that are subject to movement, wear, or stress fatigue shall be designed to operate through a minimum number of [10] [_____] cycles per [day] [hour]. One complete cycle of door operation is defined as when the door is in the closed position, moves to the full open position, and returns to the closed position.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Approved Detail Drawings; [_____], [_____]
Installation; [_____], [_____]

Drawings showing the location of each door including schedules. Drawings shall include elevations of each door type, details and method of anchorage, details of construction, location and installation of hardware, shape and thickness of materials, details of joints and connections, and details of guides, power operators, controls, and other fittings.

SD-03 Product Data

Overhead Rolling Doors; [_____], [_____]

Manufacturer's catalog data, test data, and summary of forces

and loads on the walls/jambs.

Manufacturer's preprinted installation instructions.

SD-06 Test Reports

Tests; [_____], [_____]

Written record of fire door drop test.

SD-04 Samples

Overhead Rolling Doors; [_____], [_____]

Submit [three][_____] color samples of factory applied finishes.

SD-07 Certificates

Fire Doors; [_____], [_____]

Oversize labels or certificates stating that the overhead rolling doors conform to requirements of this section. Certificates for oversize fire doors stating that the doors and hardware are manufactured in compliance with the requirements for doors of this type and class and have been tested and meet the requirements for the class indicated. Certificate is not required when fire door has a listing agency label or oversize label on the door bottom bar.

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals; [_____], [_____]

[Six] [_____] copies of the [system operation manual] [and] [system maintenance and repair manual] for each type of door and control system.

1.4 DELIVERY AND STORAGE

Doors shall be delivered to the jobsite wrapped in a protective covering with the brands and names clearly marked thereon. Doors shall be stored in a dry location that is adequately ventilated and free from dirt and dust, water, and other contaminants, and in a manner that permits easy access for inspection and handling.

1.5 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1-year period shall be provided.

1.6 OPERATION AND MAINTENANCE MANUALS

Operating instructions outlining the step-by-step procedures required for motorized door and shutter operation for the overhead rolling door unit shall be provided. The instructions shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, troubleshooting guides, and simplified diagrams for the equipment as

installed shall be provided. A complete list of parts and supplies, source of supply, and a list of the high mortality maintenance parts shall be provided.

PART 2 PRODUCTS

2.1 OVERHEAD ROLLING DOORS

Doors shall be surface-mounted type with guides at jambs set back a sufficient distance to clear the opening. Exterior doors shall be mounted [as indicated.] [on interior side of walls.]

2.1.1 Curtains

The curtains shall roll up on a barrel supported at the head of opening on brackets, and shall be balanced by helical torsion springs. [[Steel] [stainless steel] slats for doors less than 15 feet wide shall be minimum bare metal thickness of 0.0281 inches.] [[Steel] [stainless steel] slats for doors from 15 to 21 feet wide shall be minimum bare metal thickness of 0.0344 inches.] [[Steel] [stainless steel] slats for doors 21 feet wide and wider shall be minimum bare metal thickness of 0.0438 inches.] [Aluminum slats for doors up to 18 feet 4 inches wide shall be minimum 0.050 inches.] Slats shall be of the minimum bare metal decimal thickness required for the width indicated and the wind pressure specified above. Slats for fire doors over 12 feet wide and under 20 feet wide shall be not less than 0.0329 inches steel. Slats for fire doors 20 feet wide or wider shall be not less than 0.0438 inches steel.

2.1.1.1 Non-Insulated Curtains

Curtains shall be formed of interlocking slats of shapes standard with the manufacturer. Slats for exterior doors shall be flat type.

2.1.1.2 Insulated Curtains

The slat system shall supply a minimum R-value of 4 [_____] when calculated in accordance with ASHRAE Hdbk-IP ASHRAE Hdbk-SI. Slats shall be of the flat type as standard with the manufacturer. Slats shall consist of a [urethane] [polystyrene] core not less than 11/16 inch thick, completely enclosed within metal facings. Exterior face of slats shall be gauge as specified for curtains. Interior face shall be not lighter than 0.0219 inches. The insulated slat assembly shall have a flame spread rating of not more than 25 and a smoke development factor of not more than 50 when tested in accordance with ASTM E 84.

2.1.2 Endlocks and Windlocks

The ends of each alternate slat for interior doors shall have [steel] [iron] endlocks of manufacturer's stock design. [Endlocks shall be provided in accordance with manufacturer's listing on fire doors when required by test results performed by the code listing agency.] [In addition to endlocks, non-rated exterior doors shall have the manufacturer's standard windlocks as required to withstand the wind load. Windlocks shall prevent the curtain from leaving guides because of deflection from specified wind pressure.]

2.1.3 Bottom Bar

The curtain shall have a [standard] [off-set] [sloped] bottom bar

consisting of [two hot-dip galvanized steel angles for steel doors.] [two aluminum angles for aluminum doors.] [extruded aluminum T-shape.] A sensing edge shall be attached to the bottom bar of doors that are electric-power operated.

2.1.4 Guides

Guides shall be steel structural shapes or formed steel shapes, of a size and depth to provide proper clearance for operation and resistance under the design windload. Guides shall be attached to adjoining construction with fasteners recommended by the manufacturer. Spacing of fasteners shall be as required to meet the minimum design windload. Doors and guides in hazardous areas shall have static grounding.

2.1.5 Barrel

The barrel shall be steel pipe or commercial welded steel tubing of proper diameter for the size of curtain. Deflection shall not exceed 0.03 inch per foot of span. Ends of the barrel shall be closed with metal plugs, machined to fit the pipe. Aluminum plugs are acceptable on non-fire door barrels.

2.1.6 Springs

Oil tempered helical steel counter-balance torsion springs shall be installed within the barrel and shall be capable of producing sufficient torque to assure easy operation of the door curtain. Access shall be provided for spring tension adjustment from outside of the bracket without removing the hood.

2.1.7 Brackets

Brackets shall be of steel plates to close the ends of the roller-shaft housing, and to provide mounting surfaces for the hood. An operation bracket hub and shaft plugs shall have sealed prelubricated ball bearings.

2.1.8 Hoods

Hoods shall be [steel] [stainless steel] [aluminum] with minimum bare metal thickness of 0.0219 inches formed to fit contour of the end brackets, and shall be reinforced with steel rods, rolled beads, or flanges at top and bottom edges. Multiple segment and single piece hoods shall be provided with support brackets of the manufacturer's standard design as required for adequate support.

2.1.9 Weatherstripping

Exterior doors shall be fully weatherstripped. A compressible and replaceable weather seal shall be attached to the bottom bar. Weather seal at door guides shall be continuous vinyl or neoprene, bulb or leaf type, or shall be nylon-brush type. A weather baffle shall be provided at the lintel or inside the hood. Weatherstripping shall be easily replaced without special tools.

2.1.10 Slat Openings

2.1.10.1 Vision Lites

Vision lites shall be those standard for the manufacturer. The lite

assembly shall consist of [3 separate lites across and 5 slats high] [_____]. Opening shall have manufacturer's standard acrylic coverings.

2.1.10.2 Ventilation/Vision Perforations

Perforations shall be manufacturer's standard design and size. Weather stripping for door guides and hoods shall be omitted from perforated doors.

2.1.11 Operation

Doors shall be operated by means of [manual [push-up] [hand-chain] [crank] [with provision made for future installation of electric power]] [electric power with auxiliary chain hoist]. Equipment shall be designed and manufactured for usage in [non-hazardous] [hazardous Class [_____], Division [_____], and Group [_____] areas].

2.1.11.1 Manual Push-Up Operation

One lifting handle shall be provided on each side of the door. The maximum force required for lift-handle operation shall not exceed 25 lbf. Pull-down straps or pole hooks shall be provided on bottom rail of doors over 7 feet high.

2.1.11.2 Manual Hand-Chain Operation

Operation shall be by means of a [galvanized] [bronze (in hazardous areas)] endless chain extending to within 3 feet of floor. Reduction shall be provided by use of roller chain and sprocket drive or suitable gearing, to reduce the pull required on hand chain to not over 35 lbf. Gears shall be high grade gray cast iron.

2.1.11.3 Manual Crank Operation

Operation shall be by means of a vertical shaft, gear box, and [crank located approximately 34 inches above the floor] [or] [reduction gearing and awning type handle]. Gears shall be of high grade gray cast-iron. Gear reduction shall be provided to reduce pressure exerted on the crank to not over 35 lbf.

2.1.11.4 Electric Power Operator With Auxiliary Chain Hoist Operation

Electric power operators shall be heavy-duty industrial type. The unit shall operate the door through the operational cycle life specified. The electric power operator shall be complete with electric motor, auxiliary operation, [necessary means of reduction for medium-duty doors,] [self-locking worm gear in oil bath for heavy-duty doors,] brake, mounting brackets, push button controls, limit switches, magnetic reversing starter, and all other accessories necessary to operate components specified in other paragraphs of this section. The operator shall be so designed that the motor may be removed without disturbing the limit-switches settings and without affecting the emergency chain operator. Doors shall be provided with an auxiliary operator for immediate emergency manual operation of the door in case of electrical failure. Auxiliary operation shall be by means of [galvanized] [bronze (in hazardous areas)] endless chain extending to within 3 feet of the floor. The emergency manual operating mechanism shall be so arranged that it may be operated from the floor without affecting the settings of the limit switches. A mechanical device shall be included that will disconnect the motor from the drive operating mechanism when the auxiliary operator is used. Where control voltages differ from

motor voltage, a control voltage transformer shall be provided in and as part of the electric power operator system. Control voltage shall not exceed 120 volts.

a. Motors: Drive motors shall conform to NEMA MG 1, shall be high-starting torque, reversible type, and shall be of sufficient horsepower and torque output to move the door in either direction from any position at a speed range of 6 to 8 inches per second without exceeding the rated capacity. Motors shall be suitable for operation on [_____] volts, [60] [_____] hertz, [single] [3-] phase current and shall be suitable for across-the-line starting. Motors shall be designed to operate at full capacity over a supply voltage variation of plus or minus 10 percent of the motor voltage rating. Motors shall be provided with overload protection.

b. Controls: Control equipment shall conform to NEMA ICS 2. Enclosures shall conform to NEMA ICS 6, Type 12 (industrial use), Type 7 or 9 in hazardous locations, in accordance with NFPA 70. Exterior control stations shall be weatherproof key-operated type with corrosion-resistant cast-metal cover. Each control station shall be of the three position [button] [or] [switch] type, marked "OPEN," "CLOSE," and "STOP." The "OPEN" and "STOP" controls shall be of the momentary contact type with seal-in contact. The "CLOSE" control shall be of the [momentary contact type] [constant pressure type]. When the door is in motion and the "STOP" control is pressed, the door shall stop instantly and remain in the stop position; from the stop position, the door shall be operable in either direction by the "OPEN" or "CLOSE" controls. Controls shall be of the full-guarded type to prevent accidental operation. Readily adjustable limit switches shall be provided to automatically stop the doors at their fully open and closed positions.

c. Sensing Edge Device: The bottom edge of electric power operated doors shall have [an electric] [a pneumatic] sensing edge for [hazardous] [non-hazardous] areas that will reverse the door movement upon contact with an obstruction and cause the door to return to its full open position. The sensing edge shall not substitute for a limit switch. Exterior doors shall be provided with a combination compressible weather seal and sensing edge.

d. Electrical Work: Conduit and wiring necessary for proper operation shall be provided under Section 16415A ELECTRICAL WORK, INTERIOR. Flexible connections between doors and fixed supports shall be made with flexible type SJO cable, except in hazardous locations where wiring shall conform to NFPA 70, as appropriate. The cable shall have a spring-loaded automatic take up reel or a coil cord equivalent device.

2.1.12 Inertia Brake

Overhead rolling door shall have a mechanical inertia brake device which will stop the door from free fall in any position, should there be a failure in the motor operator brake or roller chain drive. The unit shall be capable of being reset with a back drive action.

2.1.13 Locking

Locking shall consist of [interior slide bolts, suitable for padlock by others, for manual push-up doors] [chain lock keeper, suitable for padlock by others, for chain operated doors] [locking disc or slide bolt, suitable for padlock by others, for crank operated doors]. Locking for motor operated doors shall consist of self-locking gearing [and optional master

keyed cylinder with electrical interlock] [with chain lock for emergency hand chain].

2.1.14 Finish

[Steel slats and hoods shall be hot-dip galvanized [G90 in accordance with ASTM A 653/A 653M,] [G60 in accordance with ASTM A 653/A 653M,] and shall be treated for paint adhesion and shall receive a [factory baked-on finish coat] [factory baked-on prime coat for field finishing].] [Aluminum slats and hoods shall receive a [mill] [clear anodized] [color anodized] finish.] [Stainless steel slats and hoods shall receive a [#2 B] [#4] finish.] Surfaces other than slats, hood, and faying surfaces shall be cleaned and treated to assure maximum paint adherence and shall be given a factory dip or spray coat of rust inhibitive metallic oxide or synthetic resin primer. Color shall be [in accordance with Section 09915 COLOR SCHEDULE][as indicated on the drawings.] [selected from manufacturers standard colors.] [white.] [brown.] [gray.] [[_____.] Color listed is not intended to limit the selection of equal colors from other manufacturers.].

2.2 FIRE DOORS

Fire rated rolling doors shall be provided at locations shown on the drawings. Fire doors shall conform to the requirements specified herein and to NFPA 80 for the class indicated. Doors shall bear the label or oversize label, or be provided with oversize certification of a recognized testing agency indicating the listed rating for the fire door. The construction details necessary for the listed rating shall take precedence over conflicting details shown or specified herein. Fire doors shall be complete with hardware, accessories, and automatic closing device. An automatic closing device shall operate upon [the fusing of a 165 degree F replaceable fusible link.] [activation of the building's fire alarm system.]

PART 3 EXECUTION

3.1 INSTALLATION

Doors shall be installed in accordance with approved detail drawings and manufacturer's instructions. Anchors and inserts for guides, brackets, [motors,] [switches,] hardware, and other accessories shall be accurately located. Upon completion, doors shall be free from warp, twist, or distortion. Doors shall be lubricated, properly adjusted, and demonstrated to operate freely. Fire doors shall be installed in conformance with the requirements of NFPA 80 and the manufacturer's instructions.

3.2 FIELD PAINTED FINISH

Steel doors and frames shall be field painted in accordance with Section 09900 PAINTING, GENERAL. Weatherstrips shall be protected from paint. Finish shall be free of scratches or other blemishes. Color shall be [in accordance with Section 09915 COLOR SCHEDULE][as indicated on the drawings] [_____].

3.3 TESTS

The fire doors shall be drop tested in accordance with NFPA 80 to show proper operation and full automatic closure and shall be reset in accordance with the manufacturer's instructions. A written record of initial test shall be provided to the Contracting Officer.

-- End of Section --

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SECTION 08331A

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-- End of Section Table of Contents --

SECTION 08331A

METAL ROLLING COUNTER DOORS
12/03

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A 653/A 653M	(2002a) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B 209	(2002a) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 221	(2002) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80	(1999) Fire Doors and Fire Windows

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Approved Detail Drawings; G-AE

Drawings showing elevations of each door type, details of anchorage, details of construction, location and description of hardware, shape and thickness of materials, details of joints and connections, and details of guides and fittings. A schedule showing the location of each counter door shall be included with the drawings.

SD-03 Product Data

Rolling Counter Doors; G-AE

Manufacturer's descriptive data and catalog cuts.

Installation
Cleaning

Manufacturer's preprinted installation and cleaning instructions.

SD-04 Samples

Rolling Counter Doors; G-AE

Three color samples of minimum 3 inches by 4 inches counter door painted finish.

SD-06 Test Reports

Tests

Test reports from fire door drop tests.

SD-10 Operation and Maintenance Data

Operation; G-AO

Six complete copies of maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, troubleshooting guides, and simplified diagrams for the equipment as installed. Spare parts data for each different item of material and equipment specified shall be supplied not later than 30 days prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of the parts recommended by the manufacturer to be replaced after 1 year and 3 years of service.

1.3 GENERAL REQUIREMENTS

Rolling counter doors shall be of the type, size, and design indicated on the drawings, and shall be the standard product of a manufacturer regularly engaged in the production of rolling counter doors. Each door shall be provided with a permanent label showing the manufacturer's name and address and the model number of the door.

1.4 DELIVERY AND STORAGE

Rolling counter doors shall be delivered to the jobsite wrapped in a protective covering with the brands and names clearly marked thereon. Rolling counter doors shall be stored in accordance with the manufacturer's instructions in a dry location that is adequately ventilated and free from dust, water, or other contaminants, and in a manner that permits easy access for inspecting and handling. Doors shall be handled carefully to prevent damage. Damaged items that cannot be restored to like-new condition shall be replaced.

1.5 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

PART 2 PRODUCTS

2.1 BASIC COMPONENTS

2.1.1 Curtain

At aluminum doors, the curtain shall be fabricated of extruded aluminum slats conforming to ASTM B 221, Alloy 6063; at fire rated doors the curtain shall be fabricated from 22 gauge minimum galvanized steel slats conforming to ASTM A 653/A 653M, Coating Designation G90 as indicated. Thickness of slat material shall be as required by width of opening. Slats shall be approximately 1-1/4 to 1-1/2 inch wide with a depth of crown of 1/2 inch. Alternate slats shall be fitted with end locks to maintain curtain alignment. Bottom of curtain shall be provided with angle at fire-rated door and tubular bar reinforcement matching the curtain and fitted with a resilient bottom seal at aluminum door.

2.1.2 Jamb Guides

Guides shall be of 1/8 inch minimum thickness extruded aluminum conforming to ASTM B 221, Alloy 6063, and shall be fitted with neoprene silencers or replaceable heavy nap striping to eliminate noise and dust infiltration at aluminum doors, and 13 gauge minimum thickness galvanized steel angles conforming to ASTM A 653/A 653M, Coating Designation G90 at fire-rated doors.

2.1.3 Counterbalance Shaft Assembly

The curtain shall be coiled around a steel tube of sufficient thickness and diameter to prevent deflection exceeding 0.03 inch per foot. The barrel shall contain oil tempered helical steel torsion springs capable of sufficient torque to counterbalance the weight of the curtain. Springs shall be calculated to provide a minimum of 50,000 operating cycles (one complete cycle of door operation will begin with the door in the closed position, move to the full open position and return to the closed position).

2.1.4 Brackets

Brackets shall be a minimum 12 gauge thickness steel if flat plate, or 16 gauge thickness if there are a minimum of 3 returns of 3/4 inch width.

2.1.5 Hood

The hood shall be of 0.040 inch minimum thickness aluminum sheet conforming to ASTM B 209, Alloy 5005 at aluminum doors, or .24 gauge galvanized steel conforming to ASTM A 653/A 653M, Coating Designation G90 at fire-rated doors.

2.1.6 Locks

The curtain shall be locked at both sides of bottom bar by a chrome-plated cylinder lock keyed into the building keying system at aluminum doors. Lock shall be on the 108 and 146 room sides of the counter doors. Keying shall conform to Section 08710 DOOR HARDWARE.

2.2 ROLLING COUNTER DOOR (NON-RATED)

Rolling counter doors shall conform to the requirements specified herein and shall be constructed of aluminum curtains, guides and hood components.

2.3 FIRE-RATED ROLLING COUNTER DOOR

Fire-rated rolling counter doors shall be between jamb mounted, rated as shown and shall conform to the requirements specified and to NFPA 80 for the class indicated. Doors shall bear the labels of a recognized testing agency indicating the applicable fire resistance rating. The construction details necessary for labeled rolling counter doors shall take precedence over details indicated or specified herein. Door curtains, guides and hood shall be galvanized steel. Fire-rated rolling counter doors shall be complete with hardware, accessories, and automatic closing device. An automatic closing device shall operate upon the fusing of a 165 degree F replaceable fusible link at each side of wall. Rolling counter doors in exit corridor walls shall be provided with perimeter smoke and draft control gasketing.

2.4 OPERATION

2.4.1 Manual Operation

The curtain shall be operated by means of manual crank with removable handle.

2.5 FINISH

Exposed parts of the rolling counter doors, including the curtain, bottom rail, guides, and hood shall be of uniform finish and appearance. Aluminum shall have a clear anodized finish.Steel galvanized coating shall have a prime coat and a baked-on or powder-coated Factory top coat finish. All other steel parts shall be given a shop coat of primer paint standard with the manufacturer. Factory coated color shall be manufacturer's standard neutral.

PART 3 EXECUTION

3.1 INSTALLATION

Doors shall be installed in accordance with approved detail drawings and manufacturer's instructions. Anchors and inserts for guides, brackets, hardware, and other accessories shall be accurately located. Upon completion, doors shall be free from warp, twist, or distortion. Doors shall be lubricated, properly adjusted, and demonstrated to operate freely. Fire-door installation shall be in conformance with NFPA 80 for the class indicated and the manufacturer's instructions.

3.2 CLEANING

Aluminum doors shall be cleaned in accordance with manufacturer's approved instructions.

3.3 TESTS

The fire doors shall be drop tested in accordance with NFPA 80 to show proper operation and full automatic closure and shall be reset in accordance with the manufacturer's instructions. A written record of initial test shall be provided to the Contracting Officer.

-- End of Section --

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SECTION 08710

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02/02

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-- End of Section Table of Contents --

SECTION 08710

DOOR HARDWARE
02/02

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM E 283	(1991; R 1999) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

BHMA A156.1	(1997) Butts and Hinges (BHMA 101)
BHMA A156.2	(1996) Bored and Preassembled Locks and Latches (BHMA 601)
BHMA A156.3	(1994) Exit Devices (BHMA 701)
BHMA A156.4	(1992) Door Controls - Closers (BHMA 301)
BHMA A156.5	(1992) Auxiliary Locks & Associated Products (BHMA 501)
BHMA A156.6	(1994) Architectural Door Trim (BHMA 1001)
BHMA A156.7	(1988) Template Hinge Dimensions
BHMA A156.8	(1994) Door Controls - Overhead Holders (BHMA 311)
BHMA A156.13	(1994) Mortise Locks & Latches (BHMA 621)
BHMA A156.15	(1995) Closer Holder Release Devices
BHMA A156.16	(1997) Auxiliary Hardware
BHMA A156.18	(1993) Materials and Finishes (BHMA 1301)
BHMA A156.21	(1996) Thresholds
BHMA A156.22	(1996) Door Gasketing Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80	(1999) Fire Doors and Fire Windows

NFPA 101 (2003) Code for Safety to Life from Fire in Buildings and Structures

STEEL DOOR INSTITUTE (SDI)

SDI 100 (1998) Standard Steel Doors and Frames

UNDERWRITERS LABORATORIES (UL)

UL Bld Mat Dir (2003) Building Materials Directory

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-02 Shop Drawings

Hardware schedule; G-AE

Keying system; G-AO

SD-03 Product Data

Hardware items; G-AE

SD-08 Manufacturer's Instructions

Installation

SD-10 Operation and Maintenance Data

Hardware Schedule items, Data Package 1; G-AE

Submit data package in accordance with Section 01781, "Operation and Maintenance Data."

SD-11 Closeout Submittals

Key bitting; G-AO

1.3 HARDWARE SCHEDULE

Prepare and submit hardware schedule in the following form:

Hardware Item	Quantity	Size	Reference Publication Type No.	Finish	Mfr. Name and Catalog No.	Key Control Symbols	UL Mark (If fire rated and listed)	BHMA Finish Designation

1.4 KEY BITTING CHART REQUIREMENTS

Submit key bitting charts to the Contracting Officer prior to completion of the work. Include:

a. Complete listing of all keys (AA1, AA2, etc.).

b. Complete listing of all key cuts (AA1-123456, AA2-123458).

c. Tabulation showing which key fits which door.

d. Copy of floor plan showing doors and door numbers.

e. Listing of 20 percent more key cuts than are presently required in each master system.

1.5 QUALITY ASSURANCE

1.5.1 Hardware Manufacturers and Modifications

Provide, as far as feasible, locks, hinges, and closers of one lock, hinge, or closer manufacturer's make. Modify hardware as necessary to provide features indicated or specified.

1.6 DELIVERY, STORAGE, AND HANDLING

Deliver hardware in original individual containers, complete with necessary appurtenances including fasteners and instructions. Mark each individual container with item number as shown in hardware schedule. Deliver permanent keys and removable cores to the Contracting Officer, either directly or by certified mail. Deliver construction master keys with the locks.

PART 2 PRODUCTS

2.1 TEMPLATE HARDWARE

Hardware to be applied to metal or to prefinished doors shall be made to template. Promptly furnish template information or templates to door and frame manufacturers. Template hinges shall conform to BHMA A156.7. Coordinate hardware items to prevent interference with other hardware.

2.2 HARDWARE FOR FIRE DOORS AND EXIT DOORS

Provide all hardware necessary to meet the requirements of NFPA 80 for fire doors and NFPA 101 for exit doors, as well as to other requirements specified, even if such hardware is not specifically mentioned under paragraph entitled "Hardware Schedule." Such hardware shall bear the label of Underwriters Laboratories, Inc., and be listed in UL Bld Mat Dir or labeled and listed by another testing laboratory acceptable to the Contracting Officer.

2.3 HARDWARE ITEMS

Hinges, locks, latches, exit devices, bolts, and closers shall be clearly and permanently marked with the manufacturer's name or trademark where it will be visible after the item is installed. For closers with covers, the name or trademark may be beneath the cover.

2.3.1 Hinges

BHMA A156.1, 4 1/2 by 4 1/2 inches unless otherwise specified. Construct loose pin hinges for exterior doors and reverse-bevel interior doors so that pins will be nonremovable when door is closed. Other antifriction bearing hinges may be provided in lieu of ball-bearing hinges.

2.3.2 Locks and Latches

2.3.2.1 Mortise Locks and Latches

BHMA A156.13, Series 1000, Operational Grade 1, Security Grade 2. Levers and roses of mortise locks shall have screwless shanks and no exposed screws.

2.3.2.2 Auxiliary Locks

BHMA A156.5, Grade 1.

2.3.2.3 Combination Locks

Heavy-duty, mechanical combination lockset with nine pushbuttons, standard-sized knobs, 3/4 inch deadlocking latch, 2 3/4 inch backset. Lock shall be operated by pressing two or more of the buttons in unison or individually in the proper sequence. Inside knob shall always operate the latch. Provide a keyed cylinder on the interior to permit setting the combination. Provide a keyed removable-core cylinder on the exterior to permit bypassing the combination.

2.3.3 Exit Devices

BHMA A156.3, Grade 1. Provide adjustable strikes for rim type and vertical rod devices. Provide open back strikes for pairs of doors with mortise and vertical rod devices. Touch bars shall be provided in lieu of conventional crossbars and arms. Provide escutcheons, not less than 7 by 2 1/4 inches.

2.3.4 Cylinders and Cores

Provide cylinders and cores for new locks, including locks provided under other sections of this specification. Cylinders and cores shall have seven pin tumblers. Cylinders shall be interchangeable and fully compatible with products from Best Lock Corp., Arrow Lock Corp., or Falcon Lock which are removable by special control keys. Stamp each interchangeable core with a key control symbol in a concealed place on the core.

2.3.5 Keying System

Provide a great grand master keying system, an extension of the existing keying system. Provide key cabinet as specified.

Sub-master keying system shall be provided for each building, and shall be keyed to the existing Best removable-core master and grand master keying systems. Equipment spaces and mechanical rooms shall be keyed separately from the building systems, and shall be keyed alike to the existing Best master and grand master systems for these doors.

2.3.6 Lock Trim

Cast, forged, or heavy wrought construction and commercial plain design.

2.3.6.1 Roses

In addition to meeting test requirements of BHMA A156.2 and BHMA A156.13,

roses and escutcheons shall be 0.050 inch thick if unreinforced. If reinforced, outer shell shall be 0.035 inch thick and combined thickness shall be 0.070 inch.

2.3.6.2 Lever Handles

Provide lever handles. Lever handles for exit devices shall meet the test requirements of BHMA A156.13 for mortise locks. Lever handle locks shall have a breakaway feature (such as a weakened spindle or a shear key) to prevent irreparable damage to the lock when a force in excess of that specified in BHMA A156.13 is applied to the lever handle. Lever handles shall return to within 1/2 inch of the door face.

2.3.7 Keys

Furnish one file key, one duplicate key, and one working key for each key change and for each master and grand master keying system. Furnish one additional working key for each lock of each keyed-alike group. Furnish 8 great grand master keys. Furnish a quantity of key blanks equal to 20 percent of the total number of file keys. Stamp each key with appropriate key control symbol and "U.S. property - Do not duplicate." Do not place room number on keys.

2.3.8 Door Bolts

BHMA A156.16. Provide dustproof strikes for bottom bolts, except for doors having metal thresholds. Automatic latching flush bolts: BHMA A156.3, Type 25.

2.3.9 Closers

BHMA A156.4, Series C02000, Grade 1, with PT 4C. Provide with brackets, arms, mounting devices, fasteners, full size covers, and other features necessary for the particular application. Size closers in accordance with manufacturer's recommendations, or provide multi-size closers, Sizes 1 through 5, and list sizes in the Hardware Schedule. Provide manufacturer's 10 year warranty.

2.3.10 Overhead Holders

BHMA A156.8.

2.3.11 Closer Holder-Release Devices

BHMA A156.15.

2.3.12 Door Protection Plates

BHMA A156.6.

2.3.12.1 Sizes of Kick Plates

Width for single doors shall be 2 inches less than door width; width for pairs of doors shall be one inch less than door width. Height of kick plates shall be 12 inches for flush doors.

2.3.13 Door Stops and Silencers

BHMA A156.16. Silencers Type L03011. Provide three silencers for each single door, two for each pair.

2.3.14 Thresholds

BHMA A156.21. Use J35100, with vinyl or silicone rubber insert in face of stop, for exterior doors opening out, unless specified otherwise.

2.3.15 Weather Stripping Gasketing

BHMA A156.22. Provide the type and function designation where specified in paragraph entitled "Hardware Schedule". A set shall include head and jamb seals, sweep strips, and, for pairs of doors, astragals. Air leakage of weather stripped doors shall not exceed 1.25 cubic feet per minute of air per square foot of door area when tested in accordance with ASTM E 283. Weather stripping shall be one of the following:

2.3.15.1 Extruded Aluminum Retainers

Extruded aluminum retainers not less than 0.050 inch wall thickness with vinyl, neoprene, silicone rubber, or polyurethane inserts. Aluminum shall be champagne anodized.

2.3.16 Rain Drips

Extruded aluminum, not less than 0.08 inch thick, champagne anodized. Set drips in sealant conforming to Section 07920, "Joint Sealants," and fasten with stainless steel screws.

2.3.16.1 Door Rain Drips

Approximately 1 1/2 inches high by 5/8 inch projection. Align bottom with bottom edge of door.

2.3.16.2 Overhead Rain Drips

Approximately 1 1/2 inches high by 2 1/2 inches projection, with length equal to overall width of door frame. Align bottom with door frame rabbet.

2.3.17 Special Tools

Provide special tools, such as spanner and socket wrenches and dogging keys, required to service and adjust hardware items.

2.4 FASTENERS

Provide fasteners of proper type, quality, size, quantity, and finish with hardware. Fasteners exposed to weather shall be of nonferrous metal or stainless steel. Provide fasteners of type necessary to accomplish a permanent installation.

2.5 FINISHES

BHMA A156.18. Hardware shall have BHMA 630 finish satin stainless steel, unless specified otherwise. Provide items not manufactured in stainless steel in BHMA 626 finish satin chromium plated over brass or bronze, except surface door closers which shall have powder coat paint finish, and except

steel hinges which shall have BHMA 652 finish (satin chromium plated). Hinges for exterior doors shall be stainless steel with BHMA 630 finish. Exit devices may be provided in BHMA 626 finish in lieu of BHMA 630 finish . Exposed parts of concealed closers shall have finish to match lock and door trim. Hardware for aluminum doors shall be finished to match the doors.

2.6 KEY CABINET AND CONTROL SYSTEM

BHMA A156.5, Type required to yield a capacity (number of hooks) 50 percent greater than the number of key changes used for door locks.

PART 3 EXECUTION

3.1 INSTALLATION

Install hardware in accordance with manufacturers' printed instructions. Fasten hardware to wood surfaces with full-threaded wood screws or sheet metal screws. Provide machine screws set in expansion shields for fastening hardware to solid concrete and masonry surfaces. Provide toggle bolts where required for fastening to hollow core construction. Provide through bolts where necessary for satisfactory installation.

3.1.1 Weather Stripping Installation

Handle and install weather stripping so as to prevent damage. Provide full contact, weather-tight seals. Doors shall operate without binding.

3.1.1.1 Stop-Applied Weather Stripping

Fasten in place with color-matched sheet metal screws not more than 9 inches o.c. after doors and frames have been finish painted.

3.1.2 Threshold Installation

Extend thresholds the full width of the opening and notch end for jamb stops. Set thresholds in a full bed of sealant and anchor to floor with cadmium-plated, countersunk, steel screws in expansion sleeves.

3.2 FIRE DOORS AND EXIT DOORS

Install hardware in accordance with NFPA 80 for fire doors, NFPA 101 for exit doors.

3.3 HARDWARE LOCATIONS

SDI 100, unless indicated or specified otherwise.

a. Kick Plates: Push side of single-acting doors.

3.4 KEY CABINET AND CONTROL SYSTEM

Locate where directed. Tag one set of file keys and one set of duplicate keys. Place other keys in appropriately marked envelopes, or tag each key. Furnish complete instructions for setup and use of key control system. On tags and envelopes, indicate door and room numbers or master or grand master key.

3.5 FIELD QUALITY CONTROL

After installation, protect hardware from paint, stains, blemishes, and other damage until acceptance of work. Submit notice of testing 15 days before scheduled, so that testing can be witnessed by the Contracting Officer. Adjust hinges, locks, latches, bolts, holders, closers, and other items to operate properly. Demonstrate that permanent keys operate respective locks, and give keys to the Contracting Officer. Correct, repair, and finish, as directed, errors in cutting and fitting and damage to adjoining work.

3.6 HARDWARE SETS

Hardware for aluminum doors shall be provided under this section. Deliver Hardware templates and hardware, except field-applied hardware to the aluminum door and frame manufacturer for use in fabricating the doors and frames.

HW SET: 01

8	EA	HINGES	A5111 4.5 X 4.5	652	
1	EA	FLUSHBOLTS	AUTOMATIC	626	
1	EA	DUST PROOF STRIKE	WITH PLATE	626	
1	EA	STOREROOM LOCKSET	F07 NO TRIM ON PUSH SIDE CYL ON PULL SIDE	626	
1	EA	IC CYLINDER	AS REQUIRED	626	BES
1	EA	COORDINATOR	COR COMPLETE	600	
1	EA	ASTRAGAL	R3A634	628	
2	EA	CLOSER	C02011 OR C02021	689	
2	EA	HD OVERHEAD STOP	C52541	630	
2	EA	KICK PLATE	12" X 1" LDW .050 B4E	630	
1	EA	SMOKE GASKET	R0E154 (BULB)	BRN	

HW SET: 02

3	EA	HINGES	A5111 4.5 X 4.5	652
1	EA	PASSAGE SET	F01	626
1	EA	CLOSER	C02011 OR C02021	689
1	EA	KICK PLATE	12" X 2" LDW .050 B4E	630
1	EA	WALL STOP	L52101 OR L52251	630
1	EA	SMOKE GASKET	R0E154 (BULB)	BRN

HW SET: 03

4	EA	HINGES	A5111 4.5 X 4.5 NRP	630	
1	EA	STOREROOM LOCKSET	F07	626	
1	EA	IC CYLINDER	AS REQUIRED	626	BES
1	EA	CLOSER	TYPE C02021 W/STOP ARM	689	
1	EA	KICK PLATE	12" X 2" LDW .050 B4E	630	
1	EA	RAIN DRIP	R3Y976	628	
1	EA	WEATHERSTRIP	R3D165 (SOLID BAR TYPE)	628	
1	EA	BRUSH SWEEP	R3A434	AL	
1	EA	THRESHOLD	J32100 1/2" X 5"	AL	

HW SET: 04

6	EA	HINGES	A5111 4.5 X 4.5 NRP	630	
2	EA	POWER TRANSFER	EPT-2	689	VON
1	EA	MULLION	KEY REMOVABLE	600	
1	EA	PANIC HARDWARE	EL99EO	626	VON
1	EA	PANIC HARDWARE	EL99NL-OP	626	VON
2	EA	IC CYLINDER	AS REQUIRED	626	BES
2	EA	STRAIGHT PULL	1" X 10" 2-1/2" PROJ X THRU BOLT	630	
2	EA	CLOSER	CUSH N STOP W/ HOLD OPEN	689	
1	EA	WEATHERSTRIP	BY DR/FR SUPPLIER	XXX	
2	EA	SWEEPS	R3D534	628	
1	EA	THRESHOLD	J32100 1/2" X 5"	AL	
1	EA	POWER SUPPLY	PS873-2	GRY	VON
1	EA	PUSHBUTTON	623RD	630	LOC
1	EA	WIRE DIAGRAM	BY HARDWARE SUPPLIER	XXX	

HW SET: 05

6	EA	HINGES	A8112 4.5 X 4.5 NRP	630	
1	EA	FLUSHBOLTS	AUTOMATIC	626	
1	EA	DUST PROOF STRIKE	WITH PLATE	626	
1	EA	STOREROOM LOCKSET	F07	626	
1	EA	IC CYLINDER	AS REQUIRED	626	BES
2	EA	CLOSER	TYPE C02021 W/STOP ARM	689	
2	EA	KICK PLATE	12" X 1" LDW .050 B4E	630	
1	EA	RAIN DRIP	R3Y976	628	
1	EA	WEATHERSTRIP	R3D165 (SOLID BAR TYPE)	628	
2	EA	SWEEPS	R3D534	628	
1	EA	THRESHOLD	J32100 1/2" X 5"	AL	

HW SET: 06

3	EA	HINGES	A8112 4.5 X 4.5 NRP	630	
1	EA	PANIC DEVICE	TYPE 01 FUNCTION 01	626	
1	EA	IC CYLINDER	AS REQUIRED	626	BES
1	EA	CLOSER	TYPE C02021 W/STOP ARM	689	
1	EA	KICK PLATE	12" X 2" LDW .050 B4E	630	
1	EA	RAIN DRIP	R3Y976	628	
1	EA	WEATHERSTRIP	R3D165 (SOLID BAR TYPE)	628	
1	EA	SWEEP	R3D534	628	
1	EA	THRESHOLD	J32100 1/2" X 5"	AL	
1	EA	POWER SUPPLY	505 24VDC	GRY	LOC
1	EA	KEYSWITCH	653-04 L2	630	LOC
1	EA	DOOR POSITION SWITCH	679-05	XXX	LOC
1	EA	WIRE DIAGRAM	BY HARDWARE SUPPLIER	XXX	
1	EA	ELECTRONIC HORN	L1910S-1 (24VDC)	WHT	LOC

HW SET: 07

3	EA	HINGES	A8112 4.5 X 4.5	652	
1	EA	OFFICE/ENTRY LOCK	F04	626	
1	EA	IC CYLINDER	AS REQUIRED	626	BES
1	EA	WALL STOP	L52101 OR L52251	630	

HW SET: 08

3	EA	HINGES	A8112 4.5 X 4.5	652	
1	EA	IC CYLINDER	AS REQUIRED	626	BES
1	EA	PRIVACY	L9496 W/OCCUPIED INDICATOR	626	SCH
1	EA	WALL STOP	L52101 OR L52251	630	

HW SET: 09

3	EA	HINGES	A8112 4.5 X 4.5	652	
1	EA	IC CYLINDER	AS REQUIRED	626	BES
1	EA	PRIVACY	L9496 W/OCCUPIED INDICATOR	626	SCH
1	EA	CLOSER	C02011 OR C02021	689	
1	EA	WALL STOP	L52101 OR L52251	630	

HW SET: 10

3	EA	HINGES	A8112 4.5 X 4.5	652	
1	EA	CLASSROOM LOCKSET	F05	626	
1	EA	IC CYLINDER	AS REQUIRED	626	BES
1	EA	CLOSER	C02011 OR C02021	689	
1	EA	HD OVERHEAD STOP	C52541	630	
1	EA	KICK PLATE	12" X 2" LDW .050 B4E	630	

HW SET: 11

1	EA	IC CYLINDER	AS REQUIRED	626	BES

HW SET: 12

3	EA	HINGES	A8112 4.5 X 4.5 NRP	652	
1	EA	PANIC DEVICE	TYPE 01 FUNCTION 03 L/TRIM	626	
1	EA	IC CYLINDER	AS REQUIRED	626	BES
1	EA	STRAIGHT PULL	1" X 10" 2-1/2" PROJ X THRU BOLT	630	
1	EA	CLOSER	TYPE C02021 W/STOP ARM	689	
1	EA	KICK PLATE	12" X 2" LDW .050 B4E	630	

HW SET: 13

3	EA	HINGES	A8112 4.5 X 4.5 NRP	652	
1	EA	CLASSROOM LOCKSET	F05	626	
1	EA	IC CYLINDER	AS REQUIRED	626	BES
1	EA	CLOSER	TYPE C02021 W/STOP ARM	689	
1	EA	KICK PLATE	12" X 2" LDW .050 B4E	630	

HW SET: 14

3	EA	HINGES	A8112 4.5 X 4.5 NRP	652	
1	EA	PANIC DEVICE	TYPE 01 FUNCTION 03 L/TRIM	626	
1	EA	IC CYLINDER	AS REQUIRED	626	BES
1	EA	STRAIGHT PULL	1" X 10" 2-1/2" PROJ X THRU BOLT	630	
1	EA	CLOSER	C02101 PT4D	689	

1	EA	KICK PLATE	12" X 2" LDW .050 B4E	630	
1	EA	WALL STOP	L52101 OR L52251	630	

HW SET: 15

6	EA	HINGES	A8112 4.5 X 4.5 NRP	652	
1	EA	MULLION	KEY REMOVABLE	600	
1	EA	PANIC DEVICE	TYPE 01 FUNCTION 01	626	
1	EA	PANIC DEVICE	TYPE 01 FUNCTION 03 L/TRIM	626	
2	EA	IC CYLINDER	AS REQUIRED	626	BES
2	EA	STRAIGHT PULL	1" X 10" 2-1/2" PROJ X THRU BOLT	630	
2	EA	CLOSER	TYPE C02021 W/STOP ARM	689	
2	EA	KICK PLATE	12" X 1" LDW .050 B4E	630	

HW SET: 16

3	EA	HINGES	A8112 4.5 X 4.5 NRP	652	
1	EA	CLASSROOM LOCKSET	F05	626	
1	EA	IC CYLINDER	AS REQUIRED	626	BES
1	EA	CLOSER	C02011 OR C02021	689	
1	EA	HD OVERHEAD STOP	C52541	630	
1	EA	KICK PLATE	12" X 2" LDW .050 B4E	630	
1	EA	SMOKE GASKET	R0E154 (BULB)	BRN	

HW SET: 17

6	EA	HINGES	A8112 4.5 X 4.5	652	
1	EA	FLUSHBOLTS	AUTOMATIC	626	
1	EA	DUST PROOF STRIKE	WITH PLATE	626	
1	EA	STOREROOM LOCKSET	F07	626	
1	EA	IC CYLINDER	AS REQUIRED	626	BES
1	EA	ASTRAGAL	R3A634	628	
1	EA	SENTRONIC CLOSER	C00191	689	
1	EA	TRACK CLOSER	C02211 180 DEG SWING	689	
1	EA	OVERHEAD STOP	900SE	630	GLY
2	EA	KICK PLATE	12" X 1" LDW .050 B4E	630	
1	EA	MAGNETIC HOLD OPEN	C00011	AL	
1	EA	SMOKE GASKET	R0E154 (BULB)	BRN	

HW SET: 18

3	EA	HINGES	A8112 4.5 X 4.5	652	
1	EA	STOREROOM LOCKSET	F07	626	
1	EA	IC CYLINDER	AS REQUIRED	626	BES
1	EA	CLOSER	C02011 OR C02021	689	
1	EA	KICK PLATE	12" X 2" LDW .050 B4E	630	
1	EA	WALL STOP	L52101 OR L52251	630	
1	EA	SMOKE GASKET	R0E154 (BULB)	BRN	

HW SET: 19

3	EA	HINGES	A8112 4.5 X 4.5	652	
1	EA	PUSH PLATE	4" X 16" .050 B4E	630	

1	EA	PULL & PLATE	4" X 16" .050 B4E W/3/4" X 8" 2-1/4" PROJ	630	
1	EA	CLOSER	C02011 OR C02021	689	
1	EA	KICK PLATE	12" X 2" LDW .050 B4E	630	
1	EA	WALL STOP	L52101 OR L52251	630	

HW SET: 20

3	EA	HINGES	A8112 4.5 X 4.5	652	
1	EA	IC CYLINDER	AS REQUIRED	626	BES
1	EA	CYPHER LOCK	MPM-17-LC	626	LOC
1	EA	CLOSER	C02011 OR C02021	689	
1	EA	HD OVERHEAD STOP	C52541	630	
1	EA	KICK PLATE	12" X 2" LDW .050 B4E	630	

HW SET: 21

3	EA	HINGES	A8112 4.5 X 4.5	652	
1	EA	IC CYLINDER	AS REQUIRED	626	BES
1	EA	CYPHER LOCK	MPM-17-LC	626	LOC
1	EA	CLOSER	C02011 OR C02021	689	
1	EA	KICK PLATE	12" X 2" LDW .050 B4E	630	
1	EA	WALL STOP	L52101 OR L52251	630	

HW SET: 22

3	EA	HINGES	A8112 4.5 X 4.5 NRP	652	
1	EA	PANIC DEVICE	TYPE 01 FUNCTION 01	626	
1	EA	IC CYLINDER	AS REQUIRED	626	BES
1	EA	CLOSER	TYPE C02021 W/STOP ARM	689	
1	EA	KICK PLATE	12" X 2" LDW .050 B4E	630	
1	EA	POWER SUPPLY	505 24VDC	GRY	LOC
1	EA	KEYSWITCH	653-04 L2	630	LOC
1	EA	DOOR POSITION SWITCH	679-05	XXX	LOC
1	EA	WIRE DIAGRAM	BY HARDWARE SUPPLIER	XXX	
1	EA	ELECTRONIC HORN	L1910S-1 (24VDC)	WHT	LOC

HW SET: 23

3	EA	HINGES	A8112 4.5 X 4.5	652	
1	EA	STOREROOM LOCKSET	F07	626	
1	EA	IC CYLINDER	AS REQUIRED	626	BES
1	EA	CLOSER	TYPE C02021 W/STOP ARM	689	
1	EA	KICK PLATE	12" X 2" LDW .050 B4E	630	

HW SET: 24

3	EA	HINGES	A5111 4.5 X 4.5 NRP	630	
1	EA	AUXILIARY DEADBOLT	E26091	626	
1	EA	IC CYLINDER	AS REQUIRED	626	BES
1	EA	PUSH PLATE	4" X 16" .050 B4E	630	
1	EA	PULL & PLATE	4" X 16" .050 B4E W/3/4" X 8" 2-1/4" PROJ	630	
1	EA	CLOSER	C02011 OR C02021	689	

1	EA	KICK PLATE	12" X 2" LDW .050 B4E	630	
1	EA	WALL STOP	L52101 OR L52251	630	

COORDINATE DEADBOLT AND PUSH/PULL

HW SET: 25

3	EA	HINGES	A5111 4.5 X 4.5 NRP	630	
1	EA	AUXILIARY DEADBOLT	E26091	626	
1	EA	IC CYLINDER	AS REQUIRED	626	BES
1	EA	PUSH PLATE	4" X 16" .050 B4E	630	
1	EA	PULL & PLATE	4" X 16" .050 B4E W/3/4" X 8" 2-1/4" PROJ	630	
1	EA	CLOSER	TYPE C02021 W/STOP ARM	689	
1	EA	KICK PLATE	12" X 2" LDW .050 B4E	630	

COORDINATE DEADBOLT AND PUSH/PULL

HW SET: 26

3	EA	HINGES	A8112 4.5 X 4.5 NRP	630	
1	EA	AUXILIARY DEADBOLT	E26081	626	
1	EA	IC CYLINDER	AS REQUIRED	626	BES
1	EA	PUSH PLATE	4" X 16" .050 B4E	630	
1	EA	PULL & PLATE	4" X 16" .050 B4E W/3/4" X 8" 2-1/4" PROJ	630	
1	EA	CLOSER	C02011 OR C02021	689	
1	EA	KICK PLATE	12" X 2" LDW .050 B4E	630	
1	EA	WALL STOP	L52101 OR L52251	630	

HW SET: 27

3	EA	HINGES	A8112 4.5 X 4.5	652	
1	EA	PUSH PLATE	4" X 16" .050 B4E	630	
1	EA	PULL & PLATE	4" X 16" .050 B4E W/3/4" X 8" 2-1/4" PROJ	630	
1	EA	CLOSER	C02011 OR C02021	689	
1	EA	KICK PLATE	12" X 2" LDW .050 B4E	630	
1	EA	WALL STOP & HOLDER	L11291	626	

HW SET: 28

6	EA	HINGES	A8112 4.5 X 4.5	652	
2	EA	PUSH PLATE	4" X 16" .050 B4E	630	
2	EA	PULL & PLATE	4" X 16" .050 B4E W/3/4" X 8" 2-1/4" PROJ	630	
2	EA	CLOSER	C02011 OR C02021	689	
2	EA	KICK PLATE	12" X 1" LDW .050 B4E	630	
2	EA	WALL STOP & HOLDER	L11291	626	

HW SET: 29

6	EA	HINGES	A5111 4.5 X 4.5 NRP	630	
1	EA	MULLION	KEY REMOVABLE	600	
1	EA	PANIC DEVICE	TYPE 01 FUNCTION 01	626	
1	EA	PANIC DEVICE	TYPE 01 FUNCTION 03 L/TRIM	626	

3	EA	IC CYLINDER	AS REQUIRED	626	BES
2	EA	STRAIGHT PULL	1" X 10" 2-1/2" PROJ X THRU BOLT	630	
2	EA	CLOSER	C02101 PT4D	689	
2	EA	HD OVERHEAD STOP	C11541	630	
1	EA	RAIN DRIP	R3Y976	628	
1	EA	WEATHERSTRIP	BY DR/FR SUPPLIER	XXX	
2	EA	SWEEPS	R3D534	628	
1	EA	THRESHOLD	J32100 1/2" X 5"	AL	
1	EA	POWER SUPPLY	505 24VDC	GRY	LOC
1	EA	KEYSWITCH	653-04 L2	630	LOC
2	EA	DOOR POSITION SWITCH	679-05	XXX	LOC
1	EA	WIRE DIAGRAM	BY HARDWARE SUPPLIER	XXX	
1	EA	ELECTRONIC HORN	L1910S-1 (24VDC)	WHT	LOC

HW SET: 30

6	EA	HINGES	A5111 4.5 X 4.5	652	
2	EA	PUSH BAR	1" DIA 2-1/2" PROJ LENGTH AS REQUIRED	630	
2	EA	STRAIGHT PULL	1" X 10" 2-1/2" PROJ X THRU BOLT	630	
2	EA	CLOSER	C02101 PT4D	689	
2	EA	HD OVERHEAD STOP	C11541	630	

HW SET: 31

6	EA	HINGES	A5111 4.5 X 4.5	652	
2	EA	PUSH PLATE	4" X 16" .050 B4E	630	
2	EA	PULL & PLATE	4" X 16" .050 B4E W/3/4" X 8" 2-1/4" PROJ	630	
2	EA	TRACK CLOSER	C02211 180 DEG SWING	689	
2	EA	KICK PLATE	12" X 1" LDW .050 B4E	630	
2	EA	WALL STOP & HOLDER	L11291	626	

HW SET: 32

3	EA	HINGES	A8112 4.5 X 4.5	652	
1	EA	CLASSROOM LOCKSET	F05	626	
1	EA	IC CYLINDER	AS REQUIRED	626	BES
1	EA	CLOSER	C02011 OR C02021	689	
1	EA	KICK PLATE	12" X 2" LDW .050 B4E	630	
1	EA	WALL STOP	L52101 OR L52251	630	

HW SET: 33

3	EA	HINGES	A8112 4.5 X 4.5 NRP	652	
1	EA	CLASSROOM LOCKSET	F05	626	
1	EA	WALL STOP	L52101 OR L52251	630	

HW SET: 34

3	EA	HINGES	A8112 4.5 X 4.5	652	
1	EA	PASSAGE SET	F01	626	

1	EA	WALL STOP	L52101 OR L52251	630	

HW SET: 35

3	EA	HINGES	A8112 4.5 X 4.5	652	
1	EA	CLASSROOM LOCKSET	F05	626	
1	EA	IC CYLINDER	AS REQUIRED	626	BES
1	EA	CLOSER	C02011 OR C02021 DELAYED ACTION	689	
1	EA	HD OVERHEAD STOP	C52541	630	
1	EA	KICK PLATE	12" X 2" LDW .050 B4E	630	
1	EA	SMOKE GASKET	R0E154 (BULB)	BRN	

HW SET: 36

3	EA	HINGES	A5111 4.5 X 4.5	652	
1	EA	CLASSROOM LOCKSET	F05	626	
1	EA	IC CYLINDER	AS REQUIRED	626	BES
1	EA	TRACK CLOSER	C02211 180 DEG SWING	689	
1	EA	KICK PLATE	12" X 2" LDW .050 B4E	630	
1	EA	MAGNETIC HOLD OPEN	C00011	AL	
1	EA	SMOKE GASKET	R0E154 (BULB)	BRN	

HW SET: 37

3	EA	HINGES	A8112 4.5 X 4.5	652	
1	EA	PRIVACY	F22	626	
1	EA	CLOSER	C02011 OR C02021	689	
1	EA	KICK PLATE	12" X 2" LDW .050 B4E	630	
1	EA	WALL STOP	L52101 OR L52251	630	

HW SET: 38

1	EA	BIFOLD TRACK & HDWRE	BF125	XXX	STA
2	EA	DOOR PULL	38	626	IVE

HW SET: 39

3	EA	HINGES	A5111 4.5 X 4.5	652	
1	EA	PUSH PLATE	4" X 16" .050 B4E	630	
1	EA	PULL & PLATE	4" X 16" .050 B4E W/3/4" X 8" 2-1/4" PROJ	630	
1	EA	TRACK CLOSER	C02211 180 DEG SWING	689	
1	EA	KICK PLATE	12" X 1" LDW .050 B4E	630	
1	EA	WALL STOP & HOLDER	L11291	626	

HW SET: 40

3	EA	HINGES	A8112 4.5 X 4.5	652	
1	EA	PUSH PLATE	4" X 16" .050 B4E	630	
1	EA	PULL & PLATE	4" X 16" .050 B4E W/3/4" X 8" 2-1/4" PROJ	630	
1	EA	CLOSER	C02011 OR C02021	689	

1	EA	HD OVERHEAD STOP	C52541	630	
1	EA	KICK PLATE	12" X 2" LDW .050 B4E	630	

HW SET: 41

6	EA	HINGES	A8112 4.5 X 4.5	652	
2	EA	PUSH PLATE	4" X 16" .050 B4E	630	
2	EA	PULL & PLATE	4" X 16" .050 B4E W/3/4" X 8" 2-1/4" PROJ	630	
2	EA	CLOSER	TYPE C02021 W/STOP ARM	689	
2	EA	KICK PLATE	12" X 1" LDW .050 B4E	630	

HW SET: 42

3	EA	HINGES	EXISTING TO REMAIN	652	
1	EA	PUSH PLATE	4" X 16" .050 B4E	630	
1	EA	PULL & PLATE	4" X 16" .050 B4E W/3/4" X 8" 2-1/4" PROJ	630	
1	EA	CLOSER	C02011 OR C02021	689	
1	EA	KICK PLATE	12" X 2" LDW .050 B4E	630	
1	EA	WALL STOP	L52101 OR L52251	630	

HW SET: 43

1	EA	CONTINUOUS HINGE	FM-300	630	MAR
1	EA	ROLLER LATCH	E19091 626		
2	EA	STRAIGHT PULL	3/4" X 8" 2-1/2" PROJ X BTB	630	
1	EA	FLOOR STOP	L12131	626	

HW SET: 44

3	EA	HINGES	A5111 4.5 X 4.5 NRP	630	
1	EA	POWER TRANSFER	EPT-2	689	VON
1	EA	PANIC DEVICE	LX99NL-OP	626	VON
1	EA	IC CYLINDER	AS REQUIRED	626	BES
1	EA	STRAIGHT PULL	1" X 10" 2-1/2" PROJ X THRU BOLT	630	
1	EA	OPERATOR	4642	689	LCN
1	EA	HD OVERHEAD STOP	C11541	630	
1	EA	RAIN DRIP	R3Y976	628	
1	EA	WEATHERSTRIP	BY DR/FR SUPPLIER	XXX	
1	EA	SWEEP	R3D534	628	
1	EA	THRESHOLD	J32100 1/2" X 5"	AL	
1	EA	ACTUATOR	7910-956 (EXTERIOR)	630	LCN
1	EA	ACTUATOR	7910-918 (INTERIOR)	630	LCN
1	EA	DOOR POSITION SWITCH	679-05	XXX	LOC
1	EA	WIRE DIAGRAM	BY HARDWARE SUPPLIER	XXX	

HW SET: 45

3	EA	HINGES	A5111 4.5 X 4.5 NRP	630	
1	EA	PANIC DEVICE	TYPE 01 FUNCTION 01	626	
1	EA	STRAIGHT PULL	1" X 10" 2-1/2" PROJ X		

			THRU BOLT	630	
1	EA	CLOSER	C02101 PT4D	689	
1	EA	HD OVERHEAD STOP	C11541	630	
1	EA	RAIN DRIP	R3Y976	628	
1	EA	WEATHERSTRIP	BY DR/FR SUPPLIER	XXX	
1	EA	SWEEP	R3D534	628	
1	EA	THRESHOLD	J32100 1/2" X 5"	AL	

HW SET: 46

3	EA	HINGES	A5111 4.5 X 4.5	652	
1	EA	PUSH BAR	1" DIA 2-1/2" PROJ LENGTH AS REQUIRED	630	
1	EA	STRAIGHT PULL	1" X 10" 2-1/2" PROJ X THRU BOLT	630	
1	EA	CLOSER	C02101 PT4D	689	
1	EA	HD OVERHEAD STOP	C11541	630	

HW SET: 47

3	EA	HINGES	A5111 4.5 X 4.5	652	
1	EA	PUSH BAR	1" DIA 2-1/2" PROJ LENGTH AS REQUIRED	630	
1	EA	STRAIGHT PULL	1" X 10" 2-1/2" PROJ X THRU BOLT	630	
1	EA	OPERATOR	4642	689	LCN
1	EA	HD OVERHEAD STOP	C11541	630	
2	EA	ACTUATOR	7910-918	630	LCN

HW SET: 48

3	EA	HINGES	A8112 4.5 X 4.5 NRP	652	
1	EA	STOREROOM LOCKSET	F07	626	
1	EA	IC CYLINDER	AS REQUIRED	626	BES
1	EA	CLOSER	TYPE C02021 W/STOP ARM	689	
1	EA	KICK PLATE	12" X 2" LDW .050 B4E	630	
1	EA	SMOKE GASKET	R0E154 (BULB)	BRN	

HW SET: 49

3	EA	HINGES	A8112 4.5 X 4.5	652	
1	EA	STOREROOM LOCKSET	F07	626	
1	EA	IC CYLINDER	AS REQUIRED	626	BES
1	EA	CLOSER	C02011 OR C02021	689	
1	EA	KICK PLATE	12" X 2" LDW .050 B4E	630	
1	EA	WALL STOP	L52101 OR L52251	630	
1	EA	SMOKE GASKET	R0E154 (BULB)	BRN	

HW SET: 50

6	EA	HINGES	A8112 4.5 X 4.5 NRP	630	
1	EA	MULLION	KEY REMOVABLE	600	
1	EA	PANIC DEVICE	TYPE 01 FUNCTION 01	626	
1	EA	PANIC DEVICE	TYPE 01 FUNCTION 03 L/TRIM	626	

3	EA	IC CYLINDER	AS REQUIRED	626	BES
2	EA	STRAIGHT PULL	1" X 10" 2-1/2" PROJ X THRU BOLT	630	
2	EA	CLOSER	C02101 PT4D	689	
2	EA	KICK PLATE	12" X 1" LDW .050 B4E	630	
2	EA	WALL STOP	L52101 OR L52251	630	
1	EA	POWER SUPPLY	505 24VDC	GRY	LOC
1	EA	KEYSWITCH	653-04 L2	630	LOC
2	EA	DOOR POSITION SWITCH	679-05 XXX	LOC	
1	EA	WIRE DIAGRAM	BY HARDWARE SUPPLIER	XXX	
1	EA	ELECTRONIC HORN	L1910S-1 (24VDC)	WHT	LOC

HW SET: 51

3	EA	HINGES	A8112 4.5 X 4.5	652	
1	EA	IC CYLINDER	AS REQUIRED	626	BES
1	EA	PRIVACY	L9496 W/OCCUPIED INDICATOR	626	SCH
1	EA	CLOSER	C02011 OR C02021	689	
1	EA	WALL STOP	L52101 OR L52251	630	
1	EA	SMOKE GASKET	R0E154 (BULB)	BRN	

HW SET: 52

6	EA	HINGES	A5111 4.5 X 4.5 NRP	630	
2	EA	POWER TRANSFER	EPT-2	689	VON
1	EA	MULLION	KEY REMOVABLE	600	
1	EA	PANIC HARDWARE	EL99EO	626	VON
1	EA	PANIC HARDWARE	EL99NL-OP	626	VON
2	EA	IC CYLINDER	AS REQUIRED	626	BES
2	EA	STRAIGHT PULL	1" X 10" 2-1/2" PROJ X THRU BOLT	630	
1	EA	ASTRAGAL	R3A634	628	
2	EA	CLOSER	CUSH N STOP W/ HOLD OPEN	689	
1	EA	WEATHERSTRIP	R3D165 (SOLID BAR TYPE)	628	
2	EA	SWEEPS	R3D534	628	
1	EA	THRESHOLD	J32100 1/2" X 5"	AL	
1	EA	POWER SUPPLY	PS873-2	GRY	VON
1	EA	PUSHBUTTON	623RD	630	LOC
1	EA	WIRE DIAGRAM	BY HARDWARE SUPPLIER	XXX	

HW SET: 53

6	EA	HINGES	A5111 4.5 X 4.5 NRP	630	
1	EA	MULLION	KEY REMOVABLE	600	
2	EA	PANIC DEVICE	TYPE 01 FUNCTION 01	626	
2	EA	IC CYLINDER	AS REQUIRED	626	BES
1	EA	ASTRAGAL	R3A634	628	
2	EA	CLOSER	TYPE C02021 W/STOP ARM	689	
1	EA	WEATHERSTRIP	R3D165 (SOLID BAR TYPE)	628	
2	EA	SWEEPS	R3D534	628	
1	EA	THRESHOLD	J32100 1/2" X 5"	AL	
1	EA	POWER SUPPLY	505 24VDC	GRY	LOC
1	EA	KEYSWITCH	653-04 L2	630	LOC
2	EA	DOOR POSITION SWITCH	679-05	XXX	LOC
1	EA	WIRE DIAGRAM	BY HARDWARE SUPPLIER	XXX	
1	EA	ELECTRONIC HORN	L1910S-1 (24VDC)	WHT	LOC

HW SET: 54

6	EA	HINGES	A5111 4.5 X 4.5 NRP	652	
1	EA	MULLION	KEY REMOVABLE FIRE RATED	600	
2	EA	FIRE EXIT DEVICE	TYPE 08 FUNCTION 08	626	
3	EA	IC CYLINDER	AS REQUIRED	626	BES
1	SET	SEALS	S77	BRN	PEM
2	EA	CLOSER	TYPE C02021 W/STOP ARM	689	
2	EA	KICK PLATE	12" X 1" LDW .050 B4E	630	
1	EA	SMOKE GASKET	R0E154 (BULB)	BRN	

HW SET: 55

3	EA	HINGES	A5111 4.5 X 4.5 NRP	652	
1	EA	FIRE EXIT DEVICE	TYPE 08 FUNCTION 08	626	
1	EA	IC CYLINDER	AS REQUIRED	626	BES
1	EA	CLOSER	C02011 OR C02021	689	
1	EA	KICK PLATE	12" X 2" LDW .050 B4E	630	
1	EA	WALL STOP	L52101 OR L52251	630	
1	EA	SMOKE GASKET	R0E154 (BULB)	BRN	

HW SET: 56

3	EA	HINGES	A5111 4.5 X 4.5	652	
1	EA	STOREROOM LOCKSET	F07	626	
1	EA	IC CYLINDER	AS REQUIRED	626	BES
1	EA	TRACK CLOSER	C02211 180 DEG SWING	689	
1	EA	KICK PLATE	12" X 2" LDW .050 B4E	630	
1	EA	MAGNETIC HOLD OPEN	C00011	AL	
1	EA	SMOKE GASKET	R0E154 (BULB)	BRN	

HW SET: 57

3	EA	HINGES	A8112 4.5 X 4.5 NRP	630	
1	EA	STOREROOM LOCKSET	F07	626	
1	EA	IC CYLINDER	AS REQUIRED	626	BES
1	EA	CLOSER	TYPE C02021 W/STOP ARM	689	
1	EA	KICK PLATE	12" X 2" LDW .050 B4E	630	
1	EA	SMOKE GASKET	R0E154 (BULB)	BRN	

HW SET: 58

3	EA	HINGES	A8112 4.5 X 4.5	630	
1	EA	STOREROOM LOCKSET	F07	626	
1	EA	IC CYLINDER	AS REQUIRED	626	BES
1	EA	CLOSER	C02011 OR C02021	689	
1	EA	KICK PLATE	12" X 2" LDW .050 B4E	630	
1	EA	WALL STOP	L52101 OR L52251	630	

HW SET: 59

3	EA	HINGES	A8112 4.5 X 4.5	652

1	EA	STOREROOM LOCKSET	F07	626	
1	EA	IC CYLINDER	AS REQUIRED	626	BES
1	EA	CLOSER	C02011 OR C02021	689	
1	EA	KICK PLATE	12" X 2" LDW .050 B4E	630	
1	EA	WALL STOP	L52101 OR L52251	630	

HW SET: 60

6	EA	HINGES	A8112 4.5 X 4.5	652
2	EA	PUSH PLATE	4" X 16" .050 B4E	630
2	EA	PULL & PLATE	4" X 16" .050 B4E W/3/4" X 8" 2-1/4" PROJ	630
2	EA	CLOSER	C02011 OR C02021	689
2	EA	KICK PLATE	12" X 1" LDW .050 B4E	630
2	EA	WALL STOP	L52101 OR L52251	630

HW SET: 61

3	EA	HINGES	A8112 4.5 X 4.5	652
1	EA	FIRE EXIT DEVICE	TYPE 08 FUNCTION 08 LESS LOCKING	626
1	EA	CLOSER	C02011 OR C02021	689
1	EA	HD OVERHEAD STOP	C52541	630
1	EA	KICK PLATE	12" X 2" LDW .050 B4E	630
1	EA	SMOKE GASKET	R0E154 (BULB)	BRN

HW SET: 62

3	EA	HINGES	A5111 4.5 X 4.5	652
1	EA	PASSAGE SET	F01	626
1	EA	CLOSER	C02101 PT4D	689
1	EA	KICK PLATE	12" X 2" LDW .050 B4E	630
1	EA	MAGNETIC HOLD OPEN	C00011	AL
1	EA	SMOKE GASKET	R0E154 (BULB)	BRN

HW SET: 63

6	EA	HINGES	A8112 4.5 X 4.5 NRP	630	
1	EA	MULLION	KEY REMOVABLE	600	
1	EA	PANIC DEVICE	TYPE 01 FUNCTION 01	626	
1	EA	PANIC DEVICE	TYPE 01 FUNCTION 03 L/TRIM	626	
2	EA	IC CYLINDER	AS REQUIRED	626	BES
2	EA	STRAIGHT PULL	1" X 10" 2-1/2" PROJ X THRU BOLT	630	
2	EA	CLOSER	CUSH N STOP W/ HOLD OPEN	689	
2	EA	KICK PLATE	12" X 1" LDW .050 B4E	630	
1	EA	RAIN DRIP	R3Y976	628	
1	EA	WEATHERSTRIP	R3D165 (SOLID BAR TYPE)	628	
2	EA	SWEEPS	R3D534	628	
1	EA	THRESHOLD	J32100 1/2" X 5"	AL	

HW SET: 64

3	EA	HINGES	A5111 4.5 X 4.5 NRP	652
1	EA	STOREROOM LOCKSET	F07	626

1	EA	IC CYLINDER	AS REQUIRED	626	BES
1	EA	CLOSER	TYPE C02021 W/STOP ARM	689	
1	EA	KICK PLATE	12" X 2" LDW .050 B4E	630	
1	EA	SMOKE GASKET	R0E154 (BULB)	BRN	

HW SET: 65

3	EA	HINGES	A5111 4.5 X 4.5	NRP	652
1	EA	FIRE EXIT DEVICE	TYPE 08 FUNCTION 08	626	
1	EA	IC CYLINDER	AS REQUIRED	626	BES
1	EA	CLOSER	TYPE C02021 W/STOP ARM	689	
1	EA	KICK PLATE	12" X 2" LDW .050 B4E	630	
1	EA	SMOKE GASKET	R0E154 (BULB)	BRN	

HW SET: 66

6	EA	HINGES	A8112 4.5 X 4.5 NRP	630	
1	EA	MULLION	KEY REMOVABLE	600	
1	EA	PANIC DEVICE	TYPE 01 FUNCTION 01	626	
1	EA	PANIC DEVICE	TYPE 01 FUNCTION 03 L/TRIM	626	
3	EA	IC CYLINDER	AS REQUIRED	626	BES
2	EA	STRAIGHT PULL	1" X 10" 2-1/2" PROJ X THRU BOLT	630	
2	EA	CLOSER	C02101 PT4D	689	
2	EA	KICK PLATE	12" X 1" LDW .050 B4E	630	
2	EA	WALL STOP	L52101 OR L52251	630	

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SECTION 08800

GLAZING
10/03

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z97.1	(1984; R 1994) Safety Glazing Materials Used in Buildings

ASTM INTERNATIONAL (ASTM)

ASTM C 669	(2000) Glazing Compounds for Back Bedding and Face Glazing of Metal Sash
ASTM C 1036	(2001) Flat Glass
ASTM C 1048	(1997b) Heat-Treated Flat Glass - Kind HS, Kind FT Coated and Uncoated Glass
ASTM C 1172	(1996e1) Laminated Architectural Flat Glass
ASTM C 1184	(2000ae1) Structural Silicone Sealants
ASTM D 395	(2001) Rubber Property - Compression Set
ASTM E 119	(2000a) Fire Tests of Building Construction and Materials
ASTM E 773	(2001) Accelerated Weathering of Sealed Insulating Glass Units
ASTM E 774	(1997) Sealed Insulating Glass Units
ASTM E 1300	(2000) Determining Load Resistance of Glass in Buildings

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

16 CFR 1201	Architectural Glazing Materials

GLASS ASSOCIATION OF NORTH AMERICA (GANA)

GANA Glazing Manual	(1997) Glazing Manual
GANA Sealant Manual	(1990) Sealant Manual
GANA Standards Manual	(2001) Tempering Division's Engineering Standards Manual

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80	(1999) Fire Doors and Fire Windows

INSULATING GLASS MANUFACTURERS ALLIANCE (IGMA)

SIGMA A1202	(1983) Commercial Insulating Glass Dimensional Tolerances
SIGMA TM-3000	(1997) Glazing Guidelines for Sealed Insulating Glass Units
SIGMA TB-3001	(1990) Sloped Glazing

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 4-010-01	(8 October 2003) Unified Faciliites Criteria DoD Mnimum Antiterrorism Standards for Buildings.

1.2 PERFORMANCE REQUIREMENTS

Glazing types, systems and installation shall comply with UFC 4-010-01.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Glass Setting; G-AE

Drawings showing complete details of the proposed setting methods, mullion details, edge blocking, size of openings, frame details, materials, and types and thickness of glass.

SD-03 Product Data

Insulating Glass; G-AE

Glazing Accessories

Manufacturer's descriptive product data, handling and storage recommendations, installation instructions, and cleaning instructions.

SD-04 Samples

Insulating Glass; G-AE

Glazing Compound

Glazing Tape

Sealants

Two 8 x 10 inch samples of each of the following: tinted glass, laminated and coated insulating glass units.

Three samples of each indicated material.

SD-07 Certificates

Insulating Glass

Certificates stating that the glass meets the specified requirements including UFC 4-010-01. Labels or manufacturers marking affixed to the glass will be accepted in lieu of certificates.

Glazing Accessories

Certificates from the manufacturer attesting that the units meet the luminous and solar radiant transmission requirements for tinted glass.

SD-08 Manufacturer's Instructions

Setting and sealing materials

Glass setting

Submit glass manufacturer's recommendations for setting and sealing materials and for installation of each type of glazing material specified.

1.4 SYSTEM DESCRIPTION

Glazing systems shall be fabricated and installed watertight and airtight to withstand thermal movement and wind loading without glass breakage, gasket failure, deterioration of glazing accessories, and defects in the work. Glazed panels shall comply with the safety standards, as indicated in accordance with ANSI Z97.1. Glazed panels shall comply with indicated wind/snow loading in accordance with ASTM E 1300. Individual glazing units shall not exceed 32 square feet for exterior doors and windows. Exterior glazing units shall be fabricated and installed in accordancae with UFC 4-010-01.

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver products to the site in unopened containers, labeled plainly with manufacturers' names and brands. Store glass and setting materials in safe, enclosed dry locations and do not unpack until needed for

installation. Handle and install materials in a manner that will protect them from damage.

1.6 ENVIRONMENTAL REQUIREMENTS

Do not start glazing work until the outdoor temperature is above 40 degrees F and rising, unless procedures recommended by the glass manufacturer and approved by the Contracting Officer are made to warm the glass and rabbet surfaces. Provide ventilation to prevent condensation of moisture on glazing work during installation. Do not perform glazing work during damp or rainy weather.

1.7 WARRANTY

1.7.1 Warranty for Insulating Glass Units

Warranty insulating glass units against development of material obstruction to vision (such as dust, fogging, or film formation on the inner glass surfaces) caused by failure of the hermetic seal, other than through glass breakage, for a 10-year period following acceptance of the work. Provide new units for any units failing to comply with terms of this warranty within 45 working days after receipt of notice from the Government.

PART 2 PRODUCTS

2.1 GLASS

ASTM C 1036, unless specified otherwise. In doors and sidelights, provide safety glazing material conforming to 16 CFR 1201.

2.1.1 Annealed Glass

Annealed glass shall be Type I transparent flat type, Class 1 - clear, Quality q3 - glazing select, conforming to ASTM C 1036.

2.1.2 Laminated Glass

ASTM C 1172, Kind LA fabricated from two nominal 1/8 inch or nominal 3/16 inch pieces, as indicated, of Type I, Class 1, Quality q3, flat annealed transparent glass conforming to ASTM C 1036. Flat glass shall be laminated together with a minimum of 0.060 inch thick, clear polyvinyl butyral interlayer. The total thickness shall be nominally 1/4 inch or 3/8 inch as indicated. Color shall be clear or gray as indicated. Incorporate in fabricated units where indicated.

2.1.3 Mirrors

2.1.3.1 Glass Mirrors

Glass for mirrors shall be Type I transparent flat type, Class 1-clear , Glazing Quality q1 1/4 inch thick conforming to ASTM C 1036. Glass color shall be clear. Glass shall be coated on one surface with silver coating, copper protective coating, and mirror backing paint. Silver coating shall be highly adhesive pure silver coating of a thickness which shall provide reflectivity of 83 percent or more of incident light when viewed through 1/4 inch thick glass, and shall be free of pinholes or other defects. Copper protective coating shall be pure bright reflective copper, homogeneous without sludge, pinholes or other defects, and shall be of proper thickness to prevent "adhesion pull" by mirror backing paint.

Mirror backing paint shall consist of two coats of special scratch and abrasion-resistant paint , and shall be baked in uniform thickness to provide a protection for silver and copper coatings which will permit normal cutting and edge fabrication.

2.1.4 Tempered Glass

ASTM C 1048, Kind FT (fully tempered), Condition B (coated), Type I, Class 1 (transparent) or Class 3 (tinted) as indicated , Quality q3, 1/4 inch thick, conforming to ASTM C 1048 and GANA Standards Manual. Color shall be clear or gray as indicated.

2.1.5 Heat-Strengthened Glass

ASTM C 1048, Kind HS (heat strengthened), Condition B (coated), Type I, Class 3 (tinted), Quality q3, 1/4 inch thick. Provide heat strengthened glass where indicated as part of insulating glass unit.

2.1.6 Spandrel Glass

2.1.6.1 Ceramic-Opacified Spandrel Glass

Ceramic-opacified spandrel glass shall be Kind HS heat-strengthened transparent flat type, Condition B, coated with a colored ceramic material on No. 6 surface of laminated, insulating glass units indicated, Quality q3 - glazing select, thickness as indicated, conforming to ASTM C 1048.

2.1.7 Fire/Safety Rated Glass

Fire/safety rated glass shall be laminated Type I transparent flat type, Class 1-clear. Glass shall have a 90 minute rating when tested in accordance with ASTM E 119. Glass shall be permanently labeled with appropriate markings.

2.1.8 Tinted (Light-Reducing) Glass

Tinted (light-reducing) glass shall be Type I transparent flat type, Class 3-tinted, Quality q3 - glazing select, light transmittance and shading coefficient indicated, conforming to ASTM C 1036. Color shall be gray. Incorporate in fabricated units where indicated.

2.2 INSULATING GLASS UNITS

Two panes of glass separated by a dehydrated airspace and hermetically sealed. Dimensional tolerances shall be as specified in SIGMA A1202. The units shall conform to ASTM E 773 and ASTM E 774, Class A. Spacer shall be roll-formed, with bent or tightly welded or keyed and sealed joints to completely seal the spacer periphery and eliminate moisture and hydrocarbon vapor transmission into airspace through the corners. Primary seal shall be compressed polyisobutylene and the secondary seal shall be a specially formulated silicone.

2.2.1 Buildings

Provide 1/2 inch airspace. The inner light shall be ASTM C 1172, Kind LA fabricated from two pieces of clear annealed flat glass Type I, Class I, Quality q3 thickness as indicated. The outer light shall be ASTM C 1048, Kind HS (heat strengthened) or Kind FT(fully tempered)as indicated, Condition B (coated), Type I, Class 3 (tinted) , Quality q3, thickness as

indicated.

2.2.2 Low Emissivity Insulating Glass

Interior glass panes for Low-E insulating units shall be as scheduled. E xterior glass panes for Low-E insulating units shall be , Kind HS (heat strengthened) or Kind FT (fully tempered), as indicated, Class 3-tinted with anti-reflective low-emissivity coating on No. 2 surface (inside surface of exterior pane), Quality q3 - glazing select, conforming to ASTM C 1048. Glass performance shall be R-Value/Winter Nighttime 3.4, shading coefficient .28. Color shall be gray.

2.3 SETTING AND SEALING MATERIALS

Provide as specified in the GANA Glazing Manual, SIGMA TM-3000, SIGMA TB-3001, and manufacturer's recommendations, unless specified otherwise herein. Do not use metal sash putty, nonskinning compounds, nonresilient preformed sealers, or impregnated preformed gaskets. Materials exposed to view and unpainted shall be gray or neutral color.

2.3.1 Glazing Compound

ASTM C 669. Use for face glazing metal sash. Do not use with insulating glass units or laminated glass.

2.3.2 Sealants

Provide structural sealants.

2.3.2.1 Structural Sealant

ASTM C 1184, wet sealant shall be elastomeric conforming to Type S or M, Grade NS, Class 25, Use G, of type compatible with setting blocks, preformed sealing tape and sealants used in manufacturing insulating glass. Color of sealant shall be gray.

2.3.3 Preformed Channels

Neoprene, vinyl, or rubber, as recommended by the glass manufacturer for the particular condition.

2.3.4 Sealing Tapes

Preformed, semisolid, polymeric-based material of proper size and compressibility for the particular condition. Use only where glazing rabbet is designed for tape and tape is recommended by the glass or sealant manufacturer. Provide spacer shims for use with compressible tapes. Tapes shall be chemically compatible with the product being set.

2.3.5 Setting Blocks and Edge Blocks

Neoprene setting blocks shall be dense extruded type conforming to ASTM D 395, Method B, Shore A durometer between 70 and 90. Edge blocking shall be Shore A durometer of 50 (+ or - 5). Silicone setting blocks shall be required when blocks are in contact with silicone sealant. Profiles, lengths and locations shall be as required and recommended in writing by glass manufacturer.

2.3.6 Glazing Gaskets

2.3.6 Glazing Gaskets

Glazing gaskets shall be extruded with continuous integral locking projection designed to engage into metal holding members to provide a watertight seal during dynamic loading, building movements and thermal movements. Glazing gaskets for a single glazed opening shall be continuous one-piece units with factory-fabricated injection-molded corners free of flashing and burrs. Glazing gaskets shall be in lengths or units recommended by manufacturer to ensure against pull-back at corners.

2.3.6.1 Aluminum Framing Glazing Gaskets

Glazing gaskets for interior aluminum framing shall be permanent, elastic, non-shrinking, non-migrating, watertight and weathertight.

2.3.7 Accessories

Provide as required for a complete installation, including, clips, shims, angles, beads, and spacer strips. Provide noncorroding metal accessories. Provide primer-sealers and cleaners as recommended by the glass and sealant manufacturers.

2.4 MIRROR ACCESSORIES

2.4.1 Mastic

Mastic for setting mirrors shall be a polymer type mirror mastic resistant to water, shock, cracking, vibration and thermal expansion. Mastic shall be compatible with mirror backing paint, and shall be approved by mirror manufacturer.

2.4.2 Mirror Frames

Mirrors shall be provided with mirror frames (J-mold channels) fabricated of one-piece roll-formed Type 304 stainless steel with No. 4 brushed satin finish and concealed fasteners which will keep mirrors snug to wall. Frames shall be 1-1/4 x 1/4 x 1/4 inch continuous at top and bottom of mirrors. Concealed fasteners of type to suit wall construction material shall be provided with mirror frames.

PART 3 EXECUTION

3.1 PREPARATION

Preparation, unless otherwise specified or approved, shall conform to applicable recommendations in the GANA Glazing Manual, GANA Sealant Manual, SIGMA TB-3001, SIGMA TM-3000, and manufacturer's recommendations. Determine the sizes to provide the required edge clearances by measuring the actual opening to receive the glass. Grind smooth in the shop glass edges that will be exposed in finish work. Leave labels in place until the installation is approved, except remove applied labels on heat-absorbing glass and on insulating glass units as soon as glass is installed. Securely fix movable items or keep in a closed and locked position until glazing compound has thoroughly set.

3.2 GLASS SETTING

Shop glaze or field glaze items to be glazed using glass of the quality and thickness specified or indicated. Glazing, unless otherwise specified or approved, shall conform to applicable recommendations in the GANA Glazing Manual, GANA Sealant Manual, SIGMA TB-3001, SIGMA TM-3000, and

manufacturer's recommendations. Wood doors may be glazed in conformance with one of the glazing methods described in the standards under which they are produced, except that face puttying with no bedding will not be permitted. Exterior and vestibule Aluminum windows, doors and curtain wall shall be glazed in conformance with UFC 4-010-01. Handle and install glazing materials in accordance with manufacturer's instructions. Use beads or stops which are furnished with items to be glazed to secure the glass in place.

3.2.1 Sheet Glass

Cut and set with the visible lines or waves horizontal.

3.2.2 Exterior and Vestibule Glazing Systems Installation

3.2.2.1 Structural Silicone Sealant Installation

Using structural silicone sealant, wet glaze exterior anv vestibule windows, doors and curtainwall in conformance with ASTM C 1401. Set in framing extrusions with minimum frame bite as specified in UFC 4-010-01.

3.2.2.2 Glazing Frame Bite

The glazing shall have a minimum 3/8 inch frame bite for structurally glazed systems.

3.2.3 Insulating Glass Units

Do not grind, nip, or cut edges or corners of units after the units have left the factory. Springing, forcing, or twisting of units during setting will not be permitted. Handle units so as not to strike frames or other objects. Installation shall conform to applicable recommendations of SIGMA TB-3001 and SIGMA TM-3000.

3.2.4 Installation of Fire/Safety Rated Glass

Install glass for fire doors in accordance with installation requirements of NFPA 80.

3.2.5 Installation of Tinted Glass

Glass shall have clean-cut, factory-fabricated edges. Field cutting will not be permitted.

3.2.6 Installation of Laminated Glass

Sashes which are to receive laminated glass shall be weeped to the outside to allow water drainage into the channel.

3.3 CLEANING

Clean glass surfaces and remove labels, paint spots, and other defacement as required to prevent staining. Glass shall be clean at the time the work is accepted.

3.4 PROTECTION

Glass work shall be protected immediately after installation. Glazed openings shall be identified with suitable warning tapes, cloth or paper

flags, attached with non-staining adhesives. Protective material shall be placed far enough away from the coated glass to allow air to circulate to reduce heat buildup and moisture accumulation on the glass. Glass units which are broken, chipped, cracked, abraded, or otherwise damaged during construction activities shall be removed and replaced with new units.

3.5 SCHEDULE

3.5.1 GT-1 Glazing Type 1

Fire Safety rated glass, 5/16 inch thick.

3.5.2 GT-2 Glazing Type 2

Glass Mirror, 1/4 inch thick.

3.5.3 GT-3 Glazing Type 3

Interior clear tempered single lite, 1/4 inch thick.

3.5.4 GT-4 Glazing Type 4

Interior clear annealed single lite, 1/4 inch thick.

3.5.5 GT-5 1 Inch Tinted Insulating Glass, Tempered

Outboard lite: Tinted, tempered glass, 1/4 inch thick
Low-E coating on #2 surface
Inboard lite: Clear glass, 1/8 inch thick
Laminate layer, 0.060 inch thick
Clear glass, 1/8 inch thick

3.5.6 GT-6 1 Inch Tinted Insulating Spandrel, Heat Strengthened

Outboard lite: Tinted, heat strengthened glass, 1/4 inch thick
Low-E coating on #2 surface
Inboard lite: Clear glass, 1/8 inch thick
Laminate layer, 0.060 inch thick
Clear glass, 1/8 inch thick
Ceramic Material on #6 surface

3.5.7 GT-7 1 Inch Tinted Insulating Glass, Heat Strengthened

Outboard lite: Tinted, heat strengthened glass, 1/4 inch thick
Low-E coating on #2 surface
Inboard lite: Clear glass, 1/8 inch thick
Laminate layer, 0.060 inch thick
Clear glass, 1/8 inch thick

3.5.8 GT-8 1-1/8 Inch Tinted Insulating Glass, Tempered

Outboard lite: Tinted, tempered glass, 1/4 inch thick
Low-E coating on #2 surface
Inboard lite: Clear glass, 3/16 inch thick
Laminate layer, 0.060 inch thick
Clear glass, 3/16 inch thick

3.5.9 GT-9 1-1/8 Inch Tinted Insulating Spandrel, Heat Strengthened

Outboard lite: Tinted, heat strengthened glass, 1/4 inch thick
Low-E coating on #2 surface
Inboard lite: Clear glass, 3/16 inch thick
Laminate layer, 0.060 inch thick
Clear glass, 3/16 inch thick
Ceramic Material on #6 surface

3.5.10 GT-10 1-1/8 Inch Tinted Insulating Glass, Heat Strengthened

Outboard lite: Tinted, heat strengthened glass, 1/4 inch thick
Low-E coating on #2 surface
Inboard lite: Clear glass, 3/16 inch thick
Laminate layer, 0.060 inch thick
Clear glass, 3/16 inch thick

3.5.11 GT-11 1/4 Inch Clear Laminated

Single Pane: Clear glass, 1/8 inch thick
Laminate layer, 0.060 inch thick
Clear glass, 1/8 inch thick

3.5.12 GT-12 1/4 Inch Tinted Laminated

Single Pane: Tinted glass, 1/8 inch thick
Laminate layer, 0.060 inch thick
Tinted glass, 1/8 inch thick

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GLAZED CURTAIN WALL

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SECTION 08900

GLAZED CURTAIN WALL
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PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ALUMINUM ASSOCIATION (AA)

AA ASD1	(1997) Aluminum Standards and Data
AA DAF-45	(1997) Designation System for Aluminum Finishes

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA MCWM-1	(1996) Metal Curtain Wall Manual
AAMA CW-10	(1997) Care and Handling of Architectural Aluminum from Shop to Site
AAMA 501	(1994) Exterior Walls
AAMA 609/610	(1993) Cleaning and Maintenance of Architectural Anodized Aluminum
AAMA 800	(1992; Addenda 1994) Sealants

ASTM INTERNATIONAL (ASTM)

ASTM A 36/A 36M	(2001) Carbon Structural Steel
ASTM A 123/A 123M	(2002) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(2001a) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 570/A 570M	(1998) Steel, Sheet and Strip, Carbon, Hot-Rolled
ASTM A 572/A 572M	(2001) High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A 611	(1997) Commercial Steel (CS) Sheet, Carbon, Cold-Rolled

ASTM A 653/A 653M	(2002a) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B 26/B 26M	(2002) Aluminum-Alloy Sand Castings
ASTM B 85	(1996) Aluminum-Alloy Die Castings
ASTM B 108	(2001a) Aluminum-Alloy Permanent Mold Castings
ASTM B 136	(1984; R 1993) Measurement of Stain Resistance of Anodic Coatings on Aluminum
ASTM B 137	(1995) Measurement of Coating Mass Per Unit Area on Anodically Coated Aluminum
ASTM B 209	(2002a) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 221	(2002) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B 244	(1997) Measurement of Thickness of Anodic Coatings on Aluminum and of Other Nonconductive Coatings on Nonmagnetic Basis Metals With Eddy-Current Instruments
ASTM C 1184	(2000ae1) Structural Silicone Sealants
ASTM C 1401	(2002) Structural Sealant Glazing
ASTM C 920	(2002) Elastomeric Joint Sealants
ASTM C 1048	(1997b) Heat-Treated Flat Glass - Kind HS, Kind FT Coated and Uncoated Glass
ASTM E 34	(1994; R 1998) Chemical Analysis of Aluminum and Aluminum-Base Alloys
ASTM E 283	(1991; R 1999) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM E 330	(2002) Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference
ASTM E 331	(2000) Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference

ASTM E 546	(1988; R 1995) Frost Point of Sealed Insulating Glass Units
ASTM E 576	(1988; R 1995) Frost Point of Sealed Insulating Glass Units in the Vertical Position

AMERICAN WELDING SOCIETY (AWS)

AWS A5.10/A5.10M	(1999) Bare Aluminum and Aluminum Alloy Welding Electrodes and Rods
AWS D1.1/D1.1M	(2002) Structural Welding Code - Steel

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 4-010-01	(8 October 2003) Unified Faciliites Criteria DoD Mnimum Antiterrorism Standards for Buildings.

1.2 PERFORMANCE REQUIREMENTS

1.2.1 General Performance

Shapes and thicknesses of all framing members, fasteners and hardware shall comply with UFC 4-010-01.

1.2.2 Frame Member Design

Steel members shall be designed using ultimate yield stresses and aluminum members shall be designed on a 0.2% offset yield strength. Equivalent static design loads for the window and door members shall be 1 lb per square inch applied to the surface of the glazing and frame. Deformations shall not exceed 1/60th of the unsupported member lengths.

1.2.3 Glazing Frame Bite

The glazing shall have a minimum frame bite 3/8 inch for structurally glazed systems.

1.2.4 Connection Design

Equivalent static design loads for connections of the window or doorframe to the surrounding walls associated connections and glazing stop connections shall be 10.8 lbs per square inch for glazing panels with a vision area less than or equal to 10.8 square feet and 4.4 lbs per square inch or glazing panels with a vision area greater than 10.8 square feet but less than or equal to 32 square feet. Loads shall be applied to the surface of the glazing and frame. Connections and hardware may be designed on ultimate strength for steel and 0.2% offset yield strength for aluminum.

1.3 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-02 Shop Drawings

Glazed curtain wall system; G-AE

Submit for curtain wall system and accessories. Drawings shall indicate in detail all system parts including elevations, full-size sections, framing, jointing, types and thickness of metal, flashing details, field connections, weep and drainage system, finishes, sealing methods, glazing, glass sizes and details, and erection details.

SD-03 Product Data

Glazed curtain wall system; G-AE

Include descriptive literature, detailed specifications, and available performance test data.

SD-05 Design Data

Calculations

SD-07 Certificates

Glazed Curtain Wall System; G-AE

Certificates stating that the glazed curtain wall system design complies with the requirements of UFC 4-010-01. Certification includes design calculations of the glazed curtain wall system and accessories; connection design; and glazing design to comply with specified loads.

SD-08 Manufacturer's Instructions

Glazed curtain wall system

Insulating glass

1.4 REQUIREMENT FOR DESIGN DATA

Submit structural and thermal calculations for complete wall assembly.

1.5 QUALITY ASSURANCE

1.5.1 Testing Requirements

The components listed below shall have been tested in accordance with the requirements below, and shall meet performance requirements specified.

a. Joint and Glazing Sealants: Perform tests as required by applicable publications referenced.

b. Spandrel Glass: Fallout resistance test, ASTM C 1048.
c. Anodized Finishes: Stain resistance, coating weight, and coating thickness tests, ASTM B 136, ASTM B 137, and ASTM B 244, respectively.

d. Insulating Glass: ASTM E 546 or ASTM E 576 at minus 20 degrees F no frost or dew point.

1.5.2 Factory Tests

Perform the following tests except that where a curtain wall system or component of similar type, size, and design as specified for this project has been previously tested, under the conditions specified herein, the resulting test reports may be submitted in lieu of testing the components.

1.5.2.1 Deflection and Structural Tests

No curtain wall framing member shall deflect, in a direction normal to the plane of the wall, more than 1/175 of its clear span or 3/4 inch, whichever is less, when tested in accordance with ASTM E 330, except that when a plastered surface will be affected the deflection shall not exceed 1/360 of the span. No framing member shall have a permanent deformation in excess of 0.2 percent of its clear span when tested in accordance with ASTM E 330 for a minimum test period of 10 seconds at 1.5 times the design wind pressures specified.

1.5.2.2 Water Penetration Test

No water penetration shall occur when the wall is tested in accordance with ASTM E 331 at a differential static test pressure of 20 percent of the inward acting design wind pressure as specified, but not less than 4 psf. Make provision in the wall construction for adequate drainage to the outside of water leakage or condensation that occurs within the outer face of the wall. Leave drainage and weep openings in members and wall open during test.

1.5.2.3 Air Infiltration Test

Air infiltration through the wall, when tested in accordance with ASTM E 283, shall not exceed 0.06 cfm per square foot of fixed wall area.

1.6 GLAZED CURTAIN WALL SYSTEM REQUIREMENTS

Provide curtainwall system and windows fabricated from curtainwall components complete with framing, mullions, trim, glass, glazing, sealants, fasteners, anchors, accessories, concealed auxiliary members, and attachment devices for securing the wall to the structure as specified or indicated.

1.6.1 Source

Curtain wall system components shall be furnished by one manufacturer or fabricator; however, all components need not be products of the same manufacturer.

1.6.2 Design

Thermally improved, unit and mullion system. Fully coordinate system accessories directly incorporated, and adjacent to contiguous related work and insure materials compatibility, deflection limitations, thermal movements, and clearances and tolerances as indicated or specified.

1.6.3 Thermal Movement

Fabricate, assemble, and erect system with adequate allowances for expansion and contraction of components and fastenings to prevent buckling damage, joint seal failure, glass breakage, undue stress on fastenings or other detrimental effects. For design purposes, base provisions for thermal movement on assumed ambient temperature range of from -40 degrees F to 110 degrees F.

1.6.4 Tolerances

Design and erect wall system to accommodate tolerances in building frame and other contiguous work as indicated or specified. Provide with the following tolerances:

a. Maximum variation from plane or location shown on approved shop drawings: 1/8 inch per 12 feet of length up to not more than 1/2 inch in any total length.

b. Maximum offset from true alignment between two identical members abutting end to end in line: 1/16 inch.

1.6.5 Structural Requirements

No member shall deflect in a direction parallel to the plane of the wall, when carrying its full design load, more than an amount which will reduce the edge cover or glass bite below 75 percent of the design dimension. No member after deflection under full design load, shall have a clearance between itself and the top of the panel, glass, sash, or other part immediately below it less than 1/8 inch; the clearance between the member and an operable window or door shall be minimum 1/16 inch. Design entire system to withstand the indicated wind and concentrated loads, and the following wind loads acting normal to the plane of the wall: 25 psf acting inward, and the same load acting outward.

1.7 QUALIFICATION OF WELDERS

Welding shall be performed by certified welders qualified in accordance with AWS D1.1/D1.1M using procedures, materials, and equipment of the type required for the work.

1.8 DELIVERY AND STORAGE

Inspect materials delivered to the site for damage; unload and store with a minimum of handling in accordance with recommendations contained in AAMA CW-10. Storage spaces shall be dry locations with adequate ventilation, free from heavy dust, not subject to combustion products or sources of water, and shall permit easy access for inspection and handling. Deliver calking and sealing compounds to the job site in sealed containers labeled to show the designated name, formula or specifications number; lot number; color; date of manufacturer; shelf life; and curing time when applicable.

1.8.1 Protective Covering

Prior to shipment from the factory, place knocked-down lineal members in cardboard containers and cover finished surfaces of aluminum with protective covering of adhesive paper, waterproof tape, or strippable plastic. Covering shall not chip, peel, or flake due to temperature or

weather, shall protect against discoloration and surface damage from transportation, and storage, and shall be resistant to alkaline mortar and plaster. Do not cover aluminum surfaces that will be in contact with sealants after installation.

1.8.2 Identification

Prior to delivery, mark wall components to correspond with shop and erection drawings placement location and erection.

1.9 WARRANTY

Insulating glass units shall be guaranteed not to develop material obstruction of vision as a result of dust or film formation on the inner glass surface caused by failure of the seal, other than through glass breakage, within a period of 5 years from date of acceptance of work by the Government. Units failing to comply with the terms of this guarantee shall be replaced with new units without additional cost to the Government. The Contractor shall require the manufacturer to execute their warranties in writing directly to the Government.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Aluminum

Shall be free from defects impairing strength or durability of surface finish. Standard alloys shall conform to standards and designations of AA ASD1. Special alloys, not covered by the following ASTM specifications, shall conform to standards and designations recommended by the manufacturer for the purpose intended.

2.1.1.1 Wrought Aluminum Alloys

Shall be those which include aluminum alloying elements not exceeding the following maximum limits when tested and additional in accordance with ASTM E 34. These limits apply to both bare products and the core of clad products. The cladding of clad products shall be within the same limits except that the maximum zinc limit may be 2.5 percent in order to assure that the cladding is anodic to the core. Special wrought alloys with a silicon content not more than 7.0 percent will be acceptable for limited structural uses where special appearance is required:

ALLOY	PERCENT
Silicon	1.5
Magnesium, Manganese, and Chromium combined	6.0
Iron	1.0
Copper	0.4
Zinc	1.0

Within the chemical composition limits set forth above, wrought aluminum alloys shall conform to the following:

a. Extruded bars, rods, shapes and tubes: ASTM B 221.

b. Sheet and Plate: ASTM B 209.

2.1.1.2 Cast Aluminum Alloys

Provide those in which the alloying elements are silicon, magnesium, manganese, or a combination of these. Other elements shall not exceed the following limits:

ELEMENT	PERCENT
Iron	1.2
Copper	0.4
Nickel	0.4
Titanium	0.2
Others (total)	0.5

Within the chemical composition limits set forth above, cast aluminum alloys shall conform to the following:

a. Sand castings: ASTM B 26/B 26M.

b. Die casting: ASTM B 85.

c. Permanent mold castings: ASTM B 108.

2.1.1.3 Welding Rods and Electrodes

Welding rods and bare electrodes shall conform to AWS A5.10/A5.10M as recommended by the manufacturer of the aluminum base metal alloy being used.

2.1.1.4 Finish

Anodized finish on aluminum surfaces shall match in appearance or fall within the two extremes of color range of the approved samples. Clean exposed aluminum surfaces and provide an anodized finish conforming to AA DAF-45. Finish shall be champagne, designation AA-M10-C22-A44, Architectural Class I 0.7 mil or thicker.

2.1.1.5 Strength

Aluminum extrusions for framing members used in curtain walls shall have a minimum ultimate tensile strength of 22,000 psi and a minimum yield strength of 16,000 psi.

2.1.2 Carbon Steel

Conform to the following specifications:

a. Rolled shapes, plates, and bars: ASTM A 36/A 36M.

b. Galvanized sheets: ASTM A 653/A 653M.

c. Other sheets: ASTM A 570/A 570M or ASTM A 611.

2.1.3 High-Strength, Low-Alloy Steel

Conform to ASTM A 572/A 572M for structural shapes, plates, and bars.

2.1.4 Metal Fasteners

Provide fasteners as specified in paragraph entitled "Fastener Metals for Joining Various Metal Combinations" in "Part 2 - Products" of the AAMA MCWM-1. Metals used for fasteners shall be chemically and galvanically compatible with contiguous materials.

2.1.5 Joint Sealants and Accessories

Provide manufacturer's standard colors as closely matching the adjacent surfaces as possible.

2.1.5.1 Elastomeric, Single or Multiple Component for Framing System

ASTM C 920, Type S, single component or Type M, multiple component. Use Grade NS, nonsag type in joints on vertical surfaces and use Grade P, self-leveling or flow type, in joints on horizontal surfaces.

2.1.5.2 Single Component Silicone Rubber Base for Framing System

ASTM C 920, Type S, Grade NS (Silicone).

2.1.5.3 Solvents and Primers

Provide material which is quick drying, colorless, nonstaining, compatible with compound used, as recommended by sealant manufacturer. Where primer is specified or recommended by sealant manufacturer, tests related to that material shall include primer.

2.1.5.4 Backing Material

Provide material which is nonstaining, nonabsorbent, and compatible with sealing compound. Polyethylene foam with a continuous outer skin conforming to ASTM C 1330, Type B.

2.1.5.5 Bond Preventive Materials

Provide polyethylene tape with pressure-sensitive adhesive; aluminum foil or waxed paper.

2.1.5.6 Preformed Sealing Compound

Provide nonskinning type conforming to AAMA 800. Tapes, beads, ribbons or other shapes as required.

2.1.6 Glass and Glazing

Insulating glass unit materials are specified under Section 08800, GLAZING. Provide frame bite as specified.

2.1.6.1 Glass Sizes and Clearances

Sizes indicated are nominal. Verify actual sizes required by measuring frames. Coordinate dimensions for glass and glass holding members to meet applicable minimum clearances as recommended by glass manufacturer. Do not nip to remove flares or to reduce oversized dimensions.

2.1.6.2 Glass Setting Materials

a. Sealants shall be as specified in Section 08800 GLAZING.

b. Setting blocks, edge blocks, and spacer shims: Fabricate from neoprene or other materials recommended by glass manufacturer compatible with compounds, sealants, or gaskets used. Unless otherwise recommended by the glass manufacturer, shore "A" Durometer hardness for setting and edge blocks shall be 90 plus or minus 5; for spacer shims, 50 plus or minus 5.

2.1.7 Metal Accessories

Flashings, Closures, and accessories. Fabricate accessories of sizes and shapes indicated from similar materials and finish as specified for wall system.

PART 3 EXECUTION

3.1 FABRICATION

The curtain wall components shall be of the materials and thickness indicated or specified. The details indicated are representative of the required design and profiles. Acceptable designs may differ from that shown if the proposed system components conform to the limiting dimensions indicated and the requirements specified herein. Unless specifically indicated or specified otherwise, the methods of fabrication and assembly shall be at the discretion of the curtain wall manufacturer. Perform fitting and assembling of components in the shop to the maximum extent practicable. Anchorage devices shall permit adjustment in three directions. Exposed fastenings used on finished surfaces shall be truss head, flat head, or oval head screws or bolts.

3.1.1 Joints

Provide welded or mechanical fasteners as indicated or specified. Match joints in exposed work to produce continuity of line and design. Bed-joints or rabbets receiving calking or sealing material shall be minimum 3/4 inch deep and 3/8 inch wide at mid ambient temperature range.

3.1.2 Welding

Conform to AWS D1.1/D1.1M. Use methods and electrodes recommended by manufacturers of base metal alloys. Welding rods shall be of an alloy that matches the color of the metal being welded. Protect glass and other finish from exposure to welding spatter. Ground and finish weld beads on exposed metal surfaces to minimize mismatch and to blend with finish on adjacent parent metal. If flux is used in welding aluminum, completely remove it immediately upon completion of welding operations. Do not use exposed welds on aluminum surfaces.

3.1.3 Soldering and Brazing

Provide as recommended by suppliers. Solder only for filling or sealing joints.

3.1.4 Ventilation and Drainage

Provide internal ventilation drainage system of weeps or based on principles of pressure equalization to ventilate the wall internally and to discharge condensation and water leakage to exterior as inconspicuously as possible. Flashings and other materials used internally shall be nonstaining, noncorrosive, and nonbleeding.

3.1.5 Protection and Treatment of Metals

3.1.5.1 General

Remove from metal surfaces lubricants used in fabrication and clean off other extraneous material before leaving the shop.

3.1.5.2 Galvanic Action

Provide protection against galvanic action wherever dissimilar metals are in contact, except in the case of aluminum in permanent contact with galvanized steel, zinc, stainless steel, or relatively small areas of white bronze. Paint contact surfaces with one coat bituminous paint or apply appropriate calking material or nonabsorptive, noncorrosive, and nonstaining tape or gasket between contact surfaces.

3.1.5.3 Protection for Aluminum

Protect aluminum which is placed in contact with, built into, or which will receive drainage from masonry, lime mortar, concrete, or plaster with one coat of alkali-resistant bituminous paint. Where aluminum is contacted by absorptive materials subject to repeated wetting or treated with preservative noncompatible with aluminum, apply two coats of aluminum paint, to such materials and seal joints with approved calking compound.

3.2 INSTALLATION

Installation and erection of glazed wall system and all components shall be performed under direct supervision of and in accordance with approved recommendations and instructions of wall system manufacturer or fabricator.

3.2.1 Bench Marks and Reference Points

Establish and permanently mark bench marks for elevations and building line offsets for alignment at convenient points on each floor level. Should any error or discrepancy be discovered in location of the marks, stop erection work in that area until discrepancies have been corrected.

3.2.2 Verifying Conditions and Adjacent Surfaces

After establishment of lines and grades and prior to system installation examine supporting structural elements. Verify governing dimensions, including floor elevations, floor to floor heights, minimum clearances between curtain wall and structural frames, and other permissible dimensional tolerances in the building frame.

3.2.3 Joint Sealants

3.2.3.1 Surface Preparation

Surfaces to be primed and sealed shall be clean, dry to the touch, free from frost, moisture, grease, oil, wax, lacquer, paint, or other foreign matter. Enclose joints on three sides. Clean out grooves to proper depth. Joint dimensions shall conform to approved detail drawings with a tolerance of plus 1/8 inch. Do not apply compound unless ambient temperature is between 40 and 90 degrees F. Clean out loose particles and mortar just before sealing. Remove protective coatings or coverings from surfaces in contact with sealants before applying sealants or tapes. Solvents used to remove coatings shall be of type that leave no residue on metals.

3.2.3.2 Applications

Match approved sample. Force compound into grooves with sufficient pressure to fill grooves solidly. Sealing compound shall be uniformly smooth and free of wrinkles and, unless indicated otherwise, shall be tooled and left sufficiently convex to result in a flush joint when dry. Do not trim edges of sealing material after joints are tooled. Mix only amount of multi-component sealant which can be installed within four hours, but at no time shall this amount exceed 5 gallons.

3.2.3.3 Primer

Apply to masonry, concrete, wood, and other surfaces as recommended by sealant manufacturer. Do not apply primer to surfaces which will be exposed after calking is completed.

3.2.3.4 Backing

Tightly pack in bottom of joints which are over 1/2 inch in depth with specified backing material to depth indicated or specified. Roll backing material of hose or rod stock into joints to prevent lengthwise stretching.

3.2.3.5 Bond Prevention

Install bond preventive material at back or bottom of joint cavities in which no backstop material is required, covering full width and length of joint cavities.

3.2.3.6 Protection and Cleaning

Remove compound smears from surfaces of materials adjacent to sealed joints as the work progresses. Use masking tape on each side of joint where texture of adjacent material will be difficult to clean. Remove masking tape immediately after filling joint. Scrape off fresh compound from adjacent surfaces immediately and rub clean with approved solvent. Upon completion of calking and sealing, remove remaining smears, stains, and other soiling, and leave the work in clean neat condition.

3.2.4 Glass

Install exterior and vestibule glazing in accordance with UFC 4-010-01. Install interior glazing in accordance with manufacturer's recommendations as modified herein.

3.2.4.1 Inspection Frames

Before installing glass, inspect frames to receive glass for defects such as dimensional variations, glass clearances, open joints, or other conditions that will prevent satisfactory glass installation. Do not proceed with installation until defects have been corrected.

3.2.4.2 Preparation of Glass and Rabbets

Clean sealing surfaces at perimeter of glass and sealing surfaces of rabbets and stop beads before applying sealantor gaskets. Use only approved solvents and cleaning agents recommended by sealant or gasket manufacturer.

3.2.4.3 Positioning Glass

Set glass from inside the building unless otherwise indicated or specified. Maintain specified edge clearances and glass bite at perimeter. Maintain position of glass in rabbet and provide required sealant thickness on both sides of glass. For glass dimensions larger than 50 united inches, provide setting blocks at sill and spacer shims on all four sides; locate setting blocks one quarter way in from each jamb edge of glass. Where setting blocks and spacer shims are set into sealant, butter with sealant, place in position, and allow to firmly set prior to installation of glass.

3.2.4.4 Setting Methods

At exterior and vestibule glazing, apply wet ASTM C 1184 compliant structural silicone sealant uniformly with accurately formed corners and bevels. AT interior glazing, apply gaskaets uniformly with accurately formed corners and bevels. Use only recommended thinners, cleaners, and solvents. Tool sealant at slight angle to shed water and provide clean sight lines. Secure stop beads in place with suitable fastenings. Do not apply sealant at temperatures lower than 40 degrees F, or on damp, dirty, or dusty surfaces. Apply in compliance with the requirements of ASTM C 1401.

3.2.4.5 Void Space

Insulating glass, and glass of other types that exceed 100 united inchesin size: Provide void space at head and jamb to allow glass to expand or move without exuding the sealant.

3.2.4.6 Insulating Glass

Provide adequate means to weep incidental water and condensation away from the sealed edges of insulated glass units and out of the wall system.

3.3 FINISHES

3.3.1 Galvanizing for Non-Visible Components

Conform to ASTM A 123/A 123M, ASTM A 153/A 153M, and ASTM A 653/A 653M, as applicable.

3.3.1.1 Repair of Zinc-Coated Surfaces

Repair zinc coated surfaces damaged by welding or other means with

galvanizing repair paint or by application of stick or thick paste material specifically designed for repair of galvanizing, as approved.

3.3.2 Cleaning

Clean steel and iron work by power wire brushing or other approved manual or mechanical means, for removal of rust, loose paint, scale, and deleterious substances. Wash cleaned surfaces which become contaminated with rust, dirt, oil, grease, or other foreign matter, with solvents until thoroughly clean. Cleaning steel embedded in concrete is not required.

3.4 FIELD TESTS

Conduct field check test for water leakage on designated wall areas after erection. Conduct test on wall area, two bays wide by full height where directed. Conduct test and take necessary remedial action as described in AAMA 501.

3.5 CLEANING AND PROTECTION

3.5.1 Glass

Upon completion of wall system installation, thoroughly wash glass surfaces on both sides and remove labels, paint spots, and other defacements. Replace cracked, broken, and defective glass with new glass at no additional cost to the Government.

3.5.2 Aluminum Surfaces

Protection methods, cleaning, and maintenance shall be in accordance with AAMA 609/610 and AAMA 609/610.

3.5.3 Other Metal Surfaces

After installation, protect windows and other exposed surfaces from disfiguration, contamination, contact with harmful materials, and from other construction hazards that will interfere with their operation, or damage their appearance or finish. Protection methods shall be in accordance with recommendations of product manufacturers or of the respective trade association. Remove paper or tape factory applied protection immediately after installation. Clean surfaces of mortar, plaster, paint, smears of sealants, and other foreign matter to present neat appearance and prevent fouling of operation. In addition, wash with a stiff fiber brush, soap and water, and thoroughly rinse. Where surfaces become stained or discolored, clean or restore finish in accordance with recommendations of product manufacturer or the respective trade association.

-- End of Section --

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DIVISION 09 - FINISHES

SECTION 09100N

METAL SUPPORT ASSEMBLIES

09/99

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SECTION 09100N

METAL SUPPORT ASSEMBLIES
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PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A 463/A 463M	(1997; Rev. A) Steel Sheet, Aluminum-Coated, by the Hot-Dip Process
ASTM A 653/A 653M	(2002a) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM C 645	(1998) Nonstructural Steel Framing Members
ASTM C 754	(1997) Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-02 Shop Drawings

Metal support systems; G-AO

Submit for the erection of metal framing and ceiling suspension systems. Indicate materials, sizes, thicknesses, and fastenings.

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the job site and store in ventilated dry locations. Storage area shall permit easy access for inspection and handling. If materials are stored outdoors, stack materials off the ground, supported on a level platform, and fully protected from the weather. Handle materials carefully to prevent damage. Remove damaged items and provide new items.

PART 2 PRODUCTS

2.1 MATERIALS

Provide steel materials for metal support systems with galvanized coating ASTM A 653/A 653M, G-60; aluminum coating ASTM A 463/A 463M, T1-25; or a 55-percent aluminum-zinc coating.

2.1.1 Materials for Attachment of Gypsum Wallboard

2.1.1.1 Suspended and Furred Ceiling Systems

ASTM C 645.

2.1.1.2 Nonload-Bearing Wall Framing and Furring

ASTM C 645, but not thinner than 0.0179 inch thickess, with 0.0329 inch minimum thickness supporting wall hung items such as cabinetwork, equipment and fixtures and at abuse-resistant type gypsum wallboard.

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3.1 INSTALLATION

3.1.1 Systems for Attachment of Gypsum Wallboard

3.1.1.1 Suspended and Furred Ceiling Systems

ASTM C 754, except that framing members shall be 16 inches o.c. unless indicated otherwise.

3.1.1.2 Nonload-Bearing Wall Framing and Furring

ASTM C 754, except as indicated otherwise.

3.2 ERECTION TOLERANCES

Framing members which will be covered by finish materials such as wallboard shall be within the following limits:

a. Layout of walls and partitions: 1/4 inch from intended position;

b. Plates and runners: 1/4 inch in 8 feet from a straight line;

c. Studs: 1/4 inch in 8 feet out of plumb, not cumulative; and

d. Face of framing members: 1/4 inch in 8 feet from a true plane.

Framing members which will be covered by ceramic tile set in dry-set mortar, latex-portland cement mortar, or organic adhesive shall be within the following limits:

a. Layout of walls and partitions: 1/4 inch from intended position;

b. Plates and runners: 1/8 inch in 8 feet from a straight line;

c. Studs: 1/8 inch in 8 feet out of plumb, not cumulative; and

d. Face of framing members: 1/8 inch in 8 feet from a true plane.

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SECTION 09250

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SECTION 09250

GYPSUM BOARD
11/01

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A108.11	(1992) Interior Installation of Cementitious Backer Units
ANSI A108.1	(1999) Installation of Ceramic Tile; including A108.1A-C, 108.4-.13, 118.1-.10, A136.1

ASTM INTERNATIONAL (ASTM)

ASTM C 36/C 36M	(1999) Gypsum Wallboard
ASTM C 79/C 79M	(2001) Standard Specification for Treated Core and Nontreated Core Gypsum Sheathing Board
ASTM C 475	(1994) Joint Compound and Joint Tape for Finishing Gypsum Board
ASTM C 630/C 630M	(2001) Water-Resistant Gypsum Backing Board
ASTM C 840	(2001) Application and Finishing of Gypsum Board
ASTM C 954	(2000) Steel Drill Screws for the Application of Gypsum Board or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness
ASTM C 1002	(2000) Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases
ASTM C 1047	(1999) Accessories for Gypsum Wallboard and Gypsum Veneer Base
ASTM C 1177/C 1177M	(2001) Glass Mat Gypsum Substrate for Use as Sheathing
ASTM C 1396/C 1396M	(2000) Standard Specification for Gypsum Board

ASTM D 226	(1997a) Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D 1037	(1999) Evaluating Properties of Wood-Base Fiber and Particle Panel Materials
ASTM D 2394	(1999) Standard Method for Simulated Service Testing of Wood and Wood-Base Finish Flooring
ASTM D 5420	(1998) Standard Test Method for Impact Resistance of Flat, Rigid Plastic Specimen by Means of a Striker Impacted by a Falling Weight (Gardner Impact)
ASTM E 84	(2001) Surface Burning Characteristics of Building Materials
ASTM E 695	(1997) Standard Method for Measure Relative Resistance of Wall, Floor and Roof Construction to Impact Loads

GYPSUM ASSOCIATION (GA)

GA 214	(1996) Recommended Levels of Gypsum Board Finish
GA 216	(2000) Application and Finishing of Gypsum Board
GA 253	(1999) Application of Gypsum Sheathing

UNDERWRITERS LABORATORIES (UL)

UL Fire Resist Dir	(2003) Fire Resistance Directory (Vol 1, 2A, 2B & 3)

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-03 Product Data

Cementitious backer units

Water-Resistant Gypsum Backing Board

Glass Mat Covered or Reinforced Gypsum Sheathing

Impact Resistant Gypsum Board

Accessories

Submit for each type of gypsum board and for cementitious backer units.

SD-07 Certificates

Asbestos Free Materials; G-AO

Certify that gypsum board types, gypsum backing board types, cementitious backer units, and joint treating materials do not contain asbestos.

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery

Deliver materials in the original packages, containers, or bundles with each bearing the brand name, applicable standard designation, and name of manufacturer, or supplier.

1.3.2 Storage

Keep materials dry by storing inside a sheltered building. Where necessary to store gypsum board and cementitious backer units outside, store off the ground, properly supported on a level platform, and protected from direct exposure to rain, snow, sunlight, and other extreme weather conditions. Provide adequate ventilation to prevent condensation.

1.3.3 Handling

Neatly stack gypsum board and cementitious backer units flat to prevent sagging or damage to the edges, ends, and surfaces.

1.4 ENVIRONMENTAL CONDITIONS

1.4.1 Temperature

Maintain a uniform temperature of not less than 50 degrees F in the structure for at least 48 hours prior to, during, and following the application of gypsum board, cementitious backer units, and joint treatment materials, or the bonding of adhesives.

1.4.2 Exposure to Weather

Protect gypsum board and cementitious backer unit products from direct exposure to rain, snow, sunlight, and other extreme weather conditions.

1.5 QUALIFICATIONS

Manufacturer shall specialize in manufacturing the types of material specified and shall have a minimum of 5 years of documented successful experience. Installer shall specialize in the type of gypsum board work required and shall have a minimum of 3 years of documented successful experience.

PART 2 PRODUCTS

2.1 MATERIALS

Conform to specifications, standards and requirements specified herein. Provide gypsum board types, gypsum backing board types, cementitious backing units, and joint treating materials manufactured from asbestos free materials only.

2.1.1 Gypsum Board

ASTM C 36/C 36M and ASTM C 1396/C 1396M.

2.1.1.1 Regular

48 inches wide, 5/8 inch thick, tapered edges.

2.1.1.2 Type X (Special Fire-Resistant)

48 inches wide, 5/8 inch thick, tapered edges.

2.1.2 Regular Water-Resistant Gypsum Backing Board

ASTM C 630/C 630M

2.1.2.1 Regular

48 inches wide, 5/8 inch thick, tapered edges.

2.1.2.2 Type X (Special Fire-Resistant)

48 inches wide, 5/8 inch thick, tapered edges.

2.1.3 Glass Mat Covered or Reinforced Gypsum Sheathing

Exceeds physical properties of ASTM C 79/C 79M and ASTM C 1177/C 1177M. Provide 5/8 inch, gypsum sheathing. Gypsum board shall consist of a noncombustible water-resistant core, with a glass mat surfaces embedded to the gypsum core or reinforcing embedded throughout the gypsum core. Gypsum sheathing board shall be warranted for at least 6 months against delamination due to direct weather exposure. Provide continuous, asphalt impregnated, building felt to cover exterior face of sheathing.

2.1.4 Impact Resistant Gypsum Board

48 inch wide, 5/8 inch thick, tapered edges.
Reinforced gypsum panel with imbedded fiber mesh or lexan backing testing in accordance with the following tests. Provide fasteners that meet manufacturer requirements and specifications stated within this section. Impact resistant gypsum board, when tested in accordance with ASTM E 84, shall have a flame spread rating of 25 or less and a smoke developed rating of 50 or less.

2.1.4.1 Structural Failure Test

ASTM E 695 or ASTM D 2394 for structural failure (drop penetration). ASTM E 695 using a 60 lb sand filled leather bag, resisting no less than 300 ft. lb. cumulative impact energy before failure or ASTM D 2394 using 5.5 inches hemispherical projectile resisting no less than 264 ft. lb. before failure.

Test specimen stud spacing shall be 16 inch or greater on center.

2.1.4.2 Indentation Test

ASTM D 5420 or ASTM D 1037 for indentation resistance. ASTM D 5420 using a 32 oz weight with a 5/8 inch hemispherical impacting head dropped once 3 feet creating not more than 0.137 inch indentation or ASTM D 1037 using no less than 470 lb weight applied to the 0.438 inch diameter ball to create not more than a 0.0197 inch indentation depth.

2.1.5 Cementitious Backer Units

ANSI A108.1.

2.1.6 Joint Treatment Materials

ASTM C 475.

2.1.6.1 Embedding Compound

Specifically formulated and manufactured for use in embedding tape at gypsum board joints and compatible with tape, substrate and fasteners.

2.1.6.2 Finishing or Topping Compound

Specifically formulated and manufactured for use as a finishing compound.

2.1.6.3 All-Purpose Compound

Specifically formulated and manufactured to serve as both a taping and a finishing compound and compatible with tape, substrate and fasteners.

2.1.6.4 Setting or Hardening Type Compound

Specifically formulated and manufactured for use with fiber glass mesh tape.

2.1.6.5 Joint Tape

Cross-laminated, tapered edge, reinforced paper, or fiber glass mesh tape recommended by the manufacturer.

2.1.7 Fasteners

2.1.7.1 Screws

ASTM C 1002, Type "G", Type "S" or Type "W" steel drill screws for fastening gypsum board to gypsum board, wood framing members and steel framing members less than 0.033 inch thick. ASTM C 954 steel drill screws for fastening gypsum board to steel framing members 0.033 to 0.112 inch thick. Provide cementitious backer unit screws with a polymer coating.

2.1.8 Adhesives

Do not use adhesive containing benzene, carbon tetrachloride, or trichloroethylene.

2.1.8.1 Adhesive for Fastening Gypsum Board to Metal Framing

Type recommended by gypsum board manufacturer.

2.1.9 Accessories

ASTM C 1047. Fabricate from corrosion protected steel or plastic designed for intended use. Accessories manufactured with paper flanges are not acceptable. Flanges shall be free of dirt, grease, and other materials that may adversely affect bond of joint treatment. Provide job decorated materials.

2.1.10 Asphalt Impregnated Building Felt

The moisture barrier over gypsum sheathing shall be 15-lb asphalt impregnated felt conforming to ASTM D 226 Type I (No. 15).

2.1.11 Water

Clean, fresh, and potable.

PART 3 EXECUTION

3.1 EXAMINATION

3.1.1 Framing and Furring

Verify that framing and furring are securely attached and of sizes and spacing to provide a suitable substrate to receive gypsum board and cementitious backer units. Verify that all blocking, headers and supports are in place to support plumbing fixtures and to receive, grab bars, towel racks, and similar items. Do not proceed with work until framing and furring are acceptable for application of gypsum board and cementitious backer units.

3.1.2 Gypsum Board and Framing

Verify that surfaces of gypsum board and framing to be bonded with an adhesive are free of dust, dirt, grease, and any other foreign matter. Do not proceed with work until surfaces are acceptable for application of gypsum board with adhesive.

3.2 APPLICATION OF GYPSUM BOARD

Apply gypsum board to framing and furring members in accordance with ASTM C 840 or GA 216 and the requirements specified herein. Apply gypsum board with separate panels in moderate contact; do not force in place. Stagger end joints of adjoining panels. Neatly fit abutting end and edge joints. Use gypsum board of maximum practical length. Cut out gypsum board as required to make neat close joints around openings. In vertical application of gypsum board, provide panels in lengths required to reach full height of vertical surfaces in one continuous piece. Surfaces of gypsum board and substrate members may be bonded together with an adhesive, except where prohibited by fire rating(s). Treat edges of cutouts for plumbing pipes, screwheads, and joints with water-resistant compound as recommended by the gypsum board manufacturer. Provide type of gypsum board for use in each system specified herein as indicated.

3.2.1 Application of Gypsum Board to Steel Framing and Furring

Apply in accordance with ASTM C 840, System VIII or GA 216.

3.2.2 Arches and Bending Radii

Apply gypsum board in accordance with ASTM C 840, System IX or GA 216.

3.2.3 Gypsum Board for Wall Tile or Tile Base Applied with Adhesive

In dry areas (areas other than shower enclosures, steam rooms, gang shower rooms), apply water-resistant gypsum backing board in accordance with ASTM C 840, System X or GA 216.

3.2.4 Glass Mat Covered or Fiber Reinforced Gypsum Sheathing

Apply gypsum sheathing in accordance to gypsum association publication GA 253. Design details for joints and fasteners shall follow gypsum sheathing manufacturer's requirements and be properly installed to protect the substrate from moisture intrusion. Exposed surfaces of the gypsum sheathing shall not be left exposed beyond the manufacture's recommendation without a weather barrier cladding. Provide continuous asphalt impregnated building felt over sheathing surface in shingle fashion with edges and ends lapped a minimum of 6 inch. Openings shall be properly flashed.

3.2.5 Control Joints

Install expansion and contraction joints in ceilings and walls in accordance with ASTM C 840, System XIII or GA 216, unless indicated otherwise. Control joints between studs in fire-rated construction shall be filled with firesafing insulation to match the fire-rating of construction.

3.2.6 Application of Impact Resistant Gypsum Board

Apply in accordance with applicable system of ASTM C 840 as specified or GA 216. Follow manufacturers written instructions on how to cut, drill and attach board.

3.3 APPLICATION OF CEMENTITIOUS BACKER UNITS

3.3.1 Application

In wet areas (shower enclosures, steam rooms, gang shower rooms), apply cementitious backer units in accordance with ANSI A108.11. A 15 lb asphalt impregnated, continuous felt paper membrane shall be placed behind cementitious backer units, between backer units and studs or base layer of gypsum board. Membrane shall be placed with a minimum 6 inch overlap of sheets laid shingle style.

3.3.2 Joint Treatment

ANSI A108.11.

3.4 FINISHING OF GYPSUM BOARD

Tape and finish gypsum board in accordance with ASTM C 840, GA 214 and GA 216. Plenum areas above ceilings shall be finished to Level 1 in accordance with GA 214. Water resistant gypsum backing board, ASTM C 630/C 630M, to receive ceramic tile shall be finished to Level 2 in accordance with GA 214. Walls and ceilings except where noted or specified otherwise shall be finished to Level 4 in accordance with GA 214. Gypsum board walls and partitions in rooms 173, 174, 175 and 176 shall be finished to Level 5

in accordance with GA 214. Provide joint, fastener depression, and corner treatment. Do not use fiber glass mesh tape with conventional drying type joint compounds; use setting or hardening type compounds only. Provide treatment for water-resistant gypsum board as recommended by the gypsum board manufacturer.

3.4.1 Uniform Surface

Wherever indicated or specified finish gypsum wall surface in accordance to GA 214 Level 5. In accordance with GA 214 Level 5, apply a thin skim coat of joint compound to the entire gypsum board surface, after the two-coat joint and fastener treatment is complete and dry.

3.5 SEALING

Seal openings around pipes, fixtures, and other items projecting through gypsum board and cementitious backer units as specified in Section 07920 JOINT SEALANTS. Apply material with exposed surface flush with gypsum board or cementitious backer units.

3.6 FIRE-RESISTANT ASSEMBLIES

Wherever fire-rated construction is indicated, provide materials and application methods, including types and spacing of fasteners, and wall framing in accordance with the specifications contained in UL Fire Resist Dir for the Design Number(s) indicated. Joints of fire-rated gypsum board enclosures shall be closed and sealed in accordance with UL test requirements. Penetrations through rated partitions and ceilings shall be sealed tight in accordance with tested systems. Fire ratings shall be as indicated.

3.7 PATCHING

Patch surface defects in gypsum board to a smooth, uniform appearance, ready to receive finish as specified.

-- End of Section --

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SECTION 09310

CERAMIC TILE, QUARRY TILE, AND PAVER TILE

8/02

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SECTION 09310

CERAMIC TILE, QUARRY TILE, AND PAVER TILE
8/02

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A108.1	(1999) Installation of Ceramic Tile; including A108.1A-C, 108.4-.13, 118.1-.10, A136.1
ANSI A137.1	(1988) Ceramic Tile

ASTM INTERNATIONAL (ASTM)

ASTM A 185	(1997) Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM C 33	(2002a) Concrete Aggregates
ASTM C 144	(2002) Aggregate for Masonry Mortar
ASTM C 150	(2002a) Portland Cement
ASTM C 206	(1984; R 1997) Finishing Hydrated Lime
ASTM C 207	(1991; R 1997) Hydrated Lime for Masonry Purposes
ASTM C 373	(1988; R 1994) Water Absorption, Bulk Density, Apparent Porosity, and Apparent Specific Gravity of Fired Whiteware Products
ASTM C 482	(1981; R 1996) Bond Strength of Ceramic Tile to Portland Cement
ASTM C 501	(1984; R 2002) Relative Resistance to Wear of Unglazed Ceramic Tile by the Taber Abraser
ASTM C 648	(1998) Breaking Strength of Ceramic Tile
ASTM C 1027	(1999) Determining Visible Abrasion Resistance of Glazed Ceramic Tile
ASTM C 1028	(1996) Determining the Static Coefficient of Friction of Ceramic Tile and Other Like

Surfaces by the Horizontal Dynamometer Pull-Meter Method

TILE COUNCIL OF AMERICA (TCA)

TCA Hdbk (1997) Handbook for Ceramic Tile Installation

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

36 CFR 1191 Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Tile; G-AE
Setting-Bed; G-AE
Mortar, Grout, and Adhesive; G-AE
Cove Base Movement Profile; G-AE
Floor Edge Protection and Transition; G-AE

Manufacturer's catalog data and preprinted installation and cleaning instructions.

SD-04 Samples

Tile; G-AE

Cove Base Movement Profile; G-AE
Floor Edge Protection and Transition; G-AE
Solid Polymer (Solid Surfacing) Thresholds; G-AE

Samples of sufficient size to show color range, pattern, type and joints.

SD-07 Certificates

Tile
Mortar, Grout, and Adhesive

Certificates indicating conformance with specified requirements. A master grade certificate shall be furnished for tile.

1.3 DELIVERY AND STORAGE

Materials shall be delivered to the project site in manufacturer's original unopened containers with seals unbroken and labels and hallmarks intact. Materials shall be kept dry, protected from weather, and stored under cover

in accordance with manufacturer's instructions.

1.4 ENVIRONMENTAL REQUIREMENTS

Ceramic tile work shall not be performed unless the substrate and ambient temperature is at least 50 degrees F and rising. Temperature shall be maintained above 50 degrees F while the work is being performed and for at least 7 days after completion of the work. When temporary heaters are used they shall be vented to the outside to avoid carbon dioxide damage to new tilework.

1.5 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1-year period shall be provided.

1.6 EXTRA STOCK

Supply an extra two percent of each type tile used in clean and marked cartons.

PART 2 PRODUCTS

2.1 TILE

Tile shall be standard grade conforming to ANSI A137.1. Containers shall be grade sealed. Seals shall be marked to correspond with the marks on the signed master grade certificate. Tile shall be impact resistant with a minimum breaking strength for wall tile of 90 lbs and 250 lbs for floor tile in accordance with ASTM C 648. . Water absorption shall be 0.50 maximum percent in accordance with ASTM C 373. Floor tile shall have a minimum coefficient of friction of 0.60 wet and dry in accordance with ASTM C 1028. Floor tile shall be Class III-Medium Heavy Traffic, durability classification as rated by the manufacturer when tested in accordance with ASTM C 1027for abrasion resistance as related to foot traffic. Color and size shall be in accordance with Section 09915 COLOR SCHEDULE.

2.1.1 Ceramic Tile

Ceramic tile and trim shall be unglazed natural clay with cushion edges with sharply formed face. Tile size shall be 8 x 8. Color shall be in accordance with Section 09915 COLOR SCHEDULE.

2.1.2 Porcelain Tile

Porcelain tile and trim shall be unglazed with the color extending uniformly through the body of the tile. Tile shall meet or exceed the following criteria: Abrasive wear in accordance with ASTM C 501 and bonding strength in accordance with ASTM C 482. Tile shall comply with 36 CFR 1191 for coefficient of friction for interior floors. Color and size shall be in accordance with Section 09915 COLOR SCHEDULE.

2.1.3 Glazed Wall Tile

Glazed wall tile and trim shall be cushion edged with bright glaze. Tile shall be 4-1/4 x 4-1/4 inches. Color shall be in accordance with Section 09915 COLOR SCHEDULE.

2.1.4 Accessories

2.1.4.1 Cove Base Movement Profile

Floor-to-wall transition shall be rigid PVC, cove shaped profile with integral tile pocket, lateral trapezoidal-perforated anchoring legs, 11/16 inch radius soft chlorinated polyethylene center movement zone, complete with 2-way inside corners, connectors and end caps. Dimensions shall be as required to suit application. Color as specified in Section 09915 COLOR SCHEDULE.

2.1.4.2 Floor Edge Protection and Transition

Tile to carpet transition shall be roll-formed, Type 304 stainless steel profile with a sloped 25 degree transition surface. Dimensions shall Be as required to suit applications. Finish shall be as specified in Section 09915 COLOR SCHEDULE.

2.2 SETTING-BED

The setting-bed shall be composed of the following:

2.2.1 Aggregate for Concrete Fill

Aggregate shall conform to ASTM C 33. Maximum size of coarse aggregate shall not be greater than one-half the thickness of concrete fill.

2.2.2 Portland Cement

Cement shall conform to ASTM C 150, Type I, white for wall mortar and gray for other uses.

2.2.3 Sand

Sand shall conform to ASTM C 144.

2.2.4 Hydrated Lime

Hydrated lime shall conform to ASTM C 206, Type S or ASTM C 207, Type S.

2.2.5 Reinforcing Wire Fabric

Wire fabric shall conform to ASTM A 185. Wire shall be either 2 x 2 inch mesh, 16/16 wire or 1-1/2 x 2 inch mesh, 16/13 wire.

2.3 WATER

Water shall be potable.

2.4 MORTAR, GROUT, AND ADHESIVE

Mortar, grout, and adhesive shall conform to the following:

2.4.1 Latex-Portland Cement Mortar

ANSI A108.1.

2.4.2 Ceramic Tile Grout

ANSI A108.1; latex-portland cement grout.

2.4.3 Organic Adhesive

ANSI A108.1, Type I.

2.5 SOLID POLYMER (SOLID SURFACING) THRESHOLDS

Solid polmer threshold shall be 4 inches wide by 3/8 inch thick by width of opening, beveled 2 inches minimum.

PART 3 EXECUTION

3.1 PREPARATORY WORK AND WORKMANSHIP

Surface to receive tile shall be inspected and shall conform to the requirements of ANSI A108.1 for surface conditions for the type setting bed specified and for workmanship. Variations of surface to be tiled shall fall within maximum values shown below:

TYPE	WALLS	FLOORS
Organic Adhesives	1/8 inch in 8 ft.	
Latex portland cement mortar	1/8 inch in 8 ft.	1/8 inch in 10 ft.

3.2 GENERAL INSTALLATION REQUIREMENTS

Tile work shall not be started until roughing in for mechanical and electrical work has been completed and tested, and built-in items requiring membrane waterproofing have been installed and tested. Floor tile installation shall not be started in spaces requiring wall tile until after wall tile has been installed. Tile in colors and patterns indicated shall be applied in the area shown on the drawings. Tile shall be installed with the respective surfaces in true even planes to the elevations and grades shown. Special shapes shall be provided as required for sills, jambs, recesses, offsets, external corners, and other conditions to provide a complete and neatly finished installation. Tile bases and coves shall be solidly backed with mortar.

3.3 INSTALLATION OF WALL TILE

Wall tile shall be installed in accordance with the TCA Hdbk, method W242-03 or W243-03 for non-wet areas, W244-03 for wet areas and SR614-03 for steam rooms.

3.3.1 Latex-Portland Cement Mortar

Latex-portland cement shall be used to install tile in accordance with ANSI A108.1. Latex portland cement shall be used when installing porcelain ceramic tile.

3.3.2 Organic Adhesive

Organic adhesive installation of ceramic tile shall conform to ANSI A108.1.

3.4 INSTALLATION OF FLOOR TILE

Floor tile in all areas scheduled to receive tile but not in shower and drying areas or steam rooms shall be installed in accordance with TCA Hdbk, method F113-03. In shower, drying areas, and steam rooms tile shall be installed in accordance with TCA Hdbk, method B415-03.

3.4.1 Workable or Cured Mortar Bed

Floor tile shall be installed over a workable mortar bed or a cured mortar bed at the option of the Contractor. Workable mortar bed materials and installation shall conform to ANSI A108.1. Cured mortar bed and materials shall conform to ANSI A108.1.

3.4.2 Dry-Set and Latex-Portland Cement

Latex-portland cement mortar shall be used to install tile directly over properly cured, plane, clean concrete slabs in accordance with ANSI A108.1 and when installing porcelain ceramic tile.

3.4.3 Ceramic Tile Grout

Ceramic Tile grout shall be prepared and installed in accordance with ANSI A108.1.

3.4.4 Waterproofing

Waterproofing under concrete fill shall conform to the requirements of Section 07131 ELASTOMERIC WATERPROOFING.

3.4.5 Concrete Fill

Concrete fill shall be 3500 psi concrete, mixed to as dry a consistency as practicable. The fill shall be spread, tamped, and screeded to a true plane, and pitched to drains or leveled as shown. Concrete fill shall be thoroughly damp cured before application of setting-bed material . Concrete fill shall be reinforced with one layer of reinforcement, with the uncut edges lapped the width of one mesh and the cut ends and edges lapped not less than 2 inches. Laps shall be tied together with 18 gauge wire every 10 inches along the finished edges and every 6 inches along the cut ends and edges. The reinforcement shall be supported and secured in the centers of concrete fills. The mesh shall be continuous; except where expansion joints occur, mesh shall be cut and discontinued across such joints. Reinforced concrete fill shall be provided under the setting-bed where the distance between the under-floor surface and the finished tile floor surface is 2 inches or greater, and shall be of such thickness that the mortar setting-bed over the concrete fill shall be not less nor more than the thickness required in the specified TCA Hdbk methods.

3.5 INSTALLATION OF COVE BASE MOVEMENT PROFILE

Apply corner joint in continuous lengths to plumb, level, straight lines, located at floor-to-wall transitions where indicated on drawings in accordance with manufacturer's recommendations. Ensure that setting material is suitable for substrate. Butt ends of units tightly together with hairline joint. Solidly embed tiles so that the tile surface is flush with the top of the profile. Do not allow top of profile to extend above tiled surface, or be more than 1/32 inch lower than tiled surface. Install pre-formed trim at all inside corners and ends.

3.6 INSTALLATION OF FLOOR EDGE PROTECTION AND TRANSITION

Fill the cavity beneath the sloped section of the profile with dry-set mortar and trowel dry-set mortar over the area where profile is to be placed. Set the transition and trowel additional-dry set mortar over anchoring leg. Solidly embed tiles so that the tile surface is flush with the top of the profile. Set the tile to a uniform joint width and fill with grout.

3.7 INSTALLATION OF SOLID POLYMER THRESHOLDS

Thresholds shall be installed where indicated in a manner similar to that of the ceramic tile floor. Thresholds shall be the full width of the opening. Head joints at ends shall not exceed 1/4 inch in width to allow for sealant.

3.8 EXPANSION JOINTS

Joints shall be formed as indicated and sealed as specified in Section 07920 JOINT SEALANTS.

3.8.1 Walls

Expansion joints shall be provided at control joints in backing material. Wherever backing material changes, an expansion joint shall be installed to separate the different materials.

3.8.2 Floors

Expansion joints shall be provided over construction joints, control joints, and expansion joints in concrete slabs. Expansion joints shall be provided where tile abuts restraining surfaces such as perimeter walls, curbs and columns and at intervals of 24 to 36 feet each way in large interior floor areas and 12 to 16 feet each way in large exterior areas or areas exposed to direct sunlight or moisture. Expansion joints shall extend through setting-beds and fill.

3.9 CLEANING AND PROTECTING

Upon completion, tile surfaces shall be thoroughly cleaned in accordance with manufacturer's approved cleaning instructions. Acid shall not be used for cleaning glazed tile. Floor tile with factory mixed grout shall be cleaned in accordance with instructions of the grout manufacturer. After the grout has set, tile wall surfaces shall be given a protective coat of a noncorrosive soap or other approved method of protection. Tiled floor areas shall be covered with building paper before foot traffic is permitted over the finished tile floors. Board walkways shall be laid on tiled floors that are to be continuously used as passageways by workmen. Damaged or defective tiles shall be replaced.

-- End of Section --

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SECTION 09510

ACOUSTICAL CEILINGS
07/02

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A 641/A 641M	(1998) Zinc-Coated (Galvanized) Carbon Steel Wire
ASTM C 423	(2002) Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
ASTM C 635	(2000) Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings
ASTM C 636	(1996) Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels
ASTM C 834	(2000e1) Latex Sealants
ASTM E 580	(2000) Application of Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels in Areas Requiring Moderate Seismic Restraint
ASTM E 795	(2000) Mounting Test Specimens During Sound Absorption Tests
ASTM E 1264	(1998) Acoustical Ceiling Products
ASTM E 1477	(1998a) Luminous Reflectance Factor of Acoustical Materials by Use of Integrating-Sphere Reflectometers

U.S. ARMY CORPS OF ENGINEERS (USACE)

TI 809-04	(1998) Seismic Design for Buildings

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Approved Detail Drawings; G-AE

Drawings showing suspension system, method of anchoring and fastening, details, and reflected ceiling plan.

SD-03 Product Data

Acoustical Units; G-AE

Manufacturer's descriptive data, catalog cuts, and installation instructions. Submittals which do not provide adequate data for the product evaluation will be rejected.

Suspension System; G-AE

SD-04 Samples

Acoustical Units; G-AE

Two samples of each type of acoustical unit and each type of suspension grid tee section showing texture, finish, and color.

SD-07 Certificates

Acoustical Units

Certificate attesting that the mineral based acoustical units furnished for the project contain recycled material and showing an estimated percent of such material.

1.3 GENERAL REQUIREMENTS

Acoustical treatment shall consist of sound controlling units mechanically mounted on a ceiling suspension system. The unit size, texture, finish, and color shall be as specified. The location and extent of acoustical treatment shall be as shown on the approved detail drawings. Reclamation of mineral fiber acoustical ceiling panels to be removed from the job site shall be in accordance with paragraph RECLAMATION PROCEDURES.

1.3.1 Ceiling Sound Absorption

Determine the NRC in accordance with ASTM C 423 Method of Test.

1.3.2 Light Reflectance

Determine light reflectance factor in accordance with ASTM E 1477 Test Method.

1.4 DELIVERY AND STORAGE

Materials shall be delivered to the site in the manufacturer's original unopened containers with brand name and type clearly marked. Materials shall be carefully handled and stored in dry, watertight enclosures. Immediately before installation, acoustical units shall be stored for not less than 24 hours at the same temperature and relative humidity as the space where they will be installed in order to assure proper temperature and moisture acclimation.

1.5 ENVIRONMENTAL REQUIREMENTS

A uniform temperature of not less than 60 degrees F nor more than 85 degrees F and a relative humidity of not more than 70 percent shall be maintained for 24 hours before, during, and 24 hours after installation of acoustical units.

1.6 SCHEDULING

Interior finish work such as concrete work shall be complete and dry before installation. Mechanical, electrical, and other work above the ceiling line shall be completed and heating, ventilating, and air conditioning systems shall be installed and operating in order to maintain temperature and humidity requirements.

1.7 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one year period shall be provided. Standard performance guarantee or warranty shall contain an agreement to repair or replace acoustical panels that fail within the warranty period. Failures include, but are not limited to, sagging and warping of panels; rusting and manufacturers defects of grid system.

1.8 EXTRA MATERIALS

Spare tiles of each color shall be furnished at the rate of 10 tiles for each 1000 tiles installed. Tiles shall be from the same lot as those installed.

PART 2 PRODUCTS

2.1 ACOUSTICAL UNITS

Contractor shall comply with EPA requirements in accordance with Section 01670 RECYCLED / RECOVERED MATERIALS. Acoustical units shall conform to ASTM E 1264, Class A, and the following requirements:

2.1.1 Units for Exposed-Grid System ACT-1

Type: III (non-asbestos mineral fiber with painted finish).

Minimum NRC: 0.60.

Pattern: EI.

Nominal size: 24 X 24 inches.

Edge detail: Square.

Finish: Factory-applied standard finish.

Minimum LR coefficient: .86.

Minimum CAC: 33.

Flame Spread: Class A, 25 or less

2.1.2 Humidity Resistant Composition Units (ACT-2)

a. Type: XX (Non-asbestos mineral or glass fibers bonded with ceramic, moisture resistant thermo-setting resin, or other moisture resistant material and having a factory applied white paint finish. Panels shall not sag or warp under conditions of heat, high humidity or chemical fumes.)

b. Class: A, flame spread 25 or less.

c. Pattern: CE Perforated.

d. NRC Grade: Minimum .55 when tested on Mounting Type E-400 of ASTM E 795.

e. Light Reflectance: LR-1, 0.75 or greater.

f. Nominal Size: 24 x 24 inches.

g. Edge Detail: Square.

2.1.3 Himidity Resistant Composition Units (ACT-3)

a. Type: XX (Non-asbestos mineral or glass fibers bonded with ceramic, moisture resistant thermo-setting resin, or other moisture resistant material and having a factory applied white paint finish. Panels shall not sag or warp under conditions of heat, high humidity or chemical fumes.)

b. Class: A, flame spread 25 or less.

c. Pattern: G Non-Perforated.

d. NRC Grade: Minimum .10 when tested on Mounting Type E-400 of ASTM E 795.

e. Light Reflectance: LR-1, 0.75 or greater.

f. Nominal Size: 24 x 24 inches.

g. Edge Detail: Square.

2.2 SUSPENSION SYSTEM

Suspension system shall be standard exposed-grid standard width flange, and shall conform to ASTM C 635 for intermediate-duty systems. Surfaces exposed to view shall be aluminum or steel with a factory-applied white baked-enamel finish. Wall molding shall have a flange of not less than

15/16 inch. Inside and outside corner caps shall be provided. Suspended ceiling framing system shall have the capability to support the finished ceiling, light fixtures, air diffusers, and accessories, as shown. The suspension system shall have a maximum deflection of 1/360 of span length. Seismic details shall conform to the guidance in TI 809-04 and ASTM E 580. At Viewing Area 190 , suspension system shall be non-corrosive aluminum designed for high humidity environments, with painted white finish.

2.3 HANGERS

Hangers and attachment shall support a minimum 300 pound ultimate vertical load without failure of supporting material or attachment.

2.3.1 Wires

Wires shall conform to ASTM A 641/A 641M, Class 1, 0.106 inches in diameter unless indicated otherwise. At Laundry 137, and Viewing Area 190, wires shall be Monel #400 Alloy, 0.106 inches in diameter.

2.4 FINISHES

Acoustical units and suspension system members shall have manufacturer's standard textures, patterns and finishes as specified. Ceiling suspension system components shall be treated to inhibit corrosion.

2.5 COLORS AND PATTERNS

Colors and patterns for acoustical units and suspension system components shall be as specified in Section 09915 COLOR SCHEDULE.

2.6 ACOUSTICAL SEALANT

Acoustical sealant shall conform to ASTM C 834, nonstaining.

PART 3 EXECUTION

3.1 INSTALLATION

Interior finish work such as concrete work shall be completed and dry before installation. Mechanical, electrical, and other work above the ceiling line shall be completed and approved prior to the start of acoustical ceiling installation. Acoustical work shall be provided complete with necessary fastenings, clips, and other accessories required for a complete installation. Mechanical fastenings shall not be exposed in the finished work. Hangers shall be laid out for each individual room or space. Hangers shall be placed to support framing around beams, ducts, columns, grilles, and other penetrations through ceilings. Main runners and carrying channels shall be kept clear of abutting walls and partitions. At least two main runners shall be provided for each ceiling span. Wherever required to bypass an object with the hanger wires, a subsuspension system shall be installed, so that all hanger wires will be plumb.

3.1.1 Suspension System

Suspension system shall be installed in accordance with ASTM C 636 and as specified herein. There shall be no hanger wires or other loads suspended from underside of steel decking.

3.1.1.1 Plumb Hangers

Hangers shall be plumb and shall not press against insulation covering ducts and pipes. Where lighting fixtures are supported from the suspended ceiling system, hangers shall be provided at a minimum of four hangers per fixture and located not more than 6 inches from each corner of each fixture. See Section 16415A ELECTRICAL WORK, INTERIOR for additional lighting installation requirements.

3.1.1.2 Splayed Hangers

Where hangers must be splayed (sloped or slanted) around obstructions, the resulting horizontal force shall be offset by bracing, countersplaying, or other acceptable means.

3.1.2 Wall Molding

Wall molding shall be provided where ceilings abut vertical surfaces. Miter corners where wall moldings intersect or install corner caps. Wall molding shall be secured not more than 3 inches from ends of each length and not more than 16 inches on centers between end fastenings. Wall molding springs shall be provided at each acoustical unit in semi-exposed or concealed systems.

3.1.3 Acoustical Units

Acoustical units shall be installed in accordance with the approved installation instructions of the manufacturer. Edges of acoustical units shall be in close contact with metal supports, with each other, and in true alignment. Acoustical units shall be arranged so that units less than one-half width are minimized. Units in exposed-grid system shall be held in place with manufacturer's standard hold-down clips, if units weigh less than 1 psf.

3.1.4 Caulking

Seal all joints around pipes, ducts or electrical outlets penetrating the ceiling. Apply a continuous ribbon of acoustical sealant on vertical web of wall or edge moldings. See Section 07920 JOINT SEALANTS.

3.2 CLEANING

Following installation, dirty or discolored surfaces of acoustical units shall be cleaned and left free from defects. Units that are damaged or improperly installed shall be removed and new units provided as directed.

3.4 RECLAMATION PROCEDURES

Ceiling tile, designated for recycling by the Contracting Officer, shall be neatly stacked on 4 by 4 foot pallets not higher than 4 foot. Panels shall be completely dry. Pallets shall then be shrink wrapped and symmetrically stacked on top of each other without falling over. Disposal shall be in accordance with Section 01572 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT.

-- End of Section --

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SECTION 09620A

RESILIENT ATHLETIC FLOORING

01/04

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SECTION 09620A

RESILIENT ATHLETIC FLOORING
01/04

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C 501	(1984; R 2002) Relative Resistance to Wear of Unglazed Ceramic Tile by the Taber Abraser
ASTM C 920	(2002) Elastomeric Joint Sealants
ASTM D 543	(1995; R 2001) Evaluating the Resistance of Plastics to Chemical Reagents
ASTM D 1042	(2001a) Test Method for Linear Dimensional Changes of Plastics Under Accelerated Service Conditions
ASTM F 355	(2001) Test Method for Shock-absorbing Properties of Playing Surface Systems and Materials

DIN DEUTSCHES INSTITUT FUR NORMUNG E.V.

DIN 18032-2	(2001-04) Sports Halls - Halls for Gymnastics, Games, and Multi-Purpose Use - Part 2: Floors for Sporting Activities; Requirements, Testing

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Sheet Vinyl Composition Flooring; G-AE

Drawings showing lane lines.

SD-03 Product Data

Installation; G-AE

Manufacturer's descriptive data and catalog cuts indicating materials of construction and physical characteristics. Installation, cleaning and maintenance instructions shall be included.

SD-04 Samples

Flooring; G-AE

Three samples minimum 9 x 11 inches of each color of flooring material required.

SD-07 Certificates

Materials

Manufacturer's certificates stating that the resilient athletic flooring materials conform to the specified requirements. Labels or markings affixed to manufacturer's products attesting that products meet requirements specified herein will be accepted in lieu of certificates.

1.3 QUALIFICATIONS

Adhesive applied flooring shall be installed by an experienced floor applicator approved by the manufacturer.

1.4 DELIVERY, STORAGE, AND HANDLING

Materials shall be delivered in manufacturer's original unopened containers with labels intact. Materials shall not be delivered to the installation area or installed before all work that may damage the materials or the finished floor, such as overhead work, is completed. Materials shall be stored in a clean, dry area. Materials in storage shall be maintained at temperatures recommended by the manufacturer. Protection boards shall be stored flat and off the ground.

1.5 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one year period shall be provided.

1.6 ENVIRONMENTAL REQUIREMENTS

Areas to receive resilient athletic flooring shall be maintained at a temperature above 68 degrees F and below 85 degrees F for 7 days before application, during application and 7 days after application, unless otherwise directed by the flooring manufacturer for the flooring being installed. A minimum temperature of 55 degrees F shall be maintained thereafter. Observe ventilation and safety procedures specified in the MSDS. Provide adequate ventilation to remove moisture from area and to comply with regulations limiting concentrations of hazardous vapors.

1.7 EXTRA MATERIALS

1.7.1 Sports Flooring

Extra material from same dye lot shall be provided for maintenance. Leave scraps largaer than two suqare feet and unused portions of rolls of each flooring type and color.

PART 2 PRODUCTS

2.1 SHEET VINYL COMPOSITION FLOORING

Sheet vinyl flooring shall consist of a 100% pure homogenous vinyl wear-layer combined with a pure vinyl closed-cell foam backing, reinforced with a fiberglass inter-layer and shall conform to the chemical resistance requirements of ASTM D 543. Flooring shall be not less than 48 inches wide and shall have a minimum thickness of 1/4 inch. Floor surface shall be stipple texture. Flooring shall have a coefficient of friction of 0.4 to 0.6 when tested in accordance with DIN 18032-2. Flooring shall have a dimensional stability of 0.1 percent when tested in accordance with ASTM D 1042. Shock absorption of flooring shall be greater than 900 when tested in accordance with ASTM F 355. Abrasion resistance shall be no greater than 0.2g when tested in accordance with ASTM C 501. Sheet vinyl flooring shall have a fungistatic and bacteriostatic treatment applied throughout the thickness of the wear layer and foam backing.

2.2 ADHESIVES

Adhesive shall be as recommended by the flooring manufacturer and must correspond to the specified flooring product and to the substrate.

2.3 CRACK FILLER/LEVELER FOR CONCRETE SURFACES

Crack filler/leveler for concrete floor surfaces shall be as recommended by flooring manufacturer.

2.4 PRIMER

Concrete primer shall be as recommended by flooring manufacturer and must correspond to the specified flooring product and to the substrate.

2.5 LINE MARKING MATERIAL

Line marking material shall as recommended by the flooring manufacturer and must correspond to the specified flooring product.

2.6 WALL BASE

Base shall be rubber, Type coved style. Base shall be 4 inches high and minimum 1/8 inch thick.

2.7 SEALANTS

Sealants shall be in accordance with Section 07920 JOINT SEALANTS.

2.8 MANUFACTURERS COLOR

Color shall be in accordance with Section 09915 COLOR SCHEDULE.

PART 3 EXECUTION

3.1 PREPARATION

Concrete surfaces shall be completely cured and dry. No curing agents, sealers, or hardeners shall be used to aid in the curing of the concrete slab. Surfaces shall be free of paint spots, and other foreign materials. Surfaces shall be ground down or leveled with an approved leveling compound to a tolerance of plus or minus 1/8 inch within a 10 foot radius. Cracks, construction joints, or damaged portions of floor shall be filled with crack filler for concrete surfaces. Expansion joints shall be filled and sealed in accordance with the approved installation instructions of the manufacturer. All sealants shall be in accordance with ASTM C 920. Expansion joints shall not be filled with a material that will make them inoperable.

3.2 MOISTURE TEST

The suitability of the concrete subfloor for receiving the resilient flooring with regard to moisture content shall be determined by a moisture test as recommended by the flooring manufacturer.

3.3 INSTALLATION

3.3.1 General Requirements

Installation shall be in accordance with the approved installation instructions. Tile or sheet flooring shall be rolled with a medium-sized roller in both directions to release entrapped air.

3.3.2 Molded Rubber Base

Base shall be installed in accordance with the approved installation instructions of the manufacturer of the base.

3.3.3 Sheet Vinyl Composition Flooring

Concrete slab shall be primed in accordance with approved installation instructions. Flooring shall be installed as recommended by the manufacturer.

3.3.3.1 Seams

End seams shall be cut and placed as recommended by the manufacturer. Seams shall be weighted as required.

3.3.3.2 Hot-welded Seams

Butted sheets shall be grooved to a depth recommended by sheet manufacturer using an electrical or hand grooving tool. Grooved seams shall be thermowelded using a hot air welding tool and a PVC welding thread. After seam has cooled to room temperature, the excess shall be trimmed off to provide a flush joint.

3.3.4 Line Marking and Finishing

After installation is complete, the floor surface shall be cleaned in accordance with installation instructions. Line marking shall be layed out, masked, and painted according to approved detail drawings and approved

installation instructions. Finishing shall be in accordance with the manufacturer's recommendations.

3.4 PROTECTION

The installed flooring shall be protected from soiling and damage with heavy reinforced, nonstaining kraft paper, plywood, or hardboard sheets as required. Edges of kraft paper protection shall be lapped and secured to provide a continuous cover. Protective covering shall be removed when directed by the Contracting Officer.

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08/01

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-- End of Section Table of Contents --

SECTION 09641N

WOOD ATHLETIC FLOORING
08/01

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D 2103	(1997) Polyethylene Film and Sheeting
ASTM D 2240	(2002a) Rubber Property - Durometer Hardness
ASTM E 96	(2000e1) Water Vapor Transmission of Materials

AMERICAN WOOD-PRESERVERS' ASSOCIATION (AWPA)

AWPA M4	(2001) Standard for the Care of Preservative-Treated Wood Products

MAPLE FLOORING MANUFACTURERS ASSOCIATION (MFMA)

MFMA GRHM	(1995) Grading Rules for Hard Maple
MFMA FFL/HDGF	(1994) Heavy Duty and Gymnasium Finishes for Maple, Beech, and Birch Floors
MFMA SSCLFMGF	(1995) Sanding, Sealing, Court Lining and Finishing Maple Gym Floors

DIN DEUTSCHES INSTITUT FUR NORMUNG E.V.

DIN 18032-2	(2001-04) Sports Halls - Halls for Gymnastics, Games, and Multi-Purpose Use - Part 2: Floors for Sporting Activities; Requirements, Testing

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-02 Shop Drawings

Hardwood strip flooring system; G-AE

Floor Sleeves and Covers; G-AE

Clearly delineate components of the system. Show layout of sleepers; location of anchor plate assemblies; flooring system details; and flooring abutting other construction. Accessories shall be approved by the flooring manufacturer.

SD-03 Product Data

Hardwood strip flooring components; G-AE
Floor Sleeves and Covers; G-AE

Manufacturer's catalog data and printed documentation stating physical characteristics and conformance to performance criteria.

SD-04 Samples

Strip flooring; G-AE

Molded-rubber base; G-AE

Pads; G-AE

Engineered Sleepers

SD-08 Manufacturer's Instructions

Flooring system

Adhesive for membrane installation

Submit flooring system manufacturer's installation instructions. Submit vaporproofing manufacturer's written recommendations for adhesives to be used in membrane installation.

SD-10 Operation and Maintenance Data

Hardwood strip flooring, Data Package 1; G-AO

Submit data package in accordance with Section 01781, "Operation and Maintenance Data."

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the building site in original unopened packages, bundles, or containers. Protect materials against dampness during shipment and after delivery. Store material under cover in a well-ventilated building. Prevent exposure to extreme changes of temperature and humidity. Do not store materials in building under construction until wet-applied building materials are dry. Store flooring in accordance with MFMA GRHM, under adequate and controlled ventilation and under approved temperature and humidity conditions at the location where it is to be laid for at least

7 days before installation. Handle and store preservative-treated materials in accordance with AWPA M4.

1.4 ENVIRONMENTAL CONDITIONS

For at least one week prior to and during installation, in the location to receive finish flooring and the location where flooring will be stored, maintain a temperature of between 65 and 80 degrees F, and a relative humidity of between 35 and 50 percent. When the interior relative humidity exceeds 60 percent during or after installation of flooring, sanding and finishing of flooring shall be delayed for 2 to 3 weeks after completion of laying, unless directed otherwise. Provide adequate ventilation during the entire sealing and finishing process to ensure that no unhealthy or hazardous accumulation of vapors occurs. Ensure that environmental conditions are met.

PART 2 PRODUCTS

2.1 HARDWOOD STRIP FLOORING SYSTEMS ON CONCRETE SLAB

2.1.1 Engineered Wood Sleepers and Plywood Subflooring with Rubber Pads

Provide flooring system consisting of hardwood strip flooring nailed to plywood subflooring which is fastened to engineered wood sleepers that are seated on rubber pads resting on vapor proofing membrane on the concrete floor slab. Flooring system shall be DIN-Certified, conforming to all six DIN 18032-2 criteria for ball bounce, shock absorption, deflection, area of deflection, rolling load and surface friction.

2.2 MATERIALS

2.2.1 Strip Flooring

Second or better grade hard maple graded in accordance with current MFMA GRHM. Flooring shall be 25/32 inch thick by 2 1/4 inches or narrower on the face, kiln dried, continuous tongue-and-groove, and end-matched. Each bundle of flooring shall be clearly grade stamped. Moisture content of strip flooring shall not exceed 8 percent at time of arrival on job site and shall be allowed to acclimate in accordance with paragraph entitled "Delivery, Storage, and Handling."

2.2.2 Molded-Rubber Base

4 inch vertical leg by 3 inch, designed to allow ventilation under floor, and as recommended by flooring manufacturer.

2.2.3 Rubber Pads

Pads made from EPDM rubber shall have a durometer hardness of A50 at Group Exercise 197A and 197B and A60 at Gymnasium 196, plus or minus 5, when tested in accordance with ASTM D 2240. PaDs shall be a standard component of a DIN-Certified flooring assembly meeting the requirements of this section.

2.2.4 Polyethylene Vaporproofing Membrane

ASTM D 2103 Type 21110. Minimum thickness shall be 6 mils. Perm rating shall not exceed 0.02 when tested in accordance with ASTM E 96.

2.2.5 Engineered Sleepers

Surfaced on four sides, 7/8 inch nominal thickness, engineered wood sleepers shall be a standard component of a DIN-Certified flooring assembly meeting the requirements of this Section. Factory drilled and assembled with pads.

2.2.6 Plywood Subflooring

Douglas fir, southern pine, or western larch structural rated sheathing grade C-D, with exterior glue; 15/32 inch thick by 4 by 8 feet.

2.2.7 Sealing and Finishing for Hardwood Strip Flooring

Conform to MFMA FFL/HDGF, Group II finish at Group Exercise 197A and 197B, Group III finish at Gymnasium 196. Seal coat and finish coat materials shall be compatible with each other.

2.2.8 Game Line Marking Materials

As recommended by wood flooring finish manufacturer.

2.2.9 Nails and Anchors

Shape and size as recommended by flooring manufacturer.

2.2.10 Adhesives

Waterproof, suitable for use with molded rubber base, recommended by rubber base manufacturer.

2.2.11 Floor Sleeves and Covers

Provide floor sleeves and cover plates to accommodate volleyball standards. Coordinate type and size of sleeves with Contracting Officer. Floor sleeves shall be round, mechanical steel tube sleeve welded to steel anchor plate for casting in concrete floor to receive volleyball standard. Floor sleeves shall be 3-1/2 inches inside diameter by 8-1/2 inches tube and 4 inches square anchor plate. Cover plates shall consist of a cast aluminum recessed mounting flange and 5 inches diameter chrome plated cover. Equip cover with swivel type retaining screw and key to open and lock cover. Cover installed with flat head wood screws.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Condition of Subfloors

Do not install flooring on surfaces that are not suitable for proper installation. Before beginning work under this section, correct defects such as rough or scaling concrete, low spots, high spots, uneven surfaces, and repair damaged portions of concrete slabs. Concrete slabs shall be given a leveling course of latex fill and the surface shall not vary more than 1/8 inch when measured with a 10 foot straightedge placed in any direction.

3.1.2 Preparation of Concrete Slab

Sweep concrete floor. Ensure that slab is dry and clean. Remove paint spots, plaster, masonry droppings, grease, dirt, and other foreign matter . Concrete shall be fully cured and dry.

3.1.3 Anchor Plate Assemblies for Portable Sports Equipment

Floor anchor plate assemblies for vertically adjustable portable sports equipment shall be installed where indicated. Flooring shall be cut neatly around floor plates.

3.1.4 Work of Other Trades

Do not start work specified under this section until work of trades which could create moisture, has been completed.

3.1.5 Moisture Content

Check flooring, subflooring, and sleepers with an approved meter verifying conformance with the requirements specified hereinbefore.

3.2 INSTALLATION

3.2.1 Vaporproofing For Slabs on Grade

Cover slab with the polyethylene membrane. Lap joints at least 6 inches. Seal joints with a full coverage of the adhesive recommended by the membrane manufacturer.

3.2.2 Flooring on Engineered Wood Sleepers and Plywood Subflooring with Rubber Pads

3.2.2.1 Installation of Wood Sleepers With Rubber Pads

Install rubber-cushioned wood sleepers end to end at right angles to finished flooring. Sleepers shall be staggerd wth rows spaced 16-1/16 inches on center unless recommended otherwise by floor system manufacturer. Provide a 2 inch air space between ends and sides of sleepers at walls and other permanent obstructions at Gymnasium 196 and 1 inch air space at Group Exercise 197A and 197B. Sleepers shall be seated level and firm with rubber cushions bearing completely on the subfloor. Properly anchor sleepers in accordance with floor system manufacturer's printed instructions. In areas where fixed or temporary seats are indicated, provide additional support as recommended by floor system manufaacturer.

3.2.2.2 Installation of Plywood Subflooring

Install plywood subflooring with the 8 foot dimension parallel to the sleepers staggering panels in adjacent rows. Fasten plywood subfloor to sleepers using staples placed in accordance with manufacturer's printed instructions.

3.2.2.3 Laying of Finished Flooring

Begin installation of flooring in center of space with double-tongue strips of flooring. Lay flooring at right angles to the wood sleepers. Blind nail each strip of flooring in accordance with flooring system manufacturer's printed instructions. Leave a continuous air space, 2 inches

wide at Gymnasium 196 and 1 inch wide at Group Exercise 197A and 197B, between the finished flooring and perimeter walls and other permanent obstructions. Stagger end joints of adjacent strips of flooring so that there will be at least two boards between each joint.

3.2.3 Molded-Rubber Base Installation

Install molded-rubber base firmly on perimeter walls in continuous adhesive as recommended by the base manufacturer. Provide vertical, circular or semicircular vent holes in base spaced 5 inches on center in a straight row. Do not fasten base to flooring.

3.2.4 Floor Sleeve and Cover Installation

Coordinate layout of volleyball courts and location of floor sleeves with installation of floor surfacing and application of game lines and boundaries. Coordinate location of sleeves and required size of sleeve footing with trade responsible for placing concrete. Provide sleeves in adequate time to allow casting in concrete floor slabs. Ensure that setting of sleeve compensates for type of floor finish to be provided. Install floor cover plates centered over floor sleeves in accordance with manufacturer's instructions. Route out floor to ensure cover is flush with finished floor. Install cover with flat head screws.

3.3 SANDING, FINISHING, AND MARKING

3.3.1 Sanding

Sand wood floor surfaces with a machine using coarse, medium, and fine grades of sandpaper; the edges shall be sanded to a smooth edge; the finished surface shall be smooth and level, free from scratches. A final disc sanding shall be provided. After sanding, buff using 100 grit screen or equal grit sandpaper with a heavy buffing machine and vacuum and/or tack floors until clean. Do not walk on floors thereafter until finish has been applied and is dry.

3.3.2 Finishing

Within one day after the final sanding, buffing, and sweeping have been completed, use a tacky rag to clean flooring with a solvent recommended by the manufacturer of the floor finish material. Follow cleaning with a coating of sealer; when thoroughly dry, burnish with No. 2 steel wool, using a power machine. After final burnishing and prior to application of final finish coat(s), layout and mark game lines as specified herein; after game lines are thoroughly dry, apply final finish coat. Floors shall be wiped with a tacky rag each burnishing. Finish floors in accordance with MFMA SSCLFMGF. Provide Group II finish at Group Exercise 197A and 197B, Group III at Gymnasium 196. Four Coat Specification: Group II finish shall consist of one sealer coat and three finish coats. Group III finish shall consist of two sealer coats and two finish coats. Allow 5 days for proper curing.

3.3.3 Marking

Lay out game lines and fields where indicated, masking edges to provide sharp, clean edges. Edge shall be straight and width shall be uniform. Apply marking of colors indicated, providing a minimum dry film thickness of one mil.

3.4 PROTECTION

After completion of laying, finishing, and marking of the flooring, do not use the floor for at least 72 hours. Avoid heavy traffic on the floor for at least one week. Upon floor drying, use nonstaining, porous building paper of the type and grade recommended by manufacturer, taped along edges. Remove kraft paper covering after work in this area is completed.

-- End of Section --

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SECTION 09650

RESILIENT FLOORING

11/03

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SECTION 09650

RESILIENT FLOORING
11/03

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D 4078	(2002) Water Emulsion Floor Polish
ASTM E 648	(2000) Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source
ASTM F 710	(2003) Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring
ASTM F 1066	(1999) Vinyl Composition Floor Tile
ASTM F 1303	(2002) Sheet Vinyl Floor Covering with Backing
ASTM F 1861	(2002) Resilient Wall Base
ASTM F 1869	(1998) Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
ASTM F 2169	(2002) Resilient Stair Treads
ASTM F 2170	(2002) Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs in situ Probes

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule #1168	(2003) Adhesive and Sealant Applications

1.2 FIRE RESISTANCE REQUIREMENTS

Flooring in corridors and exits shall have a minimum average critical radiant flux of 0.22 watts per square centimeter when tested in accordance with ASTM E 648.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as

otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Resilient Flooring and Accessories; G-AE

Scaled drawings indicating patterns (including location of patterns and colors) and dimensions.

SD-03 Product Data

Resilient Flooring and Accessories; G-AE

Manufacturer's descriptive data.

Adhesives

Manufacturer's descriptive data, documentation stating physical characteristics, and mildew and germicidal characteristics. Material Safety Data Sheets (MSDS) for all primers and adhesives shall be provided to the Contracting Officer. Highlight VOC emissions.

SD-04 Samples

Resilient Flooring and Accessories; G-AE

Three samples of each indicated color and type of flooring, base, mouldings, and accessories. Sample size shall be minimum 2-1/2 x 4 inches.

SD-06 Test Reports

Moisture, Alkalinity and Bond Tests; G-AO

Copy of test reports of moisture and alkalinity content of concrete slab, and bond test stating date of test, person conducting the test, and the area tested.

SD-08 Manufacturer's Instructions

Surface Preparation
Installation

Manufacturer's printed installation instructions for all flooring materials and accessories, including preparation of substrate, seaming techniques, and recommended adhesives.

SD-10 Operation and Maintenance Data

Resilient Flooring and Accessories; G-AO

Data Package 1 in accordance with Section 01781 OPERATION AND MAINTENANCE DATA.

1.4 DELIVERY AND STORAGE

Materials shall be delivered to the building site in original unopened containers bearing the manufacturer's name, style name, pattern color name and number, production run, project identification, and handling instructions. Materials shall be stored in a clean dry area with temperature maintained above 68 degrees F and below 85 degrees F, and shall be stacked according to manufacturer's recommendations. Materials shall be protected from the direct flow of heat from hot-air registers, radiators and other heating fixtures and appliances. Do not open containers until materials are to be used, except for verification inspection. Observe ventilation and safety procedures specified in the MSDS.

1.5 ENVIRONMENTAL REQUIREMENTS

Areas to receive resilient flooring shall be maintained at a temperature above 68 degrees F and below 85 degrees F for 2 days before application, during application and 2 days after application, unless otherwise directed by the flooring manufacturer for the flooring being installed. A minimum temperature of 55 degrees F shall be maintained thereafter. Observe ventilation and safety procedures specified in the MSDS. Provide adequate ventilation to remove moisture from area and to comply with regulations limiting concentrations of hazardous vapors.

1.6 SCHEDULING

Resilient flooring application shall be scheduled after the completion of other work which would damage the finished surface of the flooring.

1.7 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one year period shall be provided.

1.8 EXTRA MATERIALS

Extra flooring material of each color and pattern shall be furnished at the rate of 50 tiles for each 1000 tiles and 50 square feet for each 1000 square feet of sheet flooring installed. Extra wall base material composed of 20 linear feet of each type, color and pattern shall be furnished. All extra materials shall be packaged in original properly marked containers bearing the manufacturer's name, brand name, pattern color name and number, production run, and handling instructions. Extra materials shall be from the same lot as those installed. Leave extra stock at site in location as directed by Contracting Officer.

PART 2 PRODUCTS

2.1 VINYL COMPOSITION TILE VCT-1

Vinyl-composition tile shall conform to ASTM F 1066, Class 2, (through pattern tile), Composition 1, asbestos-free, and shall be 12 inches square and 1/8 inch thick. Tile shall have the color and pattern uniformly distributed throughout the thickness of the tile.

2.2 SHEET VINYL FLOORING SV-1

Sheet vinyl flooring shall conform to ASTM F 1303, Type I, Grade 1, (minimum wear layer thickness 0.020 inches and minimum overall thickness

0.080 inches) and shall not be less than 6 feet wide. Color and pattern shall extend through the total thickness of the material. As required, provide welding rods as recommended by the manufacturer for heat welding of joints.

2.3 WALL BASE

Base shall conform to ASTM F 1861, Type TP (thermoplastic rubber), orType TV (thermoplastic vinyl) as indicted, Style A (straight - installed with carpet) and Style B (coved - installed with resilient flooring). Base shall be 4 inches high and a minimum 1/8 inch thick. Job formed corners in matching height, shape, and color shall be furnished.

2.4 STAIR TREADS, RISERSAND NOSINGS

Treads, risers, and nosings shall conform to ASTM F 2169 Type TP (thermoplastic rubber). Surface of treads shall conform to ASTM F 2169 Class 2 hammered pattern. Nosing shall be square. Design shall be either a one piece nosing/tread/riser or a two piece nosing/tread with a matching coved riser.

2.5 MOULDING

Provide tapered mouldings of vinyl and types as recommended by flooring manufacturer for both edges and transitions of flooring materials specified. Vertical lip on moulding shall not be greater than 1/4 inch. Change in level between 1/4 and 1/2 inch shall be beveled with a slope no greater than 1:2.

2.6 ADHESIVES

Adhesives for flooring, base and accessories shall be as recommended by the manufacturer and comply with local indoor air quality standards. Except in wet areas VOC content must be less than the current VOC content limits of SCAQMD Rule #1168.

2.7 SURFACE PREPARATION MATERIALS

Surface preparation materials, such as floor crack fillers shall be as recommended by the flooring manufacturer for the subfloor conditions.

2.8 POLISH/FINISH

Polish shall be as recommended by the manufacturer and conform to ASTM D 4078.

2.9 CAULKING AND SEALANTS

Caulking and sealants shall be in accordance with Section 07920 JOINT SEALANTS.

2.10 MANUFACTURER'S COLOR, PATTERN AND TEXTURE

Color, pattern and texture for resilient flooring and accessories shall be in accordance with Section 09915 COLOR SCHEDULE. Color listed is not intended to limit the selection of equal colors from other manufacturers. Floor patterns shall be as specified in the drawings. Flooring in any one continuous area or replacement of damaged flooring in continuous area shall be from same production run with same shade and pattern.

PART 3 EXECUTION

3.1 EXAMINATION/VERIFICATION OF CONDITIONS

The Contractor shall examine and verify that site conditions are in agreement with the design package and shall report all conditions that will prevent a proper installation. The Contractor shall not take any corrective action without written permission from the Government. Work will proceed only when conditions have been corrected and accepted by the installer.

3.2 SURFACE PREPARATION

Flooring shall be in a smooth, true, level plane, except where indicated as sloped. Floor shall be flat to within 3/16 inch in 10 feet. Subfloor shall be prepared in accordance with flooring manufacturers recommended instructions. Concrete subfloor preparation shall comply with ASTM F 710. Floor fills or toppings may be required as recommended by the flooring manufacturer. Before any work under this section is begun, all defects such as rough or scaling concrete, chalk and dust, cracks, low spots, high spots, and uneven surfaces shall have been corrected, and all damaged portions of concrete slabs shall have been repaired as recommended by the flooring manufacturer. Concrete curing and sealer compounds, other than the type that does not adversely affect adhesion, shall be entirely removed from the slabs. Paint, varnish, oils, release agents, sealers, waxers, and adhesives shall be removed, as recommended by the flooring manufacturer.

3.3 MOISTURE, ALKALINITY AND BOND TESTS

The suitability of the concrete subfloor for receiving the resilient flooring with regard to moisture content and pH level shall be determined by moisture and alkalinity tests and shall comply with manufacturers recommendations. Moisture testing shall be in accordance with ASTM F 1869 or ASTM F 2170 unless otherwise recommended by the flooring manufacturer. Alkalinity testing shall be as recommended by the flooring manufacturer. The compatibility of the resilient flooring adhesives to the concrete floors shall be determined by a bond test in accordance with the flooring manufacturers recommendations.

3.4 PLACING VINYL-COMPOSITION TILE

Tile flooring and accessories shall be installed in accordance with manufacturer's installation instructions. Adhesives shall be prepared and applied in accordance with manufacturer's directions. Tile lines and joints shall be kept square, symmetrical, tight, and even. Keep each floor in true, level plane, except where slope is indicated. Edge width shall vary as necessary to maintain full-size tiles in the field, but no edge tile shall be less than one-half the field tile size, except where irregular shaped rooms make it impossible. Flooring shall be cut to, and fitted around, all permanent fixtures, built-in furniture and cabinets, pipes, and outlets. Edge tile shall be cut, fitted, and scribed to walls and partitions after field flooring has been applied.

3.5 PLACING SHEET VINYL FLOORING

Sheet vinyl flooring and accessories shall be installed in accordance with manufacturer's installation instructions. Adhesives shall be prepared and applied in accordance with manufacturer's directions. Flooring lines and

joints shall be square, symmetrical, tight, and even. Flooring with an integral pattern shall match at seams. Keep each floor in true, level plane, except where slope is indicated. Flooring shall be cut to, and fitted around, all permanent fixtures, built-in furniture and cabinets, pipes, and outlets. Flooring shall be cut, fitted, and scribed to walls and partitions after field flooring has been applied. Seams and edges of sheet vinyl flooring shall be chemically bonded in accordance with the manufacturer's written installation instructions. Finish joints flush, free from voids, recesses, and raised areas.

3.6 PLACING MOULDING

Provide moulding where flooring termination is higher than the adjacent finished flooring and at transitions between different flooring materials. When required, locate moulding under door centerline. Moulding is not required at doorways where thresholds are provided. Moulding shall be secured with adhesive as recommended by the manufacturer. Adhesives shall be prepared and applied in accordance with manufacturers directions.

3.7 PLACING WALL BASE

Wall base shall be installed in accordance with manufacturer's installation instructions. Adhesives shall be prepared and applied in accordance with manufacturers directions. Base joints shall be tight and base shall be even with adjacent resilient flooring. Voids along the top edge of base at masonry walls shall be filled with caulk. Roll entire vertical surface of base with hand roller, and press toe of base with a straight piece of wood to ensure proper alignment. Avoid excess adhesive in corners.

3.8 PLACING STAIR TREADS, RISERS, AND NOSINGS

Stair treads, risers, and nosings shall be securely attached and installed in accordance with manufacturer's installation instructions. Adhesives shall be prepared and applied in accordance with manufacturers directions. Treads, risers and nosings shall cover the full width of the stairs. Stairs wider than manufacturer's standard lengths shall have equal length pieces butted together to cover the treads.

3.9 CLEANING

Immediately upon completion of installation of flooring in a room or an area, flooring and adjacent surfaces shall be dry-cleaned to remove all surplus adhesive. Clean flooring as recommended in accordance with manufacturer's printed maintenance instructions. No sooner than 5 days after installation, flooring shall be washed with a nonalkaline cleaning solution, rinsed thoroughly with clear cold water, and, except for rubber flooring and stair treads and risers, vinyl and other flooring not requiring polish by manufacturer, given the number of coats of polish in accordance with manufacturers written instructions. All other flooring shall be cleaned and maintained as recommended by the manufacturer.

3.10 PROTECTION

From the time of laying until acceptance, flooring shall be protected from damage as recommended by the flooring manufacturer. Flooring which becomes damaged, loose, broken, or curled and wall base which is not tight to wall or securely adhered shall be removed and replaced.

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SECTION 09680

CARPET

11/03

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SECTION 09680

CARPET
11/03

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS (AATCC)

AATCC 16	(1998) Test Method: Colorfastness to Light
AATCC 134	(2001) Test Method: Electrostatic Propensity of Carpets
AATCC 165	(1999) Test Method: Colorfastness to Crocking: Carpets - AATCC Crockmeter Method
AATCC 174	(1998) Antimicrobial Activity Assessment of Carpet

ASTM INTERNATIONAL (ASTM)

ASTM D 418	(1993; R 1997) Pile Yarn Floor Covering Construction
ASTM D 3278	(1996e1) Test Methods for Flash Point of Liquids by Small Scale Closed-Cup Apparatus
ASTM D 5252	(2001) Practice for the Operation of the Hexapod Tumble Drum Tester
ASTM D 5417	(1999) Practice for Operation of the Vettermann Drum Tester
ASTM D 5793	(1995) Standard Test Method for Binding Sites Per Unit Length or Width of Pile Yarn Floor Coverings
ASTM D 5848	(1999) Standard Test Method for Mass Per Unit Area of Pile Yarn Floor Coverings

CARPET AND RUG INSTITUTE (CRI)

CRI 104	(2002) Commercial Carpet Installation Standard

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

16 CFR 1630	Standard for the Surface Flammability of

	Carpet and Rugs (FF 1-70)
40 CFR 247	Comprehensive Procurement Guideline for Products Containing Recovered Materials

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation; G-AE
Molding; G-AE

Three copies of drawings indicating areas receiving carpet, carpet types, textures and patterns, direction of pile, location of seams, and locations of edge molding.

SD-03 Product Data

Carpet; G-AE

Manufacturer's catalog data and printed documentation stating physical characteristics, durability, resistance to fading, and flame resistance characteristics for each type of carpet material and installation accessory.

Surface Preparation; G-AO
Installation; G-AO

Three copies of the manufacturer's printed installation instructions for the carpet, including preparation of substrate, seaming techniques, and recommended adhesives and tapes.

Regulatory Requirements; G-AO

Three copies of report stating that carpet contains recycled materials and/or involvement in a recycling or reuse program. Report shall include percentage of recycled material.

SD-04 Samples

Carpet; G-AE
Molding; G-AE

a. Carpet: Two "Production Quality" samples 18 x 18 inches of each carpet proposed for use, showing quality, pattern, and color specified.

b. Vinyl or Aluminum Moldings: Two pieces of each type at least 12 inches long.

c. Special Treatment Materials: Two samples showing system and

installation method.

SD-06 Test Reports

Moisture and Alkalinity Tests; G-AO

Three copies of test reports of moisture and alkalinity content of concrete slab stating date of test, person conducting the test, and the area tested.

SD-07 Certificates

Carpet

Certificates of compliance from a laboratory accredited by the National Laboratory Accreditation Program of the National Institute of Standards and Technology attesting that each type of carpet and carpet with cushion material conforms to the standards specified.

Regulatory Requirements

Report stating that the carpet contains recycled materials and indicating the actual percentage of recycled material.

SD-10 Operation and Maintenance Data

Carpet; G-AO
Cleaning and Protection; G-AO

Three copies of carpet manufacturer's maintenance instructions describing recommended type of cleaning equipment and material, spotting and cleaning methods, and cleaning cycles.

1.3 REGULATORY REQUIREMENTS

Carpet and adhesives shall bear the Carpet and Rug Institute (CRI) Indoor Air Quality (IAQ) label or demonstrate compliance with testing criteria and frequencies through independent laboratory test results. Carpet type bearing the label will indicate that the carpet has been tested and meets the criteria of the CRI IAQ Carpet Testing Program, and minimizes the impact on indoor air quality. Contractor shall procure carpet in accordance with 40 CFR 247. Carpet shall conform to EPA requirements in accordance with Section 01670 RECYCLED / RECOVERED MATERIALS. Where possible, product shall be purchased locally to reduce emissions of fossil fuels from transporting.

1.4 DELIVERY AND STORAGE

Materials shall be delivered to the site in the manufacturer's original wrappings and packages clearly labeled with the manufacturer's name, brand name, size, dye lot number, and related information. Materials shall be stored in a clean, dry, well ventilated area, protected from damage and soiling, and shall be maintained at a temperature above 60 degrees F for 2 days prior to installation.

1.5 ENVIRONMENTAL REQUIREMENTS

Areas in which carpeting is to be installed shall be maintained at a

temperature above 60 degrees F for 2 days before installation, during installation, and for 2 days after installation. A minimum temperature of 55 degrees F shall be maintained thereafter for the duration of the contract. Traffic or movement of furniture or equipment in carpeted area shall not be permitted for 24 hours after installation. Other work which would damage the carpet shall be completed prior to installation of carpet.

1.6 WARRANTY

Manufacturer's standard performance guarantees or warranties including minimum ten (10) year wear warranty, two (2) year material and workmanship and three (3) year tuft bind and delamination.

1.7 EXTRA MATERIAL

Extra material from same dye lot consisting of full width continuous broadloom and uncut carpet tiles shall be provided for future maintenance. A minimum of 5 percent of total square yards of each carpet type, pattern, and color shall be provided.

PART 2 PRODUCTS

2.1 CARPET

Carpet shall be first quality; free of visual blemishes, streaks, poorly dyed areas, fuzzing of pile yarn, spots or stains, and other physical and manufacturing defects. Carpet materials and treatments shall be reasonably nonallergenic and free of other recognized health hazards. All grade carpets shall have a static control construction which gives adequate durability and performance. Carpet shall bear the Carpet and Rug Institute (CRI) Indoor Air Quality (IAQ) Label. Carpet type bearing the label will indicate that carpet has been tested and meets the criteria of the CRI Green Label Requirements for Indoor Air Quality Test Criteria.

2.1.1 Physical Characteristics

2.1.1.1 BROADLOOM CARPETCPT-1

Carpet shall comply with the following:

a. Carpet Construction: Tufted.

b. Type: Broadloom 12 feet minimum usable carpet width with exception of corridors.

c. Pile Type: Dense patterned loop.

d. Pile Fiber: Commercial 100% branded (federally registered trademark) J & J Encore Type 6 Nylon.

e. Pile or Wire Height: Minimum .10 inch in accordance with ASTM D 418.

f. Gauge or Pitch: Minimum 1/10 inch in accordance with ASTM D 5793.

g. Finished Pile Yarn Weight: Minimum 24 ounces per square yard. This does not include weight of backings. Weight shall be

determined in accordance with ASTM D 5848.

h. Pile Density: Minimum 8640.

i. Dye Method: Yarn (or Skein) dyed Colorloc .

l. Backing Materials: Primary backing materials shall be those customarily used and accepted by the trade for each type of carpet, Actionbac. Secondary backing to suit project requirements shall be those customarily used and accepted by the trade for each type of carpet, except when a special unitary back designed for gluedown is provided.

2.1.1.2 ENTRANCE MODULAR TILE CARPET CPT-2

Carpet shall comply with the following:

a. Carpet Construction: Tufted.

b. Type: Entrance modular tile 18 x 18 inches square.

c. Pile Type: Performance loop pile.

d. Pile Fiber: Dupont nylon 6,6 with nylon 6,6 scraper yarn.

e. Pile or Wire Height: Minimum .249 inch in accordance with ASTM D 418.

f. Gauge or Pitch: Minimum 5/32 inch in accordance with ASTM D 5793.

g. Stitches or Rows/Wires: Minimum 8.5 per square inch.

h. Finished Pile Yarn Weight: Minimum 38 ounces per square yard. This does not include weight of backings. Weight shall be determined in accordance with ASTM D 5848.

i. Dye Method: Yarn (or Skein) dyed .

j. Backing Materials: Integrataed Cushion Thermabond. Primary back materials shall be reinforced synthetic. Secondary backing shall be fiber glass reinforced.

2.2 Performance Requirements

a. ARR (Appearance Retention Rating): Carpet shall be tested and have the minimum 3.0-3.5 (Heavy) ARR when tested in accordance with either the ASTM D 5252(Hexapod) or ASTM D 5417 (Vettermann) test methods using the number of cycles for short and long term tests as specified.

b. Static Control: Static control shall be provided to

permanently control static buildup to less than 3.0 kV when tested at 20 percent relative humidity and 70 degrees F in accordance with AATCC 134.

c. Flammability and Critical Radiant Flux Requirements: Carpet shall comply with 16 CFR 1630.

d. Tuft Bind: Tuft bind force required to pull a tuft or loop free from carpet backing shall be a minimum 10 pound average force for loop pile.

e. Colorfastness to Crocking: Dry and wet crocking shall comply with AATCC 165 and shall have a Class 4 minimum rating on the AATCC Color Transference Chart for all colors.

f. Colorfastness to Light: Colorfastness to light shall comply with AATCC 16, Test Option E "Water-Cooled Xenon-Arc Lamp, Continuous Light" and shall have a minimum 4 grey scale rating after 40 hours.

g. Delamination Strength: Delamination strength for tufted carpet with a secondary back shall be minimum of 2.5 lbs./inch.

h. Antimicrobial: Nontoxic antimicrobial treatment in accordance with AATCC 174 Part I (qualitative), guaranteed by the carpet manufacturer to last the life of the carpet.

2.3 ADHESIVES AND CONCRETE PRIMER

Adhesives and concrete primers for installation of carpet shall be waterproof, nonflammable, meet local air-quality standards, and shall be as required by the carpet manufacturer. Seam adhesive shall be waterproof, nonflammable, and nonstaining as recommended by the carpet manufacturer. Release adhesive for modular tile carpet shall be as recommended by the carpet manufacturer. Adhesives flashpoint shall be minimum 140 degrees F in accordance with ASTM D 3278.

2.4 MOLDING

Vinyl molding shall be heavy-duty and designed for the type of carpet being installed. Floor flange shall be a minimum 2 inches wide. Color shall be as specified in Section 09915 COLOR SCHEDULE.

2.5 TAPE

Tape for seams shall be as recommended by the carpet manufacturer for the type of seam used in installation.

2.6 COLOR, TEXTURE, AND PATTERN

Color, texture, and pattern shall be in accordance with Section 09915 COLOR SCHEDULE.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Carpet shall not be installed on surfaces that are unsuitable and will prevent a proper installation. Holes, cracks, depressions, or rough areas

shall be repaired using material recommended by the carpet or adhesive manufacturer. Floor shall be free of any foreign materials and swept broom clean. Before beginning work, subfloor shall be tested with glue and carpet to determine "open time" and bond.

3.2 MOISTURE AND ALKALINITY TESTS

Concrete slab shall be tested for moisture content and excessive alkalinity in accordance with CRI 104.

3.3 PREPARATION OF CONCRETE SUBFLOOR

Installation of the carpeting shall not commence until concrete substrate is at least 90 days old. The concrete surfaces shall be prepared in accordance with instructions of the carpet manufacturer. Type of concrete sealer, when required, shall be compatible with the carpet.

3.4 INSTALLATION

All work shall be performed by installers who are CFI certified (International Certified Floorcovering Installer Association), or manufacturer's approved installers. Installation shall be in accordance with the manufacturer's instructions and CRI 104. Edges of carpet meeting hard surface flooring shall be protected with molding; installation shall be in accordance with the molding manufacturer's instructions. Ventilation, personal protection, and other safety precautions recommended by the manufacturer of the adhesive shall be followed. Ventilation ahall continue for at least 72 hours following installation.

3.4.1 Broadloom Installation

Broadloom carpet shall be installed direct glue down and shall be smooth, uniform, and secure, with a minimum of seams. Seams shall be regular, unnoticeable, and treated with a seam adhesive. Side seams shall be run toward the light where practical and where such layout does not increase the number of seams. Breadths shall be installed parallel, with carpet pile in the same direction. Patterns shall be accurately matched. Cutouts, as at door jambs, columns and ducts shall be neatly cut and fitted securely. Seams at doorways shall be located parallel to and centered directly under doors. Seams shall not be made perpendicular to doors or at pivot points. Seams at changes in directions of corridors shall follow the wall line parallel to the carpet direction. Corridors with widths less than 6 feet shall have the carpet laid lengthwise down the corridors.

3.4.2 Entrance Modular Tile Installation

Entrance modular tiles shall be installed with permanent vinyl-compatible adhesive and shall be snugly jointed together. Tiles shall be laid in an alternating pattern.

3.5 CLEANING AND PROTECTION

3.5.1 Cleaning

After installation of the carpet, debris, scraps, and other foreign matter shall be removed. Soiled spots and adhesive shall be removed from the face of the carpet with appropriate spot remover. Protruding face yarn shall be cut off and removed. Carpet shall be vacuumed clean.

3.5.2 Protection

The installed carpet shall be protected from soiling and damage with heavy, reinforced, nonstaining kraft paper, plywood, or hardboard sheets. Edges of kraft paper protection shall be lapped and secured to provide a continuous cover. Traffic shall be restricted for at least 45 hours. Protective covering shall be removed when directed by the Contracting Officer.

3.6 REMNANTS

Remnants remaining from the installation, consisting of scrap pieces more than 2 feet in dimension with more than 6 square feet total, shall be provided. Non-retained scraps shall be removed from site and recycled appropriately.

-- End of Section --

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SECTION 09900

PAINTS AND COATINGS
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PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)

ACGIH 0100Doc	(2001) Documentation of the Threshold Limit Values and Biological Exposure Indices

ASTM INTERNATIONAL (ASTM)

ASTM D 2092	(1995) Preparation of Zinc-Coated (Galvanized) Steel Surfaces for Painting
ASTM D 235	Standard Specification for Mineral Spirits (Petroleum Spirits) (Hydrocarbon Dry Cleaning Solvent)
ASTM D 4214	(1998) Evaluating the Degree of Chalking of Exterior Paint Films
ASTM D 4263	(1983; R 1999) Indicating Moisture in Concrete by the Plastic Sheet Method
ASTM D 4444	(1998) Standard Test Methods for Use and Calibration of Hand-Held Moisture Meters
ASTM D 523	(1989; R 1999) Specular Gloss
ASTM F 1869	(1998) Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.1000	Air Contaminants

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FED-STD-313	(Rev. D; Am 1) Material Safety Data, Transportation Data and Disposal Data for Hazardous Materials Furnished to

Government Activities

MASTER PAINTERS INSTITUTE (MPI)

MPI 4	(2001) Interior/Exterior Latex Block Filler
MPI 11	(2001) Exterior Latex, Semi-Gloss
MPI 17	Bonding Primer (water based_
MPI 27	(2001) Exterior / Interior Alkyd Floor Enamel, Gloss
MPI 46	(Jan 2003) Interior Enamel, Undercoat
MPI 47	(2001) Interior Alkyd, Semi-Gloss
MPI 50	(2001) Interior Latex Primer Sealer
MPI 57	(2001) Interior Oil Modified Clear Urethane, Satin
MPI 64	Interior Latex Fire Retardant Flat Coating (ULC Approved)
MPI 79	(2001) Marine Alkyd Metal Primer
MPI 101	(2001) Cold Curing Epoxy Primer
MPI 107	(2001) Rust Inhibitive Primer (Water-Based)
MPI 115	Interior/Exterior Epoxy (water based)
MPI 118	Latex Dry Fog/Fall
MPI 138	(2001) High Performance Latex, White and Tints - MPI Gloss Level 2
MPI 153	Interior W.B. Light Industrial Coating, Semi-Gloss, MPI Gloss Level 5
MPI 275	Q.D. Shop Primer for Interior Structural Steel

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-STD-101	(Rev. B) Color Code for Pipelines and for Compressed Gas Cylinders

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS SP01-01	(2001) Environmentally Preferable Product Specification for Architectural and Anti-Corrosive Paints

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC QP 1	(1989) Evaluating Qualifications of Painting Contractors (Field Application to Complex Structures)
SSPC PA 1	(2000) Shop, Field, and Maintenance Painting
SSPC Guide 3	(1995) Safety in Paint Application
SSPC VIS 1	(1989) Visual Standard for Abrasive Blast Cleaned Steel (Standard Reference Photographs)
SSPC VIS 3	(1993) Visual Standard for Power- and Hand-Tool Cleaned Steel (Standard Reference Photographs)
SSPC VIS 4	(2001) Guide and Reference Photographs for Steel Surfaces Prepared by Waterjetting
SSPC SP 1	(1982) Solvent Cleaning
SSPC SP 2	(1995) Hand Tool Cleaning
SSPC SP 3	(1982; R 2000) Power Tool Cleaning
SSPC SP 6	(2000) Commercial Blast Cleaning
SSPC SP 7	(1994) Brush-Off Blast Cleaning
SSPC SP 10	(2000) Near-White Blast Cleaning
SSPC SP 12	(1995) Surface Preparation and Cleaning of Steel and Other Hard Materials by High-and Ultra high-Pressure Water Jetting Prior to Recoating

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(1996) Safety and Health Requirements Manual

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

The current MPI, "Approved Product List" which lists paint by brand, label, product name and product code as of the date of contract award, will be used to determine compliance with the submittal requirements of this specification. The Contractor may choose to use a subsequent MPI "Approved Product List", however, only one list may be used for the entire contract

and each coating system is to be from a single manufacturer. All coats on a particular substrate must be from a single manufacturer. No variation from the MPI Approved Products List is acceptable.

Samples of specified materials may be taken and tested for compliance with specification requirements.

In keeping with the intent of Executive Order 13101, "Greening the Government through Waste Prevention, Recycling, and Federal Acquisition", products certified by SCS as meeting SCS SP01-01 shall be given preferential consideration over registered products. Products that are registered shall be given preferential consideration over products not carrying any EPP designation.

SD-02 Shop Drawings

Piping identification

Submit color stencil codes

SD-03 Product Data

Coating; G-AE

Manufacturer's Technical Data Sheets

SD-04 Samples

Color; G-AE

Submit manufacturer's samples of paint colors. Cross reference color samples to color scheme as indicated.

SD-07 Certificates

Applicator's qualifications

Qualification Testing laboratory for coatings G-AO

SD-08 Manufacturer's Instructions

Application instructions

Mixing

Detailed mixing instructions, minimum and maximum application temperature and humidity, potlife, and curing and drying times between coats.

Manufacturer's Material Safety Data Sheets

Submit manufacturer's Material Safety Data Sheets for coatings, solvents, and other potentially hazardous materials, as defined in FED-STD-313.

SD-10 Operation and Maintenance Data

Coatings: G-RE

Preprinted cleaning and maintenance instructions for all coating systems shall be provided.

1.3 APPLICATOR'S QUALIFICATIONS

1.3.1 SSPC QP 1 Certification

All contractors and subcontractors that perform surface preparation or coating application shall be certified by the Society for Protective Coatings (formerly Steel Structures Painting Council) (SSPC) to the requirements of SSPC QP 1 prior to contract award, and shall remain certified while accomplishing any surface preparation or coating application. The painting contractors and painting subcontractors must remain so certified for the duration of the project. If a contractor's or subcontractor's certification expires, the firm will not be allowed to perform any work until the certification is reissued. Requests for extension of time for any delay to the completion of the project due to an inactive certification will not be considered and liquidated damages will apply. Notify the Contracting Officer of any change in contractor certification status.

1.4 QUALITY ASSURANCE

1.4.1 Field Samples and Tests

The Contracting Officer may choose up to two coatings that have been delivered to the site to be tested at no cost to the Government. Take samples of each chosen product as specified in the paragraph "Sampling Procedures." Test each chosen product as specified in the paragraph "Testing Procedure." Products which do not conform, shall be removed from the job site and replaced with new products that confrom to the referenced specification. Testing of replacement products that failed initial testing shall be at no cost to the Government.

1.4.1.1 Sampling Procedure

The Contracting Officer will select paint at random from the products that have been delivered to the job site for sample testing. The Contractor shall provide one quart samples of the selected paint materials. The samples shall be taken in the presence of the Contracting Officer, and labeled, identifying each sample. Provide labels in accordance with the paragraph "Packaging, Labeling, and Storage" of this specification.

1.4.1.2 Testing Procedure

Provide Batch Quality Conformance Testing for specified products, as defined by and performed by MPI. As an alternative to Batch Quality Conformance Testing, the Contractor may provide Qualification Testing for specified products above to the appropriate MPI product specification, using the third-party laboratory approved under the paragraph "Qualification Testing" laboratory for coatings. The qualification testing lab report shall include the backup data and summary of the test results. The summary shall list all of the reference specification requirements and the result of each test. The summary shall clearly indicate whether the tested paint meets each test requirement. Note that Qualification Testing may take 4 to 6 weeks to perform, due to the extent of testing required.

Submit name, address, telephone number, FAX number, and e-mail address of the independent third party laboratory selected to perform testing of coating samples for compliance with specification requirements. Submit documentation that laboratory is regularly engaged in testing of paint samples for conformance with specifications, and that employees performing testing are qualified. If the Contractor chooses MPI to perform the Batch Quality Conformance testing, the above submittal information is not required, only a letter is required from the Contractor stating that MPI will perform the testing.

1.5 REGULATORY REQUIREMENTS

1.5.1 Environmental Protection

In addition to requirements specified elsewhere for environmental protection, provide coating materials that conform to the restrictions of the local Air Pollution Control District and regional jurisdiction. Notify Contracting Officer of any paint specified herein which fails to conform.

1.5.2 Lead Content

Do not use coatings having a lead content over 0.06 percent by weight of nonvolatile content.

1.5.3 Chromate Content

Do not use coatings containing zinc-chromate or strontium-chromate.

1.5.4 Asbestos Content

Materials shall not contain asbestos.

1.5.5 Mercury Content

Materials shall not contain mercury or mercury compounds.

1.5.6 Silica

Abrasive blast media shall not contain free crystilline silica.

1.5.7 Human Carcinogens

Materials shall not contain ACGIH 0100Doc and ACGIH 0100Doc confirmed human carcinogens (A1) or suspected human carcinogens (A2).

1.6 PACKAGING, LABELING, AND STORAGE

Paints shall be in sealed containers that legibly show the contract specification number, designation name, formula or specification number, batch number, color, quantity, date of manufacture, manufacturer's formulation number, manufacturer's directions including any warnings and special precautions, and name and address of manufacturer. Pigmented paints shall be furnished in containers not larger than 5 gallons. Paints and thinners shall be stored in accordance with the manufacturer's written directions, and as a minimum, stored off the ground, under cover, with sufficient ventilation to prevent the buildup of flammable vapors, and at temperatures between 40 to 95 degrees F.

1.7 SAFETY AND HEALTH

Apply coating materials using safety methods and equipment in accordance with the following:

Work shall comply with applicable Federal, State, and local laws and regulations, and with the ACCIDENT PREVENTION PLAN, including the Activity Hazard Analysis as specified in Appendix A of EM 385-1-1. The Activity Hazard Analysis shall include analyses of the potential impact of painting operations on painting personnel and on others involved in and adjacent to the work zone.

1.7.1 Safety Methods Used During Coating Application

Comply with the requirements of SSPC Guide 3.

1.7.2 Toxic Materials

To protect personnel from overexposure to toxic materials, conform to the most stringent guidance of:

a. The applicable manufacturer's Material Safety Data Sheets (MSDS) or local regulation.

b. 29 CFR 1910.1000.

c. ACGIH 0100Doc, threshold limit values.

1.8 ENVIRONMENTAL CONDITIONS

1.8.1 Coatings

Do not apply coating when air or substrate conditions are:

a. Less than 5 degrees F above dew point;

b. Below 50 degrees F or over 95 degrees F, unless specifically pre-approved by the Contracting Officer and the product manufacturer. Under no circumstances shall application conditions exceed manufacturer recommendations.

1.9 COLOR SELECTION

Colors of finish coats shall be as indicated or specified. Where not indicated or specified, colors shall be selected by the Contracting Officer. Manufacturers' names and color identification are used for the purpose of color identification only. Named products are acceptable for use only if they conform to specified requirements. Products of other manufacturers are acceptable if the colors approximate colors indicated and the product conforms to specified requirements.

Tint each coat progressively darker to enable confirmation of the number of coats.

Color, texture, and pattern of wall coating systems shall be in accordance with Section 09915 COLOR SCHEDULE.

1.10 LOCATION AND SURFACE TYPE TO BE PAINTED

1.10.1 Painting Included

Where a space or surface is indicated to be painted, include the following unless indicated otherwise.

a. Surfaces behind portable objects and surface mounted articles readily detachable by removal of fasteners, such as screws and bolts.

b. New factory finished surfaces that require identification or color coding and factory finished surfaces that are damaged during performance of the work.

c. Existing coated surfaces that are damaged during performance of the work.

1.10.1.1 Exterior Painting

Includes new surfaces and existing coated surfaces of the buildings and appurtenances. Also included are existing coated surfaces made bare by cleaning operations.

1.10.1.2 Interior Painting

Includes new surfaces, existing uncoated surfaces, and existing coated surfaces of the buildings and appurtenances as indicated and existing coated surfaces made bare by cleaning operations. Where a space or surface is indicated to be painted, include the following items, unless indicated otherwise.

a. Exposed columns, girders, beams, joists, and metal deck; and

b. Other contiguous surfaces.

1.10.2 Painting Excluded

Do not paint the following unless indicated otherwise.

a. Surfaces concealed and made inaccessible by panelboards, fixed ductwork, machinery, and equipment fixed in place.

b. Surfaces in concealed spaces. Concealed spaces are defined as enclosed spaces above suspended ceilings, furred spaces, and chases.

c. Steel to be embedded in concrete.

d. Copper, stainless steel, aluminum, brass, and lead except existing coated surfaces.

e. Hardware, fittings, and other factory finished items.

1.10.3 Mechanical and Electrical Painting

Includes field coating of interior and exterior new surfaces.

a. Where a space or surface is indicated to be painted, include the following items unless indicated otherwise.

(1) Exposed piping, conduit, and ductwork;

(2) Supports, hangers, air grilles, and registers;

(3) Miscellaneous metalwork and insulation coverings.

b. Do not paint the following, unless indicated otherwise:

(1) New zinc-coated, aluminum, and copper surfaces under insulation

(2) New aluminum jacket on piping

(3) New interior ferrous piping under insulation.

1.10.3.1 Fire Extinguishing Sprinkler Systems

Clean, pretreat, prime, and paint new fire extinguishing sprinkler systems including valves, piping, conduit, hangers, supports, miscellaneous metalwork, and accessories. Apply coatings to clean, dry surfaces, using clean brushes. Clean the surfaces to remove dust, dirt, rust, and loose mill scale. Immediately after cleaning, provide the metal surfaces with one coat primer per schedules. Shield sprinkler heads with protective covering while painting is in progress. Upon completion of painting, remove protective covering from sprinkler heads. Remove sprinkler heads which have been painted and replace with new sprinkler heads. Provide primed surfaces in finished areas with the following:

Piping in Finished Areas: Provide primed surfaces with two coats of paint to match adjacent surfaces, except provide valves and operating accessories with one coat of red alkyd gloss enamel applied to a minimum dry film thickness of 1.0 mil. Provide piping with 2 inch wide red enamel bands or self-adhering red plastic bands spaced at maximum of 20 foot intervals throughout the piping systems.

1.10.4 Exterior Painting of Site Work Items

Field coat the following items: Pipe Guards.

1.10.5 Definitions and Abbreviations

1.10.5.1 Qualification Testing

Qualification testing is the performance of all test requirements listed in the product specification. This testing is accomplished by MPI to qualify each product for the MPI Approved Product List, and may also be accomplished by Contractor's third party testing lab if an alternative to Batch Quality Conformance Testing by MPI is desired.

1.10.5.2 Batch Quality Conformance Testing

Batch quality conformance testing determines that the product provided is the same as the product qualified to the appropriate product specification. This testing shall only be accomplished by MPI testing lab.

1.10.5.3 Coating

A film or thin layer applied to a base material called a substrate. A coating may be a metal, alloy, paint, or solid/liquid suspensions on various substrates (metals, plastics, wood, paper, leather, cloth, etc.). They may be applied by electrolysis, vapor deposition, vacuum, or mechanical means such as brushing, spraying, calendering, and roller coating. A coating may be applied for aesthetic or protective purposes or both. The term "coating" as used herein includes emulsions, enamels, stains, varnishes, sealers, epoxies, and other coatings, whether used as primer, intermediate, or finish coat. The terms paint and coating are used interchangeably.

1.10.5.4 DFT or dft

Dry film thickness, the film thickness of the fully cured, dry paint or coating.

1.10.5.5 DSD

Degree of Surface Degradation, the MPI system of defining degree of surface degradation. Five (5) levels are generically defined under the Assessment sections in the MPI Maintenance Repainting Manual.

1.10.5.6 EPP

Environmentally Preferred Products, a standard for determining environmental preferability in support of Executive Order 13101.

1.10.5.7 EXT

MPI short term designation for an exterior coating system.

1.10.5.8 INT

MPI short term designation for an interior coating system.

1.10.5.9 micron / microns

The metric measurement for 0.001 mm or one/one-thousandth of a millimeter.

1.10.5.10 mil / mils

The English measurement for 0.001 in or one/one-thousandth of an inch, equal to 25.4 microns or 0.0254 mm.

1.10.5.11 mm

The metric measurement for millimeter, 0.001 meter or one/one-thousandth of a meter.

1.10.5.12 MPI Gloss Levels

MPI system of defining gloss. Seven (7) gloss levels (G1 to G7) are generically defined under the Evaluation sections of the MPI Manuals. Traditionally, Flat refers to G1/G2, Eggshell refers to G3, Semigloss refers to G5, and Gloss refers to G6.

Gloss levels are defined by MPI as follows:

Gloss Level	Description	Units @ 60 degrees	Units @ 85 degrees
G1	Matte or Flat	0 to 5	10 max
G2	Velvet	0 to 10	10 to 35
G3	Eggshell	10 to 25	10 to 35
G4	Satin	20 to 35	35 min
G5	Semi-Gloss	35 to 70	
G6	Gloss	70 to 85	
G7	High Gloss		

Gloss is tested in accordance with ASTM D 523. Historically, the Government has used Flat (G1 / G2), Eggshell (G3), Semi-Gloss (G5), and Gloss (G6).

1.10.5.13 MPI System Number

The MPI coating system number in each Division found in either the MPI Architectural Painting Specification Manual or the Maintenance Repainting Manual and defined as an exterior (EXT/REX) or interior system (INT/RIN). The Division number follows the CSI Master Format.

1.10.5.14 Paint

See Coating definition.

1.10.5.15 REX

MPI short term designation for an exterior coating system used in repainting projects or over existing coating systems.

1.10.5.16 RIN

MPI short term designation for an interior coating system used in repainting projects or over existing coating systems.

PART 2 PRODUCTS

2.1 MATERIALS

Conform to the coating specifications and standards referenced in PART 3. Submit manufacturer's technical data sheets for specified coatings and solvents.

PART 3 EXECUTION

3.1 PROTECTION OF AREAS AND SPACES NOT TO BE PAINTED

Prior to surface preparation and coating applications, remove, mask, or

otherwise protect, hardware, hardware accessories, machined surfaces, radiator covers, plates, lighting fixtures, public and private property, and other such items not to be coated that are in contact with surfaces to be coated. Following completion of painting, workmen skilled in the trades involved shall reinstall removed items. Restore surfaces contaminated by coating materials, to original condition and repair damaged items.

3.2 SURFACE PREPARATION

Remove dirt, splinters, loose particles, grease, oil, disintegrated coatings, and other foreign matter and substances deleterious to coating performance as specified for each substrate before application of paint or surface treatments. Oil and grease shall be removed prior to mechanical cleaning. Cleaning shall be programmed so that dust and other contaminants will not fall on wet, newly painted surfaces. Exposed ferrous metals such as nail heads on or in contact with surfaces to be painted with water-thinned paints, shall be spot-primmed with a suitable corrosion-inhibitive primer capable of preventing flash rusting and compatible with the coating specified for the adjacent areas.

3.2.1 Additional Requirements for Preparation of Surfaces With Existing Coatings

Before application of coatings, perform the following on surfaces covered by soundly-adhered coatings, defined as those which cannot be removed with a putty knife:

a. Wipe previously painted surfaces to receive solvent-based coatings, except stucco and similarly rough surfaces clean with a clean, dry cloth saturated with mineral spirits, ASTM D 235. Allow surface to dry. Wiping shall immediately precede the application of the first coat of any coating, unless specified otherwise.

b. Sand existing glossy surfaces to be painted to reduce gloss. Brush, and wipe clean with a damp cloth to remove dust.

c. The requirements specified are minimum. Comply also with the application instructions of the paint manufacturer.

d. Previously painted surfaces specified to be repainted or damaged during construction shall be thoroughly cleaned of all grease, dirt, dust or other foreign matter.

e. Blistering, cracking, flaking and peeling or other deteriorated coatings shall be removed.

f. Chalk shall be removed so that when tested in accordance with ASTM D 4214, the chalk resistance rating is no less than 8.

g. Slick surfaces shall be roughened. Damaged areas such as, but not limited to, nail holes, cracks, chips, and spalls shall be repaired with suitable material to match adjacent undamaged areas.

h. Edges of chipped paint shall be feather edged and sanded smooth.

i. Rusty metal surfaces shall be cleaned as per SSPC requirements. Solvent, mechanical, or chemical cleaning methods shall be used to provide surfaces suitable for painting.

j. New, proposed coatings shall be compatible with existing coatings.

3.2.2 Existing Coated Surfaces with Minor Defects

Sand, spackle, and treat minor defects to render them smooth. Minor defects are defined as scratches, nicks, cracks, gouges, spalls, alligatoring, chalking, and irregularities due to partial peeling of previous coatings. Remove chalking by sanding so that when tested in accordance with ASTM D 4214, the chalk rating is not less than 8.

3.2.3 Removal of Existing Coatings

Remove existing coatings from the following surfaces:

a. Surfaces containing large areas of minor defects;

b. Surfaces containing more than 20 percent peeling area; and

c. Surfaces designated by the Contracting Officer, such as surfaces where rust shows through existing coatings.

3.2.4 Substrate Repair

a. Repair substrate surface damaged during coating removal;

b. Sand edges of adjacent soundly-adhered existing coatings so they are tapered as smooth as practical to areas involved with coating removal; and

c. Clean and prime the substrate as specified.

3.3 PREPARATION OF METAL SURFACES

3.3.1 Existing and New Ferrous Surfaces

a. Ferrous Surfaces including Shop-coated Surfaces and Small Areas That Contain Rust, Mill Scale and Other Foreign Substances: Solvent clean or detergent wash in accordance with SSPC SP 1 to remove oil and grease. Where shop coat is missing or damaged, clean according to SSPC SP 2, SSPC SP 3, , or SSPC SP 10. Shop-coated ferrous surfaces shall be protected from corrosion by treating and touching up corroded areas immediately upon detection.

b. Surfaces With More Than 20 Percent Rust, Mill Scale, and Other Foreign Substances: Clean entire surface in accordance with SSPC SP 6/SSPC SP 12 WJ-3.

3.3.2 Final Ferrous Surface Condition:

For tool cleaned surfaces, the requirements are stated in SSPC SP 2 and SSPC SP 3. As a visual reference, cleaned surfaces shall be similar to photographs in SSPC VIS 3.

For abrasive blast cleaned surfaces, the requirements are stated in SSPC SP 7, SSPC SP 6, and SSPC SP 10. As a visual reference, cleaned surfaces shall be similar to photographs in SSPC VIS 1.

For waterjet cleaned surfaces, the requirements are stated in SSPC SP 12. As a visual reference, cleaned surfaces shall be similar to photographs in SSPC VIS 4.

3.3.3 Galvanized Surfaces

a. New or Existing Galvanized Surfaces With Only Dirt and Zinc Oxidation Products: Clean with solvent, steam, or non-alkaline detergent solution in accordance with SSPC SP 1. If the galvanized metal has been passivated or stabilized, the coating shall be completely removed by brush-off abrasive blast. New galvanized steel to be coated shall not be "passivated" or "stabilized" If the absence of hexavalent stain inhibitors is not documented, test as described in ASTM D 2092, Appendix X2, and remove by one of the methods described therein.

b. Galvanized with Slight Coating Deterioration or with Little or No Rusting: Water jetting to SSPC SP 12 WJ3 to remove loose coating from surfaces with less than 20 percent coating deterioration and no blistering, peeling, or cracking. Use inhibitor as recommended by the coating manufacturer to prevent rusting.

c. Galvanized With Severe Deteriorated Coating or Severe Rusting: Water jet to SSPC SP 12 WJ3 degree of cleanliness.

3.3.4 Non-Ferrous Metallic Surfaces

Aluminum and aluminum-alloy, lead, copper, and other nonferrous metal surfaces.

a. Surface Cleaning: Solvent clean in accordance with SSPC SP 1 and wash with mild non-alkaline detergent to remove dirt and water soluble contaminants.

3.3.5 Existing Surfaces with a Bituminous or Mastic-Type Coating

Remove chalk, mildew, and other loose material by washing with a solution of 1/2 cup trisodium phosphate, 1/4 cup household detergent, one quart 5 percent sodium hypochlorite solution and 3 quarts of warm water.

3.4 PREPARATION OF CONCRETE AND CEMENTITIOUS SURFACE

3.4.1 Concrete and Masonry

a. Curing: Masonry surfaces shall be allowed to cure at least 30 days before painting.

b. Surface Cleaning: Remove the following deleterious substances.

(1) Dirt, Chalking, Grease, and Oil: Wash new and existing uncoated surfaces with a solution composed of 1/2 cup trisodium phosphate, 1/4 cuphousehold detergent, and 4 quarts of warm water. Then rinse thoroughly with fresh water. Wash existing coated surfaces with a suitable detergent and rinse thoroughly. For large areas, water blasting may be used.

(2) Fungus and Mold: Wash new, existing coated, and existing uncoated surfaces with a solution composed of 1/2 cup trisodium

phosphate, 1/4 cup household detergent, 1 quart 5 percent sodium hypochlorite solution and 3 quarts of warm water. Rinse thoroughly with fresh water.

(3) Paint and Loose Particles: Remove by wire brushing.

(4) Efflorescence: Remove by scraping or wire brushing followed by washing with a 5 to 10 percent by weight aqueous solution of hydrochloric (muriatic) acid. Do not allow acid to remain on the surface for more than five minutes before rinsing with fresh water. Do not acid clean more than 4 square feet of surface, per workman, at one time.

c. Cosmetic Repair of Minor Defects: Repair or fill mortar joints and minor defects, including but not limited to spalls, in accordance with manufacturer's recommendations and prior to coating application.

d. Allowable Moisture Content: Latex coatings may be applied to damp surfaces, but not to surfaces with droplets of water. Do not apply epoxies to damp vertical surfaces as determined by ASTM D 4263 or horizontal surfaces that exceed 3 lbs of moisture per 1000 square feet in 24 hours as determined by ASTM F 1869. In all cases follow manufacturers recommendations. Allow surfaces to cure a minimum of 30 days before painting.

3.4.2 Gypsum Board

a. Surface Cleaning: Gypsum board shall be dry. Remove loose dirt and dust by brushing with a soft brush, rubbing with a dry cloth, or vacuum-cleaning prior to application of the first coat material. A damp cloth or sponge may be used if paint will be water-based.

b. Repair of Minor Defects: Prior to painting, repair joints, cracks, holes, surface irregularities, and other minor defects with patching plaster or spackling compound and sand smooth.

c. Allowable Moisture Content: Latex coatings may be applied to damp surfaces, but not surfaces with droplets of water. Do not apply epoxies to damp surfaces as determined by ASTM D 4263.

3.5 PREPARATION OF WOOD AND PLYWOOD SURFACES

3.5.1 New Plywood and Wood Surfaces, Except Floors:

a. Wood surfaces shall be cleaned of foreign matter.

Surface Cleaning: Surfaces shall be free from dust and other deleterious substances and in a condition approved by the Contracting Officer prior to receiving paint or other finish. Do not use water to clean uncoated wood. Scrape to remove loose coatings. Lightly sand to roughen the entire area of previously enamel-coated wood surfaces.

b. Moisture content of the wood shall not exceed 12 percent as

measured by a moisture meter in accordance with ASTM D 4444, Method A, unless otherwise authorized.

c. Wood surfaces adjacent to surfaces to receive water-thinned paints shall be primed and/or touched up before applying water-thinned paints.

d. Cracks and Nailheads: Set and putty stop nailheads and putty cracks after the prime coat has dried.

e. Cosmetic Repair of Minor Defects:

(1) Knots and Resinous Wood: Prior to application of coating, cover knots and stains with two or more coats of 3-pound-cut shellac varnish, plasticized with 5 ounces of castor oil per gallon. Prime before applying any putty over shellacked area.

(2) Open Joints and Other Openings: Fill with whiting putty, linseed oil putty. Sand smooth after putty has dried.

(3) Checking: Where checking of the wood is present, sand the surface, wipe and apply a coat of pigmented orange shellac. Allow to dry before paint is applied.

3.5.2 Interior Wood Surfaces, Stain Finish

Interior wood surfaces to receive stain shall be sanded. Oak and other open-grain wood to receive stain shall be given a coat of wood filler not less than 8 hours before the application of stain; excess filler shall be removed and the surface sanded smooth.

3.6 APPLICATION

3.6.1 Coating Application

Painting practices shall comply with applicable federal, state and local laws enacted to insure compliance with Federal Clean Air Standards. Apply coating materials in accordance with SSPC PA 1. SSPC PA 1 methods are applicable to all substrates, except as modified herein.

At the time of application, paint shall show no signs of deterioration. Uniform suspension of pigments shall be maintained during application.

Unless otherwise specified or recommended by the paint manufacturer, paint may be applied by brush, roller, or spray. Rollers for applying paints and enamels shall be of a type designed for the coating to be applied and the surface to be coated.

Paints, except water-thinned types, shall be applied only to surfaces that are completely free of moisture as determined by sight or touch.

Thoroughly work coating materials into joints, crevices, and open spaces. Special attention shall be given to insure that all edges, corners, crevices, welds, and rivets receive a film thickness equal to that of adjacent painted surfaces.

Each coat of paint shall be applied so dry film shall be of uniform thickness and free from runs, drops, ridges, waves, pinholes or other

voids, laps, brush marks, and variations in color, texture, and finish. Hiding shall be complete.

Touch up damaged coatings before applying subsequent coats. Interior areas shall be broom clean and dust free before and during the application of coating material.

Apply paint to new fire extinguishing sprinkler systems in Finished Areas including valves, piping, conduit, hangers, supports, miscellaneous metal work, and accessories. Shield sprinkler heads with protective coverings while painting is in progress. Remove sprinkler heads which have been painted and replace with new sprinkler heads. Do not prime or paint piping in unfinished spaces. Unfinished spaces include spaces above suspended ceilings, pipe chases, mechanical equipment room, and space where walls or ceiling are not painted. For piping in finished areas, provide prime surfaces with two coats of paint to match adjacent surfaces, except provide valves and operating accessories with one coat of red alkyd gloss enamel. Upon completion of painting, remove protective covering from sprinkler heads.

a. Drying Time: Allow time between coats, as recommended by the coating manufacturer, to permit thorough drying, but not to present topcoat adhesion problems. Provide each coat in specified condition to receive next coat.

b. Primers, and Intermediate Coats: Do not allow primers or intermediate coats to dry more than 30 days, or longer than recommended by manufacturer, before applying subsequent coats. Follow manufacturer's recommendations for surface preparation if primers or intermediate coats are allowed to dry longer than recommended by manufacturers of subsequent coatings. Each coat shall cover surface of preceding coat or surface completely, and there shall be a visually perceptible difference in shades of successive coats.

c. Finished Surfaces: Provide finished surfaces free from runs, drops, ridges, waves, laps, brush marks, and variations in colors.

d. Thermosetting Paints: Topcoats over thermosetting paints (epoxies and urethanes) should be applied within the overcoating window recommended by the manufacturer.

3.6.2 Mixing and Thinning of Paints

Reduce paints to proper consistency by adding fresh paint, except when thinning is mandatory to suit surface, temperature, weather conditions, application methods, or for the type of paint being used. Obtain written permission from the Contracting Officer to use thinners. The written permission shall include quantities and types of thinners to use.

When thinning is allowed, paints shall be thinned immediately prior to application with not more than 1 pint of suitable thinner per gallon. The use of thinner shall not relieve the Contractor from obtaining complete hiding, full film thickness, or required gloss. Thinning shall not cause the paint to exceed limits on volatile organic compounds. Paints of different manufacturers shall not be mixed.

3.6.3 Two-Component Systems

Two-component systems shall be mixed in accordance with manufacturer's instructions. Any thinning of the first coat to ensure proper penetration and sealing shall be as recommended by the manufacturer for each type of substrate.

3.6.4 Coating Systems

a. Systems by Substrates: Apply coatings that conform to the respective specifications listed in the following Tables:

Table

Division 4. Exterior Concrete Masonry Units Paint Table
Division 5. Exterior Metal, Ferrous and Non-Ferrous Paint Table

Division 4. Interior Concrete Masonry Units Paint Table
Division 5. Interior Metal, Ferrous and Non-Ferrous Paint Table
Division 6. Interior Wood Paint Table
Division 9: Interior Plaster, Gypsum Board, Textured Surfaces Paint Table

b. Minimum Dry Film Thickness (DFT): Apply paints, primers, varnishes, enamels, undercoats, and other coatings to a minimum dry film thickness of 1.5 mil each coat unless specified otherwise in the Tables. Coating thickness where specified, refers to the minimum dry film thickness.

c. Coatings for Surfaces Not Specified Otherwise: Coat surfaces which have not been specified, the same as surfaces having similar conditions of exposure.

d. Existing Surfaces Damaged During Performance of the Work, Including New Patches In Existing Surfaces: Coat surfaces with the following:

(1) One coat of primer.

(2) One coat of undercoat or intermediate coat.

(3) One topcoat to match adjacent surfaces.

e. Existing Coated Surfaces To Be Painted: Apply coatings conforming to the respective specifications listed in the Tables herein, except that pretreatments, sealers and fillers need not be provided on surfaces where existing coatings are soundly adhered and in good condition. Do not omit undercoats or primers.

3.7 COATING SYSTEMS FOR METAL

Apply coatings of Tables in Division 5 for Exterior and Interior.

a. Apply specified ferrous metal primer on the same day that surface is cleaned, to surfaces that meet all specified surface preparation requirements at time of application.

b. Inaccessible Surfaces: Prior to erection, use one coat of specified primer on metal surfaces that will be inaccessible after erection.

c. Shop-primed Surfaces: Touch up exposed substrates and damaged coatings to protect from rusting prior to applying field primer.

d. Surface Previously Coated with Epoxy or Urethane: Apply MPI 101, 1.5 mils DFT immediately prior to application of epoxy or urethane coatings.

e. Pipes and Tubing: The semitransparent film applied to some pipes and tubing at the mill is not to be considered a shop coat, but shall be overcoated with the specified ferrous-metal primer prior to application of finish coats.

f. Exposed Nails, Screws, Fasteners, and Miscellaneous Ferrous Surfaces. On surfaces to be coated with water thinned coatings, spot prime exposed nails and other ferrous metal with latex primer MPI 107.

3.8 COATING SYSTEMS FOR CONCRETE AND CEMENTITIOUS SUBSTRATES

Apply coatings of Tables in Division 4 and 9 for Exterior and Interior.

3.9 COATING SYSTEMS FOR WOOD AND PLYWOOD

a. Apply coatings of Tables in Division 6 for Exterior and Interior.

b. Prior to erection, apply two coats of specified primer to treat and prime plywood surfaces which will be inaccessible after erection.

c. Apply stains in accordance with manufacturer's printed instructions.

3.10 PIPING IDENTIFICATION

Piping Identification, Including Surfaces In Concealed Spaces: Provide in accordance with MIL-STD-101. Place stenciling in clearly visible locations. On piping not covered by MIL-STD-101, stencil approved names or code letters, in letters a minimum of 1/2 inch high for piping and a minimum of 2 inches high elsewhere. Stencil arrow-shaped markings on piping to indicate direction of flow using black stencil paint.

3.11 INSPECTION AND ACCEPTANCE

In addition to meeting previously specified requirements, demonstrate mobility of moving components, including swinging doors and cabinets for inspection by the Contracting Officer. Perform this demonstration after appropriate curing and drying times of coatings have elapsed and prior to invoicing for final payment.

3.12 PAINT TABLES

All DFT's are minimum values.

3.12.1 EXTERIOR PAINT TABLES

DIVISION 4: EXTERIOR CONCRETE MASONRY UNITS PAINT TABLE

A. New concrete masonry on uncoated surface:

1. Latex

New; MPI EXT 4.2A-G5 (Semigloss)

Block Filler:	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 11	MPI 11

System DFT: 11 mils

B. Existing concrete masonry on coated surface:

1. Latex

Primer:	Intermediate:	Topcoat:
MPI 17	MPI 11	MPI 11

System DFT: Per Manufacturer

DIVISION 5: EXTERIOR METAL, FERROUS AND NON-FERROUS PAINT TABLE

STEEL / FERROUS SURFACES

A. New Steel that has been blast-cleaned to SSPC SP 6:

1. Alkyd

New; MPI EXT 5.1C-G5 (Semi Gloss) / Existing; MPI REX 5.1C-G5

Primer:	Intermediate:	Topcoat:
MPI 79	MPI 163	MPI 163

System DFT: Per Manufacturer

EXTERIOR GALVANIZED SURFACES

B. New Galvanized surfaces:

1. Epoxy Primer / Waterborne Light Industrial Coating
MPI EXT 5.3K-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 101	MPI 153	MPI 153

System DFT: 5 mils

3.12.2 INTERIOR PAINT TABLES

DIVISION 4: INTERIOR CONCRETE MASONRY UNITS PAINT TABLE

A. New Concrete masonry units in areas requiring a high degree of sanitation, and
other high humidity areas unless otherwise specified:

1. Waterborne Light Industrial Coating

MPI INT 4.2K-G5(Semigloss)

Filler:	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 153	MPI 153

System DFT: 11 mils

Fill all holes in masonry surface

DIVISION 5: INTERIOR METAL, FERROUS AND NON-FERROUS PAINT TABLE

INTERIOR STEEL / FERROUS SURFACES

A. Metal, Mechanical, Electrical, Surfaces adjacent to
painted surfaces (Match surrounding finish),and
miscellaneous metal items not otherwise specified except floors, hot metal
surfaces, and new prefinished equipment:

1. Alkyd

MPI INT 5.1E-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 79	MPI 47	MPI 47

System DFT: 5.25 mils

B. Metal floors (non-shop-primed surfaces or non-slip deck surfaces) with
non-skid additive (NSA), load at manufacturer's recommendations.:

1. 1Alkyd Floor Paint
MPI INT 5.1U-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 79	MPI 27	MPI 27 (+NSA)

System DFT: 5.25 mils 1

C. Metal roof floor deck, roof trusses, joists, and miscellaneous
mechanical and electrical items in Gymnasium not otherwise specified:

1. Latex Dry Fog/Fall

INTERIOR STEEL / FERROUS SURFACES
MPI INT 5.1cc (Eggshell)
Spot Primer: Topcoat:
MPI 275 MPI 118
System DFT: per manufactuarer.

Provide eggshell finish.

DIVISION 6: INTERIOR WOOD PAINT TABLE

A. New plywood telephone and electronic backboards:

1. Interior Latex Fire Retardant Flat Coating
Primer: Topcoat:
MPI 46 MPI 64

B. New Wood
except floors; natural finish or stained:

1. Natural finish, oil-modified polyurethane
New; MPI INT 6.4J-G4
Primer: Intermediate: Topcoat:
MPI 57 MPI 57 MPI 57
System DFT: 4 mils

DIVISION 9: INTERIOR PLASTER, GYPSUM BOARD, TEXTURED SURFACES PAINT TABLE

A. New and Existing, previously painted Wallboard not
otherwise specified:

1. High Performance Architectural Latex - High Traffic Areas
New; MPI INT 9.2B-G2 (Flat) / Existing; MPI RIN 9.2B-G2 (Flat)
Primer: Intermediate: Topcoat:
MPI 50 MPI 138 MPI 138
System DFT: 4 mils

B. New and Existing, previously painted Wallboard in
toilets, restrooms, laundry
areas, shower areas, areas requiring a high degree of sanitation, and
other high humidity areas not otherwise specified.:

1. Waterborne Light Industrial Coating (Epoxy)
New; MPI INT 9.2F(Semigloss) / Existing; MPI RIN 9.2F (Semigloss)
Primer: Intermediate: Topcoat:
MPI 50 MPI 115 MPI 115
System DFT: 4 mils

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DIVISION 09 - FINISHES

SECTION 09915

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08/02

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SECTION 09915

COLOR SCHEDULE
08/02

PART 1 GENERAL

1.1 GENERAL

This section covers only the color of the exterior and interior materials and products that are exposed to view in the finished construction. The word "color" as used herein includes surface color and pattern. Requirements for quality and method of installation are covered in other appropriate sections of the specifications. Specific locations where the various materials are required are shown on the drawings. Items not designated for color in this section may be specified in other sections. When color is not designated for items, the Contractor shall propose a color for approval.

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-04 Samples

Color Schedule; G-AE

2 sets of color boards, 120 days after the Contractor is given Notice to proceed, complying with the following requirements:

a. Color boards shall reflect all actual finish textures, patterns, and colors required for this contract.

b. Materials shall be labeled with the finish type, manufacturer's name, pattern, and color reference.

c. Samples shall be on size 8-1/2 by 11 inch boards with a maximum spread of size 25-1/2 by 33 inches for foldouts.

d. Samples for this color board are required in addition to samples requested in other specification sections.

e. Color boards shall be submitted to the following addresses: to be coordinated with Area Offices and A/E.

PART 2 PRODUCTS

2.1 REFERENCE TO MANUFACTURER'S COLOR

Where color is shown as being specific to one manufacturer, an equivalent color by another manufacturer may be submitted for approval. Manufacturers and materials specified are not intended to limit the selection of equal

colors from other manufacturers.

2.2 COLOR SCHEDULE

The color schedule lists the colors, patterns and textures required for exterior and interior finishes, including both factory applied and field applied colors.

2.2.1 Exterior Walls

Exterior wall colors shall apply to exterior wall surfaces including recesses at entrances and projecting vestibules. Conduit shall be painted to closely match the adjacent surface color. Wall color shall be provided to match the colors listed below.

2.2.1.1 Brick:
Brick-1: Hebron Brick Co, MAFB standard blend of 2/3 Red and 1/3 Maroon
Brick-2: Hebron Brick Co, Toasted Gray

2.2.1.2 Mortar:
M-1: Match existing grey mortar.

2.2.1.3 Paint: Painting of existing concrete block - match existing

2.2.1.4 Metal Wall Panels, Hardware, and Associated Trim:
Centria, Color: Champagne Bronze #9948

2.2.1.5 Precast Stone: Color to match brick Brick-2

2.2.1.6 Glass and Glazing:
GL-1: Viracon, Gray vision glass
GL-2: Viracon, Dark Gray Spandrell glazing

2.2.2 Exterior Trim

Exterior trim shall be provided to match the colors listed below.

2.2.2.1 Steel Doors and Door Frames:
PNT-10:

2.2.2.2 Aluminum Doors and Door Frames:
Champagne anodized

2.2.2.3 Aluminum Windows (mullion, muntin, sash, trim, and sill):
Champagne anodized

2.2.2.4 Fascia:
MBCI, Dark Bronze #154

2.2.2.5 Soffits and Ceilings:
MBCI, Dark Bronze #154

2.2.2.6 Louvers, and Flashings:
Louvers in Brick-1: PNT-11 Sherwin Willians, Color: Mesquite Brown #SW1336
Louvers in Brick-2: PNT-12 Sherwin Williams, Color Sanderling #SW2030

2.2.2.7 Precast Stone Sills:
PS-1: Continental Cast Stone, Color: #1104

2.2.2.8 Caulking and Sealants:
[_____]

2.2.3 Exterior Roof

Roof color shall apply to exterior roof surfaces including sheet metal flashings and copings, mechanical units, roof trim, pipes, conduits, electrical appurtenances, and similar items. Roof color shall be provided to match the colors listed below.

2.2.3.1 Metal:
MBCI, Dark Bronze #154

2.2.3.2 Penetrations:
Shall match roof in color.

2.2.4 Interior Floor Finishes

Flooring materials shall be provided to match the colors listed below.

2.2.4.1 Carpet:
CPT-1: J&J Commercial Style Center Stage 2655, Color: Costume #3858

2.2.4.2 Carpet Tile:
CPT-2: Lee's, First Step T, L8512, Color: Charcoal Gray #508

2.2.4.3 Resilient Textile Sheet Flooring

RTSF-1: Lee's Neoflor, Pattern Montana #N023F, Color: Anthracite #028
RTSF-2: Lee's Neofloor, Pattern Montana #N023F, Color: Grey #048
RTSF-3: NOT USED
RTSF-4: Lee's Neofloor, Pattern Montana #N023F, Color: Ocean #027
RTSF-5: Lee's Neofloor, Pattern Montana #N023F, Color: Red #013

2.2.4.4 Vinyl Composition Tile:
VCT-1: Mannington, Essentials, Color: Glacier #122

2.2.4.5 Sheet Vinyl:
SV-1: Armstrong, Translations, Color: Wheat
SV-2: Gerfloor Taraflex Sport M, Color: Silver Gray #6758 (Running track)
Gerfloor Taraflex Sport M, Color:Lagoon #6445 (Stretching areas)

2.2.4.6 Rubber Tile:
RBR-1: To Market/Atmosphere, Style;: Synthesis, Color: #TM701
RBR-2: To Market/Atmosphere, Style;: Synthesis, Color #TM701

2.2.4.7 Stair Treads, Kick Strips, and Risers:
RST: Johnsonite, Hammered Speckled, Color: Ming Blue #715

2.2.4.8 Ceramic Tile:
CT-1: Crossville Cross-Colors Mosaics, Color: Pepper Quartz #A291UPS
CT-2: Crossville Cross-Colors Mosaics, Color: Pepper Quartz #A291CTS
CT-6: Crossville Cross-Colors Mosaics, Color: Windsurf A583 UPS (8 x 8)
CT-7: Crossville Cross-Colors Mosaics, Color: Steel Blue #A815UPS (8 x 8)
CT-8: Crossville Cross-Colors Mosaics, Color: Oceana #A580UPS (8 x 8)

2.2.4.9 Porcelain Tile:
PT-1: Crossville Strong Series, Color: Nero #VS105

2.2.4.10 Grout:
GR-1: Laticrete Spectralock, Color: Almond 85 (Wall CT)
GR-2: Laticrete Spectralock, Color: Platinum #42 (PT-1)
GT-3: Laticrete Spectralock, Color: Latte #40 (Floor CT)

2.2.5 Interior Base Finishes

Base materials shall be provided to match the colors listed below.

2.2.5.1 Resilient Base and Moldings:
VB-1: Johnsonite, Color: Charcoal #20
RB-1: Johnsonite, Color: Charcoal #20

2.2.5.2 Ceramic Tile:
CTB-1: Crossville Cross Colors Mosaics, Color: PepperQuartz #A291UPS (CT-1,2)

2.2.5.3 Porcelain Tile:
PTB-1: Crossville Strong Series #VS105SBN, Color: Nero (PT-1)

2.2.5.4 Grout:
GR-1: Laticrete Spectralock, Color: Almond #85 (Floor CT)
GR-2: Laticrete Spectralock, Color: Platinum #42 (PT-1)

2.2.6 Interior Wall Finishes

Interior wall color shall apply to the entire wall surface, including reveals, vertical furred spaces, grilles, diffusers, electrical and access panels, and piping and conduit adjacent to wall surfaces unless otherwise specified. Items not specified in other paragraphs shall be painted to match adjacent wall surface. Wall materials shall be provided to match the colors listed below.

2.2.6.1 Paint:
PNT-1: Martin Senour, Color: Down Pillow #9-7 (WW)
PNT-2: Martin Senour, Color: Frescoe Gray #9-6 (WW)
PNT-3: Benjamin Moore, Color: Pueblo Brown #2102-30 (Wall Accent)
PNT-4: Martin Senour, Color: Blue Chip #116-5 (MT) (Wall Accent)
PNT-5: Martin Senour, Color: Stipple Grey #9-5 (MT)
PNT-6: NOT USED
PNT-7: NOT USED

2.2.6.2 Ceramic Tile:
CT-3: Crossville Cross-Colors Mosaics, Color: Empress White #A215GL (8 x 8)
CT-4: NOT USED
CT-5: NOT USED
CT-6: Crossville Cross-Colors Mosaics, Color: Windsurf #A583UPS (8 x 8)
CT-7: Crossville Cross-Colors Mosaics, Color: Steel Blue #A815UPS (8 x 8)
CT-8: Crossville Cross-Colors Mosaics, Color: Oceana #A580UPS (8 x 8)

2.2.6.3 Ceramic Tile Grout:
Laticrete Spectralock, Color: Parchment #61

2.2.6.4 Prefaced Concrete Masonry Units:
[_____]

2.2.6.5 Columns:
PNT-5: Martin Senour, Color: Stipple Gray #9-5 (MT)

2.2.7 Interior Ceiling Finishes

Ceiling colors shall apply to ceiling surfaces including soffits, furred down areas, grilles, diffusers, registers, and access panels. Ceiling color shall also apply to joist, underside of roof deck, and conduit and piping where joists and deck are exposed and required to be painted. Ceiling materials shall be provided to match the colors listed below.

2.2.7.1 Acoustical Tile and Grid: Grid White
ACT-1: Armstrong Cirrus (Admin)
ACT-2: Armstrong Ceramaguard Perforated
ACT-3: Armstrong Ceramaguard Non-perforated (Kitchen, Laundry)

2.2.7.2 Paint:

PNT-9: Benjamin Moore, Color: Ready Mix White

2.2.7.3 Metal Deck:
[_____]

2.2.7.4 Structural Framing:
[_____]

2.2.8 Interior Trim

Interior trim shall be provided to match the colors listed below.

2.2.8.1 Steel Doors:
PNT-5: Martin Senour, Color: Stiple Gray #9-5 (MT)

2.2.8.2 Steel Door Frames:
PNT-5: Martin Senour, Color: Stipple Gray #9-5 (MT)

2.2.8.3 Steel Windows (mullion, muntin, sash, trim, and stool):
PNT-5: Martin Senour, Color: Stipple Gray #9-5 (MT)

2.2.8.4 Aluminum Doors and Door Frames:
Champagne Anodized

2.2.8.5 Aluminum Windows (mullion, muntin, sash, trim, and sill):
Champagne Anodized

2.2.8.6 Wood Doors:
WD-1: Red Oak, clear finish, plain-sliced

2.2.8.7 Window Sills:
SS-2: Corian, Color: Savannah

2.2.8.8 Fire Extinguisher Cabinets:
Manufacturer standard white

2.2.8.9 Handrails:
PNT-4: Martin Senour, Color: Bluechip #116-5 (Lobby, Gym

handrails)
PNT-5: Martin Senour, Color: Stipple Gray #9-5 (MT)

2.2.8.10 Ladders:
PNT-5: Martin Senour, Color: Stipple Gray #9-5 (MT)

2.2.8.11 Metal Stairs: Stringers
PNT-5: Martin Senour, Color: Stipple Gray #9-5 (MT)

2.2.8.12 Exposed Ductwork:
[_____]

2.2.9 Interior Window Treatment

Window treatments shall be provided to match the colors listed below.

2.2.9.1 Window Shades:
WS-1: Meccoshade EuroVeil 5300, Color: Silver Brich #5306

2.2.10 Interior Miscellaneous

Miscellaneous items shall be provided to match the colors listed below.

2.2.10.1 Toilet Partitions and Urinal Screens:
PL-4: Bobrick, Wilsonart Beige #1530-60

2.2.10.2 Plastic Laminate:
PL-1: Wilsonart, Color: Windswept Pewter #4795-60
PL-2: Wilsonart, Color: Dove Moraine #4640-60
PL-3: Wilsonart, Color: Caldera Beige #4608-60

2.2.10.3 Solid Surfacing Material:
SS-1: Corian, Color: Gray Fieldstone (Lobby millwork) (DV vanity tops and thresholds)
SS-2: Corian, Color: Savannah (Vanity tops, thresholds)

2.2.10.4 Wood Lockers:
Hollman, Clear Stain on Mahogany

2.2.10.5 Metal Lockers (Optin 4)

LKR-1: Lyon, Color: #BN933-LT
LKR-2: Lyon, Color: #GY647-5G

2.2.10.6 Signage Message Color (excluding handicapped signage):
PNT-1

2.2.10.7 Signage Background Color (excluding handicapped signage):
PNT-3

2.2.10.8 Operable Partitions:
OP-1: Side facing Room 109A: VWC-1 Memerase Colorwall, Color: Chalk #MCW-6002 - Side facing Room 109B: Hufcor Classic, Color: Chardonnay #33-13
OP-2: Both sides to receive MDC, Cass #ISP55756 (VWC-2)

2.2.10.9 Visual Display Boards:

VWC-1: Memerase, Colorwall, Color: Chalk #MCW-6002

2.2.10.10 Corner Guards:
CG-1: Acrovyn Co-8/SCO-8, Finish: Stainless Steel

2.2.10.11 Wall Switch Handles and Standard Receptacle Bodies:
Gray

2.2.10.12 Electrical Device Cover Plates:
Stainless Steel

2.2.10.13 Electrical Panels:
PNT-1

2.2.10.14 Wood Benches (DV Locker Rooms)

Clear Stain on Mahogany. Top surface: Neofloor Montana, Color: Anthracite #028

2.2.10.15 Metal Base, Wood Top Benches

Base: Lyon GY647-5G
Top: Clear finish on maple

2.2.10.16 Shower Doors:
[_____]

2.2.10.17 Fabric for Juice Bar Banquette Seating
FAB-1: ArcCom Pattern: Broadway #AC-67004, Color: Mulberry #5, Finish: Crypton

PART 3 EXECUTION (Not Applicable)

-- End of Section --

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SECTION 10100A

VISUAL COMMUNICATIONS SPECIALTIES

07/02

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1.3 SUBMITTALS
1.4 DELIVERY, STORAGE AND HANDLING
1.5 WARRANTY

PART 2 PRODUCTS

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2.2 MATERIALS
2.2.1 Flexible Dry-Erase Surface
2.2.2 Aluminum
2.3 FLEXIBLE DRY-ERASE WRITING SURFACE

PART 3 EXECUTION

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3.2 CLEANING

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SECTION 10100A

VISUAL COMMUNICATIONS SPECIALTIES
07/02

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM B 221	(2002) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

1.2 GENERAL REQUIREMENTS

The term visual display board when used herein includes flexible dry-erase writing surface. Visual display boards shall be from manufacturer's standard product line.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Visual Display Boards; G-AE

Manufacturer's descriptive data and catalog cuts. Manufacturer's installation instructions, and cleaning and maintenance instructions.

SD-04 Samples

Aluminum; G-AE

Sections of frame, and chalktray.

Flexible Dry-Erase Surface

Section of material showing the lamination of vinyl wall covering. Samples shall be minimum 8 by 8 inches and show range of color.

SD-07 Certificates

Visual Display Boards

Certificate of compliance signed by Contractor attesting that visual display boards conform to the requirements specified.

1.4 DELIVERY, STORAGE AND HANDLING

Materials shall be delivered to the building site in the manufacturer's original unopened containers and shall be stored in a clean dry area with temperature maintained above 50 degrees F. Materials shall be stacked according to manufacturer's recommendations. Visual display boards shall be allowed to acclimate to the building temperature for 24 hours prior to installation.

1.5 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one year period shall be provided.

PART 2 PRODUCTS

2.1 COLOR

Finish colors for required items shall be as specified in Section 09915 COLOR SCHEDULE.

2.2 MATERIALS

2.2.1 Flexible Dry-Erase Surface

Dry-erase writing surface shall meet the requirements for a Type II wall covering specification. It shall be 23 mil thick, meet 160 x 160 tensile strength and 82 x 89 tear strength. It shall be available in widths as required and of unlimited length to provide a seamless writing surface, Class "A" fire rated, cadmium and mercury free, and shall not contain nor degrade to perfluorooctanic acid (PFOA). Surface must be easily cleanable and resistant to staining.

2.2.2 Aluminum

Aluminum frame extrusions shall be alloy 6063-T5 or 6063-T6, conform to ASTM B 221, and be a minimum 0.06 inches thick. Exposed aluminum shall have an anodized, satin finish. Straight, single lengths shall be used wherever possible. Joints shall be kept to a minimum.

2.3 FLEXIBLE DRY-ERASE WRITING SURFACE

Dry erase writing surface shall be field installed with a flexible dry erase writing surface, snap-on aluminum trim and tray. Writing surface shall be installed horizontally, without seams. Trim shall be cut to length, without joints, and installed along top and side edges. Tray shall extend along full length of bottom edge. Dry-erase markings shall be removable with a felt eraser or dry cloth without ghostng. Each unit shall come complete with an eraser and four different color compatible dry-erase markers. The size shall be as shown on the drawings.

PART 3 EXECUTION

3.1 INSTALLATION

Installation and assembly shall be in accordance with manufacturer's printed instructions. Concealed fasteners shall be used. Visual display boards shall be attached to the walls with suitable devices to anchor each unit. The Contractor shall furnish and install trim items, accessories and miscellaneous items in total, including but not limited to hardware, grounds, clips, backing materials, adhesives, brackets, and anchorages incidental to or necessary for a sound, secure, complete and finished installation. Installation shall not be initiated until completion of room painting and finishing operations. Visual display boards shall be installed in locations and at mounting heights indicated. Visual display boards shall be installed level and plumb, and if applicable doors shall be aligned and hardware shall be adjusted. Damaged materials shall be repaired or replaced by the Contractor as directed by the Contracting Officer.

3.2 CLEANING

Writing surfaces shall be cleaned in accordance with manufacturer's instructions.

-- End of Section --

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DIVISION 10 - SPECIALTIES

SECTION 10153

TOILET PARTITIONS

11/03

PART 1 GENERAL

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2.5.1 Colors
2.5.2 Finishes

PART 3 EXECUTION

3.1 INSTALLATION
3.2 ADJUSTING AND CLEANING

-- End of Section Table of Contents --

SECTION 10153

TOILET PARTITIONS
11/03

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

36 CFR 1191	Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-60003	(Basic) Partitions, Toilet, Complete

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation; G-AE

Drawings showing plans, elevations, details of construction, hardware, reinforcing, fittings, mountings, and anchorings.

SD-03 Product Data

Toilet Partition System; G-AE

Shower Seats; G-AE

Manufacturer's technical data and catalog cuts including installation and cleaning instructions.

SD-04 Samples

Colors and Finishes; G-AE

Manufacturer's standard color charts and color samples.

1.3 SYSTEM DESCRIPTION

Toilet partition system, including toilet enclosures and urinal screens, shall be a complete and usable system of panels, hardware, and support components. The Contractor shall comply with EPA requirements in accordance with Section 01670 RECYCLED / RECOVERED MATERIALS. The partition system shall be provided by a single manufacturer, and shall be a standard product as shown in the most recent catalog data. The partition system shall be as shown.

1.4 DELIVERY, STORAGE, AND HANDLING

Components shall be delivered to the jobsite in the manufacturer's original packaging with the brand, item identification, and project reference clearly marked. Components shall be stored in a dry location that is adequately ventilated; free from dust, water, or other contaminants; and shall have easy access for inspection and handling.

1.5 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

PART 2 PRODUCTS

2.1 TOILET ENCLOSURES

Toilet enclosures shall conform to CID A-A-60003, Type I, Style C, floor mounted overhead braced. Width, length, and height of toilet enclosures shall be as shown. Finish surface of panels shall be solidly fused plastic laminate with matte finish melamine surfaces integrally bonded to black phenolic-resin core. Panels indicated to receive toilet paper holders or grab bars as specified in Section 10800 TOILET ACCESSORIES, shall be reinforced for mounting of the items required. Grab bars shall withstand a bending stress, shear stress, shear force, and a tensile force induced by 250 lbf. Grab bars shall not rotate within their fittings.

2.2 URINAL SCREENS

Urinal screens shall conform to CID A-A-60003, Type III, wall mounted. Finish surface of screens shall be solidly fused plastic laminate with matte finish melamine surfaces integrally bonded to black phenolic-resin core. Width and height of urinal screens shall be as shown. Secure wall hung urinal screens with 42 inch long, continuous flanges.

2.3 SHOWER SEATS

Shower seats shall be wall mounted. Finish surface of seats shall be solidly fused plastic laminate with matte finish melamine surfaces integrally bonded to black phenolic-resin core. Seats shall be 10 inches wide by 24 inches long and 1/2 inch thick. Support seats from partitions on stainless steel brackets.

2.4 HARDWARE

Hardware for the toilet partition system shall conform to CID A-A-60003 for the specified type and style of partitions. Hardware finish shall be highly resistant to alkalies, urine, and other common toilet room acids. Latching devices and hinges for handicap compartments shall comply with 36

CFR 1191 and shall be stainless steel door latches that operate without either tight grasping or twisting of the wrist of the operator. Coat hooks shall be provided at the inside of each toilet partition door.

2.5 COLORS AND FINISHES

2.5.1 Colors

Color of finishes for toilet partition system components including shower seats shall be manufacturer's standard as specified in Section 09915 COLOR SCHEDULE.

2.5.2 Finishes

Partitions, panels and doors fabricated of solid phenolic core with melamine facing sheets formed under high pressure rendering a single component section not less than 1/2 inch thick for panels and 3/4 inch thick for doors and pilasters. Exposed finish surfaces shall be smooth, waterproof, non-absorbant, and resistant to staining and marking with pens, pencils, or other writing devices. Solid phenolic partitions shall not show any sign of deterioration when placed in contact with:

Acids

1. Nitric Acid (all concentrations)**
2. Glacial Acetic Acid 99% (concentrated)
3. Sulfuric Acid (all concentrations)**
4. Hydrochloric Acid (all concentrations)
5. Phosphoric Acid (all concentrations)
6. Formic Acid (all concentrations)
7. Acetic Acid (all concentrations)
8. Hydrofluoric Acid 48% (concentrated)*
9. Aqua Regia
10. Chromic Trioxide (Chromic Acid Cleaning Solution)*
11. Perchloric Acid (concentrated)
12. Picric Acid 1.2% (0.05M)
13. Tannic Acid (sat.)
14. Uric Acid (sat.)

Solvents

15. Carbon Tetrachloride
16. Carbon Disulfide
17. Acetone
18. Formaldehyde
19. Methanol
20. Ethyl Acetate
21. Toluene
22. n-Hexane
23. Ethyl Alcohol
24. Chloroform
25. Phenal (all concentrations)*
26. EDTA
27. Xylene
28. Butyl Alcohol
29. Amyl Alcohol
30. Amyl Acetate
31. Cresol
32. Dioxane
33. Trichloroethane
34. Chlorobenzene

35. Dimethylformamide
36. Methylene Chloride
37. Methyl Ethyl Ketons
38. Naphthalene
39. Tetrahydrofuran

Bases
40. Sodium Hydroxide (all concentrations)
41. Sodium Sulfide 15%
42. Ammonium Hydroxide (all concentrations)

General Reagents
43. Sodium Hypochlorite 5%
44. Calcium Hypochlorite (concenrtated)
45. Hydrogen Peroxide 3%
46. Trisodium Phosphate 30%
47. Sodium Thiocyanate
48. Zinc Chloride
49. Lactated Ringers
50. Sucrose 50%
51. Gasoline
52. Kerosene
53. Mineral Oil
54. Vegetable Oils
55. Water
56. Sodium Chromate
57. Potassium Permanganate
58. Silver Nitrate
59. Formalin
60. Benedicts Solution
61. Phosphate Buffered Saline (PBS)
62. Copper Sulfate
63. Petroleum Jelly
64. Aluminon
65. Ethylene Glycol
66. Pine Oil
67. Methyl Methacrylate
68. Alconox (Lab. Detergent)
69. Karl Fisher Reagent
70. Urea
71. Naphtha
72. Cellosolve
73. Ammonium Phosphate
74. Iodine
75. Povidone Iodine
76. Tincture of Mercurochrome
77. Tincture of Iodine
78. Tincture of Merthiolate
79. Eucalyptol
80. Procaine
81. Zephiran Chloride
82. Zinc Oxide Ointment
83. Lysol
84. Aromatic Ammonia
85. Thymol & Alcohol
86. Camphorated para-chlorophenol*
87. Quatemary Ammonia Compounds
88. Monsel's Solution (Ferric Subsulfate)
89. Sodium Azide

Stains and Indicators
90. Bromolthymol Blue
91. Phenolphthalein
92. Methyl Red
93. Methyl Orange
94. Ag Eosin Bluish 5% in Alcohol
95. Gentian Voilet 1%
96. Wright's Blood Stain
97. Methylene Blue
98. Sudan III
99. Nigrosine
100. Crystal Violet
101. Malachite Green
102. Crestoi Red
103. Gram Stains
104. Safranin O
105. Thymoi Blue

Test Procedures: Listed materials placed in contact with surface under 1" (25.4mm) diameter watch cover glass for 16 hours duration prior to evaluation for effect.

* Causes slight change of gloss or color.
** Causes slight damage, with degree of damage proportionate to length of exposure and concentration. Other items leave no effect.

PART 3 EXECUTION

3.1 INSTALLATION

Toilet partitions shall be installed straight and plumb with uniform clearance of 1/2 inch between pilasters and panels; 1 inch between pilasters and walls; and not more than 3/16 inch between pilasters and doors, in accordance with approved manufacturer's instructions with horizontal lines level and rigidly anchored to the supporting construction. Shower seats shall be supported from partitions on stainless steel brackets screwed to underside of seat and anchored to blocking in the wall cavity. Where indicated, anchorage to walls shall be by toggle-bolting. Drilling and cutting for installation of anchors shall be at locations that will be concealed in the finished work. In the finished work, conceal evidence of drilling in floors and walls. Screws and bolts shall be stainless steel.

3.2 ADJUSTING AND CLEANING

Doors shall have a uniform vertical edge clearance of approximately 3/16 inch and shall rest open at approximately 30 degrees when unlatched. Baked enamel finish shall be touched up with the same color of paint that was used for the finish. Toilet partitions shall be cleaned in accordance with approved manufacturer's instructions and shall be protected from damage until accepted.

-- End of Section --

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SECTION 10201N

METAL WALL LOUVERS

09/99

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2.2.1 Extruded Aluminum Louvers
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-- End of Section Table of Contents --

SECTION 10201N

METAL WALL LOUVERS
09/99

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ALUMINUM ASSOCIATION (AA)

AA DAF-45	(1997) Designation System for Aluminum Finishes

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 2603	(2002) Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL(AMCA)

AMCA 500-D	(1998) Laboratory Methods of Testing Dampers for Rating
AMCA 511	(1991) Certified Ratings Program for Air Control Devices

ASTM INTERNATIONAL (ASTM)

ASTM B 209	(2002a) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 221	(2002) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-02 Shop Drawings

Wall louvers; G-AE

Show all information necessary for fabrication and installation of louvers. Indicate materials, sizes, thicknesses, fastenings, and profiles.

SD-03 Product Data

Wall Louvers; G-AE

Manufacturer's literature including performance data.

SD-04 Samples

Wall louvers; G-AE

Colors of finishes shall closely approximate colors indicated.

1.3 DELIVERY, STORAGE, AND PROTECTION

Deliver materials to the site in an undamaged condition. Carefully store materials off the ground to provide proper ventilation, drainage, and protection against dampness. Louvers shall be free from nicks, scratches, and blemishes. Replace defective or damaged materials with new.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Aluminum Sheet

ASTM B 209, alloy 3003 or 5005 with temper as required for forming.

2.1.2 Extruded Aluminum

ASTM B 221, alloy 6063-T5 or -T52.

2.2 METAL WALL LOUVERS

Weather resistant type, with bird screens and made to withstand a wind load as shown on the contract drawings. Wall louvers shall bear the AMCA certified ratings program seal for air performance and water penetration in accordance with AMCA 500-D and AMCA 511. The rating shall show a water penetration of 0.020 or less ounce per square foot of free area at a free velocity of 800 feet per minute.

2.2.1 Extruded Aluminum Louvers

Fabricated of extruded 6063-T5 or -T52 aluminum with a wall thickness of not less than 0.081 inch.

2.2.2 Mullions and Mullion Covers

Same material and finish as louvers. Provide mullions where indicated. Provide mullions covers on both faces of joints between louvers except where concealed mullions are indicated.

2.2.3 Bird Screens and Frames

For relief and exhaust aluminum louvers, provide 1/2 inch square mesh, 14 or 16 gage aluminum bird screening. Mount screens in removable, rewirable frames of same material and finish as the louvers.

2.3 FASTENERS AND ACCESSORIES

Provide stainless steel screws and fasteners for aluminum louvers. Provide other accessories as required for complete and proper installation.

2.4 FINISHES

2.4.1 Aluminum

Provide factory-applied anodic coating or organic coating as indicated on drawings.

2.4.1.1 Anodic Coating

Clean exposed aluminum surfaces and apply an anodized finish conforming to AA DAF-45 Designation System for Aluminum Finishes, integral color anodized, M10C22A32, Architectural Class II, color champagne.

2.4.1.2 Organic Coating

Clean and prime exposed aluminum surfaces and apply a baked enamel finish conforming to AAMA 2603, 0.8 mil minimum dry film thickness, color as indicated in Section 09915 COLOR SCHEDULE.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Wall Louvers

Install using strap anchors or jamb fasteners as appropriate for the wall construction and in accordance with manufacturer's recommendations.

3.1.2 Screens and Frames

Attach frames to louvers with screws or bolts.

3.2 PROTECTION FROM CONTACT OF DISSIMILAR MATERIALS

3.2.1 Copper or Copper-Bearing Alloys

Paint copper or copper-bearing alloys in contact with dissimilar metal with heavy-bodied bituminous paint or separate with inert membrane.

3.2.2 Aluminum

Where aluminum contacts metal other than zinc, paint the dissimilar metal with a primer and two coats of aluminum paint.

3.2.3 Metal

Paint metal in contact with mortar, concrete, or other masonry materials with alkali-resistant coatings such as heavy-bodied bituminous paint.

3.2.4 Wood

Paint wood or other absorptive materials that may become repeatedly wet and in contact with metal with two coats of aluminum paint or a coat of heavy-bodied bituminous paint.

-- End of Section --

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SECTION 10260

WALL AND CORNER GUARDS

10/03

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SECTION 10260

WALL AND CORNER GUARDS
10/03

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by thebasic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A 167	(1999) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Corner Guards; G-AE

Drawings indicating locations and typical elevations of each type of item. Drawings shall show vertical and horizontal dimensions, full size sections, thickness of materials, and fastening details.

SD-03 Product Data

Corner Guards; G-AE

Manufacturer's descriptive data, catalog cuts, installation instructions, and recommended cleaning instructions.

SD-04 Samples

Finish; G-AE

Submit three samples indicating texture of materials.

1.3 DELIVERY AND STORAGE

Materials shall be delivered to the project site in manufacturer's original unopened containers with seals unbroken and labels and trademarks intact. Materials shall be kept dry, protected from weather and damage, and stored under cover. Materials shall be stored at approximately 70 degrees F for at least 48 hours prior to installation.

1.4 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

PART 2 PRODUCTS

2.1 GENERAL

To the maximum extent possible, corner guards shall be the standard products of a single manufacturer and shall be furnished as detailed. Drawings show general configuration of products required, and items differing in minor details from those shown will be acceptable.

2.2 CORNER GUARDS

2.2.1 Stainless Steel Corner Guards

Stainless steel corner guards shall be fabricated of 0.0625 inch thick material conforming to ASTM A 167, type 302 or 304. Corner guards shall be 6'-0" feet high. Corner guard shall be formed to dimensions shown.

2.3 FINISH

2.3.1 Stainless Steel Finish

Finish for stainless steel shall be in accordance with ASTM A 167, Type 302 or 304, finish number 4.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Corner Guards

Material shall be mounted at location indicated in accordance with manufacturer's recommendations.

3.1.2 Stainless Steel Guards

a. Mount guards on external corners of interior walls, partitions and columns as shown.

(1) Where corner guards are installed on masonry wall, partitions or columns, anchor corner guards to existing walls with 1/4 inch oval head stainless steel countersunk expansion or toggle bolts. Grout spaces solid between guards and backing with portland cement and sand mortar.

(2) Where corner guards are installed on gypsum board, clean surfaces and anchor guards with a neoprene solvent-type contact adhesive specifically manufactured for use on gypsum board construction. Remove excess adhesive from the guard edges and allow to cure undisturbed for 24 hours.

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10/03

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SECTION 10270A

RAISED FLOOR SYSTEM
10/03

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D 635	(1998) Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position
ASTM D 2843	(1999) Density of Smoke from the Burning or Decomposition of Plastics
ASTM E 84	(2001) Surface Burning Characteristics of Building Materials
ASTM E 684	(2000) Standard Practice for Approximate Determination of Current Density of Large-Diameter Ion Beams for Sputter Depth Profiling of Solid Surfaces

CEILINGS & INTERIOR SYSTEMS CONSTRUCTION ASSOCIATION (CISCA)

CISCA Access Floors	(1987) Test Procedures for Access Floors

INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS (ICBO)

ICBO UBC	(1997) Uniform Building Code (3 Vol.)

1.2 SYSTEM DESCRIPTION

Raised flooring shall be installed at the location and in the arrangement shown on the drawings. The maximum height from subfloor to top of floor panel shall not exceed 2-1/2 inches. The floor system shall be of the stringerless molded polypropylene interlocking modular base type, complete with all supplemental items, and shall be the standard product of a manufacturer specializing in the manufacture of raised floor systems.

1.2.1 Floor Panels

Floor panel testing shall be conducted in accordance with CISCA Access Floors. When tested as specified, all deflection and deformation

measurements shall be made at the point of load application on the top surface of the panel. Floor panels shall be capable of supporting 2500 pounds concentrated load without deflecting more than 0.080 inch and without permanent deformation in excess of 0.010 inch in any of the specified tests. Floor panels shall be capable of supporting 45000 pounds per square foot uniform live load without deflection more than 0.040 inch. Floor panels shall be capable of supporting 400 pounds rolling load without deflecting more than 0.040 inch and without permanent deformation in excess of 0.020 inch. In accordance with CISCA Access Floors, the permanent deformation limit under rolling load shall be satisfied in all of the specified tests. In the specified tests, the permanent deformation shall be measured after 10 passes with Wheel 1 and after 10,000 passes with Wheel 2.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Raised Floor System; G-AE

Drawings showing layout of the work, sizes and details of components, details at floor perimeter, typical cutout details including size and shape limitation, and installation height above structural floor.

SD-03 Product Data

Raised Floor System; G-AE

Manufacturer's descriptive data, catalog cuts, and installation instructions. The data shall include information about any design and production techniques, procedures and policies used to conserve energy, reduce material, improve waste management or incorporate green building/recycled products into the manufacturer of their components or products. Cleaning and maintenance instructions shall be included. Design calculations which demonstrate that the proposed floor system meets requirements for seismic loading, prepared in accordance with subparagraph Underfloor Bracing under paragraph PANEL SUPPORT SYSTEM and ICBO UBC. Certified copies of test reports may be submitted in lieu of calculations.

SD-04 Samples

Raised Floor System; G-AE

One sample of each panel type and suspension system proposed for use.

SD-06 Test Reports

Tests

Certified copies of test reports from an approved testing laboratory, attesting that the proposed floor system components meet the performance requirements specified.

SD-07 Certificates

Raised Floor System

Certificate of compliance attesting that the raised floor system meets specification requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

Materials shall be stored in original protective packaging in a safe, dry, and clean location and shall be handled in a manner to prevent damage. Panels shall be stored at temperatures between 40 and 90 degrees F, and between 20 percent and 70 percent humidity.

1.5 SITE CONDITIONS

Subfloor shall be smooth and dry with a maximum deviation of 3/8 inch in 10 feet.

1.6 EXTRA MATERIALS

Spare floor panels and spare complete grid support assemblies shall be furnished at the rate of one space for each 100 or fraction thereof required.

PART 2 PRODUCTS

2.1 FLOOR PANELS

2.1.1 Panel Construction

Except for edge panels, panel size shall be 23.62 x 23.62 inches (600 mm x 600 mm). Panels shall be nominal 3/4 inch thick. Finished panels shall be within a 0.010 inch tolerance of the nominal size, and shall be square within a tolerance of 0.015 inch measured corner-to-corner. The top surface of panels shall be flat within a 0.020 inchtolerance measured corner-to-corner. Panels shall be permanently marked to indicate load rating and model number.

2.1.1.1 Fiber Cement Composite Panels

Fiber cement composit panels shall be smooth surfaced with corners milled to receive flush, recessed corner clamps. Floor panel fiber cement board shall have a flame spread of 0 and a smoke density of 0 when tested in accordance with ASTM E 84 and a minimum critical radiant heat flux of 1.1 when tested in accordance with ASTM E 684.

2.1.2 Floor Covering and Resilient Base

Floor panels shall receive field installed flooring as specified in Section 09650 RESILIENT FLOORING. Resilient base is specified in Section 09650 RESILIENT FLOORING.

2.1.3 Corner Clamps

Corners of the panels shall be configured to permit a flush fit for rigid corner clamps that secure the panels to the base system. Nylon corner clamps and screws fasteners shall install flush with the panel surface to secure the panels.

2.2 PANEL SUPPORT SYSTEM

2.2.1 Modular Base System

The modular base system shall be injection molded polypropylene support cylinders and interconnecting base straps with pads to connect adjacent modules. Modular base system polypropylene material shall have a CC1 classification when tested for rate of burning in accordance with ASTM D 635 and a maximum 45 smoke density rating when tested in accordance with ASTM D 2843. Provide molded cable tie anchor points on straps between each cylinder. The module size shall be nominally 1 yard square sections with 1-3/4 inches high by 2-3/4 inches diameter cylinders spaced 5.9 inches on center, providing 3-1/8 inches wide cable raceways. Nylon corner clamps and screw fasteners install flush with the panel surface to secure the panels to the support cylinders.

2.2.2 Performance Requirements

Access floor shall comply with seismic requirements of UBC Seismic Zone 4.

2.3 FASCIA

Fascia plates fabricated from steel, aluminum, or the ramp material shall be provided at sides of ramps and elsewhere as required to enclose the free area under the raised floor. Trim, angles, and fasteners shall be provided as required.

2.4 STEPS AND RAMPS

Ramps shall be securely fastened to the raised floor system and to the structural floor. Construction shall include standard floor system components and custom components as required, and shall include all supports, fasteners, and trim necessary for a finished installation. T hreshold strips, and floor bevel strips shall be cast or extruded aluminum with nonslip traffic surfaces. Slope of ramps shall be as indicated on drawings. Ramps shall be provided where indicated and shall be designed to support the minimum uniformly distributed live load of 200 pounds per square foot and the minimum concentrated load of 2000 pounds. Fabricate from Class A, fire retardant treated, 3/4 inch thick plywood with Class A treated solid lumber supports. Taper underside at bottom of ramp to provide smooth transition.

2.4.1 Ramps

Slope of ramps shall not exceed 1 inch rise to 12 inches of run.

2.5 RAILINGS

Railings shall be the double rail and post type, fabricated of at least 1 inch round or square seamless aluminum tubing with a satin natural anodized finish. The top rail shall be 42 inches high at open ends of the floor.

2.6 TESTS

Raised flooring shall be factory tested by an independent laboratory at the same position and design elevation and in the same arrangement as shown on the drawings for installation so as to duplicate service conditions as much as possible.

2.6.1 Load Tests

Floor panel, and modular base system testing shall be conducted in accordance with CISCA Access Floors.

PART 3 EXECUTION

3.1 EXAMINATION/VERIFICATION OF CONDITIONS

The Contractor shall examine and verify that site conditions are in agreement with the design package and shall report all conditions that will prevent a proper installation. The Contractor shall not take any corrective action without written permission from the Government. Work will proceed only when conditions have been corrected and accepted by the installer.

3.2 INSTALLATION

The floor system shall be installed in accordance with the manufacturer's instructions and with the approved detail drawings. Open ends of the floor, where the floor system does not abut wall or other construction, shall have positive anchorage and rigid support. Areas to receive raised flooring shall be maintained between 60 and 90 degrees F, and between 20 percent and 70 percent humidity for 24 hours prior to and during installation.

3.2.1 Preparation for Installation

The area in which the floor system is to be installed shall be cleared of all debris. Structural floor surfaces shall be thoroughly cleaned and all dust shall be removed. Floor coatings required for dust or vapor control shall be installed prior to installation of pedestals only if the support cylinder adhesive will not damage the coating. If the coating and adhesive are not compatible, the coating shall be applied after the support cylinders have been installed and the adhesive has cured.

3.2.2 Grid Support System

Grid support system and support cylinders shall be accurately spaced, and shall be set plumb and in true alignment. Support cylinders shall be in full and firm contact with the structural floor, and shall be secured to the structural floor with adhesive in accordance with the manufacturer's printed instructions.

3.2.3 Auxiliary Framing

Auxiliary framing or support cylinders shall be provided around columns and other permanent construction, at sides of ramps, and beneath panels that are substantially cut to accommodate utility systems. Special framing for additional lateral support shall be as shown on the approved detail drawings.

3.2.4 Panels

The panels shall be interlocked with supports in a manner that will preclude lateral movement. Perimeter panels, cutout panels, and panels adjoining columns and ramps must be fastened to the supporting components to form a rigid boundary for the interior panels. Floors shall be level within 3/8 inch measured with a 10 foot straightedge in all directions. Cut edges of panels shall be treated as recommended by the panel manufacturer. Extruded vinyl edging shall be secured in place at all cut edges of all panel cut-outs to prevent abrasion of cables.

3.2.5 Fascia Plates

Exposed floor ends and exposed openings of ramps shall be covered with closures.

3.3 CLEANING AND PROTECTION

3.3.1 Cleaning

The space below the completed floor shall be free of all debris. Before any traffic, floor finish installation or other work on the completed raised floor is started, the completed floor shall be cleaned in accordance with the panel manufacturer's instructions.

3.3.2 Protection

Traffic areas of raised floor systems shall be protected with a covering of building paper, fiberboard, or other suitable material to prevent damage to the surface. Cutouts shall be covered with material of sufficient strength to support the loads to be encountered. Plywood or similar material shall be placed on the floor to serve as runways for installation of heavy equipment. Protection shall be maintained until the raised floor system is accepted.

-- End of Section --

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SECTION 10430

EXTERIOR SIGNAGE

11/03

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SECTION 10430

EXTERIOR SIGNAGE
11/03

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic the designation only.

ALUMINUM ASSOCIATION (AA)

AA DAF-45	(1997) Designation System for Aluminum Finishes

ASTM INTERNATIONAL (ASTM)

ASTM B 108	(2001a) Aluminum-Alloy Permanent Mold Castings

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Approved Detail Drawings; G-AE

Drawings showing elevations of each type of sign; dimensions, details, and methods of mounting or anchoring; shape and thickness of materials; and details of construction.

SD-03 Product Data

Dimensional Building Letters; G-AE

Manufacturer's descriptive data and catalog cuts.

Installation; G-AE

Manufacturer's installation instructions and cleaning instructions.

SD-04 Samples

Dimensional Building Letters; G-AE

One sample cast aluminum letter. Sample may be installed in the work, provided each sample is identified and location recorded.

SD-10 Operation and Maintenance Data

Protection and Cleaning; G-AO

Six copies of maintenance instructions listing routine maintenance procedures.

1.3 GENERAL

All exterior signage shall be provided by a single manufacturer. Exterior signage shall be of the design, detail, sizes, types, and message content shown on the drawings, shall conform to the requirements specified, and shall be provided at the locations indicated. Signs shall be complete with lettering and related components for a complete installation. Recyclable materials shall conform to EPA requirements in accordance with Section 01670 RECYCLED / RECOVERED MATERIALS.

1.4 QUALIFICATIONS

Dimensional letters shall be the standard product of a manufacturer regularly engaged in the manufacture of the products. Items of equipment shall essentially duplicate equipment that has been in satisfactory use at least 2 years prior to bid opening.

1.5 DELIVERY AND STORAGE

Materials shall be wrapped for shipment and storage, delivered to the jobsite in manufacturer's original packaging, and stored in a clean, dry area in accordance with manufacturer's instructions.

1.6 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one year period shall be provided.

PART 2 PRODUCTS

2.1 DIMENSIONAL BUILDING LETTERS

2.1.1 Fabrication

Letters shall be fabricated from cast aluminum. Letters shall be cleaned by chemical etching or cleaned ultrasonically in a special degreasing bath. Letters shall be packaged for protection until installation.

2.1.2 Typeface

Typeface shall be helvetica medium.

2.1.3 Size

Letter size shall be 12" high .

2.1.4 Finish

Anodized aluminum finish shall be provided.

2.1.5 Mounting

Threaded studs of number and size as recommended by manufacturer, shall be used for concealed anchorage. Letters which project from the building line shall have stud spacer sleeves. Install letters with a maximum of 2-1/4 inches between nominal face of wall and letters. Letters, studs, and sleeves shall be of the same material. Templates for mounting shall be supplied.

2.2 ALUMINUM ALLOY PRODUCTS

Aluminum alloy products shall conform to ASTM B 108 for castings.

2.3 ANODIC COATING

Anodized finish shall conform to AA DAF-45 as follows:

Electrolytically deposited color - anodized designation AA-M10-C22-A34, Architectural Class II 0.4 to 0.7 mil., Dark Bronze.

2.4 SHOP FABRICATION AND MANUFACTURE

2.4.1 Factory Workmanship

Work shall be assembled in the shop, as far as practical, ready for installation at the site. Work that cannot be shop assembled shall be given a trial fit in the shop to ensure proper field assembly. Exposed surfaces of work shall have a smooth finish. Fastenings shall be concealed.

2.4.2 Dissimilar Materials

Where dissimilar metals are in contact, or where aluminum is in contact with concrete, mortar, masonry, wet or pressure-treated wood, or absorptive materials subject to wetting, the surfaces shall be protected with a coat of asphalt varnish or a coat of zinc-molybdate primer to prevent galvanic or corrosive action.

PART 3 EXECUTION

3.1 INSTALLATION

Dimensional letters shall be installed in accordance with approved manufacturer's instructions at locations shown on the approved detail drawings. Signs shall be installed plumb and true at mounting heights indicated, and by method shown or specified. Signs mounted on other surfaces shall not be installed until finishes on such surfaces have been completed.

3.1.1 Anchorage

Anchorage and fastener materials shall be in accordance with approved manufacturer's instructions for the indicated substrate. .

3.1.2 Protection and Cleaning

The work shall be protected against damage during construction. Sign surfaces shall be cleaned in accordance with manufacturer's instructions.

After signs are completed and inspected, the Contractor shall cover all project identification and other signs which may mislead the public. Covering shall be maintained until instructed to be removed by the Contracting Officer or until the facility is to be opened for business. Signs shall be cleaned, as required, at time of cover removal.

-- End of Section --

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SECTION 10440

INTERIOR SIGNAGE

07/02

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-- End of Section Table of Contents --

SECTION 10440

INTERIOR SIGNAGE
07/02

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM B 221	(2002) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings; G-AE

Drawings showing elevations of each type of sign, dimensions, details and methods of mounting or anchoring, shape and thickness of materials, and details of construction. A schedule showing the location, each sign type, and message shall be included.

SD-03 Product Data

Installation; G-AE

Manufacturer's descriptive data, catalogs cuts, installation and cleaning instructions.

SD-04 Samples

Interior Signage; G-AE

One sample of each of the following sign types showing typical quality and workmanship. The samples may be installed in the

work, provided each sample is identified and location recorded.

a. Directional sign.

b. Door identification sign.

Two samples of manufacturer's standard color chips for each material requiring color selection.

SD-10 Operation and Maintenance Data

Approved Manufacturer's Instructions; G-AE
Protection and Cleaning; G-AE

Six copies of operating instructions outlining the step-by-step procedures required for system operation shall be provided. The instructions shall include simplified diagrams for the system as installed. Six copies of maintenance instructions listing routine procedures, repairs, and guides shall be provided. The instructions shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Each set shall be permanently bound and shall have a hard cover. The following identification shall be inscribed on the covers: the words "OPERATING AND MAINTENANCE INSTRUCTIONS", name and location of the facility, name of the Contractor, and contract number.

1.3 GENERAL

Interior signage shall be of the design, detail, sizes, types, and message content shown on the drawings, shall conform to the requirements specified, and shall be provided at the locations indicated. Signs shall be complete with lettering, framing as detailed, and related components for a complete installation. Recyclable materials shall conform to EPA requirements in accordance with Section 01670 RECYCLED / RECOVERED MATERIALS.

1.3.1 Character Proportions and Heights

Letters and numbers on indicated signs in handicapped-accessible buildings, which do not designate permanent rooms or spaces, shall have a width-to-height ratio between 3:5 and 1:1 and a stroke-width-to-height ratio between 1:5 and 1:10. Characters and numbers on indicated signs shall be sized according to the viewing distance from which they are to be read. The minimum height is measured using an upper case letter "X". Lower case characters are permitted. Suspended or projected overhead signs shall have a minimum character height of 3 inches.

1.3.2 Raised and Brailled Characters and Pictorial Symbol Signs (Pictograms)

Letters and numbers on indicated signs which designate permanent rooms and spaces in handicapped-accessible buildings shall be raised 1/32 inch upper case, sans serif or simple serif type and shall be accompanied with Grade 2 Braille. Raised characters shall be at least 5/8 inch in height, but no higher than 2 inches. Pictograms shall be accompanied by the equivalent verbal description placed directly below the pictogram. The border dimension of the pictogram shall be 6 inches minimum in height. Indicated accessible facilities shall use the international symbol of accessibility.

1.4 QUALIFICATIONS

Signs, plaques, and dimensional letters shall be the standard product of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate signs that have been in satisfactory use at least 2 years prior to bid opening.

1.5 DELIVERY AND STORAGE

Materials shall be delivered to the jobsite in manufacturer's original packaging and stored in a clean, dry area in accordance with manufacturer's instructions.

1.6 EXTRA STOCK

The Contractor shall provide 6 extra frames and extra stock of the following: Six blank plates of each color and size for sign types 2.

PART 2 PRODUCTS

2.1 ROOM IDENTIFICATION/DIRECTIONAL SIGNAGE SYSTEM

Signs shall be fabricated of extruded aluminum conforming to ASTM B 221.

2.1.1 Standard Room Signs

Signs shall consist of gloss finish . Units shall be frameless.

2.1.2 Type of Mounting For Signs

Extruded aluminum brackets, mounted as shown, shall be furnished for hanging, projecting, and double-sided signs. Mounting for projecting signs shall be by mechanical fasteners. Surface mounted signs shall be provided with 1/16 inch thick vinyl foam tape.

2.1.3 Graphics

Signage graphics for modular identification/directional signs shall conform to the following:

Pressure sensitive prespaced and prealigned precision computer cut vinyl letters on release paper shall be provided. Edges and corners of finished letter forms and graphics shall be true and clean. Vinyl sheeting for graphics shall be 5 to 7 year premium type and shall be a minimum 0.003 inch film thickness. Film shall include a precoated pressure sensitive adhesive backing.

2.2 PRESSURE SENSITIVE LETTERS

2.2.1 Typeface

Helvetica medium.

2.2.2 Size

As indicated.

2.2.3 Color

As indicated.

PART 3 EXECUTION

3.1 INSTALLATION

Signs shall be installed in accordance with approved manufacturer's instructions at locations shown on the detail drawings. Signs shall be installed plumb and true at mounting heights indicated, and by method shown or specified. Required blocking shall be installed as detailed. Signs which designate permanent rooms and spaces in handicapped-accessible buildings shall be installed on the wall adjacent to the latch side of the door. Where there is no wall space to the latch side of the door, including at double leaf doors, signs shall be placed on the nearest adjacent wall. Mounting location for such signage shall be so that a person may approach within 3 inches of signage without encountering protruding objects or standing within the swing of a door. Signs on doors or other surfaces shall not be installed until finishes on such surfaces have been installed. Signs installed on glass surfaces shall be installed with matching blank back-up plates in accordance with manufacturer's instructions.

3.1.1 Anchorage

Anchorage shall be in accordance with approved manufacturer's instructions. Anchorage not otherwise specified or shown shall include slotted inserts, expansion shields, and powder-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine carriage bolts for steel; lag bolts and screws for wood. Exposed anchor and fastener materials shall be compatible with metal to which applied and shall have matching color and finish. Where recommended by signage manufacturer, foam tape pads may be used for anchorage. Foam tape pads shall be minimum 1/16 inch thick closed cell vinyl foam with adhesive backing. Adhesive shall be transparent, long aging, high tech formulation on two sides of the vinyl foam. Adhesive surfaces shall be protected with a 5 mil green flatstock treated with silicone. Foam pads shall be sized for the signage as per signage manufacturer's recommendations. Signs mounted to painted gypsum board surfaces shall be removable for painting maintenance. Signs mounted to lay-in ceiling grids shall be mounted with clip connections to ceiling tees.

3.1.2 Protection and Cleaning

The work shall be protected against damage during construction. Hardware and electrical equipment shall be adjusted for proper operation. Glass, frames, and other sign surfaces shall be cleaned in accordance with the manufacturer's approved instructions.

-- End of Section --

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SECTION 10505N

STEEL CLOTHING LOCKERS
09/99

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A 653/A 653M	(2002a) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B 456	(1995) Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium
ASTM D 2092	(1995) Preparation of Zinc-Coated (Galvanized) Steel Surfaces for Painting

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS AA-L-00486	(Rev. J) Lockers, Clothing, Steel

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-C-22750	(Rev. F) Coating, Epoxy, Hihg Solids
MIL-P-23377	(Rev. G) Primer Coatings: Epoxy, Chemical and Solvent Resistant

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-02 Shop Drawings

Types; G-AE

Location; G-AE

Installation

Numbering system

SD-03 Product Data

Material

Finish

Locker components

Assembly instructions

SD-04 Samples

Color chips; G-AE

1.3 DELIVERY, HANDLING, AND STORAGE

Deliver lockers and associated materials in their original packages, containers, or bundles bearing the manufacturer's name and the name of the material. Protect from weather, soil, and damage during delivery, storage, and construction.

1.4 FIELD MEASUREMENTS

To ensure proper fits, make field measurements prior to the preparation of drawings and fabrication.

1.5 QUALITY ASSURANCE

1.5.1 Color Chips

Provide a minimum of three color chips, not less than 3 inches square, of each color scheduled.

PART 2 PRODUCTS

2.1 TYPES

FS AA-L-00486. Provide Type II, double-tier, Style 1 or 2 lockers in the location, and quantities indicated. Locker size shall be 18 inches wide by 18 inches deep by 72 inches high not including base. Provide locker finish colors as scheduled. Provide lockers "set-up" (pre-assembled).

2.2 MATERIAL

2.2.1 Glavannealed Steel Sheet

ASTM A 653/A 653M, commercial quality, minimized spangle, galvannealed steel sheet. Prepare surface of sheet for painting in accordance with ASTM D 2092, Method A. Minimum uncoated sheet thickness as specified.

2.2.2 Chromium Coating

Nickel and chromium electrodeposited on the specified base metal. Conform to ASTM B 456, SC-3, as applicable to the base metal.

2.2.3 Finish

Primer,MIL-P-23377; topcoat, MIL-C-22750. Color as specified in Section 09915 COLOR SCHEDULE.

2.2.3.1 Color

As selected.

2.3 COMPONENTS

2.3.1 Built-In Locks

FS AA-L-00486. Provide a padlock eye in the door latching mechanism.

2.3.2 Coat Hooks

FS AA-L-00486, chromium plated.

2.3.3 Door Handles

FS AA-L-00486. Provide recessed style, zinc alloy or steel handles with a chromium coating.

2.3.4 Doors

FS AA-L-00486, not less than 0.0598 inch thick steel sheet.

2.3.4.1 Hinges

In addition to the requirements of FS AA-L-00486, provide 5-knuckle hinges, minimum 2 inches high. Fabricate knuckle hinges from not less than 0.0747 inch thick steel sheet. Weld or bolt hinges to the door frame. Weld, bolt, or rivet hinges to the door.

2.3.4.2 Latching Mechanisms

FS AA-L-00486.

2.3.5 Latch Strikes

FS AA-L-00486. Fabricate from not less than 0.0747 inch thick steel sheet, except latch strike may be continuous from top to bottom and fabricated as part of the door framing.

2.3.6 Silencers

FS AA-L-00486.

2.3.7 Back and Side Panels, Tops, and Bottoms

FS AA-L-00486, not less than 0.0474 inch thick steel sheet.

2.3.8 Base Panels

FS AA-L-00486.

2.3.9 Legs

Provide lockers without legs, as indicated.

2.3.10 Number Plates

FS AA-L-00486. Aluminum. Provide consecutive numbers as indicated on drawings.

2.3.11 Fastening Devices

Provide bolts, nuts, and rivets as specified in FS AA-L-00486.

2.4 BENCHES

Benches shall be standard product of steel clothing locker manufacturer. Pedestals shall be of heavy duty cast iron, primer and topcoat material and color shall match lockers. Space pedestals not more than 6 feet on center. Attach pedestals to top with screws recommended by manufacturer. Hardwood bench shall have clear hardwood tops 9-1/2 inches wide and 1-1/4 inches thick finished with two coats of acrylic finish, lengths as indicated on drawings. Overall height shall be approximately 18 inches.

PART 3 EXECUTION

3.1 ASSEMBLY AND INSTALLATION

Assemble lockers according to the locker manufacturer's instructions. Align lockers horizontally and vertically. Secure lockers to wall and base with screws as indicated. Bolt adjacent lockers together. Adjust doors to operate freely without sticking or binding and to ensure they close tightly. Anchor bench pedestals to floor with minimum two anchors.

3.2 NUMBERING SYSTEM

Install number plates on lockers consecutively with odd numbers on top and even numbers on bottom.

3.3 FIELD QUALITY CONTROL

3.3.1 Testing

Government may request performance-characteristic tests on assembled lockers in accordance with FS AA-L-00486. Lockers not conforming will be rejected.

3.3.2 Repairing

Remove and replace damaged and unacceptable portions of completed work with new.

3.3.3 Cleaning

Clean surfaces of the work, and adjacent surfaces soiled as a result of the work, in an approved manner. Remove equipment, surplus materials, and rubbish from the site.

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SECTION 10510

WOOD CLOTHING LOCKERS AND BENCHES

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D 1037	(1999) Evaluating Properties of Wood-Base Fiber and Particle Panel Materials

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A208.1	(1999) Particleboard
ANSI A208.2	(2002) Medium Density Fiberboard (MDF) For Interior Applications

ARCHITECTURAL WOODWORK INSTITUTE (AWI)

AWI Qual Stds	(1999) AWI Quality Standards

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Types; G-AE

Location; G-AE

Numbering System

SD-03 Product Data

Material

Finish

Assembly and installation

SD-04 Samples

Finish Samples; G-AE

1.3 DELIVERY, HANDLING, AND STORAGE

Deliver lockers and associated materials in their original packages, containers, or bundles bearing the manufacturer's name and the name of the material. Store products in a dry, ventilated area until ready for installation. Protect from weather, soil, and damage during delivery, storage, and construction.

1.4 FIELD MEASUREMENTS

To ensure proper fits, make field measurements prior to the preparation of drawings and fabrication.

1.5 QUALITY ASSURANCE

1.5.1 Quality Standards

Unless otherwise noted on the drawings, all materials, construction methods, and fabrication shall conform to and comply with the custom grade quality standards as outlined in AWI Qual Stds, Section 400G and Section 400A for wood cabinets. These standards shall apply in lieu of omissions or specific requirements in this specification.

1.5.2 Finish Samples

Provide a minimum of three finish samples, not less than 3 inches square, of each finish indicated.

1.5.3 Project Conditions

Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer. Do not install products under environmental conditions outside manufacturer limits. During and after installation, maintain same temperature and humidity conditions in building spaces as will occur after occupancy.

PART 2 PRODUCTS

2.1 TYPES

Provide single-tier lockers in the location, quantities and size indicated. Provide locker finish as scheduled. Provide lockers pre-assembled to extent possible. Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate items that have been in satisfactory use for at least 2 year prior to bid opening.

2.2 MATERIAL

2.2.1 Particleboard

All particleboard shall be industrial grade, medium density (40-50 pounds per cubic foot), 5/8 inch thick. Particleboard shall meet the minimum standards listed in ASTM D 1037 and ANSI A208.1.

2.2.2 Medium Density Fiberboard

Medium density fiberboard shall meet the minimum standards listed in ANSI A208.2.

2.2.3 Thermoset Decorative Overlays (Melamine)

Thermoset decorative overlays (melamine panels) shall be used for locker interior and semi-exposed surfaces.

2.2.4 Edge Banding

Edge banding for locker doors shall be PVC vinyl and shall be 0.080 inch thick. Color shall match exposed door veneer pattern and color.

2.2.5 Wood Veneer

A-1 plain sliced Mahogany.

2.2.5.1 Finish

As selected in Section 09915 COLOR SCHEDULE.

2.3 COMPONENTS

2.3.1 Built-In Locks

Provide built-in keyless, cardless mechanical locks with integral knobs with 10,000 possible 4 digit personal codes with management override key safeguard. Provide platinum finish.

2.3.2 Hanger Rods

Satin chromium plated.

2.3.3 Hinges

Provide three concealed, heavy duty European style hinges allowing 125 degree door opening.

2.3.4 Silencers

Manufacturer's standard rubber bumpers.

2.3.5 Number Plates

Zinc. Provide consecutive numbers as approved by Contracting Officer.

2.3.6 Fastening Devices

Provide bolts, nuts, and connectors as required for a complete, assembled unit.

2.4 FABRICATION

Fabrication and assembly of components shall be accomplished at the shop to the maximum extent possible. Construction shall meet or exceed requirements for AWI custom grade.

2.4.1 Locker Frame

Locker frame, top and shelf shall be constructed of 5/8 inch thick particleboard finished both sides with thermo fused almond colored melamine. Visible edges shall be finished with edge banding. Exposed ends and fillers shall be constructed of particleboard or medium density fiberboard and be finished with wood veneer to match door face. Fabricate using doweled and glued assembly process.

2.4.2 Door

Door shall be constructed of 3/4 inch medium density fiberboard core with wood veneer exterior and thermo fused almond colored melamine interior finishes. Visible edges shall be finished with edge banding. Door style shall be raised panel as indicated on drawings.

2.4.3 Venting

Venting shall be accomplished by means of 1/2 inch openings between door and top and bottom of locker.

2.5 BENCHES

Benches shall be a standard product of the wood locker manufacturer and of matching design and wood veneer wth raised panel ends. Seats shall be fabricated carpet ready.

PART 3 EXECUTION

3.1 ASSEMBLY AND INSTALLATION

Assemble lockers according to the locker manufacturer's instructions. Align lockers horizontally and vertically. Secure lockers to wall and base with screws as indicated. Bolt adjacent lockers together. Adjust doors to operate freely without sticking or binding and to ensure they close tightly. Secure benches to floor where indicated and field install carpet as selected in Section 09915 COLOR SCHEDULE.

3.2 NUMBERING SYSTEM

Install number plates on lockers consecutively as approved.

3.3 FIELD QUALITY CONTROL

3.3.1 Repairing

Remove and replace damaged and unacceptable portions of completed work with new.

3.3.2 Cleaning

Clean surfaces of the work, and adjacent surfaces soiled as a result of the work, in an approved manner. Remove equipment, surplus materials, and rubbish from the site.

-- End of Section --

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SECTION 10650A

OPERABLE PARTITIONS

12/03

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SECTION 10650A

OPERABLE PARTITIONS
12/03

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM E 84	(2001) Surface Burning Characteristics of Building Materials
ASTM E 90	(2002) Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
ASTM E 413	(1987; R 1999) Rating Sound Insulation

1.2 GENERAL REQUIREMENTS

The Contractor shall supply and install flat wall, manual operation, acoustical operable partitions as shown on the drawings including all hardware, seals, track and rollers as needed to close the specified opening. The partition shall be made up of a series of rigid, flat wall panels; each panel being a one-piece assembly nominally 48 inches wide, in paired panel configuration. Unless otherwise specified, the wall shall comprise the least number of panels. The mechanical seal of the panel shall actuate with a single operating action.

1.2.1 Manual Operation

The manual operation shall be accomplished with less than 20 lbf force to start movement at the rate of 3.33 ft/s (200 ft/min). A removable handle shall be used to extend and retract the bottom operable seals; vertical movement of seals shall be 2 inches. Closure to the lead wall shall be by use of a flexible bulb; final closing shall be accomplished by means of a lever exerting pressure against wall.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Operable Partitions; G-AE

Drawings containing complete schematic diagrams and details required to demonstrate that the system has been coordinated and will properly function as a unit. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearances for maintenance and operation.

SD-03 Product Data

Operable Partitions; G-AE

Manufacturer's descriptive data, performance charts, catalog cuts, and installation instructions.

SD-04 Samples

Operable Partitions; G-AE

Color samples of specified surfaces and finishes to match those specified. Finish and color requirements shall not be limited to manufacturer's standard selections in order to meet these requirements.

SD-07 Certificates

Materials; G-AO
Operable Partitions; G-AO

Certificate attesting that the materials meet the requirements specified and that partitions have specified acoustical and flame retardant properties, as determined by test.

SD-10 Operation and Maintenance Data

Operable Partitions

Six complete copies of operating instructions. The instructions shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and operating features. Data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of the parts recommended by the manufacturer to be replaced after 1 year and 3 years of service. Six complete copies of maintenance instructions explaining routine maintenance procedures including inspection, adjustments, lubrication, and cleaning. The instructions shall list possible breakdown, methods of repair, and a troubleshooting guide. The instructions shall include equipment layout and simplified wiring and control diagrams of the system as installed.

1.4 DELIVERY AND STORAGE

Materials shall be delivered to the jobsite in the manufacturer's original, unopened packages and shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, or other contaminants.

1.5 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

PART 2 PRODUCTS

2.1 MATERIALS

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate items that have been in satisfactory use for at least 2 year prior to bid opening. Equipment shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site. Door and partition finishes shall have a Class A rating when tested in accordance with ASTM E 84.

2.1.1 Panel Surface Finish

Side Facing Room 109A:
Side Panel surface finish shall be a flexible dry-erase surface (VWC-1) as specified in Section 10100A VISUAL COMMUNICATION SPECIALTIES.

Side Facing Room 109B:
Panel surface finish shall be a vertically-ribbed acoustical synthetic fabric material of 100 percent polyolefin. Pile height shall be minimum 0.098 inch thickness. Color shall match that listed in Section 09915 COLOR SCHEDULE.

Sides Facing Rooms 198A and 198B:
Sides facing Rooms 198A anda 198B shall be surfaed wth vinyl wall covering material, color and pattern as specified in Section 0915 COLOR SCHEDULE.

2.1.2 Hardware

Operable partitions shall have manufacturer's standard hardware. Hardware shall be anodized aluminum with a natural finish, chrome plated metal, or painted finish.

2.1.3 Sweep Strips

Sweep strips shall be multi-ply vinyl or other material which will not crack or craze with severe usage. Sweep strip shall control STC to the specified rating.

2.1.4 Track

Track shall be recessed as shown and shall be of extruded aluminum . Track shall be manufacturer's standard product designed for the weight of the finished partition, including door. Track sections shall be provided in the maximum lengths practicable, not less than 6 feet long except for narrow doors and at ends of runs where short length is required. Suitable joint devices such as interlocking keys shall be provided at each joint to provide permanent alignment of track.

2.1.5 Metal Soffit

Soffit on aluminum track shall be an integral part of the track.

2.1.6 Vinyl Restrictions

Vinyls shall contain a non-mercury based mildewcide and shall be manufactured without the use of cadmium-based stabilizers.

2.2 OPERABLE PARTITIONS

Operable partitions shall consist of top hung 4-wheeled, ball bearing carriers which support paired modular panels. Partition finish shall have a flame spread rating of not more than 25 in accordance with ASTM E 84.

2.2.1 Panels

Panels shall be constructed of minimum 16 gauge thick steel frames with minimum 22 gauge thick face panels spot welded to the frame. Panels shall be not more than 4 feet wide, except for end closure panels, and shall be full height to track. Panels shall lock in place to form a stable, rigid partition; low profile hinges shall project 1/4 inch maximum from panel edge. Panels shall be surfaced with wall carpet which wraps around the vertical panel edges without vertical trim. Panel thickness (3 inch nominal) and composition shall be designed to provide an STC rating of not less than 49 in accordance with ASTM E 90 and ASTM E 413.

2.2.2 Doors

Doors shall be ADA compliant and have vinyl sweep top seals which compress against the bottom of the top track. Doors shall be nonfire rated and shall be manually operated.

2.2.3 Seals

Bottom seals shall consist of a vinyl sweep mechanical seal which will expand in place or shall be accomplished by using panels which can be lowered by a removable operating device. Vertical seal between panels shall be anodized, architectural grade, aluminum extrusion with vinyl sound seal.

2.3 COLOR

Color shall be in accordance with Section 09915 COLOR SCHEDULE.

PART 3 EXECUTION

3.1 INSTALLATION

Installation shall be in accordance with the manufacturer's approved installation instructions.

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SECTION 10800

TOILET ACCESSORIES

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2.2.4 Sanitary Napkin Disposer (SND)
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SECTION 10800

TOILET ACCESSORIES
07/02

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C 1036 (2001) Flat Glass

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Finishes; G-AE
Accessory Items; G-AE

Manufacturer's descriptive data and catalog cuts indicating materials of construction, fasteners proposed for use for each type of wall construction, mounting instructions, operation instructions, and cleaning instructions.

SD-04 Samples

Finishes; G-AE
Accessory Items; G-AO

One sample of each accessory proposed for use. Approved samples may be incorporated into the finished work, provided they are identified and their locations noted.

SD-07 Certificates

Accessory Items

Submit for each type of accessory specified, attesting that the items meet the specified requirements.

SD-10 Operation and Maintenance Data

Electric Hand Dryer; G-AO

Electric Hair Dryer; G-AO

Four complete copies of maintenance instructions listing routine maintenance procedures and possible breakdowns and repairs. Instructions shall include simplified wiring and control diagrams and other information necessary for unit maintenance.

1.3 DELIVERY, STORAGE, AND HANDLING

Toilet accessories shall be wrapped for shipment and storage, delivered to the jobsite in manufacturer's original packaging, and stored in a clean, dry area protected from construction damage and vandalism.

1.4 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

PART 2 PRODUCTS

2.1 MANUFACTURED UNITS

Toilet accessories shall be provided where indicated in accordance with paragraph SCHEDULE. Porcelain type, tile-wall accessories are specified in Section 09310 CERAMIC TILE. Each accessory item shall be complete with the necessary mounting plates and shall be of sturdy construction with corrosion resistant surface.

2.1.1 Anchors and Fasteners

Anchors and fasteners shall be capable of developing a restraining force commensurate with the strength of the accessory to be mounted and shall be suited for use with the supporting construction. Exposed fasteners shall be of tamperproof design and shall be finished to match the accessory.

2.1.2 Finishes

Except where noted otherwise, finishes on metal shall be provided as follows:

Metal	Finish
Stainless steel	No. 4 satin finish
Carbon steel, copper alloy, and brass	Chromium plated, satin finish

2.2 ACCESSORY ITEMS

Accessory items shall conform to the requirements specified below.

2.2.1 Grab Bar (GB)

Grab bar shall be 18 gauge, 1-1/4 inches OD Type 304 stainless steel. Grab bar shall be form and length as indicated. Exposed mounting flange shall have mounting holes concealed. Grab bar shall have peened non-slip surface. Installed bars shall be capable of withstanding a 500 pound vertical load without coming loose from the fastenings and without obvious

permanent deformation. Space between wall and grab bar shall be 1-1/2 inch.

2.2.2 Mirrors, Glass (MG)

Glass for mirrors shall be Type I transparent flat type, Class 1-clear. Glazing Quality q1 1/4 inch thick conforming to ASTM C 1036. Glass shall be coated on one surface with silver coating, copper protective coating, and mirror backing paint. Silver coating shall be highly adhesive pure silver coating of a thickness which shall provide reflectivity of 83 percent or more of incident light when viewed through 1/4 inch thick glass, and shall be free of pinholes or other defects. Copper protective coating shall be pure bright reflective copper, homogeneous without sludge, pinholes or other defects, and shall be of proper thickness to prevent "adhesion pull" by mirror backing paint. Mirror backing paint shall consist of two coats of special scratch and abrasion-resistant paint and shall be baked in uniform thickness to provide a protection for silver and copper coatings which will permit normal cutting and edge fabrication. Frames shall be Type 304 stainless steel.

2.2.3 Combination Paper Towel Dispenser/Waste Receptacle Units (PTDWR)

Dispenser/receptacle shall be semi-recessed and shall have a capacity of 600 sheets of C-fold, single-fold, or quarter-fold towel. Waste receptacle shall be designed to be locked in unit and removable for service. Locking mechanism shall be tumbler key lock. Waste receptacle shall have a capacity of 18 gallons. Unit shall be fabricated of not less than 0.30 inch stainless steel welded construction with all exposed surfaces having a satin finish. Waste receptacle that accepts reusable liner standard for unit manufacturer shall be provided.

2.2.4 Sanitary Napkin Disposer (SND)

Sanitary napkin disposal shall be constructed of Type 304 stainless steel with removable leak-proof receptacle for disposable liners. Fifty disposable liners of the type standard with the manufacturer shall be provided. Receptacle shall be retained in cabinet by tumbler lock. Disposer shall be provided with a door for inserting disposed napkins, and shall be surface mounted.

2.2.5 Sanitary Napkin and Tampon Dispenser (SNTD)

Sanitary napkin and tampon dispenser shall be recessed. Dispenser, including door shall be Type 304 stainless steel and shall dispense both napkins and tampons with a minimum capacity of 20 each. Dispensing mechanism shall be for coin operation. Coin mechanisms shall have minimum denominations of 10 cents, 25 cents, 50 cents. Doors shall be hung with a full-length corrosion-resistant steel piano hinge and secured with a tumbler lock. Keys for coin box shall be different from the door keys.

2.2.6 Shower Curtain (SC)

Shower curtain shall be size to suit conditions. Curtain shall be anti-bacterial nylon/vinyl fabric. Color shall be matte white. Provide complete with stainless steel shower curtain hooks.

2.2.7 Shower Curtain Rods (SCR)

Shower curtain rods shall be Type 304 stainless steel 1-1/4 inch OD by

0.049 inch minimum, straight to meet installation conditions.

2.2.8 Soap Dispenser (SD)

Soap dispenser shall be surface mounted, liquid type consisting of a vertical Type 304 stainless steel tank with holding capacity of 40 fluid ounces with a corrosion-resistant all-purpose valve that dispenses liquid soaps, lotions, detergents and antiseptic soaps.

2.2.9 Towel Pin (TP)

Towel pin shall have concealed wall fastenings, and a pin integral with or permanently fastened to wall flange. Maximum projection shall be 4 inches. Design shall be consistent with design of other accessory items. Finish shall be satin.

2.2.10 Toilet Tissue Dispenser (TTD)

Toilet tissue holder shall be Type II - surface mounted with two rolls of standard tissue mounted horizontally. Cabinet shall be stainless steel, satin finish.

2.2.11 Electric Hand Dryer (EHD)

Electric hand dryer shall be not touch operation, recessed mount and shall be designed to operate on 110/125 volts, 60 cycle, single phase alternating current with a heating element core rating of not more than 2100 watts delivering average air velocity of 5300 linear feet per minute. Dryer automatically shuts off after hands are removed.. Dryer housing shall be of single piece construction and shall be chrome plated steel.

2.2.12 Electric Hair Dryer - Men's Locker Room (EHDM)

Electric hair dryer for men's locker rooms shall be recessed mounted and shall be designed to operate on 110/125 volts, 60 cycle, single phase alternating current with a heating element core rating of not more than 2300 watts delivering 7300 linear feet of air per minute. Dryers shall be activated by means of a push button control device. Timer shall be mechanical type, designed to operate the dryer for no less than 80 seconds after activation. Dryers housing shall be of single piece construction and shall be brushed stainless steel.

2.2.13 Electric Hair Dryer - Women's Locker Room (EHDW)

Electric hair dryer shall be wall mounted and shall be designed to operate on 110/125 volts, 60 cycle, single phase alternating current with a heating element core rating of not more than 1200 watts. Cover and back plate shall be made of high impact ABS plastic with flexible hose permanently attached to direct air flow. Unit shall be equipped with 2 speed dry/style switch and shall deliver 50 CFM and 3500 LFM at maximum rated voltage. Hose exit shall be fitted with a rotating nozzle and be thermally insulated. Nozzle shall be fitted with air deflection vanes to provide uniform air flow.

2.2.14 Diaper Changing Station (DCS)

Diaper changing station shall be surface mounted and shall be fabricated of high impact plastic with no sharp edges. Unit fold down platform shall be concave to the child's shape, equipped with nylon and velcro safety straps

and engineered to withstand a minimum static load of 340 lb. Unit shall have an integral dispenser for sanitary liners. Safety graphics shall be pictorial for universal use. Color shall be cream.

2.2.15 Mop Holder with Shelf (MH-S)

Mop holder with shelf shall be surfaced mounted and shall be fabricated from 18 gauge, Type 304 stainless steel, satin finish. Shelf shall be 8 inches deep and 44 inches long. Four anti-slip mop holders with spring-loaded rubber cams that grip handles and five stainless steel hooks shall be provided.

2.2.16 Shower Seat (SS)

Shower seat shall consist of slotted 1/2 inch thick minimum phenolic resin attached to frame. Frame and support structure from Type 304 stainless steel includes self locking mechanism. Seat color is standard manufacturer's color. Seat handing shown in drawings.

PART 3 EXECUTION

3.1 INSTALLATION

Surfaces of fastening devices exposed after installation shall have the same finish as the attached accessory. Exposed screw heads shall be of tamper-proof design. Install accessories at the location and height indicated. Protect exposed surfaces of accessories with strippable plastic or by other means until the installation is accepted. After acceptance of accessories, remove and dispose of strippable plastic protection. Coordinate accessory manufacturer's mounting details with other trades as their work progresses. Brackets, plates, anchoring devices and similar items used for mounting accessories in showers shall be bedded in a silicone sealant as they are set to provide a watertight installation. After installation, thoroughly clean exposed surfaces and restore damaged work to its original condition or replace with new work.

3.1.1 Recessed Accessories

Fasten accessories with wood screws to studs, blocking or rough frame in wood construction. Set anchors in mortar in masonry construction. Fasten to metal studs or framing with sheet metal screws in metal construction.

3.1.2 Surface Mounted Accessories

Mount on concealed backplates, unless specified otherwise. Accessories without backplates shall have concealed fasteners. Unless indicated or specified otherwise, install accessories with sheet metal screws or wood screws in lead-lined braided jute, teflon or neoprene sleeves, or lead expansion shields, or with toggle bolts or other approved fasteners as required by the construction. Install backplates in the same manner, or provide with lugs or anchors set in mortar, as required by the construction. Fasten accessories mounted on gypsum board and plaster walls without solid backing into the metal or wood studs or to solid wood blocking secured between wood studs, or to metal backplates secured to metal studs.

3.2 CLEANING

Material shall be cleaned in accordance with manufacturer's

recommendations. Alkaline or abrasive agents shall not be used. Precautions shall be taken to avoid scratching or marring of surfaces.

-- End of Section --

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SECTION 11401N

ELECTRIC KITCHEN EQUIPMENT

08/01

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SECTION 11401N

ELECTRIC KITCHEN EQUIPMENT
08/01

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2002) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 430	(1994; Rev thru Mar 2001) Waste Disposers
UL 749	(1997; Rev thru Mar 2003) Household Dishwashers
UL 858	(1993; Rev thru Sept 2001) Household Electric Ranges
UL 923	(1995; R 1998) Microwave Cooking Appliances

1.2 RELATED REQUIREMENTS

Section 15050N, "Basic Mechanical Materials and Methods," applies to this section, with additions and modifications specified herein.

1.3 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-03 Product Data

Kitchen equipment

SD-08 Manufacturer's Instructions

Kitchen equipment

Exhaust hood

SD-10 Operation and Maintenance Data

Kitchen equipment, Data Package 2;

Submit operation and maintenance data in accordance with Section

01781, "Operation and Maintenance Data."

PART 2 PRODUCTS

2.1 KITCHEN EQUIPMENT

2.1.1 Materials

Except as modified herein, provide manufacturer's standard materials for kitchen equipment. Provide quantities, physical dimensions, colors, and electrical characteristics as indicated.

2.1.2 Cooking Top

UL 858. Natural gas, 30” stainless steel gas cook top surface with a minimum of 4 sealed burners including a power boil burner (15,000BTU) and a precise simmer burner. Electronic, pilotless ignition, integrated control panel. Tactile grip knobs, “on” indicator lights. Black, dishwasher safe, cast iron porcelainized, continuous interlocking burner grates.

2.1.3 Microwave Oven

UL 923. 1 cu.ft., built-in, 30 inch stainless steel microwave with black glass window and designer handle, 10 power levels, electronic digital display with clock, electronic touch controls, kitchen timer, minute pad, popcorn instant-on, reheat instant-on, add 30 seconds instant-on, auto and time defrost, delay start. 120V.

2.1.4 Oven

UL 858. 4.4 cu.ft. built-in, 30 inch stainless steel oven with black glass window door, automatic self clean with safety door lock, broiler pan and grid, digital clock with timer, automatic oven light, oven racks. 240V

2.1.5 DISHWASHER

UL 749. Built-in, 24 inch dishwasher with full-length, stainless steel flat door, stainless steel interior, stainless steel tub and door liner. Touchpad controls, dual pumps and motors, last cycle memory, 2 wash arms, 4 wash levels, 100% water filtration, delay start, heated dry on/off, 180 degree wash cycle, hi temp wash, nylon racks, adjustable top rack, silverware basket, detergent cup. 120V, 60 Hz, 12.0A.

2.1.6 HOUSEHOLD GARBAGE DISPOSAL

UL 430. Stainless steel, continuous feed model, ½ hp motor, and stainless steel grinding element with two 360 degree stainless steel swivel impellers. Provide polyethylene or polyester drain flow chamber. Equip motor with manual reset, thermal overload protection, and sound insulation.

PART 3 EXECUTION

3.1 INSTALLATION

NFPA 70, Section 15400N, "Plumbing Systems," and Section 16402N, "Interior Distribution System." Install kitchen equipment in accordance with manufacturers' instructions.

3.2 FIELD QUALITY CONTROL

Conduct inspection and testing in the presence of the Contracting Officer.

3.2.1 Field Inspection

Before and after installation, inspect each piece of kitchen equipment for compliance with specified requirements.

3.2.2 Operation Tests

Upon completion, but before final acceptance, perform operation tests on each piece of equipment to determine that components, including controls, safety devices, and attachments, operate properly and in accordance with specified requirements.

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SECTION 11480

GYMNASIUM DIVIDER CURTAIN

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Shop Drawings;

Submit in accordance with Section 01330 SUBMITTAL PROCEDURES. Show layout, installation requirements, fasteners, colors, controls wiring, finishes and appurtenances.

SD-03 Product Data

Product Data

Submit in accordance with Section 01330 SUBMITTAL PROCEDURES.

SD-10 Operation and Maintenance Data

Operation and Maintenance Manual

Submit in accordance with Section 01330 SUBMITTAL PROCEDURES, including manufacturer's printed maintenance procedures for items in this Section.

PART 2 PRODUCTS

2.1 GYMNASIUM DIVIDER CURTAIN

The gymnasium divider curtain shall be Model #665 Roll-fold curtain, opaque fabric 18 ounces per yard Flexivide, 10 feet high, mesh 6 ounces per yard Fleximesh, above 10 feet. Color as specified in Section 09915 COLOR SCHEDULE.

2.1.1 Manufacturers

Manufacturers shall be Porter Athletic Equipment Company, Nerco Scoreboard Company, Greenville, IL, or other manufactures approved as equal.

PART 3 EXECUTION

3.1 DELIVERY, STORAGE AND HANDLING

Deliver, store and handle items to prevent damage and deterioration.

Provide product data and factory packaging to protect items.

3.2 EXAMINATION

Examine surfaces and supports as indicarted on shop drawings to receive items and report unsatisfactory conditions in writing to Contracting Officer. Do not proceed until conditions are satisfactory. Starting installation signifies acceptance of conditions.

3.3 INSTALLATION

Install in accordance with manufacturer's current published instructions using manufacturer's authorized installers. Provide necessary anchorage and fastenings. Connect power and control wiring to power source installed under Division 16. Adjust for proper operation and instruct Contracting Officer's designated personnel in proper operation and maintenance.

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12/03

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SECTION 12490A

WINDOW TREATMENT
12/03

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 701	(1999) Fire Tests for Flame Propagation of Textiles and Films

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Approved Detail Drawings; G-AE

Drawings showing fabrication and installation details. Drawings shall show layout and locations of draw chain and details.

SD-03 Product Data

Window Treatments; G-AE
Hardware

Manufacturer's data composed of catalog cuts, brochures, product information, and maintenance instructions.

SD-04 Samples

Window Treatments

Three samples of each type and color of window treatment. Shade material shall be minimum 6 x 6 inches in size.

1.3 GENERAL REQUIREMENTS

Window treatment shall be provided, complete with necessary brackets, fittings, and hardware. Each window treatment type shall be a complete unit. Equipment shall be mounted and operated as indicated. Windows to receive a treatment shall be completely covered. The Contractor shall take measurements at the building and shall be responsible for the proper

fitting and hanging of the equipment.

1.4 DELIVERY, STORAGE, AND HANDLING

Components shall be delivered to the jobsite in the manufacturer's original packaging with the brand or company name, item identification, and project reference clearly marked. Components shall be stored in a dry location that is adequately ventilated and free from dust, water, or other contaminants and shall have easy access for inspection and handling. Materials shall be stored flat in a clean dry area with temperature maintained above 50 degrees F.

1.5 FIELD MEASUREMENTS

The Contractor shall become familiar with details of the work, verify dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work.

1.6 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

PART 2 PRODUCTS

2.1 WINDOW TREATMENTS

Roller tube shall operate smoothly and be of sufficient diameter and thickness to prevent excessive deflection. Brackets shall be provided that are appropriate for inside mount. The shade cloth shall meet the performance described in NFPA 701, small scale test. Steel features shall be treated for corrosion resistance.

2.1.1 Light Filtering Shades

Light filtering shades shall conform to the following: Roller tube shall be steel and shall operate by clutch and bead operation mechanism. Fascia mounting brackets shall be steel to support roller tube and fascia panel. The fascia panel shall be channel shaped extruded aluminum with standard enamel finish. The shade shall be made from a single piece of thermoplasatic matrix, polyester core yarn.

2.2 COLOR

Color shall be in accordance with Section 09915 COLOR SCHEDULE.

PART 3 EXECUTION

3.1 WINDOW TREATMENT PLACEMENT SCHEDULE

Refer to drawings for locations of window shades. 3.2 INSTALLATION

Installation shall be in accordance with the approved detail drawings and manufacturer's installation instructions. Units shall be level, plumb, secure, and at proper height and location relative to window units. The Contractor shall furnish and install supplementary or miscellaneous items in total, including clips, brackets, or anchorages incidental to or necessary for a sound, secure, and complete installation. Installation shall not be initiated until completion of room painting and finishing

operations. Upon completion of the installation, window treatments shall be adjusted for form and appearance, shall be in proper operating condition, and shall be free from damage or blemishes. Damaged units shall be repaired or replaced by the Contractor as directed by the Contracting Officer.

-- End of Section --

SPECIFICATIONS
(FOR CONSTRUCTION CONTRACT)

SOLICITATION NO. W9128F-04-B-0011

ADAL PHYSICAL FITNESS CENTER
PDC NO. QJVF 8800034R2

MINOT AFB, North Dakota

VOLUME 3 OF 3 – DIVISION 13 THRU DIVISION 16

JULY 2004

Prepared By : U.S. Army Corps of Engineers
Omaha District

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ADAL PHYSICAL FITNESS CENTER
MINOT AFB, NORTH DAKOTA

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ANTITERRORISM/FORCE PROTECTION (AT/FP)FOR MISCELLANEOUS EQUIPMENT

04/99

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SECTION 13080

ANTITERRORISM/FORCE PROTECTION (AT/FP)FOR MISCELLANEOUS EQUIPMENT
04/99

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A 36/A 36M	(2001) Carbon Structural Steel
ASTM A 53	(1999b) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 153/A 153M	(2001a) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 307	(2002) Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 500	(2001a) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 563	(2000) Carbon and Alloy Steel Nuts
ASTM A 572/A 572M	(2001) High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A 603	(1998) Zinc-Coated Steel Structural Wire Rope
ASTM A 653/A 653M	(2002a) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASME INTERNATIONAL (ASME)

ASME B18.2.1	(1996) Square and Hex Bolts and Screws, Inch Series
ASME B18.2.2	(1987; R 1999) Square and Hex Nuts

U.S. ARMY CORPS OF ENGINEERS (USACE)

TI 809-04	(1998) Seismic Design for Buildings

1.2 SYSTEM DESCRIPTION

1.2.1 General Requirements

The requirements for AT/FP measures described in this section shall be applied to the mechanical equipment and systems including the electrical equipment and systems outlined in Section 16070A ANTITERRORISM/FORCE PROTECTION FOR ELECTRICAL EQUIPMENT, and the miscellaneous equipment and systems listed below. AT/FP protection requirements shall be in accordance with TI 809-04 and additional data furnished by the Contracting Officer, and shall be provided in addition to any other requirements called for in other sections of these specifications. The design for seismic protection shall be based on a Seismic Use Group I building occupancy and on site response coefficients for S_{MS} = 0.15 and S_{M1} = 0.04. Resistance to lateral forces induced by earthquakes shall be accomplished without consideration of friction resulting from gravity loads. The basic force formulas, for Ground Motions A and B in Chapter 3 of TI 809-04, use the design spectral response acceleration parameters for the performance objective of the building, not for equipment in the building; therefore, corresponding adjustments to the formulas shall be required.

Equipment weighing 14 kg (31 lb) or more shall be mounted to resist forces of 0.5 times the component weight in any direction and 1.5 times the component weight in the downward direction or as required by seismic design (whichever is greater).

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Bracing; G-AE

Equipment Requirements; G-AE

Detail drawings along with catalog cuts, templates, and erection and installation details, as appropriate, for the items listed. Submittals shall be complete in detail; shall indicate thickness, type, grade, class of metal, and dimensions; and shall show construction details, reinforcement, anchorage, and installation with relation to the building construction. For equipment and systems in buildings that have a performance objective higher than life-safety, the drawings shall be stamped by the registered engineer who stamps the calculations required above.

SD-03 Product Data

Bracing; G-AE
Equipment Requirements; G-AE

Copies of the design calculations with the detail drawings. Calculations shall be stamped by a registered engineer and shall verify the capability of structural members to which bracing is attached for carrying the load from the brace.

1.4 EQUIPMENT REQUIREMENTS

Equipment weighing 14 kg (31 lb) or more shall be mounted to resist forces of 0.5 times the component weight in any direction and 1.5 times the component weight in the downward direction or as required by seismic design (whichever is greater).

PART 2 PRODUCTS

2.1 BOLTS AND NUTS

Squarehead and hexhead bolts, and heavy hexagon nuts, ASME B18.2.1, ASME B18.2.2, or ASTM A 307 for bolts and ASTM A 563 for nuts. Bolts and nuts used underground and/or exposed to weather shall be galvanized in accordance with ASTM A 153/A 153M.

2.2 SWAY BRACING

Material used for members listed in this section and on the drawings, shall be structural steel conforming with the following:

a. Plates, rods, and rolled shapes, ASTM A 36/A 36M. If the Contractor does the design, both ASTM A 36/A 36Mand ASTM A 572/A 572M, grade 503 will be allowed.

b. Wire rope, ASTM A 603.

c. Tubes, ASTM A 500, Grade B.

d. Pipes, ASTM A 53, Type E or S, Grade B.

e. Light gauge angles, less than 1/4 inch thickness, ASTM A 653/A 653M.

PART 3 EXECUTION

3.1 BRACING

Bracing shall conform to the arrangements shown. Trapeze-type hanger shall be secured with not less than two 1/2 inch bolts.

3.2 SWAY BRACES FOR PIPING

Transverse sway bracing for steel and copper pipe shall be provided at intervals not to exceed those shown on the drawings. Transverse sway bracing for pipes of materials other than steel and copper shall be provided at intervals not to exceed the hanger spacing as specified in Section 15400A PLUMBING, GENERAL PURPOSE. Bracing shall consist of at least one vertical angle 2 x 2 x 16 gauge and one diagonal angle of the same size.

3.2.1 Anchor Rods, Angles, and Bars

Anchor rods, angles, and bars shall be bolted to either pipe clamps or pipe flanges at one end and cast-in-place concrete or masonry insert or clip angles bolted to the steel structure on the other end. Rods shall be solid metal or pipe as specified below. Anchor rods, angles, and bars shall not exceed lengths given in the tabulation below.

3.2.2 Maximum Length for Anchor Braces

Type	Size (Inches)	Maximum Length* (Feet/Inches)
Angles	1-1/2 x 1-1/2 x 1/4	4-10
	2 x 2 x 1/4	6-6
	2-1/2 x 1-1/2 x 1/4	8-0
	3 x 2-1/2 x 1/4	8-10
	3 x 3 x 1/4	9-10
Rods	3/4	3-1
	7/8	3-8
Flat Bars	1-1/2 x 1/4	1-2
	2 x 1/4	1-2
	2 x 3/8	1-9
Pipes (40S)	1	7-0
	1-1/4	9-0
	1-1/2	10-4
	2	13-1

3.2.3 Bolts

Bolts used for attachment of anchors to pipe and structure shall be not less than 1/2 inch diameter.

3.3 EQUIPMENT SWAY BRACING

3.3.1 Suspended Equipment

Equipment sway bracing shall be provided for items supported from overhead floor or roof structural systems, including light fixtures. Braces shall consist of angles, rods, wire rope, bars, or pipes arranged as shown and secured at both ends with not less than 1/2 inch bolts. Sufficient braces shall be provided for equipment to resist a horizontal force equal to 0.15 times the weight of equipment without exceeding safe working stress of bracing components. Details of equipment bracing shall be submitted for acceptance. In lieu of bracing with vertical supports, these items may be supported with hangers inclined at 45 degrees directed up and radially away from equipment and oriented symmetrically in 90-degree intervals on the horizontal plane, bisecting the angles of each corner of the equipment, provided that supporting members are properly sized to support operating weight of equipment when hangers are inclined at a 45-degree angle.

-- End of Section --

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SECTION 13110A

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11/98

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SECTION 13110A

CATHODIC PROTECTION SYSTEM (SACRIFICIAL ANODE)
11/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM B 843	(1993; R 1998) Magnesium Alloy Anodes for Cathodic Protection

NACE INTERNATIONAL (NACE)

NACE RP0169	(2002) Control of External Corrosion on Underground or Submerged Metallic Piping Systems
NACE RP0188	(1999) Discontinuity (Holiday) Testing of Protective Coatings
NACE RP0190	(1995) External Protective Coatings for Joints, Fittings, and Valves on Metallic Underground or Submerged Pipelines and Piping Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2002) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 510	(1994; Rev thru Apr 1998) Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When

used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Drawings; G-AE

Six copies of detail drawings consisting of a complete list of equipment and material including manufacturer's descriptive and technical literature, catalog cuts, results of system design calculations including soil-resistivity, installation instructions and certified test data stating the maximum recommended anode current output density and the rate of gaseous production if any at that current density. Detail drawings shall contain complete wiring and schematic diagrams and any other details required to demonstrate that the system has been coordinated and will function properly as a unit.

Contractor's Modifications; G-AE

Six copies of detail drawings showing proposed changes in location, scope of performance indicating any variations from, additions to, or clarifications of contract drawings. The drawings shall show proposed changes in anode arrangement, anode size and number, anode materials and layout details, conduit size, wire size, mounting details, wiring diagram, method for electrically-isolating each pipe, and any other pertinent information to proper installation and performance of the system.

SD-03 Product Data

Equipment; G-AE

Within 30 days after receipt of notice to proceed, an itemized list of equipment and materials including item number, quantity, and manufacturer of each item. The list shall be accompanied by a description of procedures for each type of testing and adjustments, including testing of coating for thickness and holidays. Installation of materials and equipment shall not commence until this submittal is approved.

Spare Parts

Spare parts data for each different item of material and equipment specified, after approval of detail drawings and not later than six (6) months prior to the date of beneficial occupancy. The data shall include a complete list of parts, special tools, and supplies, with current unit prices and source of supply. One (1) spare anode and one spare test station shall be furnished.

SD-06 Test Reports

Tests and Measurements; G-AO

Test reports in booklet form tabulating all field tests and measurements performed, upon completion and testing of the installed system and including close interval potential survey,

casing and interference tests, final system test verifying protection, insulated joint and bond tests, and holiday coating test.

Contractor's Modifications; G-AO

Final report regarding Contractor's modifications. The report shall include pipe-to-soil measurements throughout the affected area, indicating that the modifications improved the overall conditions, and current measurements for anodes. The following special materials and information are required: taping materials and conductors; installation and testing procedures, and equipment; coating material; system design calculations for anode number, life, and parameters to achieve protective potential; backfill shield material and installation details showing waterproofing; bonding and waterproofing details; insulated resistance wire; exothermic weld equipment and material.

SD-07 Certificates

Cathodic Protection System

Proof that the materials and equipment furnished under this section conform to the specified requirements contained in the referenced standards or publications. The label or listing by the specified agency will be acceptable evidence of such compliance.

Services of "Corrosion Expert"

Evidence of qualifications of the "corrosion expert."

a. The "corrosion expert's" name and qualifications shall be certified in writing to the Contracting Officer prior to the start of construction.

b. Certification shall be submitted giving the name of the firm, the number of years of experience, and a list of not less than five (5) of the firm's installations three (3) or more years old that have been tested and found satisfactory.

SD-10 Operation and Maintenance Data

Cathodic Protection System; G-AO

Before final acceptance of the cathodic protection system, six copies of operating manuals outlining the step-by-step procedures required for system startup, operation, adjustment of current flow, and shutdown. The manuals shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Six copies of maintenance manual, listing routine maintenance procedures, recommendation for maintenance testing, possible breakdowns and repairs, and troubleshooting guides. The manuals shall include single-line diagrams for the system as installed; instructions in making pipe-to-reference cell potential measurements and frequency of monitoring; instructions for dielectric connections, interference and sacrificial anode bonds; instructions shall include precautions to ensure safe conditions during repair of pipe or other metallic systems. The instructions

shall be neatly bound between permanent covers and titled "Operating and Maintenance Instructions." These instructions shall be submitted for the Contracting Officer's approval. The instructions shall include the following:

a. As-built drawings, to scale of the entire system, showing the locations of the piping and metallic components, location of all anodes and test stations, locations of all insulating joints, and structure-to-reference cell potentials as measured during the tests required by Paragraph: TESTS AND MEASUREMENTS, of this section.

b. Recommendations for maintenance testing, including instructions in making pipe-to-reference cell potential measurements and frequency of testing.

c. All maintenance and operating instructions and nameplate data shall be in English.

d. Instructions shall include precautions to insure safe conditions during repair of pipe system.

Training Course; G-AO

The proposed Training Course Curriculum (including topics and dates of discussion) indicating that all of the items contained in the operating and maintenance instructions, as well as demonstrations of routine maintenance operations, including testing procedures included in the maintenance instructions, are to be covered.

1.3 GENERAL REQUIREMENTS

The Contractor shall furnish and install a complete, operating, sacrificial anode cathodic protection system in complete compliance with NFPA 70, with all applicable Federal, State, and local regulations and with minimum requirements of this contract. The services required include planning, installation, adjusting and testing of a cathodic protection system, using sacrificial anodes for cathodic protection of the Water and Fire Protection lines, their connectors and . The cathodic protection system shall include anodes, cables, connectors, corrosion protection test stations, and any other equipment required for a complete operating system providing the NACE criteria of protection as specified. Insulators are required whenever needed to insulate the pipes from any other structure. The cathodic protection shall be provided on Water and Fire Protection pipes.

1.3.1 Services of "Corrosion Expert"

The Contractor shall obtain the services of a "corrosion expert" to supervise, inspect, and test the installation and performance of the cathodic protection system. "Corrosion expert" refers to a person, who by thorough knowledge of the physical sciences and the principles of engineering and mathematics, acquired by professional education and related practical experience, is qualified to engage in the practice of corrosion control of buried or submerged metallic surfaces. Such a person must be accredited or certified by the National Association of Corrosion Engineers (NACE) as a NACE Accredited Corrosion Specialist or a NACE certified Cathodic Protection (CP) Specialist or be a registered professional engineer who has certification or licensing that includes education and

experience in corrosion control of buried or submerged metallic piping and tank systems, if such certification or licensing includes 5 years experience in corrosion control on underground metallic surfaces of the type under this contract. The "corrosion expert" shall make at least 3 visits to the project site. The first of these visits shall include obtaining soil resistivity data, acknowledging the type of pipeline coatings to be used and reporting to the Contractor the type of cathodic protection required. Once the submittals are approved and the materials delivered, the "corrosion expert" shall revisit the site the ensure the Contractor understands installation practices and laying out the components. The third visit shall involve testing the installed cathodic protection systems and training applicable personnel on proper maintenance techniques. The "corrosion expert" shall supervise installation and testing of all cathodic protection.

1.3.2 Contractor's Modifications

The specified system is based on a complete system with magnesium sacrificial anodes. The Contractor may modify the cathodic protection system after review of the project, site verification, and analysis, if the proposed modifications include the anodes specified and will provide better overall system performance. The modifications shall be fully described, shall be approved by the Contracting Officer's representative, and shall meet the following criteria. The proposed system shall achieve a minimum pipe-to-soil "instant off" potential of minus 850 millivolts with reference to a saturated copper-copper sulfate reference cell on the underground components of the piping or other metallic surface. The Contractor shall take resistivity measurements of the soil in the vicinity of the pipes and ground bed sites. Based upon the measurements taken, the current and voltage shall be required to produce a minimum of minus 850 millivolts "instant off" potential between the structure being tested and the reference cell. This potential shall be obtained over 95 percent of the metallic area. The anode system shall be designed for a life of twenty-five (25) years of continuous operation.

1.3.3 Isolators

Isolators are required to insulate the water and fire water pipes from above ground structures.

1.3.4 Summary of Services Required

The scope of services shall include, but shall not be limited to, the following:

a. Cathodic Protection Systems.

b. System testing.

c. Training.

d. Operating and maintenance manual.

e. Insulator testing.

f. Coating and holiday testing shall be submitted within 45 days of notice to proceed.

1.3.5 Nonmetallic Pipe System

In the event pipe other than metallic pipe is approved and used in lieu of metallic pipe, all metallic components of this pipe system shall be protected with cathodic protection. Detailed drawings of cathodic protection for each component shall be submitted to the Contracting Officer for approval within 45 days after date of receipt of notice to proceed, and before commencement of any work.

1.3.5.1 Coatings

Coatings for metallic components shall be as required for metallic fittings. Protective covering (coating and taping) shall be completed and tested on each metallic component (such as valves, hydrants and fillings). This covering shall be as required for underground metallic pipe. Each test shall be witnessed by the Contracting Officer. Coatings shall be selected, applied, and inspected in accordance with NACE RP0190 and as specified in these specifications. The use of nonmetallic pipe does not change other requirements of the specifications. Any deviations due to the use of nonmetallic pipe shall be submitted for approval.

1.3.6 Tests of Components

A minimum of four (4) tests shall be made at each metallic component in the piping system. Two (2) measurements shall be made directly over the anodes and the other two (2) tests shall be over the outer edge of the component, but at the farthest point from the anodes. Structure and pipes shall be shown with the cathodic protection equipment. All components of the cathodic protection system shall be shown on drawings, showing their relationship to the protected structure or component. A narrative shall describe how the cathodic protection system will work and provide testing at each component. Components requiring cathodic protection shall include but not be limited to the following:

a. Pipes under the floor slab or foundations.

b. PIV.

c. Shutoff valves.

d. Metallic pipe extended from aboveground locations.

e. Each connector or change-of-direction device.

f. Any metallic pipe component or section.

1.3.7 Drawings

Detailed drawings shall be provided showing location of anodes, insulated fittings, test stations, and bonding. Locations shall be referenced to two (2) permanent facilities or mark points.

1.3.8 Electrical Potential Measurements

All potential tests shall be made at a minimum of 10 foot intervals witnessed by the Contracting Officer. Submittals shall identify test locations on separate drawing, showing all metal to be protected and all

cathodic protection equipment. Test points equipment and protected metal shall be easily distinguished and identified.

1.3.9 Achievement of Criteria for Protection

All conductors, unless otherwise shown, shall be routed to or through the test stations. Each system provided shall achieve a minimum pipe-to-soil "instant off" potential of minus 1000 millivolt potentials with reference to a saturated copper-copper-sulfate reference cell on all underground components of the piping. This potential should be obtained over 95 percent of the metallic area. Testing will be witnessed by the Contracting Officer. Additional anodes shall be provided by the Contractor if required to achieve the minus 1000 millivolts "instant off". Although acceptance criteria of the cathodic protection systems are defined in NACE RP0169, for this project the "instant off" potential of minus 1000 millivolts is the only acceptable criteria.

1.3.10 Metallic Components and Typicals

a. Metallic components: As a minimum, each metallic component shall be protected with one (1) magnesium anode. This number of anodes is required to achieve minus 1000 millivolts "instant off" potential on the metallic area. As a minimum, the magnesium anode unpackaged weight shall be 20 pounds. The magnesium anodes shall be located about 3 feet from the side of the metallic component and routed through a test station.

b. Fire Hydrants: Fire hydrant pipe components shall have a minimum of two (2) anodes. These magnesium anodes shall have an unpackaged weight of 20 pounds.

c. Pipe Under Concrete Slab: Pipe under concrete slab shall have a minimum of 2 magnesium anodes. These magnesium anodes shall have an unpackaged weight of 20 pounds. Pipe under concrete slab shall have 1 permanent reference electrodes located under the slab. All conductors shall be routed to a test station.

d. Valves: Each valve shall be protected with 1 magnesium anodes. The magnesium anode shall have an unpackaged weight of 20 pounds.

e. Metallic Pipe Component or Section: Each section of metallic pipe shall be protected with 1 magnesium anode. The magnesium anodes shall have an unpackaged weight of 20 pounds.

f. Connectors or Change-of-Direction Devices: Each change-of-direction device shall be protected with 1 magnesium anode. The magnesium anode shall have an unpackaged weight of 20 pounds.

1.3.11 Metallic Component Coating

Coatings for metallic components shall be as required for metallic fittings as indicated. This will include fire hydrants, T's, elbows, valves, etc. Coatings shall be selected, applied, and inspected in accordance with NACE RP0190 and as specified in these specifications.

PART 2 PRODUCTS

2.1 MAGNESIUM ANODES

A minimum of 2 anodes shall be installed on each pipe system. See

Paragraph METALLIC COMPONENTS AND TYPICALS for additional anodes under slab.

2.1.1 Anode Composition

Anodes shall be of high-potential magnesium alloy, made of primary magnesium obtained from sea water or brine, and not made from scrap metal. Magnesium anodes shall conform to ASTM B 843 and to the following analysis (in percents) otherwise indicated:

Aluminum, max.	0.010
Manganese, max.	0.50 to 1.30
Zinc	0.05
Silicon, max.	0.05
Copper, max.	0.02
Nickel, max.	0.001
Iron, Max.	0.03
Other impurities, max.	0.05 each or 0.3 max. total
Magnesium	Remainder

The Contractor shall furnish spectrographic analysis on samples from each heat or batch of anodes used on this project.

2.1.2 Dimensions and Weights

Dimensions and weights of anodes shall be approximately as follows:

TYPICAL MAGNESIUM ANODE SIZE

(Cross sections may be round, square, or D shaped)

NOMINAL WT. LBS.	APPROX. SIZE (IN)	NOMINAL GROSS WT lb PACKAGED IN BACKFILL	NOMINAL PACKAGE DIMENSIONS (IN)
3	3 X 3 X 5	8	5-1/4 X 5-1/4 X 8
5	3 X 3 X 8	13	5-1/4 X 5-1/4 X 11-1/4
9	3 X 3 X 14	27	5-1/4 X 20
12	4 X 4 X 12	32	7-1/2 X 18
17	4 X 4 X 17	45	7-1/2 X 24
20	2-1/2x2-1/2x58-3/4	72	5-1/2 x 5-1/2 x 60
32	5 X 5 X 20-1/2	68	8-1/2 X 28
50	7 X 7 X 16	100	10 X 24

2.1.3 Packaged Anodes

Anodes shall be provided in packaged form with the anode surrounded by specially-prepared quick-wetting backfill and contained in a water permeable cloth or paper sack. Anodes shall be centered by means of spacers in the backfill material. The backfill material shall have the following composition, unless otherwise indicated:

Material	Approximate Percent by Weight
Gypsum	75
Bentonite	20
Sodium Sulphate	5
Total	100

2.1.4 Connecting Wire

2.1.4.1 Wire Requirements

Wire shall be No. 12 AWG solid copper wire, not less than 10 feet long, unspliced, complying with NFPA 70, Type TW and RHH insulation. Connecting wires for magnesium anodes shall be factory installed with the place or emergence from the anode in a cavity sealed flush with a dielectric sealing compound.

2.2 MISCELLANEOUS MATERIALS

2.2.1 Electrical Wire

2.2.1.1 Test Wires

Test wires shall be AWG No. 12 stranded copper wire with NFPA 70, Type TW or RHW or polyethylene insulation.

2.2.2 Joint, Patch, Seal, and Repair Coating

Sealing and dielectric compound shall be a black, rubber based compound that is soft, permanently pliable, tacky, moldable, and unbacked. Compound shall be applied as recommended by the manufacturer, but not less than 1/2-inch thick. Coating compound shall be cold-applied coal-tar base mastic. Pressure-sensitive vinyl plastic electrical tape shall conform to UL 510.

2.2.3 Thermite Weld Caps or Shields

Shields shall consist of approved pipeline wrapping or fiberglass-reinforced, coal-tar impregnated tape, or plastic weld caps, specifically made for the purpose and installed in accordance with the manufacturer's recommendations.

2.2.4 Test Stations

Stations shall be of the flush-curb-box type and shall be the standard product of a recognized manufacturer. Test stations shall be complete with an insulated terminal block having the required number of terminals. The test station shall be provided with a lockable cover and shall have an embossed legend, "C.P. Test." A minimum of one (1) test station shall be provided each component of the pipe. A minimum of four (4) terminals shall be provided in each test station. A minimum of two (2) leads are required to the metallic pipe or component from each test station. Other conductors shall be provided for each anode, other foreign pipe, and reference cells as required. The test stations shall be listed for the particular application for which they are to be utilized. All structure lead wires are to be red.

2.2.5 Electrical Isolation of Structures

As a minimum, isolating flanges or unions shall be provided at the following locations:

a. Pressure piping under floor slab to a building.

b. Service entrance of water and fire water, just after the piping comes above the floor.

2.2.5.1 Electrically Isolating Pipe Joints

Electrically isolating pipe joints shall be of a type that is in regular factory production.

2.2.5.2 Insulating Joint Testing

A Model 601 Insulation Checker, as manufactured by "Gas Electronics" or an approved equal, shall be used for insulating joint (flange) electrical testing.

2.2.6 Underground Structure Coating

This coating specification shall take precedence over any other project specification and drawing notes, whether stated or implied, and shall also apply to the pipeline or tank supplier. No variance in coating quality shall be allowed by the Contractor or Base Construction Representative without the written consent of the designer. All underground metallic pipelines and tanks to be cathodically protected shall be afforded a good quality factory-applied coating. This includes all carbon steel, cast-iron and ductile-iron pipelines or vessels. Coatings shall be selected, applied, and inspected in accordance with NACE RP0190 and as specified. If non-metallic pipelines are installed, all metallic fittings on pipe sections shall be coated in accordance with this specification section.

The nominal thickness of coatings shall be: Fusion Bonded Epoxy - 12 mil; Coal Tar Epoxy - 22 mil; Tape Systems - 20 mil plus or minus 5 percent.

2.2.6.1 Inspection of Pipe Coatings

Any damage to the protective covering during transit and handling shall be repaired before installation. After field coating and wrapping has been applied, the entire pipe shall be inspected by an electric holiday detector with impressed current in accordance with NACE RP0188 using a full-ring, spring-type coil electrode. The holiday detector shall be equipped with a bell, buzzer, or other type of audible signal which sounds when a holiday is detected. All holidays in the protective covering shall be repaired immediately upon detection. Occasional checks of holiday detector potential will be made by the Contracting Officer's representative to determine suitability of the detector. All labor, materials, and equipment necessary for conducting the inspection shall be furnished by the Contractor.

a. Protective covering for aboveground piping system: Finish painting shall conform to the applicable paragraph of SECTION: 09900, PAINTING, GENERAL, and as follows:

b. Ferrous surfaces: Shop-primed surfaces shall be touched-up with ferrous metal primer. Surfaces that have not been shop-primed shall be solvent-cleaned. Surfaces that contain loose rust, loose mil scale, and other foreign substances shall be mechanically-cleaned by power wire-brushing and primed with ferrous metal primer. Primed surface shall

be finished with two (2) coats of exterior oil paint and vinyl paint. Coating for each entire piping service shall be an approved pipe line wrapping having a minimum coating resistance of 50,000 Ohms per square foot.

2.2.7 Electrical Connections

Electrical connections shall be done as follows:

a. Exothermic welds shall be "Cadweld", " Bundy", "Thermoweld" or an approved equal. Use of this material shall be in strict accordance with the manufacturer's recommendations.

b. Electrical-shielded arc welds shall be approved for use on steel pipe by shop drawing submittal action.

c. Brazing shall be as specified in Paragraph: Lead Wire Connections.

2.2.8 Electrical Tape

Pressure-sensitive vinyl plastic electrical tape shall conform to UL 510.

2.2.9 Permanent Reference Electrodes

Permanent reference electrodes shall be Cu-CuS04 electrodes suitable for direct burial. Electrodes shall be guaranteed by the supplier for 15 years' service in the environment in which they shall be placed. Electrodes shall be installed directly beneath pipe.

PART 3 EXECUTION

3.1 CRITERIA OF PROTECTION

Acceptance criteria for determining the adequacy of protection on a buried underground pipe or metallic component shall be in accordance with NACE RP0169 and as specified below.

3.1.1 Iron and Steel

The following method (a) shall be used for testing cathodic protection voltages. If more than one method is required, method (b) shall be used.

a. A negative voltage of at least minus 1000 millivolts as measured between the underground component and a saturated copper-copper sulphate reference electrode connecting the earth (electrolyte) directly over the underground component. Determination of this voltage shall be made with the cathodic protection system in operation. Voltage drops shall be considered for valid interpretation of this voltage measurement. A minimum of minus 1000 millivolts "instant off" potential between the underground component being tested and the reference cell shall be achieved over 95 percent of the area of the structure. Adequate number of measurements shall be obtained over the entire structure, pipe, or other metallic component to verify and record achievement of minus 1000 millivolts "instant off." This potential shall be obtained over 95 percent of the total metallic area.

b. For any metallic component, a minimum of four (4) measurements shall be made using subparagraph (a), above, and achieving the "instant

off" potential of minus 850 millivolts. Two (2) measurements shall be made over the anodes and two (2) measurements shall be made at different locations near the component and farthest away from the anode.

3.2 ANODE STORAGE AND INSTALLATION

3.2.1 Anode Storage

Storage area for magnesium anodes will be designated by the Contracting Officer. If anodes are not stored in a building, tarps or similar protection should be used to protect anodes from inclement weather. Packaged anodes, damaged as a result of improper handling or being exposed to rain, shall be resacked by the Contractor and the required backfill added.

3.2.2 Anode Installation

Unless otherwise authorized, installation shall not proceed without the presence of the Contracting Officer. Anodes of the size specified shall be installed to the depth indicated and at the locations shown. Locations may be changed to clear obstructions with the approval of the Contracting Officer. Anodes shall be installed in sufficient number and of the required type, size, and spacing to obtain a uniform current distribution over the surface of the structure. The anode system shall e designed for a life of 25 years of continuous operation. Anodes shall be installed as indicated in a dry condition after any plastic or waterproof protective covering has been completely removed from the water permeable, permanent container housing the anode metal. The anode connecting wire shall not be used for lowering the anode into the hole. The annular space around the anode shall be backfilled with fine earth in 6 inch layers and each layer shall be hand tamped. Care must be exercised not to strike the anode or connecting wire with the tamper. Approximately 5 gallonsof water shall be applied to each filled hole after anode backfilling and tamping has been completed to a point about 6inches above the anode. After the water has been absorbed by the earth, backfilling shall be completed to the ground surface level.

3.2.2.1 Single Anodes

Single anodes, spaced as shown, shall be connected through a test station to the pipeline or component, allowing adequate slack in the connecting wire to compensate for movement during backfill operation.

3.2.2.2 Welding Methods

Connections to ferrous pipe or components shall be made by exothermic weld methods manufactured for the type of pipe supplied. Electric arc welded connections and other types of welded connections to ferrous pipe and structures shall be approved before use.

3.2.3 Anode Placement - General

Packaged anodes shall be installed completely dry, and shall be lowered into holes by rope sling or by grasping the cloth gather. The anode lead wire shall not be used in lowering the anodes. The hole shall be backfilled with fine soil in 6inch layers and each layer shall be hand-tamped around the anode. Care must be exercised not to strike the anode or lead wire

with the tamper. If immediate testing is to be performed, water shall be added only after backfilling and tamping has been completed to a point 6 inches above the anode. Approximately 5 gallons of water may be poured into the hole. After the water has been absorbed by the soil, backfilling and tamping may be completed to the top of the hole. Anodes shall be installed as specified or shown. In the event a rock strata is encountered prior to achieving specified augered-hole depth, anodes may be installed horizontally to a depth at least as deep as the bottom of the pipe, with the approval of the Contracting Officer.

3.2.4 Underground Pipeline

Anodes shall be installed at a minimum of 3 feet and a maximum of 10 feet from the line to be protected.

3.2.5 Installation Details

Details shall conform to the requirements of this specification. Details shown on the drawings are indicative of the general type of material required, and are not intended to restrict selection to material of any particular manufacturer.

3.2.6 Lead Wire Connections

3.2.6.1 Underground Pipeline (Metallic)

To facilitate periodic electrical measurements during the life of the sacrificial anode system and to reduce the output current of the anodes, if required, all anode lead wires shall be connected to a test station and buried a minimum of 24 inches in depth. The cable shall be No. 12 AWG, stranded copper, polyethylene, TW or RHW-USE insulated cable. The cable shall make contact with the structure only through a test station. Lead wire-to-structure connections shall be accomplished by an exothermic welding process. All welds shall be in accordance with the manufacturer's recommendations. A backfill shield filled with a pipeline mastic sealant or material compatible with the coating shall be placed over the weld connection and shall be of such diameter as to cover the exposed metal adequately.

3.2.7 Location of Test Stations

Test stations shall be of the type and location shown and shall be curb box mounted. Buried insulating joints shall be provided with test wire connections brought to a test station. Unless otherwise shown, other test stations shall be located as follows:

At each pipe or component.

3.2.8 Underground Pipe Joint Bonds

Underground pipe having other than welded or threaded coupling joints shall be made electrically continuous by means of a bonding connection installed across the joint.

3.3 ELECTRICAL ISOLATION OF STRUCTURES

3.3.1 Isolation Joints and Fittings

Isolating fittings, including main line isolating flanges and couplings, shall be installed aboveground, or within manholes, wherever possible. Where isolating joints must be covered with soil, they shall be fitted with a paper joint cover specifically manufactured for covering the particular joint, and the space within the cover filled with hot coal-tar enamel. Isolating fittings in lines entering buildings shall be located at least 12 inches above grade of floor level, when possible.

3.4 TESTS AND MEASUREMENTS

3.4.1 Baseline Potentials

Each test and measurement will be witnessed by the Contracting Officer. The Contractor shall notify the Contracting Officer a minimum of five (5) working days prior to each test. After backfill of the pipe or component , the static potential-to-soil of the pipe or component shall be measured. The locations of these measurements shall be identical to the locations specified for pipe-to-reference electrode potential measurements. The initial measurements shall be recorded.

3.4.2 Isolation Testing

Before the anode system is connected to the pipe, an isolation test shall be made at each isolating joint or fitting. This test shall demonstrate that no metallic contact, or short circuit exists between the two isolated sections of the pipe. Any isolating fittings installed and found to be defective shall be reported to the Contracting Officer.

3.4.2.1 Insulation Checker

A Model 601 insulation checker, as manufactured by "Gas Electronics", or an approved equal, using the continuity check circuit, shall be used for isolating joint (flange) electrical testing. Testing shall conform to the manufacturer's operating instructions. Test shall be witnessed by the Contracting Officer. An isolating joint that is good will read full scale on the meter. If an isolating joint is shorted, the meter pointer will be deflected or near zero on the meter scale. Location of the fault shall be determined from the instructions, and the joint shall be repaired. If an isolating joint is located inside a vault, the pipe shall be sleeved with insulator when entering and leaving the vault.

3.4.3 Anode Output

As the anodes or groups of anodes are connected to the pipe or component tank, current output shall be measured with an approved clamp-on milliammeter, calibrated shunt with a suitable millivoltmeter or multimeter, or a low resistance ammeter. (Of the three methods, the low-resistance ammeter is the least desirable and most inaccurate. The clamp-on milliammeter is the most accurate.) The valves obtained and the date, time, and location shall be recorded.

3.4.4 Reference Electrode Potential Measurements

Upon completion of the installation and with the entire cathodic protection system in operation, electrode potential measurements shall be made using a

copper-copper sulphate reference electrode and a potentiometer-voltmeter, or a direct-current voltmeter having an internal resistance (sensitivity) of not less than 10 megohms per volt and a full scale of 10 volts. The locations of these measurements shall be identical to the locations used for baseline potentials. The values obtained and the date, time, and locations of measurements shall be recorded. No less than two (2) measurements shall be made over any length of line or component. Additional measurements shall be made at each distribution service riser, with the reference electrode placed directly over the service line.

3.4.5 Location of Measurements

3.4.5.1 Piping or Conduit

For coated piping or conduit, measurements shall be taken from the reference electrode located in contact with the earth, directly over the pipe. Connection to the pipe shall be made at service risers, valves, test leads, or by other means suitable for test purposes. Pipe-to-soil potential measurements shall be made at intervals not exceeding 5 feet. The Contractor may use a continuous pipe-to-soil potential profile in lieu of 5 foot interval pipe-to-soil potential measurements. Additional measurements shall be made at each distribution service riser, with the reference electrode placed directly over the service line adjacent to the riser. Potentials shall be plotted versus distance to an approved scale. Locations where potentials do not meet or exceed the criteria shall be identified and reported to the Contracting Officer's representative.

3.4.5.2 Holiday Test

Any damage to the protective covering during transit and handling shall be repaired before installation. After field-coating and wrapping has been applied, the entire pipe shall be inspected by an electric holiday detector with impressed current in accordance with NACE RP0188 using a full-ring, spring-type coil electrode. The holiday detector shall be equipped with a bell, buzzer, or other type of audible signal which sounds when a holiday is detected. Holidays in the protective covering shall be repaired upon detection. Occasional checks of holiday detector potential will be made by the Contracting Officer to determine suitability of the detector. Labor, materials, and equipment necessary for conducting the inspection shall be furnished by the Contractor. The coating system shall be inspected for holes, voids, cracks, and other damage during installation.

3.4.5.3 Recording Measurements

All pipe-to-soil potential measurements, including initial potentials where required, shall be recorded. The Contractor shall locate, correct and report to the Contracting Officer any short circuits to foreign pipes encountered during checkout of the installed cathodic protection system. Pipe-to-soil potential measurements shall be taken on as many pipes or components as necessary to determine the extent of protection or to locate short-circuits.

3.5 TRAINING COURSE

The Contractor shall conduct a training course for the operating staff as designated by the Contracting Officer. The training period shall consist of a total of 4 hours of normal working time and shall start after the system is functionally completed but prior to final acceptance tests. The field instructions shall cover all of the items contained in the operating

and maintenance instructions, as well as demonstrations of routine maintenance operations, including testing procedures included in the maintenance instructions. At least 14 days prior to date of proposed conduction of the training course, the training course curriculum shall be submitted for approval, along with the proposed training date. Training shall consist of demonstration of test equipment, providing forms for test data and the tolerances which indicate that the system works.

3.6 CLEANUP

The Contractor shall be responsible for cleanup of the construction site. All paper bags, wire clippings, etc., shall be disposed of as directed. Paper bags, wire clippings and other waste shall not be put in bell holes or anodes excavation.

3.7 MISCELLANEOUS INSTALLATION AND TESTING

3.7.1 Coatings

All aboveground pipeline shall be coated as indicated or as approved. The coating shall have a minimum thickness of 7 mil. The pipeline coating shall be in accordance with all applicable Federal, State, and local regulations.

3.7.2 Excavation

In the event rock is encountered in providing the required depth for anodes, the Contractor shall determine an alternate approved location and, if the depth is still not provided, an alternate plan shall be submitted to the Contracting Officer. Alternate techniques and depths must be approved prior to implementation.

3.8 SPARE PARTS

After approval of shop drawings, and not later than three (3) months prior to the date of beneficial occupancy, the Contractor shall furnish spare parts data for each different item of material and equipment specified. The data shall include a complete list of parts, special tools, and supplies, with current unit prices and source of supply. In addition, the Contractor shall supply information for material and equipment replacement for all other components of the complete system, including anodes, cables, splice kits and connectors, corrosion test stations, and any other components not listed above.

3.9 SYSTEM TESTING

The Contractor shall submit a report including potential measurements taken at adequately-close intervals to establish that minus 1000 millivolts potential, "instant-off" potential, is provided, and that the cathodic protection is not providing interference to other foreign pipes causing damage to paint or pipes. The report shall provide a narrative describing how the criteria of protection is achieved without damaging other pipe or structures in the area.

-- End of Section --

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SECTION 13851A

FIRE DETECTION AND ALARM SYSTEM, ADDRESSABLE
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PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI S3.41	(1990; R 1996) Audible Emergency Evacuation Signal

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41	(1991) Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 1221	(2002) Installation, Maintenance and Use of Public Emergency Service Communications Systems
NFPA 70	(2002) National Electrical Code
NFPA 72	(2002) National Fire Alarm Code
NFPA 90A	(2002) Installation of Air Conditioning and Ventilating Systems

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

47 CFR 15	Radio Frequency Devices

UNDERWRITERS LABORATORIES (UL)

UL 1242	(1996; Rev Mar 1998) Intermediate Metal Conduit
UL 1971	(1995; Rev thru Apr 1999) Signaling Devices for the Hearing Impaired
UL 228	(1997; Rev Jan 1999) Door Closers-Holders, With or Without Integral Smoke Detectors
UL 268	(1996; Rev thru Jan 1999) Smoke Detectors for Fire Protective Signaling Systems
UL 268A	(1998) Smoke Detectors for Duct Application

UL 38	(1999) Manually Actuated Signaling Boxes for Use with Fire-Protective Signaling Systems
UL 464	(1996; Rev thru May 1999) Audible Signal Appliances
UL 521	(1999) Heat Detectors for Fire Protective Signaling Systems
UL 6	(1997) Rigid Metal Conduit
UL 797	(1993; Rev thru Mar 1997) Electrical Metallic Tubing
UL 864	(1996; Rev thru Mar 1999) Control Units for Fire Protective Signaling Systems

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fire Alarm Reporting System; G-AE

Detail drawings, prepared and signed by a Registered Professional Engineer or a NICET Level 4 Fire Alarm Technician, consisting of a complete list of equipment and material, including manufacturer's descriptive and technical literature, catalog cuts, and installation instructions. Note that the contract drawings show layouts based on typical detectors. The Contractor shall check the layout based on the actual detectors to be installed and make any necessary revisions in the detail drawings. The detail drawings shall also contain complete wiring and schematic diagrams for the equipment furnished, equipment layout, and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Detailed point-to-point wiring diagram shall be prepared and signed by a Registered Professional Engineer or a NICET Level 4 Fire Alarm Technician showing points of connection. Diagram shall include connections between system devices, appliances, control panels, supervised devices, and equipment that is activated or controlled by the panel.

SD-03 Product Data

Storage Batteries; G-AE

Substantiating battery calculations for supervisory and alarm power requirements. Ampere-hour requirements for each system component and each panel component, and the battery recharging period shall be included.

Voltage Drop; G-AE

Voltage drop calculations for notification appliance circuits to indicate that sufficient voltage is available for proper appliance operation.

Special Tools and Spare Parts; G-AO

Spare parts data for each different item of material and equipment specified, not later than 3 months prior to the date of beneficial occupancy. Data shall include a complete list of parts and supplies with the current unit prices and source of supply and a list of the parts recommended by the manufacturer to be replaced after 1 year of service.

Technical Data and Computer Software; G-AE

Technical data which relates to computer software.

Training; G-AO

Lesson plans, operating instructions, maintenance procedures, and training data, furnished in manual format, for the training courses. The operations training shall familiarize designated government personnel with proper operation of the fire alarm system. The maintenance training course shall provide the designated government personnel adequate knowledge required to diagnose, repair, maintain, and expand functions inherent to the system.

Testing; G-AE

Detailed test procedures, prepared and signed by a Registered Professional Engineer or a NICET Level 4 Fire Alarm Technician, for the fire detection and alarm system 60 days prior to performing system tests.

SD-06 Test Reports

Testing; G-AE

Test reports, in booklet form, showing field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall document readings, test results and indicate the final position of controls. The Contractor shall include the NFPA 72 Certificate of Completion and NFPA 72 Inspection and Testing Form, with the appropriate test reports.

SD-07 Certificates

Equipment; G-AE

Certified copies of current approvals or listings issued by an independent test lab if not listed by UL, FM or other nationally recognized testing laboratory, showing compliance with specified NFPA standards.

Qualifications; G-AE

Proof of qualifications for required personnel. The installer shall submit proof of experience for the Professional Engineer, fire alarm technician, and the installing company.

SD-10 Operation and Maintenance Data

Technical Data and Computer Software; G-AO

Six copies of operating manual outlining step-by-step procedures required for system startup, operation, and shutdown. The manual shall include the manufacturer's name, model number, service manual, parts list, and complete description of equipment and their basic operating features. Six copies of maintenance manual listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guide. The manuals shall include conduit layout, equipment layout and simplified wiring, and control diagrams of the system as installed. The manuals shall include complete procedures for system revision and expansion, detailing both equipment and software requirements. Original and backup copies of all software delivered for this project shall be provided, on each type of media utilized. Manuals shall be approved prior to training.

1.3 GENERAL REQUIREMENTS

1.3.1 Standard Products

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 2 years prior to bid opening. Equipment shall be supported by a service organization that can provide service within 24 hours of notification.

1.3.2 Nameplates

Major components of equipment shall have the manufacturer's name, address, type or style, voltage and current rating, and catalog number on a noncorrosive and nonheat-sensitive plate which is securely attached to the equipment.

1.3.3 Keys and Locks

Locks shall be keyed alike. Four keys for the system shall be provided.

1.3.4 Tags

Tags with stamped identification number shall be furnished for keys and locks.

1.3.5 Verification of Dimensions

After becoming familiar with details of the work, the Contractor shall verify dimensions in the field and shall advise the Contracting Officer of any discrepancy before performing the work.

1.3.6 Compliance

The fire detection and alarm system and the central reporting system shall be configured in accordance with NFPA 72; exceptions are acceptable as

directed by the Contracting Officer. The equipment furnished shall be compatible and be UL listed, FM approved, or approved or listed by a nationally recognized testing laboratory in accordance with the applicable NFPA standards.

1.3.7 Qualifications

1.3.7.1 Engineer and Technician

a. Registered Professional Engineer with verification of experience and at least 4 years of current experience in the design of the fire protection and detection systems.

b. National Institute for Certification in Engineering Technologies (NICET) qualifications as an engineering technician in fire alarm systems program with verification of experience and current NICET certificate.

c. The Registered Professional Engineer may perform all required items under this specification. The NICET Fire Alarm Technician shall perform only the items allowed by the specific category of certification held.

1.3.7.2 Installer

The installing Contractor shall provide the following: NICET Fire Alarm Technicians to perform the installation of the system. A NICET Level 4 Fire Alarm Technician shall supervise the installation of the fire alarm system. NICET Level 2 or higher Fire Alarm Technician shall install and terminate fire alarm devices, cabinets and panels. An electrician or NICET Level 1 Fire Alarm Technician shall install conduit for the fire alarm system. The Fire Alarm technicians installing the equipment shall be factory trained in the installation, adjustment, testing, and operation of the equipment specified herein and on the drawings.

1.3.7.3 Design Services

Installations requiring designs or modifications of fire detection, fire alarm, or fire suppression systems shall require the services and review of a qualified fire protection engineer. For the purposes of meeting this requirement, a qualified fire protection engineer is defined as an individual meeting one of the following conditions:

a. An engineer having a Bachelor of Science or Masters of Science Degree in Fire Protection Engineering from an accredited university engineering program, plus a minimum of 2 years' work experience in fire protection engineering.

b. A registered professional engineer (P.E.) in fire protection engineering.

c. A registered PE in a related engineering discipline and member grade status in the National Society of Fire Protection Engineers.

d. An engineer with a minimum of 10 years' experience in fire protection engineering and member grade status in the National Society of Fire Protection Engineers.

1.4 SYSTEM DESIGN

1.4.1 Operation

The fire alarm and detection system and equipment shall be a complete, supervised fire alarm reporting system. The system shall be activated into the alarm mode by actuation of any alarm initiating device. The system shall remain in the alarm mode until the initiating device is reset and the fire alarm control panel is reset and restored to normal. Alarm initiating devices shall be connected to initiating device circuits (IDC), Style D, to signal line circuits (SLC), Style 6, in accordance with NFPA 72. Alarm notification appliances shall be connected to notification appliance circuits (NAC), Style Z in accordance with NFPA 72. A looped conduit system shall be provided so that if the conduit and all conductors within are severed at any point, all IDC, NAC and SLC will remain functional. The conduit loop requirement is not applicable to the signal transmission link from the local panels (at the protected premises) to the Supervising Station (fire station, fire alarm central communication center). Textual, audible, and visual appliances and systems shall comply with NFPA 72. Fire alarm system components requiring power, except for the control panel power supply, shall operate on 24 Volts dc. Addressable system shall be microcomputer (microprocessor or microcontroller) based with a minimum word size of eight bits and shall provide the following features:

a. Sufficient memory to perform as specified and as shown for addressable system.

b. Individual identity of each addressable device for the following conditions: alarm; trouble; open; short; and appliances missing/failed remote detector - sensitivity adjustment from the panel for smoke detectors

c. Capability of each addressable device being individually disabled or enabled from the panel.

d. Each SLC shall be sized to provide 40 percent addressable expansion without hardware modifications to the panel.

1.4.2 Operational Features

The system shall have the following operating features:

a. Monitor electrical supervision of IDC, SLC, and NAC.

b. Monitor electrical supervision of the primary power (ac) supply, battery voltage, placement of alarm zone module (card, PC board) within the control panel, and transmitter tripping circuit integrity.

c. A trouble buzzer and trouble LED/LCD (light emitting diode/liquid crystal diode) to activate upon a single break, open, or ground fault condition which prevents the required normal operation of the system. The trouble signal shall also operate upon loss of primary power (ac) supply, low battery voltage, removal of alarm zone module (card, PC board), and disconnection of the circuit used for transmitting alarm signals off-premises. A trouble alarm silence switch shall be provided which will silence the trouble buzzer, but will not extinguish the trouble indicator LED/LCD. Subsequent trouble and supervisory alarms shall sound the trouble

signal until silenced. After the system returns to normal operating conditions, the trouble buzzer shall again sound until the silencing switch returns to normal position, unless automatic trouble reset is provided.

d. A one person test mode. Activating an initiating device in this mode will activate an alarm for a short period of time, then automatically reset the alarm, without activating the transmitter during the entire process.

e. A transmitter disconnect switch to allow testing and maintenance of the system without activating the transmitter but providing a trouble signal when disconnected and a restoration signal when reconnected.

f. Evacuation alarm silencing switch which, when activated, will silence alarm devices, but will not affect the zone indicating LED/LCD nor the operation of the transmitter. This switch shall be over-ridden upon activation of a subsequent alarm from an unalarmed device and the NAC devices will be activated.

g. Electrical supervision for circuits used for supervisory signal services (i.e., sprinkler systems, valves, etc.). Supervision shall detect any open, short, or ground.

h. Confirmation or verification of all smoke detectors. The control panel shall interrupt the transmission of an alarm signal to the system control panel for a factory preset period. This interruption period shall be adjustable from 1 to 60 seconds and be factory set at 20 seconds. Immediately following the interruption period, a confirmation period shall be in effect during which time an alarm signal, if present, will be sent immediately to the control panel. Fire alarm devices other than smoke detectors shall be programmed without confirmation or verification.

i. The fire alarm control panel shall provide supervised addressable relays for HVAC shutdown. An override at the HVAC panel shall not be provided.

j. Provide one person test mode - Activating an initiating device in this mode will activate an alarm for a short period of time, then automatically reset the alarm, without activating the transmitter during the entire process.

k. The fire alarm control panel shall provide the required monitoring and supervised control outputs needed to accomplish elevator recall.

l. The fire alarm control panel shall monitor the fire sprinkler system, or other fire protection extinguishing system.

m. The control panel and field panels shall be software reprogrammable to enable expansion or modification of the system without replacement of hardware or firmware. Examples of required changes are: adding or deleting devices or zones; changing system responses to particular input signals; programming certain input signals to activate auxiliary devices.

n. Zones for IDC and NAC shall be arranged as indicated on the contract drawings.

1.4.3 Alarm Functions

An alarm condition on a circuit shall automatically initiate the following functions:

a. Transmission of signals over the station radio fire reporting system. The signal shall be common for any device.

b. Visual indications of the alarmed devices on the fire alarm control panel display and on the remote audible/visual display.

c. Continuous sounding or operation of alarm notification appliances throughout the building as required by ANSI S3.41.

d. Closure of doors held open by electromagnetic devices.

e. Operation of the smoke control system.

f. Deactivation of the air handling units throughout the building.

g. Shutdown of power to the data processing equipment in the alarmed area.

1.4.4 Primary Power

Operating power shall be provided as required by paragraph Power Supply for the System. Transfer from normal to emergency power or restoration from emergency to normal power shall be fully automatic and not cause transmission of a false alarm. Loss of ac power shall not prevent transmission of a signal via the fire reporting system upon operation of any initiating circuit. Conductors shall be sized to account for voltage drop.

1.4.5 Battery Backup Power

Battery backup power shall be through use of rechargeable, sealed-type storage batteries and battery charger.

1.4.6 Interface With other Equipment

Interfacing components shall be furnished as required to connect to subsystems or devices which interact with the fire alarm system, such as supervisory or alarm contacts in suppression systems, operating interfaces for smoke control systems, door releases, etc.

1.5 TECHNICAL DATA AND COMPUTER SOFTWARE

Technical data and computer software (meaning technical data which relates to computer software) which is specifically identified in this project, and which may be defined/required in other specifications, shall be delivered, strictly in accordance with the CONTRACT CLAUSES, and in accordance with the Contract Data Requirements List, DD Form 1423. Data delivered shall be identified by reference to the particular specification paragraph against which it is furnished. Data to be submitted shall include complete system, equipment, and software descriptions. Descriptions shall show how the

equipment will operate as a system to meet the performance requirements of this contract. The data package shall also include the following:

(1) Identification of programmable portions of system equipment and capabilities.

(2) Description of system revision and expansion capabilities and methods of implementation detailing both equipment and software requirements.

(3) Provision of operational software data on all modes of programmable portions of the fire alarm and detection system.

(4) Description of Fire Alarm Control Panel equipment operation.

(5) Description of auxiliary and remote equipment operations.

(6) Library of application software.

(7) Operation and maintenance manuals as specified in SD-19 of the Submittals paragraph.

1.6 DELIVERY AND STORAGE

Equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variation, dirt, dust, and any other contaminants.

PART 2 PRODUCTS

2.1 CONTROL PANEL

Control Panel shall comply with the applicable requirements of UL 864. Panel shall be modular, installed in a surface mounted steel cabinet with hinged door and cylinder lock. Control panel shall be a clean, uncluttered, and orderly assembled panel containing components and equipment required to provide the specified operating and supervisory functions of the system. The panel shall have prominent rigid plastic, phenolic or metal identification plates for LED/LCDs, zones, SLC, controls, meters, fuses, and switches. Nameplates for fuses shall also include ampere rating. The LED/LCD displays shall be located on the exterior of the cabinet door or be visible through the cabinet door. Control panel switches shall be within the locked cabinet. A suitable means (single operation) shall be provided for testing the control panel visual indicating devices (meters or LEDs/LCDs). Meters and LEDs shall be plainly visible when the cabinet door is closed. Signals and LEDs/LCDs shall be provided to indicate by zone any alarm, supervisory or trouble condition on the system. Each IDC shall be powered and supervised so that a signal on one zone does not prevent the receipt of signals from other devices. Loss of power, including batteries, shall not require the manual reloading of a program. Upon restoration of power, startup shall be automatic, and shall not require any manual operation. The loss of primary power or the sequence of applying primary or emergency power shall not affect the transmission of alarm, supervisory or trouble signals. Visual annunciation shall be provided for LED/LCD visual display as an integral part of the control panel and shall identify with a word description and id number each device. Cabinets shall be provided with ample gutter space to allow proper clearance between the cabinet and live parts of the panel equipment. If more than one modular unit is required to form a control panel, the units

shall be installed in a single cabinet large enough to accommodate units. Cabinets shall be painted red. Each fire alarm and supervisory alarm initiating device shall be individually addressed.

2.1.1 Remote System Audible/Visual Display

Audible appliance shall have a minimum sound level output rating of 85 dBA at 10 feet and operate in conjunction with the panel integral display. The audible device shall be silenced by a system silence switch on the remote system. The audible device shall be silenced by the system silence switch located at the remote location, but shall not extinguish the visual indication. The remote LED/LCD visual display shall provide identification, consisting of the word description and id number for each device as displayed on the control panel. A rigid plastic, phenolic or metal identification sign which reads "Fire Alarm System Remote Display" shall be provided at the remote audible/visual display. The remote visual appliance located with the audible appliance shall not be extinguished until the trouble or alarm has been cleared.

2.1.2 Circuit Connections

Circuit conductors entering or leaving the panel shall be connected to screw-type terminals with each conductor and terminal marked for identification.

2.1.3 System Expansion and Modification Capabilities

Any equipment and software needed by qualified technicians to implement future changes to the fire alarm system shall be provided as part of this contract.

2.1.4 Addressable Control Module

The control module shall be capable of operating as a relay (dry contact form C) for interfacing the control panel with other systems, and to control door holders or initiate elevator fire service. The module shall be UL listed as compatible with the control panel. The indicating device or the external load being controlled shall be configured as a Style Y notification appliance circuits. The system shall be capable of supervising, audible, visual and dry contact circuits. The control module shall have both an input and output address. The supervision shall detect a short on the supervised circuit and shall prevent power from being applied to the circuit. The control model shall provide address setting means compatible with the control panel's SLC supervision and store an internal identifying code. The control module shall contain an integral LED that flashes each time the control module is polled.

2.1.5 Addressable Initiating Device Circuits Module

The initiating device being monitored shall be configured as a Style D initiating device circuits. The system shell be capable of defining any module as an alarm module and report alarm trouble, loss of polling, or as a supervisory module, and reporting supervisory short, supervisory open or loss of polling. The module shall be UL listed as compatible with the control panel. The monitor module shall provide address setting means compatible with the control panel's SLC supervision and store an internal identifying code. Monitor module shall contain an integral LED that flashes each time the monitor module is polled. Pull stations with a monitor module in a common backbox are not required to have an LED.

2.2 STORAGE BATTERIES

Storage batteries shall be provided and shall be 24 Vdc sealed, lead-calcium type requiring no additional water. The batteries shall have ample capacity, with primary power disconnected, to operate the fire alarm system for a period of 72 hours. Following this period of battery operation, the batteries shall have ample capacity to operate all components of the system, including all alarm signaling devices in the total alarm mode for a minimum period of 15 minutes. Batteries shall be located at the bottom of the panel. Batteries shall be provided with overcurrent protection in accordance with NFPA 72. Separate battery cabinets shall have a lockable, hinged cover similar to the fire alarm panel. The lock shall be keyed the same as the fire alarm control panel. Cabinets shall be painted to match the fire alarm control panel.

2.3 BATTERY CHARGER

Battery charger shall be completely automatic, 24 Vdc with high/low charging rate, capable of restoring the batteries from full discharge (18 Volts dc) to full charge within 48 hours. A pilot light indicating when batteries are manually placed on a high rate of charge shall be provided as part of the unit assembly, if a high rate switch is provided. Charger shall be located in control panel cabinet or in a separate battery cabinet.

2.4 ADDRESSABLE MANUAL FIRE ALARM STATIONS

Addressable manual fire alarm stations shall conform to the applicable requirements of UL 38. Manual stations shall be connected into signal line circuits. Stations shall be installed on semi-flush mounted outlet boxes. Manual stations shall be mounted at 48 inches. Stations shall be double action type. Stations shall be finished in red, with raised letter operating instructions of contrasting color. Stations requiring the breaking of glass or plastic panels for operation are not acceptable. Stations employing glass rods are not acceptable. The use of a key or wrench shall be required to reset the station. Gravity or mercury switches are not acceptable. Switches and contacts shall be rated for the voltage and current upon which they operate. Addressable pull stations shall be capable of being field programmed, shall latch upon operation and remain latched until manually reset. Stations shall have a separate screw terminal for each conductor. Surface mounted boxes shall be matched and painted the same color as the fire alarm manual stations.

2.5 FIRE DETECTING DEVICES

Fire detecting devices shall comply with the applicable requirements of NFPA 72, NFPA 90A, UL 268, UL 268A, and UL 521. The detectors shall be provided as indicated. Detector base shall have screw terminals for making connections. No solder connections will be allowed. Detectors located in concealed locations (above ceiling, raised floors, etc.) shall have a remote visible indicator LED/LCD. Addressable fire detecting devices, except flame detectors, shall be dynamically supervised and uniquely identified in the control panel. All fire alarm initiating devices shall be individually addressable, except where indicated. Installed devices shall conform to NFPA 70 hazard classification of the area where devices are to be installed.

2.5.1 Smoke Detectors

Smoke detectors shall be designed for detection of abnormal smoke densities. Smoke detectors shall be photoelectric type. Detectors shall contain a visible indicator LED/LCD that shows when the unit is in alarm condition. Detectors shall not be adversely affected by vibration or pressure. Detectors shall be the plug-in type in which the detector base contains terminals for making wiring connections. Detectors that are to be installed in concealed (above false ceilings, etc.) locations shall be provided with a remote indicator LED/LCD suitable for mounting in a finished, visible location.

2.5.1.1 Photoelectric Detectors

Detectors shall operate on a light scattering concept using an LED light source. Failure of the LED shall not cause an alarm condition. Detectors shall be factory set for sensitivity and shall require no field adjustments of any kind. Detectors shall have an obscuration rating in accordance with UL 268. Addressable smoke detectors shall be capable of having the sensitivity being remotely adjusted by the control panel.

2.5.1.2 Duct Detectors

Duct-mounted photoelectric smoke detectors shall be furnished and installed where indicated and in accordance with NFPA 90A. Units shall consist of a smoke detector as specified in paragraph Photoelectric Detectors, mounted in a special housing fitted with duct sampling tubes. Detector circuitry shall be mounted in a metallic enclosure exterior to the duct. Detectors shall have a manual reset. Detectors shall be rated for air velocities that include air flows between 500 and 4000 fpm. Detectors shall be powered from the fire alarm panel. Sampling tubes shall run the full width of the duct. The duct detector package shall conform to the requirements of NFPA 90A, UL 268A, and shall be UL listed for use in air-handling systems. The control functions, operation, reset, and bypass shall be controlled from the fire alarm control panel. Lights to indicate the operation and alarm condition; and the test and reset buttons shall be visible and accessible with the unit installed and the cover in place. Detectors mounted above 6 feet and those mounted below 6 feet that cannot be easily accessed while standing on the floor, shall be provided with a remote detector indicator panel containing test and reset switches. Remote lamps and switches as well as the affected fan units shall be properly identified in etched plastic placards. Detectors shall have auxiliary contacts to provide control, interlock, and shutdown functions specified in Section 15951A DIRECT DIGITAL CONTROL FOR HVAC. The detectors shall be supplied by the fire alarm system manufacturer to ensure complete system compatibility.

2.6 NOTIFICATION APPLIANCES

Audible appliances shall conform to the applicable requirements of UL 464. Devices shall be connected into notification appliance circuits. Devices shall have a separate screw terminal for each conductor. Audible appliances shall generate a unique audible sound from other devices provided in the building and surrounding area. Surface mounted audible appliances shall be painted red. Recessed audible appliances shall be installed with a grill that is painted red.

2.6.1 Alarm Bells

Bells shall be surface mounted with the matching mounting back box surface mounted. Bells shall be suitable for use in an electrically supervised circuit. Bells shall be the underdome type producing a minimum output rating of 85 dBA at 10 feet. Bells used in exterior locations shall be specifically listed or approved for outdoor use and be provided with metal housing and protective grilles. Single stroke, electrically operated, supervised, solenoid bells shall be used for coded applications.

2.6.2 Alarm Horns

Horns shall be surface mounted, with the matching mounting back box surface mounted single or double projector, vibrating type suitable for use in an electrically supervised circuit. Horns shall produce a sound rating of at least 85 dBA at 10 feet. Horns used in exterior locations shall be specifically listed or approved for outdoor use and be provided with metal housing and protective grilles.

2.6.3 Visual Notification Appliances

Visual notification appliances shall conform to the applicable requirements of UL 1971 and the contract drawings. Appliances shall have clear high intensity optic lens, xenon flash tubes, and output white light. Strobe flash rate shall be between 1 to 3 flashes per second. Strobe shall be semi-flush mounted.

2.6.4 Combination Audible/Visual Notification Appliances

Combination audible/visual notification appliances shall provide the same requirements as individual units except they shall mount as a unit in standard backboxes. Units shall be factory assembled. Any other audible notification appliance employed in the fire alarm systems shall be approved by the Contracting Officer.

2.7 FIRE DETECTION AND ALARM SYSTEM PERIPHERAL EQUIPMENT

2.7.1 Electromagnetic Door Hold-Open Devices

Devices shall be attached to the walls unless otherwise indicated. Devices shall comply with the appropriate requirements of UL 228. Devices shall operate on 24 Volt dc power. Compatible magnetic component shall be attached to the door. Under normal conditions, the magnets shall attract and hold the doors open. When magnets are de-energized, they shall release the doors. Magnets shall have a holding force of 25 pounds. Devices shall be UL or FM approved. Housing for devices shall be brushed aluminum or stainless steel. Operation shall be fail safe with no moving parts. Electromagnetic door hold-open devices shall not be required to be held open during building power failure.

2.7.2 Conduit

Conduit and fittings shall comply with NFPA 70, UL 6, UL 1242, and UL 797.

2.7.3 Wiring

Wiring shall conform to NFPA 70. Wiring for 120 Vac power shall be No. 12 AWG minimum. The SLC wiring shall be copper cable in accordance with the manufacturers requirements. Wiring for fire alarm dc circuits shall be No.

14 AWG minimum. Voltages shall not be mixed in any junction box, housing, or device, except those containing power supplies and control relays. Wiring shall conform to NFPA 70. System field wiring shall be solid copper and installed in metallic conduit or electrical metallic tubing, except that rigid plastic conduit may be used under slab-on-grade. Conductors shall be color coded. Conductors used for the same functions shall be similarly color coded. Wiring code color shall remain uniform throughout the circuit. Pigtail or T-tap connections to initiating device circuits, supervisory alarm circuits, and notification appliance circuits are prohibited. T-tapping of fire alarm circuits is prohibited.

2.7.4 Special Tools and Spare Parts

Software, connecting cables and proprietary equipment, necessary for the maintenance, testing, and reprogramming of the equipment shall be furnished to the Contracting Officer. Two spare fuses of each type and size required shall be furnished. Two percent of the total number of each different type of detector, but no less than two each, shall be furnished. Spare fuses shall be mounted in the fire alarm panel.

2.8 TRANSMITTERS

2.8.1 Radio Alarm Transmitters

Transmitters shall be compatible with proprietary supervising station receiving equipment. Each radio alarm transmitter shall be the manufacturer's recognized commercial product, completely assembled, wired, factory tested, and delivered ready for installation and operation. Transmitters shall be provided in accordance with applicable portions of NFPA 72, NFPA 1221, and 47 CFR 15. Transmitter electronics module shall be contained within the physical housing as an integral, removable assembly. The proprietary supervising station receiving equipment is existing and the transceiver shall be fully compatible with this equipment. At the contractors option, and if UL listed, the transmitter may be housed in the same panel as the fire alarm control panel.

2.8.1.1 Transmitter Power Supply

Each radio alarm transmitter shall be powered by a combination of locally available 120-volt ac power and a sealed, lead-calcium battery.

a. Operation: Each transmitter shall operate from 120-volt ac power. In the event of 120-volt ac power loss, the transmitter shall automatically switch to battery operation. Switchover shall be accomplished with no interruption of protective service, and shall automatically transmit a trouble message. Upon restoration of ac power, transfer back to normal ac power supply shall also be automatic.

b. Battery Power: Transmitter standby battery capacity shall provide sufficient power to operate the transmitter in a normal standby status for a minimum of 72 hours and be capable of transmitting alarms during that period.

2.8.1.2 Radio Alarm Transmitter Housing

Transmitter housing shall be NEMA Type 1. The housing shall contain a lock that is keyed identical to radio alarm transmitter housings on the base. Radio alarm transmitter housing shall be factory painted with a suitable

priming coat and not less than two coats of a hard, durable weatherproof enamel.

2.8.1.3 Antenna

The Contractor shall provide omnidirectional, coaxial, halfwave dipole antennas for radio alarm transmitters with a driving point impedance to match transmitter output. The antenna and antenna mounts shall be corrosion resistant and designed to withstand wind velocities of 100 mph. Antennas shall not be mounted to any portion of the building roofing system.

PART 3 EXECUTION

3.1 INSTALLATION

All work shall be installed as shown, and in accordance with NFPA 70 and NFPA 72, and in accordance with the manufacturer's diagrams and recommendations, unless otherwise specified. Smoke detectors shall not be installed until construction is essentially complete and the building has been thoroughly cleaned.

3.1.1 Power Supply for the System

A single dedicated circuit connection for supplying power from a branch circuit to each building fire alarm system shall be provided. The power shall be supplied as shown on the drawings. The power supply shall be equipped with a locking mechanism and marked in red with the words "FIRE ALARM CIRCUIT CONTROL".

3.1.2 Wiring

Conduit size for wiring shall be in accordance with NFPA 70. Wiring for the fire alarm system shall not be installed in conduits, junction boxes, or outlet boxes with conductors of lighting and power systems. Not more than two conductors shall be installed under any device screw terminal. The wires under the screw terminal shall be straight when placed under the terminal then clamped in place under the screw terminal. The wires shall be broken and not twisted around the terminal. Circuit conductors entering or leaving any mounting box, outlet box enclosure, or cabinet shall be connected to screw terminals with each terminal and conductor marked in accordance with the wiring diagram. Connections and splices shall be made using screw terminal blocks. The use of wire nut type connectors in the system is prohibited. Wiring within any control equipment shall be readily accessible without removing any component parts. The fire alarm equipment manufacturer's representative shall be present for the connection of wiring to the control panel.

3.1.3 Control Panel

The control panel and its assorted components shall be mounted so that no part of the enclosing cabinet is less than 12 inches nor more than 78 inches above the finished floor. Manually operable controls shall be between 36 and 42 inches above the finished floor. Panel shall be installed to comply with the requirements of UL 864.

3.1.4 Detectors

Detectors shall be located and installed in accordance with NFPA 72. Detectors shall be connected into signal line circuits or initiating device

circuits as indicated on the drawings. Detectors shall be at least 12 inches from any part of any lighting fixture. Detectors shall be located at least 3 feet from diffusers of air handling systems. Each detector shall be provided with appropriate mounting hardware as required by its mounting location. Detectors which mount in open space shall be mounted directly to the end of the stubbed down rigid conduit drop. Conduit drops shall be firmly secured to minimize detector sway. Where length of conduit drop from ceiling or wall surface exceeds 3 feet, sway bracing shall be provided. Detectors installed in concealed locations (above ceiling, raised floors, etc.) shall have a remote visible indicator LED/LCD in a finished, visible location.

3.1.5 Notification Appliances

Notification appliances shall be mounted 80 inches above the finished floor or 6 inches below the ceiling, whichever is lower.

3.1.6 Annunciator Equipment

Annunciator equipment shall be mounted where indicated on the drawings.

3.1.7 Addressable Initiating Device Circuits Module

The initiating device circuits module shall be used to connect supervised conventional initiating devices (water flow switches, water pressure switches, manual fire alarm stations, high/low air pressure switches, and tamper switches). The module shall mount in an electrical box adjacent to or connected to the device it is monitoring and shall be capable of Style B supervised wiring to the initiating device. In order to maintain proper supervision, there shall be no T-taps allowed on style B lines. Addressable initiating device circuits modules shall monitor only one initiating device each. Contacts in suppression systems and other fire protection subsystems shall be connected to the fire alarm system to perform supervisory and alarm functions as specified in NFPA 72, as indicated on the drawings and as specified herein.

3.1.8 Addressable Control Module

Addressable and control modules shall be installed in the outlet box or adjacent to the device they are controlling. If a supplementary suppression releasing panel is provided, then the monitor modules shall he mounted in a common enclosure adjacent to the suppression releasing panel and both this enclosure and the suppression releasing panel shall be in the same room as the releasing devices. All interconnecting wires shall be supervised unless an open circuit or short circuit abnormal condition does not affect the required operation of the fire alarm system. If control modules are used as interfaces to other systems, such as HVAC or elevator control, they shall be within the control panel or immediately adjacent to it. Control modules that control a group of notification appliances shall be adjacent to the first notification appliance in the notification appliance circuits. Control modules that connect to devices shall supervise the notification appliance circuits. Control modules that connect to auxiliary systems or interface with other systems (non-life safety systems) and where not required by NFPA 72, shall not require the secondary circuits to be supervised. Contacts in suppression systems and other fire protection subsystems shall be connected to the fire alarm system to perform required alarm functions as specified in NFPA 72, as indicated on the drawings and as specified herein.

3.2 OVERVOLTAGE AND SURGE PROTECTION

3.2.1 Power Line Surge Protection

All equipment connected to alternating current circuits shall be protected from surges per IEEE C62.41 B3 combination waveform and NFPA 70. Fuses shall not be used for surge protection. The surge protector shall be rated for a maximum let thru voltage of 350 Volts ac (line-to-neutral) and 350 Volt ac (neutral-to-ground).

3.2.2 Low Voltage DC Circuits Surge Protection

All IDC, NAC, and communication cables/conductors, except fiber optics, shall have surge protection installed at each point where it exits or enters a building. Equipment shall be protected from surges per IEEE C62.41 B3 combination waveform and NFPA 70. The surge protector shall be rated to protect the 24 Volt dc equipment. The maximum dc clamping voltages shall be 36 V (line-to-ground) and 72 Volt dc (line-to-line).

3.2.3 Signal Line Circuit Surge Protection

All SLC cables/conductors, except fiber optics, shall have surge protection/isolation circuits installed at each point where it exits or enters a building. The circuit shall be protected from surges per IEEE C62.41 B3 combination waveform and NFPA 70. The surge protector/isolator shall be rated to protect the equipment.

3.3 GROUNDING

Grounding shall be provided by connecting to building ground system.

3.4 TESTING

The Contractor shall notify the Contracting Officer at least 10 days before the preliminary and acceptance tests are to be conducted. The tests shall be performed in accordance with the approved test procedures in the presence of the Contracting Officer. The control panel manufacturer's representative shall be present to supervise tests. The Contractor shall furnish instruments and personnel required for the tests.

3.4.1 Preliminary Tests

Upon completion of the installation, the system shall be subjected to functional and operational performance tests including tests of each installed initiating and notification appliance, when required. Tests shall include the meggering of system conductors to determine that the system is free from grounded, shorted, or open circuits. The megger test shall be conducted prior to the installation of fire alarm equipment. If deficiencies are found, corrections shall be made and the system shall be retested to assure that it is functional. After completing the preliminary testing the Contractor shall complete and submit the NFPA 72, Certificate of Completion.

3.4.2 Acceptance Test

Acceptance testing shall not be performed until the Contractor has completed and submitted the Certificate of Completion. Testing shall be in accordance with NFPA 72. The recommended tests in NFPA 72 shall be considered mandatory and shall verify that previous deficiencies have been

corrected. The Contractor shall complete and submit the NFPA 72, Inspection and Testing Form. The test shall include all requirements of NFPA 72 and the following:

a. Test of each function of the control panel.

b. Test of each circuit in both trouble and normal modes.

c. Tests of each alarm initiating devices in both normal and trouble conditions.

d. Tests of each control circuit and device.

e. Tests of each alarm notification appliance.

f. Tests of the battery charger and batteries.

g. Complete operational tests under emergency power supply.

h. Visual inspection of wiring connections.

i. Opening the circuit at each alarm initiating device and notification appliance to test the wiring supervisory feature.

j. Ground fault

k. Short circuit faults

l. Stray voltage

m. Loop resistance

3.5 TRAINING

Training course shall be provided for the operations and maintenance staff. The course shall be conducted in the building where the system is installed or as designated by the Contracting Officer. The training period for systems operation shall consist of 1 training days (8 hours per day) and shall start after the system is functionally completed but prior to final acceptance tests. The training period for systems maintenance shall consist of 2 training days (8 hours per day) and shall start after the system is functionally completed but prior to final acceptance tests. The instructions shall cover items contained in the operating and maintenance instructions. In addition, training shall be provided on performance of expansions or modifications to the fire detection and alarm system. The training period for system expansions and modifications shall consist of at least 1 training days (8 hours per day) and shall start after the system is functionally completed but prior to final acceptance tests.

-- End of Section --

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SECTION 13920A

FIRE PUMPS
01/04

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM B 135	(2002) Seamless Brass Tube

AMERICAN WATER WORKS ASSOCIATION(AWWA)

AWWA B300	(1999) Hypochlorites
AWWA B301	(1999) Liquid Chlorine
AWWA EWW	(1998) Standard Methods for the Examination of Water and Wastewater
AWWA M20	(1973) Manual: Water Chlorination Principles and Practices

ASME INTERNATIONAL (ASME)

ASME B16.5	(1996) Pipe Flanges and Flanged Fittings

FM GLOBAL (FM)

FM P7825a	(2003) Approval Guide Fire Protection
FM P7825b	(2003) Approval Guide Electrical Equipment

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(1998) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 1963	(2003) Fire Hose Connections
NFPA 20	(2003) Installation of Stationary Pumps

	for Fire Protection
NFPA 70	(2002) National Electrical Code

NATIONAL INSTITUTE FOR CERTIFICATION IN ENGINEERING TECHNOLOGIES (NICET)

NICET 1014-7	(1995) Program Detail Manual for Certification in the Field of Fire Protection Engineering Technology (Field Code 003) Subfield of Automatic Sprinkler System Layout

UNDERWRITERS LABORATORIES (UL)

UL 448	((1994; Rev thru May 1999) Pumps for Fire-Protection Service
UL Fire Prot Dir	(2003) Fire Protection Equipment Directory

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation Requirements; G-AO

Three copies of the Fire Pump Installation Drawings consisting of a detailed plan view, detailed elevations and sections of the pump room, equipment and piping, drawn to a scale of not less than 1/2 inch = 1 foot. Drawings shall indicate equipment, piping, and associated pump equipment to scale. All clearance, such as those between piping and equipment; between equipment and walls, ceiling and floors; and for electrical working distance clearance around all electrical equipment shall be indicated. Drawings shall include a legend identifying all symbols, nomenclatures, and abbreviations. Drawings shall indicate a complete piping and equipment layout including elevations and/or section views of the following:

a. Fire pumps, controllers, piping, valves, and associated equipment.

b. Sensing line for each pump including the pressure maintenance pump.

c. Pipe hangers and sway bracing .

d. Restraint of underground water main at entry-point to the building including details of pipe clamps, tie rods, mechanical retainer glands, and thrust blocks.

e. A one-line schematic diagram indicating layout and sizes of all piping, devices, valves and fittings.

f. A complete point-to-point connection drawing of the pump power, control and alarm systems, as well as interior wiring schematics of each controller.

As-Built Drawings

As-built drawings, as specified.

SD-03 Product Data

Fire Pump Installation Related Submittals

A list of the Fire Pump Installation Related Submittals, no later than 7 days after the approval of the Fire Protection Specialist and the Manufacturer's Representative.

Installation Requirements; G-AE

Manufacturer's catalog data included with the Fire Pump Installation Drawings for each separate piece of equipment proposed for use in the system. Catalog data shall indicate the name of the manufacturer of each item of equipment, with data annotated to indicate model to be provided. In addition, a complete equipment list that includes equipment description, model number and quantity shall be provided. Catalog data for material and equipment shall include, but not be limited to, the following:

a. Fire pumps, drivers and controllers including manufacturer's certified shop test characteristic curve for each pump. Shop test curve may be submitted after approval of catalog data but shall be submitted prior to the final tests.

b. Pressure maintenance pump and controller.

c. Piping components.

d. Valves, including gate, check, globe and relief valves.

e. Gauges.

f. Hose valve manifold test header and hose valves.

g. Flow meter.

h. Restrictive orifice union.

i. Associated devices and equipment.

Spare Parts

Spare parts data for each different item of material and equipment specified.

Preliminary Test

Proposed procedures for Preliminary Tests, at least 14 days

prior to the proposed start of the tests.

Proposed date and time to begin Preliminary Tests, submitted with the Preliminary Tests Procedures.

Field Tests; G-AO

Proposed diagrams, at least 2 weeks prior to start of related testing.

Fire Protection Specialist; G-AO

The name and documentation of certification of the proposed Fire Protection Specialists, no later than 14 days after the Notice to Proceed and prior to the submittal of the fire pump installation drawings.

Manufacturer's Representative; G-AO

The name and documentation of certification of the proposed Manufacturer's Representative, concurrent with submittal of the Fire Protection Specialist Qualifications.

Field Training; G-AO

Proposed schedule for field training submitted at least 14 days prior to the start of related training.

Final Acceptance Test

Proposed date and time to begin Final Acceptance Test, submitted with the Final Acceptance Test Procedures. Notification shall be provided at least 14 days prior to the proposed start of the test. Notification shall include a copy of the Contractor's Material & Test Certificates.

Proposed procedures for Final Acceptance Test, no later than 14 days prior to the proposed start of the tests.

SD-06 Test Reports

Preliminary Test; G-AO

Three copies of the completed Preliminary Tests Reports, no later that 7 days after the completion of the Preliminary Tests. The Preliminary Tests Report shall include both the Contractor's Material and Test Certificate for Underground Piping and the Contractor's Material and Test Certificate for Aboveground Piping. All items in the Preliminary Tests Report shall be signed by the Fire Protection Specialist and the Manufacturer's Representative.

Final Acceptance Test; G-AO

Three copies of the completed Final Acceptance Tests Reports , no later that 7 days after the completion of the Final Acceptance Tests. All items in the Final Acceptance Report shall be signed by the Fire Protection Specialist and the Manufacturer's Representative. Test reports in booklet form (each copy furnished in a properly labeled three ring binder) showing all field tests

and measurements taken during the preliminary and final testing, and documentation that proves compliance with the specified performance criteria, upon completion of the installation and final testing of the installed system. Each test report shall indicate the final position of the controls and pressure switches. The test reports shall include the description of the hydrostatic test conducted on the piping and flushing of the suction and discharge piping. A copy of the manufacturer's certified pump curve for each fire pump shall be included in the report.

SD-07 Certificates

Fire Protection Specialist; G-AO

Concurrent with the Final Acceptance Test Report, certification by the Fire Protection Specialist that the fire pump installation is in accordance with the contract requirements, including signed approval of the Preliminary and Final Acceptance Test Reports.

SD-10 Operation and Maintenance Data

Fire Pumps

Six manuals listing step-by-step procedures required for system startup, operation, shutdown, and routine maintenance, at least 14 days prior to field training. The manuals shall include the manufacturer's name, model number, parts list, list of parts and tools that should be kept in stock by the owner for routine maintenance including the name of a local supplier, simplified wiring and controls diagrams, troubleshooting guide, and recommended service organization (including address and telephone number) for each item of equipment. Each service organization submitted shall be capable of providing 4 hour onsite response to a service call on an emergency basis.

1.3 GENERAL REQUIREMENTS

a. Except as modified in this Section or on the drawings, fire pumps shall be installed in conformance with NFPA 20, including all recommendations and advisory portions, which shall be considered mandatory. All reference to the authority having jurisdiction shall be interpreted to mean the Contracting Officer.

b. The Contractor shall submit Spare Parts data for each different item of equipment and material specified. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of parts recommended by the manufacturer to be replaced after 1 year and 3 years of service. A list of special tools and test equipment required for maintenance and testing of the products supplied by the Contractor shall be included.

1.4 SEQUENCE OF OPERATION

1.4.1 Primary Fire Pump

Primary fire pump shall automatically operate when the pressure drops to 95 psi. The fire pump shall automatically stop operating when the system pressure reaches 110 psi and after the fire pump has operated for the minimum pump run time specified herein.

1.4.1.1 Pressure Maintenance Pump

Pressure maintenance pump shall operate when the system pressure drops to 100 psi. Pump shall automatically stop when the system pressure reaches 110 psi and after the pump has operated for the minimum pump run time specified herein.

1.4.2 Safety Requirements

Coupling, rotating parts, gears, projecting equipment, etc. shall be fully enclosed or properly guarded so as to prevent possible injury to persons that come in close proximity of the equipment. The Contractor shall conduct testing of the fire pumps in a safe manner and ensure that all equipment is safely secured. Hoses and nozzles used to conduct flow tests shall be in excellent condition and shall be safely anchored and secured to prevent any misdirection of the hose streams.

1.5 COORDINATION OF TRADES

Tank supports, piping offsets, fittings, and any other accessories required shall be furnished as specified to provide a complete installation and to eliminate interference with other construction.

1.6 DELIVERY AND STORAGE

All equipment delivered and placed in storage shall be housed with protection from the weather, excessive humidity and temperature variations, dirt and dust, or other contaminants. Additionally, all pipes shall be either capped or plugged until installed.

1.7 FIELD MEASUREMENTS

After becoming familiar with all details of the work, the Contractor shall verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work.

1.8 FIRE PROTECTION SPECIALIST

Work specified in this section shall be performed under the supervision of and certified by the Fire Protection Specialist. The Fire Protection Specialist shall be an individual who is a registered professional engineer and a Full Member of the Society of Fire Protection Engineers or who is certified as a Level IV Technician by National Institute for Certification in Engineering Technologies (NICET) in the Automatic Sprinkler System Layout subfield of Fire Protection Engineering Technology in accordance with NICET 1014-7. The Fire Protection Specialist shall be regularly engaged in the design and installation of the type and complexity of system specified in the Contract documents, and shall have served in a similar capacity for at least three systems that have performed in the manner intended for a period of not less than 6 months.

1.9 MANUFACTURER'S REPRESENTATIVE

Work specified in this section shall be performed under the supervision of and certified by a representative of the fire pump manufacturer. The Manufacturer's Representative shall be regularly engaged in the installation of the type and complexity of fire pump(s) specified in the Contract documents, and shall have served in a similar capacity for at

least three systems that have performed in the manner intended for a period of not less than 6 months.

1.10 REGULATORY REQUIREMENTS

Compliance with referenced NFPA standards is mandatory. This includes advisory provisions listed in the appendices of such standards, as though the word "shall" had been substituted for the word "should" wherever it appears. In the event of a conflict between specific provisions of this specification and applicable NFPA standards, this specification shall govern. Reference to "authority having jurisdiction" shall be interpreted to mean the Contracting Officer.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

2.2 NAMEPLATES

All equipment shall have a nameplate that identifies the manufacturer's name, address, type or style, model or serial number, and catalog number. Pumps and motors shall have standard nameplates securely affixed in a conspicuous place and easy to read. Fire pump shall have nameplates and markings in accordance with UL 448. Electric motor nameplates shall provide the minimum information required by NFPA 70, Section 430-7.

2.3 REQUIREMENTS FOR FIRE PROTECTION SERVICE

Materials and Equipment shall have been tested by Underwriters Laboratories, Inc. and listed in UL Fire Prot Dir or approved by Factory Mutual and listed in FM P7825a and FM P7825b. Where the terms "listed" or "approved" appear in this specification, such shall mean listed in UL Fire Prot Dir or FM P7825a and FM P7825b.

2.4 FIRE PUMP

Fire pump shall be electric motor driven. Each pump capacity shall be rated at 500 gpm with a rated net pressure of 40 psi. Fire pump shall furnish not less than 150 percent of rated flow capacity at not less than 65 percent of rated net pressure. Pump shall be centrifugal in-line fire pump. Pump shall conform to the requirements of UL 448. Fire pump discharge and suction gauges shall be oil-filled type.

2.5 ELECTRIC MOTOR DRIVER

Motor shall conform to NEMA MG 1 and be marked as complying with NEMA Design B standards. Motor horsepower shall be of sufficient size so that the nameplate horsepower rating will not be exceeded throughout the entire published pump characteristic curve. The motor and fire pump controller shall be fully compatible.

2.6 FIRE PUMP CONTROLLER

Controller shall be the automatic type and UL listed UL Fire Prot Dir or FM

approved FM P7825a and FM P7825b for fire pump service. Pump shall be arranged for automatic start and stop, and manual push-button stop. Automatic stopping shall be accomplished only after all starting causes have returned to normal and after a minimum pump run time has elapsed. Controllers shall be completely terminally wired, ready for field connections, and mounted in a NEMA Type 2 drip-proof enclosure arranged so that controller current carrying parts will not be less than 12 inches above the floor. Controller shall be provided with voltage surge arresters installed per NFPA 20. Controller shall be equipped with a bourdon tube pressure switch or a solid state pressure switch with independent high and low adjustments, automatic starting relay actuated from normally closed contacts, visual alarm lamps and supervisory power light. Controller shall be equipped with a thermostat switch with adjustable setting to monitor the pump room temperature and to provide an alarm when temperatures falls below 40 degrees F.

2.6.1 Controller for Electric Motor Driven Fire Pump

Controller shall be across the line starting type with service entrance rated disconnect switch. Controller shall be designed for 125 HP at 480 volts. Controller shall have a short circuit rating of 50,000 amps r.m.s. symmetrical at 480 volts a.c.. Controller shall monitor pump running, loss of a phase or line power, phase reversal, and pump room temperature. Alarms shall be individually displayed in front of panel by lighting of visual lamps. Each lamp shall be labeled with rigid etched plastic labels. Controller shall be equipped with terminals for remote monitoring of pump running, pump power supply trouble (loss of power or phase and phase reversal), and pump room trouble (pump room temperature), and for remote start. Limited service fire pump controllers are not permitted, except for fire pumps driven by electric motors rated less than 15 hp. Controller shall be equipped with a 7-day electric pressure recorder with 24-hour spring wound back-up. The pressure recorder shall provide a readout of the system pressure from 0 to 15 hp, time, and date. Controller shall require the pumps to run for ten minutes for pumps with driver motors under 200 horsepower and for 15 minutes for pumps with motors 200 horsepower and greater, prior to automatic shutdown. The controller shall be equipped with an externally operable isolating switch which manually operates the motor circuit. Means shall be provided in the controller for measuring current for all motor circuit conductors.

2.7 PRESSURE SENSING LINE

A completely separate pressure sensing line shall be provided for each fire pump and for the jockey pump. The sensing line shall be arranged in accordance with Figure A-7-5.2.1. of NFPA 20. The sensing line shall be1/2 inchH58 brass tubing complying with ASTM B 135. The sensing line shall be equipped with two restrictive orifice unions each. Restricted orifice unions shall be ground-face unions with brass restricted diaphragms drilled for a 3/32 inch. Restricted orifice unions shall be mounted in the horizontal position, not less than 5 feet apart on the sensing line. Two test connections shall be provided for each sensing line. Test connections shall consist of two brass 1/2 inch globe valves and 1/4 inch gauge connection tee arranged per NFPA 20. One of the test connections shall be equipped with a 0 to 300 psi water oil-filled gauge. Sensing line shall be connected to the pump discharge piping between the discharge piping control valve and the check valve.

2.8 PRESSURE MAINTENANCE PUMP

Pressure maintenance pump shall be electric motor driven, in-line vertical shaft, centrifugal type with a rated discharge of 5 gpm at 65 psig. Pump shall draft as indicated and shall discharge into the system at the downstream side of the pump discharge gate valve. An approved indicating gate valve of the outside screw and yoke (O.S.&Y.) type shall be provided in the maintenance pump discharge and suction piping. Oil-filled water pressure gauge and approved check valve in the maintenance pump discharge piping shall be provided. Check valve shall be swing type with removable inspection plate.

2.8.1 Pressure Maintenance Pump Controller

Pressure maintenance pump controller shall be arranged for automatic and manual starting and stopping and equipped with a "manual-off-automatic" switch. The controller shall be completely prewired, ready for field connections, and wall-mounted in a NEMA Type 2 drip-proof enclosure. The controller shall be equipped with a bourdon tube pressure switch or a solid state pressure switch with independent high and low adjustments for automatic starting and stopping. A sensing line shall be provided connected to the pressure maintenance pump discharge piping between the control valve and the check valve. The sensing line shall conform to paragraph, PRESSURE SENSING LINE. The sensing line shall be completely separate from the fire pump sensing lines. An adjustable run timer shall be provided to prevent frequent starting and stopping of the pump motor. The run timer shall be set for 2 minutes.

2.9 PUMP BASE PLATE AND PAD

For vertical shaft pumps, pump head shall be provided with a cast-iron base plate and shall serve as the sole plate for mounting the discharge head assembly. Pump units and bases shall be mounted on a raised 4 inches reinforced concrete pad that is an integral part of the reinforced concrete floor.

2.10 HOSE VALVE MANIFOLD TEST HEADER

Hose valve test header shall be connected by ASME B16.5, Class 150 flange inlet connection. Hose valves shall be UL listed UL Fire Prot Dir or FM approved FM P7825a and FM P7825b bronze hose gate valves with 2.5 inches American National Fire Hose Connection Screw Standard Threads (NH) per NFPA 1963. The number of valves shall be per NFPA 20. Each hose valve shall be equipped with a cap and chain, and located no more than 3 feet and no less than 2 feet above grade.

2.11 FLOW METER

Meter shall be UL listed UL Fire Prot Dir or FM approved FM P7825a and FM P7825bas flow meters for fire pump installation with direct flow readout device. Flow meter shall be capable of metering any waterflow quantities between 50 percent and 150 percent of the rated flow of the pumps. The flow meter shall be arranged in accordance with NFPA 20. The meter throttle valve and the meter control valves shall be O.S.&Y. valves. Automatic air release shall be provided if flow meter test discharge is piped to the pump suction and forms a closed-loop meter arrangement as defined in NFPA 20.

2.12 PIPE SLEEVE

A pipe sleeve shall be provided at each location where piping passes through walls, ceilings, roofs, and floors, including pipe entering buildings from the exterior. Sleeves shall be grouted in position during construction. Sleeve shall be of sufficient length to pass through the entire thickness of the wall, ceilings, roofs and floors. The space between the exterior surface of the pipe and the interior surface of the sleeve shall be firmly packed with mineral wool insulation and caulk at both ends with plastic waterproof cement which will dry to a firm but pliable mass, or with a segmented elastomeric seal. Where pipes pass through fire walls or fire floors, a fire seal shall be provided between the pipe and the sleeve in accordance with Section 07840 FIRESTOPPING. Sleeves in masonry and concrete walls, ceiling, roofs and floors shall be hot-dip galvanized steel, ductile-iron, or cast-iron. Other sleeves shall be galvanized steel sheet pipe not less than 0.90 psf.

2.13 ESCUTCHEON (WALL) PLATES

Escutcheon plates shall be one-piece or split-hinge type metal plates and shall be provided for piping passing through floors, walls, and ceiling in exposed areas. In finished areas, plates shall be polished stainless steel or chromium-plated finish on copper alloy. In unfinished areas, plates shall have painted finish. Plates shall be secured in position.

2.14 DISINFECTING MATERIALS

2.14.1 Liquid Chlorine

Liquid chlorine shall conform to AWWA B301.

2.14.2 Hypochlorites

Calcium hypochlorite and sodium hypochlorite shall conform to AWWA B300.

PART 3 EXECUTION

3.1 FIRE PUMP INSTALLATION RELATED SUBMITTALS

The Fire Protection Specialist shall prepare a list of the submittals from the Contract Submittal Register that relate to the successful installation the fire pump. The submittals identified on this list shall be accompanied by a letter of approval signed and dated by the Fire Protection Specialist when submitted to the Government.

3.2 INSPECTION BY FIRE PROTECTION SPECIALIST

The Fire Protection Specialist shall inspect the fire pump installation periodically assure that the installation conforms to the contract requirements. The Fire Protection Specialist shall perform a thorough inspection of the fire pump installation, including visual observation of the pump while running shall be conducted. There shall be no excessive vibration, leaks (oil or water), unusual noises, overheating, or other potential problems. Inspection shall include piping and equipment clearance, access, supports, and guards. Any discrepancy shall be brought to the attention of the Contracting Officer in writing, no later than three working days after the discrepancy is discovered. The Fire Protection Specialist shall witness the preliminary and final acceptance tests and, after completion of the inspections and a successful final acceptance test,

shall sign test results and certify in writing that the installation the fire pump installation is in accordance with the contract requirements.

3.3 INSTALLATION REQUIREMENTS

Installation, workmanship, fabrication, assembly, erection, examination, inspection and testing shall be in accordance NFPA 20, except as modified herein. In addition, the fire pump and motor shall be installed in accordance with the written instructions of the manufacturer.

3.4 ELECTRICAL WORK

Electric motor and controls shall be in accordance with NFPA 20 and NFPA 70, unless more stringent requirements are specified herein or are indicated on the drawings. Electrical wiring and associated equipment shall be provided in accordance with NFPA 20 and Section 16415A ELECTRICAL WORK, INTERIOR.

3.5 FLUSHING

The fire pump suction and discharge piping shall be flushed at 120 percent of rated capacity of each pump. The new pump may be used to attain the required flushing volume. Flushing operations shall continue until water is clear, but not less than 10 minutes. The Contractor shall submit a signed and dated flushing certificate before requesting field testing.

3.6 FIELD TESTS

The Contractor shall submit, atleast 2 weeks before starting field tests, system diagrams that show the layout of equipment, piping, and storage units, and typed condensed sequence of operation, wiring and control diagrams, and operation manuals explaining preventative maintenance procedures, methods of checking the system for normal, safe operation, and procedures for safely starting and stopping the system shall be framed under glass or laminated plastic. After approval, these items shall be posted where directed.

3.6.1 Preliminary Test

The Fire Protection Specialist shall take all readings and measurements. The Manufacturer's Representative and a representative of the fire pump controller manufacturer shall witness the complete operational testing of the fire pump and drivers. The fire pump controller manufacturer's representative shall each be an experienced technician employed by the respective manufacturers and capable of demonstrating operation of all features of respective components including trouble alarms and operating features. Fire pumps, drivers and equipment shall be thoroughly inspected and tested to insure that the system is correct, complete, and ready for operation. Tests shall ensure that pumps are operating at rated capacity, pressure and speed. Tests shall include manual starting and running to ensure proper operation and to detect leakage or other abnormal conditions, flow testing, automatic start testing, testing of automatic settings, sequence of operation check, test of required accessories; test of pump alarms devices and supervisory signals, test of pump cooling, operational test of relief valves, and test of automatic power transfer, if provided. Pumps shall run without abnormal noise, vibration or heating. If any component or system was found to be defective, inoperative, or not in compliance with the contract requirements during the tests and inspection, the corrections shall be made and the entire preliminary test shall be repeated.

3.6.2 Final Acceptance Test

The Fire Protection Specialist shall take all readings and measurements. The Manufacturer's Representative and the fire pump controller manufacturer's representative shall also witness for the final tests. The Contractor shall be responsible for repairing any damage caused by hose streams or other aspects of the test. The final acceptance test shall include the following:

3.6.2.1 Flow Tests

Flow tests using the test header, hoses and playpipe nozzles shall be conducted. Flow tests shall be performed at churn (no flow), 75, 100, 125 and 150 percent capacity for each pump and at full capacity of the pump installation. Flow readings shall be taken from each nozzle by means of a calibrated pitot tube with gauge or other approved measuring equipment. Rpm, suction pressure and discharge pressure reading shall be taken as part of each flow test. Voltage and ampere readings shall taken on each phase as part of each flow test for electric-motor driven pumps.

3.6.2.2 Starting Tests

Pumps shall be tested for automatic starting and sequential starting. Setting of the pressure switches shall be tested when pumps are operated by pressure drop. Tests may be performed by operating the test connection on the pressure sensing lines. As a minimum, each pump shall be started automatically 10 times and manually 10 times, in accordance with NFPA 20. The fire pumps shall be operated for a period of a least 10 minutes for each of the starts; except that electric motors over 200 horsepowershall be operated for at least 15 minutes and shall not be started more than 2 times in 10 hours. Pressure settings that include automatic starting and stopping of the fire pump(s) shall be indicated on an etched plastic placard, attached to the corresponding pump controller.

3.6.2.3 Alarms

All pump alarms, both local and remote, shall be tested.

3.6.2.4 Miscellaneous

Valve tamper switches shall be tested. Pressure recorder operation relief valve settings, valve operations, operation and accuracy of meters and gauges, and other accessory devices shall be verified.

3.6.3 Correction of Deficiencies

If equipment was found to be defective or non-compliant with contract requirements, the Contractor shall performed corrective actions and repeat the tests. Tests shall be conducted and repeated if necessary until the system has been demonstrated to comply with all contract requirements.

3.6.4 Test Equipment

The Contractor shall provide all equipment and instruments necessary to conduct a complete final test, including 2.5 inchdiameter hoses, playpipe nozzles, pitot tube gauges, portable digital tachometer, voltage and ampere meters, and calibrated oil-filled water pressure gauges. The Contractor shall provide all necessary supports to safely secure hoses and nozzles

during the test. The Contractor shall furnish water for the tests.

3.6.5 Test Documentation

The Manufacturer's Representative shall supply a copy of the manufacturer's certified curve for each fire pump at the time of the test. The Fire Protection Specialist shall record all test results and plot curve of each pump performance during the test. Complete pump acceptance test data of each fire pump shall be recorded. The pump acceptance test data shall be on forms that give the detail pump information such as that which is indicated in Figure A-14.2.7.3 of NFPA 20. All test data records shall be submitted in a three ring binder.

3.6.6 As-Built Drawings

The Contractor shall submit As-Built Drawings, no later than 14 days after completion of the Final Tests. The Fire Pump Installation Drawings shall be updated to reflect as-built conditions after all related work is completed and shall be on reproducible full-size mylar film.

3.7 DISINFECTION

After all system components are installed including pumps, piping, and other associated work, and all hydrostatic test(s) are successfully completed, thoroughly flush the pumps and all piping to be disinfected with potable water until there is no visible sign of dirt or other residue. and hydrostatic test are successfully completed, each portion of the piping specified in this Section system to be disinfected shall be thoroughly flushed with potable water until all entrained dirt and other foreign materials have been removed before introducing chlorinating material. The chlorinating material shall be hypochlorites or liquid chlorine. Water chlorination procedure shall be in accordance with AWWA M20. The chlorinating material shall be fed into the sprinkler piping at a constant rate of 50 parts per million (ppm). A properly adjusted hypochlorite solution injected into the system with a hypochlorinator, or liquid chlorine injected into the system through a solution-fed chlorinator and booster pump shall be used. Chlorination application shall continue until the entire system if filled. The water shall remain in the system for a minimum of 24 hours. Each valve in the system shall be opened and closed several times to ensure its proper disinfection. Following the 24-hour period, no less than 25 ppm chlorine residual shall remain in the system. The system shall then be flushed with clean water until the residual chlorine is reduced to less than one part per million. Samples of water in disinfected containers for bacterial examination will be taken from several system locations which are approved by the Contracting Officer. Samples shall be tested for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with AWWA EWW. The testing method shall be either the multiple-tube fermentation technique or the membrane-filter technique. The disinfection shall be repeated until tests indicate the absence of coliform organisms (zero mean coliform density per 100 milliliters) in the samples for at least 2 full days. The system will not be accepted until satisfactory bacteriological results have been obtained.

3.8 FIELD TRAINING

The Fire Protection Specialist and the Manufacturer's Representative shall conduct a training course for operating and maintenance personnel as designated by the Contracting Officer. Training shall be provided for a

period of 2 hours of normal working time and shall start after the fire pump installation is functionally complete and after the Final Acceptance Test. The field instruction shall cover all of the items contained in the approved Operating and Maintenance Instructions.

-- End of Section --

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SECTION 13930A

WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION
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PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A 135	(2001) Electric-Resistance-Welded Steel Pipe
ASTM A 183	(1998) Carbon Steel Track Bolts and Nuts
ASTM A 47/A 47M	(1999) Ferritic Malleable Iron Castings
ASTM A 53/A 53M	(2002) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 536	(1984; R 1999e1) Ductile Iron Castings
ASTM A 795	(2000) Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use
ASTM F 436	(2002) Hardened Steel Washers
ASTM F 442/F 442M	(1999) Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR)

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1015	(1999) Double Check Backflow Prevention Assemblies and Double Check Fire Protection Backflow Prevention Assemblies

AMERICAN WATER WORKS ASSOCIATION(AWWA)

AWWA B300	(1999) Hypochlorites
AWWA B301	(1999) Liquid Chlorine
AWWA C104	(1995) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C110	(1998) Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (76 mm through 1219 mm), for Water
AWWA C111	(2000) Rubber-Gasket Joints for

	Ductile-Iron Pressure Pipe and Fittings
AWWA C151	(2002) Ductile-Iron Pipe, Centrifugally Cast, for Water
AWWA C203	(2002; A C203a-99) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied
AWWA C500	(2002; A C500a-95) Metal-Seated Gate Valves for Water Supply Service
AWWA C651	(1999) Disinfecting Water Mains
AWWA C652	(2002) Disinfection of Water-Storage Facilities
AWWA EWW	(1998) Standard Methods for the Examination of Water and Wastewater

ASME INTERNATIONAL (ASME)

ASME B16.1	(1998) Cast Iron Pipe Flanges and Flanged Fittings
ASME B16.11	(2002) Forged Fittings, Socket-Welding and Threaded
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.3	(1998) Malleable Iron Threaded Fittings
ASME B16.4	(1998) Gray Iron Threaded Fittings
ASME B16.9	(2001) Factory-Made Wrought Steel Buttwelding Fittings
ASME B18.2.1	(1996) Square and Hex Bolts and Screws, Inch Series
ASME B18.2.2	(1987; R 1999) Square and Hex Nuts

FM GLOBAL (FM)

FM P7825a	(2003) Approval Guide Fire Protection
FM P7825b	(2003) Approval Guide Electrical Equipment

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-71	(1997) Gray Iron Swing Check Valves, Flanged and Threaded Ends

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 13	(2002) Installation of Sprinkler Systems
NFPA 1963	(2003) Fire Hose Connections
NFPA 24	(2002) Installation of Private Fire Service Mains and Their Appurtenances

NATIONAL INSTITUTE FOR CERTIFICATION IN ENGINEERING TECHNOLOGIES (NICET)

NICET 1014-7	(1995) Program Detail Manual for Certification in the Field of Fire Protection Engineering Technology (Field Code 003) Subfield of Automatic Sprinkler System Layout

UNDERWRITERS LABORATORIES (UL)

UL 262	(1994; Rev thru Dec 1998) Gate Valves for Fire-Protection Service
UL Bld Mat Dir	(2003) Building Materials Directory
UL Fire Prot Dir	(2003) Fire Protection Equipment Directory

1.2 GENERAL REQUIREMENTS

Wet pipe sprinkler system shall be provided in all areas of the building. The sprinkler system shall provide fire sprinkler protection for the entire area. Except as modified herein, the system shall be designed and installed in accordance with NFPA 13. Pipe sizes which are not indicated on drawings shall be determined by hydraulic calculation. The Contractor shall design any portions of the sprinkler system that are not indicated on the drawings including locating sprinklers, piping and equipment, and size piping and equipment when this information is not indicated on the drawings or is not specified herein. The design of the sprinkler system shall be based on hydraulic calculations, and the other provisions specified herein.

1.2.1 Hydraulic Design

The system shall be hydraulically designed to discharge a minimum density of .15 gpm per square foot over the hydraulically most demanding 3,000 square feet of floor area. The minimum pipe size for branch lines in gridded systems shall be 1-1/4 inch. Hydraulic calculations shall be in accordance with the Area/Density Method of NFPA 13. Water velocity in the piping shall not exceed 20 ft/s. See draawing F0.01 for further flow and density/area information.

1.2.1.1 Hose Demand

An allowance for exterior hose streams of 500 gpm shall be added to the sprinkler system demand at the fire hydrant shown on the drawings closest to the point where the water service enters the building.

1.2.1.2 Basis for Calculations

The design of the system shall be based upon a water supply with a static pressure of 50 psig, and a flow of 1950 pgm at a residual pressure of 45. Water supply shall be presumed available at the point of connection to existing. Hydraulic calculations shall be based upon the Hazen-Williams formula with a "C" value of 120 for steel piping, 150 for copper tubing, 140 for new cement-lined ductile-iron piping, and 100 for existing underground piping. Hydraulic calculations shall be based on operation of the fire pump(s) provided in Section 13920A FIRE PUMPS. See drawings for pressure requirements.

1.2.2 Sprinkler Coverage

Sprinklers shall be uniformly spaced on branch lines. In buildings protected by automatic sprinklers, sprinklers shall provide coverage throughout 100 percent of the building. This includes, but is not limited to, telephone rooms, electrical equipment rooms, boiler rooms, switchgear rooms, transformer rooms, and other electrical and mechanical spaces. Coverage per sprinkler shall be in accordance with NFPA 13, but shall not exceed 100 square feet for extra hazard occupancies, 130 square feet for ordinary hazard occupancies, and 225 square feet for light hazard occupancies. Exception as follows:

1.3 COORDINATION OF TRADES

Piping offsets, fittings, and any other accessories required shall be furnished as required to provide a complete installation and to eliminate interference with other construction. Sprinkler shall be installed over and under ducts, piping and platforms when such equipment can negatively effect or disrupt the sprinkler discharge pattern and coverage.

1.4 DELIVERY AND STORAGE

All equipment delivered and placed in storage shall be housed in a manner to preclude any damage from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Additionally, all pipes shall either be capped or plugged until installed.

1.5 FIELD MEASUREMENTS

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work.

1.6 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Shop Drawings; G-AE

Three copies of the Sprinkler System Shop Drawings, no later than 21 days prior to the start of sprinkler system installation.

As-Built Drawings

As-built shop drawings, at least 14 days after completion of the Final Tests. The Sprinkler System Drawings shall be updated to reflect as-built conditions after all related work is completed and shall be on reproducible full-size mylar film.

SD-03 Product Data

Fire Protection Related Submittals

A list of the Fire Protection Related Submittals, no later than 7 days after the approval of the Fire Protection Specialist.

Sway Bracing; G-AE

For systems that are required to be protected against damage from earthquakes, load calculations shall be provided for sizing of sway bracing.

Materials and Equipment; G-AE

Manufacturer's catalog data included with the Sprinkler System Drawings for all items specified herein. The data shall be highlighted to show model, size, options, etc., that are intended for consideration. Data shall be adequate to demonstrate compliance with all contract requirements. In addition, a complete equipment list that includes equipment description, model number and quantity shall be provided.

Hydraulic Calculations; G-AE

Hydraulic calculations, including a drawing showing hydraulic reference points and pipe segments.

Spare Parts

Spare parts data shall be included for each different item of material and equipment specified.

Preliminary Tests; G-AO

Proposed procedures for Preliminary Tests, no later than 14 days prior to the proposed start of the tests. Proposed date and time to begin the preliminary tests.

Final Acceptance Test; G-AO

Proposed procedures for Final Acceptance Test, no later than 14 days prior to the proposed start of the tests. Proposed date and time to begin Final Acceptance Test, submitted with the Final Acceptance Test Procedures. Notification shall be provided at least 14 days prior to the proposed start of the test. Notification shall include a copy of the Contractor's Material & Test Certificates.

On-site Training; G-AO

Proposed On-site Training schedule, at least 14 days prior to the start of related training.

Fire Protection Specialist; G-AO

The name and documentation of certification of the proposed Fire Protection Specialists, no later than 14 days after the Notice to Proceed and prior to the submittal of the sprinkler system drawings and hydraulic calculations.

Sprinkler System Installer; G-AO

The name and documentation of certification of the proposed Sprinkler System Installer, concurrent with submittal of the Fire Protection Specialist Qualifications.

SD-06 Test Reports

Preliminary Test Report; G-AO

Three copies of the completed Preliminary Test Report, no later that 7 days after the completion of the Preliminary Tests. The Preliminary Tests Report shall include both the Contractor's Material and Test Certificate for Underground Piping and the Contractor's Material and Test Certificate for Aboveground Piping. All items in the Preliminary Tests Report shall be signed by the Fire Protection Specialist.

Final Acceptance Test Report; G-AO

Three copies of the completed Final Acceptance Tests Reports, no later that 7 days after the completion of the Final Acceptance Tests. All items in the Final Acceptance Report shall be signed by the Fire Protection Specialist.

SD-07 Certificates

Inspection by Fire Protection Specialist; G-AO

Concurrent with the Final Acceptance Test Report, certification by the Fire Protection Specialist that the sprinkler system is installed in accordance with the contract requirements, including signed approval of the Preliminary and Final Acceptance Test Reports.

SD-10 Operation and Maintenance Data

Operating and Maintenance Instructions

Six manuals listing step-by-step procedures required for system startup, operation, shutdown, and routine maintenance, at least 14 days prior to field training. The manuals shall include the manufacturer's name, model number, parts list, list of parts and tools that should be kept in stock by the owner for routine maintenance including the name of a local supplier, simplified wiring and controls diagrams, troubleshooting guide, and

recommended service organization (including address and telephone number) for each item of equipment. Each service organization submitted shall be capable of providing 4 hour on-site response to a service call on an emergency basis.

1.7 HYDRAULIC CALCULATIONS

Hydraulic calculations shall be as outlined in NFPA 13 except that calculations shall be performed by computer using software intended specifically for fire protection system design using the design data shown on the drawings. Software that uses k-factors for typical branch lines is not acceptable. Calculations shall be based on the water supply data shown on the drawings. Calculations shall substantiate that the design area used in the calculations is the most demanding hydraulically. Water supply curves and system requirements shall be plotted on semi-logarithmic graph paper so as to present a summary of the complete hydraulic calculation. A summary sheet listing sprinklers in the design area and their respective hydraulic reference points, elevations, actual discharge pressures and actual flows shall be provided. Elevations of hydraulic reference points (nodes) shall be indicated. Documentation shall identify each pipe individually and the nodes connected thereto. The diameter, length, flow, velocity, friction loss, number and type fittings, total friction loss in the pipe, equivalent pipe length and Hazen-Williams coefficient shall be indicated for each pipe. For gridded systems, calculations shall show peaking of demand area friction loss to verify that the hydraulically most demanding area is being used. Also for gridded systems, a flow diagram indicating the quantity and direction of flows shall be included. A drawing showing hydraulic reference points (nodes) and pipe designations used in the calculations shall be included and shall be independent of shop drawings.

1.8 FIRE PROTECTION SPECIALIST

Work specified in this section shall be performed under the supervision of and certified by the Fire Protection Specialist. The Fire Protection Specialist shall be an individual who is a registered professional engineer and a Full Member of the Society of Fire Protection Engineers or who is certified as a Level IV Technician by National Institute for Certification in Engineering Technologies (NICET) in the Automatic Sprinkler System Layout subfield of Fire Protection Engineering Technology in accordance with NICET 1014-7. The Fire Protection Specialist shall be regularly engaged in the design and installation of the type and complexity of system specified in the Contract documents, and shall have served in a similar capacity for at least three systems that have performed in the manner intended for a period of not less than 6 months.

1.9 SPRINKLER SYSTEM INSTALLER

Work specified in this section shall be performed by the Sprinkler System Installer. The Sprinkler System Installer shall be regularly engaged in the installation of the type and complexity of system specified in the Contract documents, and shall have served in a similar capacity for at least three systems that have performed in the manner intended for a period of not less than 6 months.

1.10 REGULATORY REQUIREMENTS

Compliance with referenced NFPA standards is mandatory. This includes advisory provisions listed in the appendices of such standards, as though

the word "shall" had been substituted for the word "should" wherever it appears. In the event of a conflict between specific provisions of this specification and applicable NFPA standards, this specification shall govern. Reference to "authority having jurisdiction" shall be interpreted to mean the Contracting Officer.

1.11 SPARE PARTS

The Contractor shall submit spare parts data for each different item of material and equipment specified. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of parts recommended by the manufacturer to be replaced after 1 year and 3 years of service. A list of special tools and test equipment required for maintenance and testing of the products supplied by the Contractor shall be included.

1.12 SHOP DRAWINGS

The Sprinkler System Shop Drawings shall conform to the requirements established for working plans as prescribed in NFPA 13. Drawings shall include plan and elevation views demonstrating that the equipment will fit the allotted spaces with clearance for installation and maintenance. Each set of drawings shall include the following:

a. Descriptive index of drawings in the submittal with drawings listed in sequence by drawing number. A legend identifying device symbols, nomenclature, and conventions used.

b. Floor plans drawn to a scale not less than 1/8" = 1'-0" which clearly show locations of sprinklers, risers, pipe hangers, seismic separation assemblies, sway bracing, inspector's test connections, drains, and other applicable details necessary to clearly describe the proposed arrangement. Each type of fitting used and the locations of bushings, reducing couplings, and welded joints shall be indicated.

c. Actual center-to-center dimensions between sprinklers on branch lines and between branch lines; from end sprinklers to adjacent walls; from walls to branch lines; from sprinkler feed mains, cross-mains and branch lines to finished floor and roof or ceiling. A detail shall show the dimension from the sprinkler and sprinkler deflector to the ceiling in finished areas.

d. Longitudinal and transverse building sections showing typical branch line and cross-main pipe routing as well as elevation of each typical sprinkler above finished floor.

e. Details of each type of riser assembly; pipe hanger; sway bracing for earthquake protection, and restraint of underground water main at point-of-entry into the building, and electrical devices and interconnecting wiring.

f. Stamp and signature of registered fire protection engineer on drawings and hydraulic calculations.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

2.2 NAMEPLATES

All equipment shall have a nameplate that identifies the manufacturer's name, address, type or style, model or serial number, and catalog number.

2.3 REQUIREMENTS FOR FIRE PROTECTION SERVICE

Materials and Equipment shall have been tested by Underwriters Laboratories, Inc. and listed in UL Fire Prot Dir or approved by Factory Mutual and listed in FM P7825a and FM P7825b. Where the terms "listed" or "approved" appear in this specification, such shall mean listed in UL Fire Prot Dir or FM P7825a and FM P7825b

2.4 UNDERGROUND PIPING COMPONENTS

2.4.1 Pipe

Piping from a point 6 inches above the floor to a point 5 feet outside the building wall shall be ductile iron with a rated working pressure of 150 psi conforming to AWWA C151, with cement mortar lining conforming to AWWA C104. Piping more than 5 feet outside the building walls shall comply with Section 02510A WATER DISTRIBUTION SYSTEM.

2.4.2 Fittings and Gaskets

Fittings shall be ductile iron conforming to AWWA C110. Gaskets shall be suitable in design and size for the pipe with which such gaskets are to be used. Gaskets for ductile iron pipe joints shall conform to AWWA C111.

2.4.3 Gate Valve and Indicator Posts

Gate valves for underground installation shall be of the inside screw type with counter-clockwise rotation to open. Where indicating type valves are shown or required, indicating valves shall be gate valves with an approved indicator post of a length to permit the top of the post to be located 3 feet above finished grade. Gate valves and indicator posts shall be listed in UL Fire Prot Dir or FM P7825a and FM P7825b.

2.4.4 Valves and Valve Boxes

Valves shall be gate valves conforming to AWWA C500 or UL 262. Valves shall have cast-iron body and bronze trim. Valve shall open by counterclockwise rotation.Except for post indicator valves, all underground valves shall be provided with an adjustable cast-iron or ductile iron valve box of a size suitable for the valve on which the box is to be used, but not less than 5.25 inches in diameter. The box shall be coated with bituminous coating. A cast-iron or ductile-iron cover with the word "WATER" cast on the cover shall be provided for each box.

2.4.5 Buried Utility Warning and Identification Tape

Detectable aluminum foil plastic-backed tape or detectable magnetic plastic tape manufactured specifically for warning and identification of buried piping shall be provided for all buried piping. Tape shall be detectable by an electronic detection instrument. Tape shall be color-coded for the utility involved and imprinted in bold black letters continuously and repeatedly over the entire tape length. Warning and identification shall be "CAUTION BURIED WATER PIPING BELOW" or similar wording. Code and lettering shall be permanent and unaffected by moisture and other substances contained in the trench backfill material. Tape shall be buried at a depth of 12 inches below the top surface of earth or the top surface of the subgrade under pavement.

2.5 ABOVEGROUND PIPING COMPONENTS

Aboveground piping shall be steel or plastic.

2.5.1 Steel Piping Components

2.5.1.1 Steel Pipe

Except as modified herein, steel pipe shall be black as permitted by NFPA 13 and shall conform to applicable provisions of ASTM A 795, ASTM A 53/A 53M, or ASTM A 135. Pipe in which threads or grooves are cut shall be Schedule 40 or shall be listed by Underwriters' Laboratories to have a corrosion resistance ratio (CRR) of 1.0 or greater after threads or grooves are cut. Pipe shall be marked with the name of the manufacturer, kind of pipe, and ASTM designation.

2.5.1.2 Fittings for Non-Grooved Steel Pipe

Fittings shall be cast iron conforming to ASME B16.4, steel conforming to ASME B16.9 or ASME B16.11, or malleable iron conforming to ASME B16.3. Steel press fittings shall be approved for fire protection systems. Fittings into which sprinklers, drop nipples or riser nipples (sprigs) are screwed shall be threaded type. Plain-end fittings with mechanical couplings, fittings that use steel gripping devices to bite into the pipe and segmented welded fittings shall not be used.

2.5.1.3 Grooved Mechanical Joints and Fittings

Joints and fittings shall be designed for not less than 175 psi service and shall be the product of the same manufacturer;segmented welded fittings shall not be used. Fitting and coupling houses shall be malleable iron conforming to ASTM A 47/A 47M, Grade 32510; ductile iron conforming to ASTM A 536, Grade 65-45-12. Gasket shall be the flush type that fills the entire cavity between the fitting and the pipe. Nuts and bolts shall be heat-treated steel conforming to ASTM A 183 and shall be cadmium plated or zinc electroplated.

2.5.1.4 Flanges

Flanges shall conform to NFPA 13 and ASME B16.1. Gaskets shall be non-asbestos compressed material in accordance with ASME B16.21, 1/16 inch thick, and full face or self-centering flat ring type.

2.5.1.5 Bolts, Nut, and Washers

Bolts shall be squarehead conforming to ASME B18.2.1 and shall extend no less than three full threads beyond the nut with bolts tightened to the required torque. Nuts shall be hexagon type conforming to ASME B18.2.2. Washers shall meet the requirements of ASTM F 436. Flat circular washers shall be provided under all bolt heads and nuts.

2.5.2 Plastic Piping Components (Swimming Pool Area)

2.5.2.1 Plastic Pipe

Plastic pipe shall be chlorinated polyvinyl chloride (CPVC) conforming to ASTM F 442/F 442M, 175 psi rating and listed in UL Fire Prot Dir for use in wet pipe sprinkler systems.

2.5.2.2 Plastic Fittings

Plastic fitting shall be chlorinated polyvinyl chloride (CPVC) as listed in UL Fire Prot Dir for use in wet pipe sprinkler systems.

2.5.3 Pipe Hangers

Hangers shall be listed in UL Fire Prot Dir or FM P7825a and FM P7825b and of the type suitable for the application, construction, and pipe type and sized to be supported.

2.5.4 Valves

2.5.4.1 Control Valve and Gate Valve

Manually operated sprinkler control valve and gate valve shall be outside stem and yoke (OS&Y) type and shall be listed in UL Bld Mat Dir or FM P7825a and FM P7825b.

2.5.4.2 Check Valve

Check valve 2 inches and larger shall be listed in UL Bld Mat Dir or FM P7825a and FM P7825b. Check valves 4 inches and larger shall be of the swing type with flanged cast iron body and flanged inspection plate, shall have a clear waterway and shall meet the requirements of MSS SP-71, for Type 3 or 4.

2.6 ALARM CHECK VALVE ASSEMBLY

Assembly shall include an alarm check valve, standard trim piping, pressure gauges, bypass, retarding chamber, testing valves, main drain, and other components as required for a fully operational system.

2.7 WATERFLOW ALARM

Electrically operated, exterior-mounted, waterflow alarm bell shall be provided and installed in accordance with NFPA 13. Waterflow alarm bell shall be rated 24 VDC and shall be connected to the Fire Alarm Control Panel(FACP) in accordance with Section 13851A FIRE DETECTION AND ALARM SYSTEM, ADDRESSABLE.

2.8 ALARM INITIATING AND SUPERVISORY DEVICES

2.8.1 Sprinkler Waterflow Indicator Switch, Vane Type

Switch shall be vane type with a pipe saddle and cast aluminum housing. The electro-mechanical device shall include a flexible, low-density polyethylene paddle conforming to the inside diameter of the fire protection pipe. The device shall sense water movements and be capable of detecting a sustained flow of 10 gpm or greater. The device shall contain a retard device adjustable from 0 to 90 seconds to reduce the possibility of false alarms caused by transient flow surges. The switch shall be tamper resistant and contain two SPDT (Form C) contacts arranged to transfer upon removal of the housing cover, and shall be equipped with a silicone rubber gasket to assure positive water seal and a dustproof cover and gasket to seal the mechanism from dirt and moisture.

2.8.2 Sprinkler Pressure (Waterflow) Alarm Switch

Pressure switch shall include a metal housing with a neoprene diaphragm, SPDT snap action switches and a 1/2 inch NPT male pipe thread. The switch shall have a maximum service pressure rating of 175 psi. There shall be two SPDT (Form C) contacts factory adjusted to operate at 4 to 8 psi. The switch shall be capable of being mounted in any position in the alarm line trim piping of the alarm check valve.

2.8.3 Valve Supervisory (Tamper) Switch

Switch shall be suitable for mounting to the type of control valve to be supervised open. The switch shall be tamper resistant and contain one set of SPDT (Form C) contacts arranged to transfer upon removal of the housing cover or closure of the valve of more than two rotations of the valve stem.

2.9 FIRE DEPARTMENT CONNECTION

Fire department connection shall be flush type with cast brass body, matching wall escutcheon lettered "Auto Spkr" with a polished brass finish. The connection shall have two inlets with individual self-closing clappers, caps with drip drains and chains. Female inlets shall have 2-1/2 inch diameter American National Fire Hose Connection Screw Threads (NH) per NFPA 1963.

2.10 SPRINKLERS

Sprinklers with internal O-rings shall not be used. Sprinklers shall be used in accordance with their listed coverage limitations. Temperature classification shall be ordinary. Sprinklers in close proximity to unit heaters shall have temperature classification in accordance with NFPA 13. Extended coverage sprinklers shall not be used.

2.10.1 Concealed Sprinkler

Concealed sprinkler shall be white polyester and shall have a nominal 1/2 inch or 17/32 inch orifice.

2.10.2 Recessed Sprinkler

Upright sprinkler shall be white polyester and shall have a nominal 1/2 inch or 17/32 inch orifice.

2.10.3 Flush Sprinkler

Flush sprinkler shall be white polyester and shall have a nominal 1/2 inch or 17/32 inch orifice.

2.10.4 Pendent Sprinkler

Pendent sprinkler shall be of the fusible strut or glass bulb type, recessed type with nominal 1/2 inch or 17/32 inch orifice. Pendent sprinklers shall have a white polyester finish.

2.10.5 Upright Sprinkler

Upright sprinkler shall be white polyester and shall have a nominal 1/2 inch or 17/32 inch orifice.

2.10.6 Sidewall Sprinkler

Sidewall sprinkler shall have a nominal 1/2 inch orifice. Sidewall sprinkler shall have a white polyester finish. Sidewall sprinkler shall be the quick-response type.

2.10.7 Corrosion Resistant Sprinkler (Swimming Pool Area Steam and Shower Rooms)

Corrosion resistant sprinkler shall be the upright or pendent type installed in locations as indicated. Corrosion resistant coatings shall be factory-applied by the sprinkler manufacturer.

2.11 DISINFECTING MATERIALS

2.11.1 Liquid Chlorine

Liquid chlorine shall conform to AWWA B301.

2.11.2 Hypochlorites

Calcium hypochlorite and sodium hypochlorite shall conform to AWWA B300.

2.12 ACCESSORIES

2.12.1 Sprinkler Cabinet

Spare sprinklers shall be provided in accordance with NFPA 13 and shall be packed in a suitable metal or plastic cabinet. Spare sprinklers shall be representative of, and in proportion to, the number of each type and temperature rating of the sprinklers installed. At least one wrench of each type required shall be provided.

2.12.2 Pendent Sprinkler Escutcheon

Escutcheon shall be one-piece metallic type with a depth of less than 3/4 inch and suitable for installation on pendent sprinklers. The escutcheon shall have a factory finish that matches the pendent sprinkler heads.

2.12.3 Pipe Escutcheon

Escutcheon shall be polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Escutcheons shall be either one-piece or

split-pattern, held in place by internal spring tension or set screw.

2.12.4 Sprinkler Guard

Guard shall be a steel wire cage designed to encase the sprinkler and protect it from mechanical damage. Guards shall be provided on sprinklers located under running track.

2.12.5 Identification Sign

Valve identification sign shall be minimum 6 inches wide x 2 inches high with enamel baked finish on minimum 18 gauge steel or 0.024 inch aluminum with red letters on a white background or white letters on red background. Wording of sign shall include, but not be limited to "main drain," "auxiliary drain," "inspector's test," "alarm test," "alarm line," and similar wording as required to identify operational components.

2.13 DOUBLE-CHECK VALVE BACKFLOW PREVENTION ASSEMBLY

Double-check backflow prevention assembly shall comply with ASSE 1015. The assembly shall have a bronze, cast-iron or stainless steel body with flanged ends. The assembly shall include pressure gauge test ports and OS&Y shutoff valves on the inlet and outlet, 2-positive-seating check valve for continuous pressure application, and four test cocks. Assemblies shall be rated for working pressure of 150 psi The maximum pressure loss shall be 6 psi at a flow rate equal to the sprinkler water demand, at the location of the assembly. A test port for a pressure gauge shall be provided both upstream and downstream of the double check backflow prevention assembly valves. Contractor shall certify, via flow tests, during the preliminary testing that the at the 6-psi minimum loss is not exceeded. This test shall be conducted at the system demand flow. This test shall be repeated at the time of the final inspections and tests. As a condition for acceptance of the backflow preventer, the pressure drop shall not exceed the manufacture's data.

PART 3 EXECUTION

3.1 FIRE PROTECTION RELATED SUBMITTALS

The Fire Protection Specialist shall prepare a list of the submittals from the Contract Submittal Register that relate to the successful installation of the sprinkler systems(s). The submittals identified on this list shall be accompanied by a letter of approval signed and dated by the Fire Protection Specialist when submitted to the Government.

3.2 INSTALLATION REQUIREMENTS

The installation shall be in accordance with the applicable provisions of NFPA 13, NFPA 24 and publications referenced therein. Installation of in-rack sprinklers shall comply with applicable provisions of NFPA 13.

3.3 INSPECTION BY FIRE PROTECTION SPECIALIST

The Fire Protection Specialist shall inspect the sprinkler system periodically during the installation to assure that the sprinkler system is being provided and installed in accordance with the contract requirements. The Fire Protection Specialist shall witness the preliminary and final tests, and shall sign the test results. The Fire Protection Specialist, after completion of the system inspections and a successful final test,

shall certify in writing that the system has been installed in accordance with the contract requirements. Any discrepancy shall be brought to the attention of the Contracting Officer in writing, no later than three working days after the discrepancy is discovered.

3.4 ABOVEGROUND PIPING INSTALLATION

3.4.1 Protection of Piping Against Earthquake Damage

The system piping shall be protected against damage from earthquakes. Seismic protection shall include flexible and rigid couplings, sway bracing, seismic separation assemblies where piping crosses building seismic separation joints, and other features as required by NFPA 13 for protection of piping against damage from earthquakes.

3.4.2 Piping in Exposed Areas

Exposed piping shall be installed so as not to diminish exit access widths, corridors or equipment access. Exposed horizontal piping, including drain piping, shall be installed to provide maximum headroom.

3.4.3 Piping in Finished Areas

In areas with suspended or dropped ceilings and in areas with concealed spaces above the ceiling, piping shall be concealed above ceilings. Piping shall be inspected, tested and approved before being concealed. Risers and similar vertical runs of piping in finished areas shall be concealed.

3.4.4 Pendent Sprinklers

Drop nipples to pendent sprinklers shall consist of minimum 1 inch pipe with a reducing coupling into which the sprinkler shall be threaded. Hangers shall be provided on arm-overs to drop nipples supplying pendent sprinklers when the arm-over exceeds 12 inches. Where sprinklers are installed below suspended or dropped ceilings, drop nipples shall be cut such that sprinkler ceiling plates or escutcheons are of a uniform depth throughout the finished space. The outlet of the reducing coupling shall not extend more than 1 inch below the underside of the ceiling. On pendent sprinklers installed below suspended or dropped ceilings, the distance from the sprinkler deflector to the underside of the ceiling shall not exceed 4 inches. Recessed pendent sprinklers shall be installed such that the distance from the sprinkler deflector to the underside of the ceiling shall not exceed the manufacturer's listed range and shall be of uniform depth throughout the finished area.

3.4.4.1 Pendent Sprinkler Locations

Pendent sprinklers in suspended ceilings shall be a minimum of 6 inches from ceiling grid.

3.4.5 Upright Sprinklers

Riser nipples or "sprigs" to upright sprinklers shall contain no fittings between the branch line tee and the reducing coupling at the sprinkler. Riser nipples exceeding 30 inches in length shall be individually supported.

3.4.6 Pipe Joints

Pipe joints shall conform to NFPA 13, except as modified herein. Not more

than four threads shall show after joint is made up. Welded joints will be permitted, only if welding operations are performed as required by NFPA 13 at the Contractor's fabrication shop, not at the project construction site. Flanged joints shall be provided where indicated or required by NFPA 13. Grooved pipe and fittings shall be prepared in accordance with the manufacturer's latest published specification according to pipe material, wall thickness and size. Grooved couplings, fittings and grooving tools shall be products of the same manufacturer. For copper tubing, pipe and groove dimensions shall comply with the tolerances specified by the coupling manufacturer. The diameter of grooves made in the field shall be measured using a "go/no-go" gauge, vernier or dial caliper, narrow-land micrometer, or other method specifically approved by the coupling manufacturer for the intended application. Groove width and dimension of groove from end of pipe shall be measured and recorded for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances. Grooved joints shall not be used in concealed locations, such as behind solid walls or ceilings, unless an access panel is shown on the drawings for servicing or adjusting the joint.

3.4.7 Reducers

Reductions in pipe sizes shall be made with one-piece tapered reducing fittings. The use of grooved-end or rubber-gasketed reducing couplings will not be permitted. When standard fittings of the required size are not manufactured, single bushings of the face type will be permitted. Where used, face bushings shall be installed with the outer face flush with the face of the fitting opening being reduced. Bushings shall not be used in elbow fittings, in more than one outlet of a tee, in more than two outlets of a cross, or where the reduction in size is less than 1/2 inch.

3.4.8 Pipe Penetrations

Cutting structural members for passage of pipes or for pipe-hanger fastenings will not be permitted. Pipes that must penetrate concrete or masonry walls or concrete floors shall be core-drilled and provided with pipe sleeves. Each sleeve shall be Schedule 40 galvanized steel, ductile iron or cast iron pipe and shall extend through its respective wall or floor and be cut flush with each wall surface. Sleeves shall provide required clearance between the pipe and the sleeve per NFPA 13. The space between the sleeve and the pipe shall be firmly packed with mineral wool insulation. Where pipes penetrate fire walls, fire partitions, or floors, pipes shall be fire stopped in accordance with Section 07840 FIRESTOPPING. In penetrations that are not fire-rated or not a floor penetration, the space between the sleeve and the pipe shall be sealed at both ends with plastic waterproof cement that will dry to a firm but pliable mass or with a mechanically adjustable segmented elastomer seal.

3.4.9 Escutcheons

Escutcheons shall be provided for pipe penetration of ceilings and walls. Escutcheons shall be securely fastened to the pipe at surfaces through which piping passes.

3.4.10 Inspector's Test Connection

Unless otherwise indicated, test connection shall consist of 1 inch pipe connected at the riser as a combination test and drain valve; a test valve located approximately 7 feet above the floor; a smooth bore brass outlet equivalent to the smallest orifice sprinkler used in the system; and a

painted metal identification sign affixed to the valve with the words "Inspector's Test." The discharge orifice shall be located outside the building wall directed so as not to cause damage to adjacent construction or landscaping during full flow discharge.

3.4.11 Drains

Main drain piping shall be provided to discharge at a safe point outside the building. Auxiliary drains shall be provided as required by NFPA 13.

3.4.12 Installation of Fire Department Connection

Connection shall be mounted on the exterior wall approximately 3 feet above finished grade. The piping between the connection and the check valve shall be provided with an automatic drip in accordance with NFPA 13 and arranged to drain to the outside.

3.4.13 Identification Signs

Signs shall be affixed to each control valve, inspector test valve, main drain, auxiliary drain, test valve, and similar valves as appropriate or as required by NFPA 13. Hydraulic design data nameplates shall be permanently affixed to each sprinkler riser as specified in NFPA 13.

3.5 UNDERGROUND PIPING INSTALLATION

The fire protection water main shall be laid, and joints anchored, in accordance with NFPA 24. Minimum depth of cover shall be 8 feet. The supply line shall terminate inside the building with a flanged piece, the bottom of which shall be set not less than 6 inches above the finished floor. A blind flange shall be installed temporarily on top of the flanged piece to prevent the entrance of foreign matter into the supply line. A concrete thrust block shall be provided at the elbow where the pipe turns up toward the floor. In addition, joints shall be anchored in accordance with NFPA 24 using pipe clamps and steel rods from the elbow to the flange above the floor and from the elbow to a pipe clamp in the horizontal run of pipe. Buried steel components shall be provided with a corrosion protective coating in accordance with AWWA C203. Piping more than 5 feet outside the building walls shall meet the requirements of Section 02510A WATER DISTRIBUTION SYSTEM.

3.6 EARTHWORK

Earthwork shall be performed in accordance with applicable provisions of Section 02300 EARTHWORK.

3.7 ELECTRICAL WORK

Except as modified herein, electric equipment and wiring shall be in accordance with Section 16415A ELECTRICAL WORK, INTERIOR. Alarm signal wiring connected to the building fire alarm control system shall be in accordance with Section 13851A FIRE DETECTION AND ALARM SYSTEM, ADDRESSABLE.

3.8 DISINFECTION

After all system components are installed and hydrostatic test(s) are successfully completed, each portion of the sprinkler system to be disinfected shall be thoroughly flushed with potable water until all entrained dirt and other foreign materials have been removed before

introducing chlorinating material. Flushing shall be conducted by removing the flushing fitting of the cross mains and of the grid branch lines, and then back-flushing through the sprinkler main drains. The chlorinating material shall be hypochlorites or liquid chlorine. Water chlorination procedure shall be in accordance with AWWA C651 and AWWA C652. The chlorinating material shall be fed into the sprinkler piping at a constant rate of 50 parts per million (ppm). A properly adjusted hypochlorite solution injected into the system with a hypochlorinator, or liquid chlorine injected into the system through a solution-fed chlorinator and booster pump shall be used. Chlorination application shall continue until the entire system if filled. The water shall remain in the system for a minimum of 24 hours. Each valve in the system shall be opened and closed several times to ensure its proper disinfection. Following the 24-hour period, no less than 25 ppm chlorine residual shall remain in the system. The system shall then be flushed with clean water until the residual chlorine is reduced to less than one part per million. Samples of water in disinfected containers for bacterial examination will be taken from several system locations which are approved by the Contracting Officer. Samples shall be tested for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with AWWA EWW. The testing method shall be either the multiple-tube fermentation technique or the membrane-filter technique. The disinfection shall be repeated until tests indicate the absence of coliform organisms (zero mean coliform density per 100 milliliters) in the samples for at least 2 full days. The system will not be accepted until satisfactory bacteriological results have been obtained. After successful completion, verify installation of all sprinklers and plugs and pressure test the system.

3.9 PIPE COLOR CODE MARKING

Color code marking of piping shall be as specified in Section 09900 PAINTS AND COATINGS.

3.10 PRELIMINARY TESTS

The system, including the underground water mains, and the aboveground piping and system components, shall be tested to assure that equipment and components function as intended. The underground and aboveground interior piping systems and attached appurtenances subjected to system working pressure shall be tested in accordance with NFPA 13 and NFPA 24. Upon completion of specified tests, the Contractor shall complete certificates as specified in paragraph SUBMITTALS.

3.10.1 Underground Piping

3.10.1.1 Flushing

Underground piping shall be flushed in accordance with NFPA 24. This includes the requirement to flush the lead-in connection to the fire protection system at a flow rate not less that the calculated maximum water demand rate of the system.

3.10.1.2 Hydrostatic Testing

New underground piping shall be hydrostatically tested in accordance with NFPA 24. The allowable leakage shall be measured at the specified test pressure by pumping from a calibrated container. The amount of leakage at the joints shall not exceed 2 quarts per hour per 100 gaskets or joints, regardless of pipe diameter.

3.10.2 Aboveground Piping

3.10.2.1 Hydrostatic Testing

Aboveground piping shall be hydrostatically tested in accordance with NFPA 13 at not less than 200 psi or 50 psi in excess of maximum system operating pressure and shall maintain that pressure without loss for 2 hours. There shall be no drop in gauge pressure or visible leakage when the system is subjected to the hydrostatic test. The test pressure shall be read from a gauge located at the low elevation point of the system or portion being tested.

3.10.2.2 Backflow Prevention Assembly Forward Flow Test

Each backflow prevention assembly shall be tested at system flow demand as specified in NFPA 13. The Contractor shall provide all equipment and instruments necessary to conduct a complete forward flow test, including playpipe nozzles, calibrated pressure gauges, and pitot tube gauge. The Contractor shall provide all necessary supports to safely secure hoses and nozzles during the test. At the system demand flow, the pressure readings and pressure drop (friction) across the assembly shall be recorded. A metal placard shall be provided on the backflow prevention assembly that lists the pressure readings both upstream and downstream of the assembly, total pressure drop, and the system test flow rate. The pressure drop shall be compared to the manufacturer's data.

3.10.3 Testing of Alarm Devices

Each alarm switch shall be tested by flowing water through the inspector's test connection. Each water-operated alarm devices shall be tested to verify proper operation.

3.10.4 Main Drain Flow Test

Following flushing of the underground piping, a main drain test shall be made to verify the adequacy of the water supply. Static and residual pressures shall be recorded on the certificate specified in paragraph SUBMITTALS. In addition, a main drain test shall be conducted each time after a main control valve is shut and opened.

3.11 FINAL ACCEPTANCE TEST

Final Acceptance Test shall begin only when the Preliminary Test Report has been approved. The Fire Protection Specialist shall conduct the Final Acceptance Test and shall provide a complete demonstration of the operation of the system. This shall include operation of control valves and flowing of inspector's test connections to verify operation of associated waterflow alarm switches. After operation of control valves has been completed, the main drain test shall be repeated to assure that control valves are in the open position. In addition, the representative shall have available copies of as-built drawings and certificates of tests previously conducted. The installation shall not be considered accepted until identified discrepancies have been corrected and test documentation is properly completed and received. The Contractor shall submit the Final Acceptance Test Report as specified in the Submittals paragraph.

3.12 ON-SITE TRAINING

The Fire Protection Specialist shall conduct a training course for operating and maintenance personnel as designated by the Contracting Officer. Training shall be provided for a period of 8 hours of normal working time and shall start after the system is functionally complete and after the Final Acceptance Test. The On-Site Training shall cover all of the items contained in the approved Operating and Maintenance Instructions.

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SECTION 15070A

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SECTION 15070A

ANTITERRORISM/FORCE PROTECTION (AT/FP) FOR MECHANICAL EQUIPMENT
01/02

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA Seismic Restraint Mnl	(1998) Seismic Restraint Manual Guidelines for Mechanical Systems

1.2 SYSTEM DESCRIPTION

1.2.1 General Requirements

The requirements for seismic protection measures described in this section shall be applied to the mechanical equipment and systems listed below. Structural requirements shall be in accordance with Section 13080 ANTITERRORISM/FORCE PROTECTION (AT/FP)FOR MISCELLANEOUS EQUIPMENT.

Mechanical equipment shall be anchored or braced to resist an AT/FP force of 0.5 times the equipment weight in any horizontal direction as well as in the upward vertical direction. Mechanical equipment shall be anchored or braced to resist an AT/FP force of 1.5 times the equipment weight in the downward vertical direction.

1.2.2 Mechanical Equipment

Mechanical equipment to be AT/FP protected shall include the following items to the extent required on the drawings or in other sections of these specifications:

Water Heaters
Air Separator Tanks

Refrigerant Piping

Valves and Fittings for Piping

Air Handling Units (Suspended)

Ducts
Unit Heaters

Mechanical equipment requiring AT/FP protection includes all mechanical equipment and components weighing over 31 pounds at locations as given in paragraphs 1.2.4.1 and 1.2.4.2 of specification Section 13080 ANTITERRORISM/FORCE PROTECTION (AT/FP) FOR MISCELLANEOUS EQUIPMENT.

1.2.3 Mechanical Systems

The following mechanical systems shall be installed as required on the drawings and other sections of these specifications:

All Piping Inside the Building Except as Specifically Stated Below Under "Items Not Covered By This Section".

Mechanical equipment requiring AT/FP protection includes all mechanical systems listed above which are located inside of buildings at locations as given in paragraphs 1.2.4.1 and 1.2.4.2 of specification Section 13080 ANTITERRORISM/FORCE PROTECTION (AT/FP) FOR MISCELLANEOUS EQUIPMENT.

1.2.4 Contractor Designed Bracing

The Contractor shall design the bracing in accordance with SMACNA SEISMIC RESTRAINT MANUAL.

1.2.5 Items Not Covered By This Section

1.2.5.1 Fire Protection Systems

Piping for fire protection systems shall be installed as specified in Sections 13920A FIRE PUMPS, and 13930A WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION.

1.3 EQUIPMENT REQUIREMENTS

Equipment weighing 14 kg (31 lb) or more shall be mounted to resist forces of 0.5 times the component weight in any direction and 1.5 times the component weight in the downward direction or as required by seismic design (whichever is greater).

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Coupling and Bracing; G-AE.

Equipment Requirements; G-AE.
Contractor Designed Bracing; G-AE.

Detail drawings along with catalog cuts, templates, and erection and installation details, as appropriate, for the items listed. Submittals shall be complete in detail; shall indicate thickness, type, grade, class of metal, and dimensions; and shall show construction details, reinforcement, anchorage, and installation with relation to the building construction.

SD-03 Product Data

Coupling and Bracing; G-AE.
Equipment Requirements; G-AE.

Copies of the design calculations with the detail drawings. Calculations shall be stamped by a registered engineer and shall verify the capability of structural members to which bracing is attached for carrying the load from the brace.

Contractor Designed Bracing; G-AE.

Copies of the design calculations with the drawings. Calculations shall be approved, certified, stamped and signed by a registered Professional Engineer. Calculations shall verify the capability of structural members to which bracing is attached for carrying the load from the brace.

PART 2 PRODUCTS

2.1 SWAY BRACING MATERIALS

Sway bracing materials (e.g. rods, plates, rope, angles, etc.) shall be as specified in Section 13080 ANTITERRORISM FORCE PROTECTION (AT/FP) FOR MISCELLANEOUS EQUIPMENT.

PART 3 EXECUTION

3.1 COUPLING AND BRACING

Coupling installation shall conform to the details shown on the drawings. Provisions of this paragraph apply to all piping within a 5 foot line around outside of building unless buried in the ground. Piping grouped for support on trapeze-type hangers shall be braced at the most frequent interval as determined by applying the requirements of this sepcification to each piping run on the common support. Bracing components shall be sized as required for the total load carried by the common supports. Bracing rigidly attached to pipe flanges, or similar, shall not be used where it would interfere with thermal expansion of piping.

3.2 PIPE SLEEVES

Pipe sleeves in interior non-fire rated walls shall be sized as indicated on the drawings to provide clearances that will permit differential movement of piping without the piping striking the pipe sleeve. Pipe sleeves in fire rated walls shall conform to the requirements in Section

07840 FIRESTOPPING.

3.3 SWAY BRACES FOR PIPING

Sway braces shall be provided to prevent movement of the pipes under loading. Braces shall be provided in both the longitudinal and transverse directions, relative to the axis of the pipe. The bracing shall not interfere with thermal expansion requirements for the pipes as described in other sections of these specifications.

3.3.1 Transverse Sway Bracing

Transverse sway bracing for steel and copper pipe shall be provided as specified in Section 13080 ANTITERRORISM FORCE PROTECTION (AT/FP) FOR MISCELLANEOUS EQUIPMENT. All runs (length of pipe between end joints) shall have a minimum of two transverse braces. Transverse sway bracing for pipes of materials other than steel and copper shall be provided at intervals not to exceed the hanger spacing as specified in Section 15400A PLUMBING, GENERAL PURPOSE.

3.3.2 Longitudinal Sway Bracing

Longitudinal sway bracing shall be provided at intervals as required for AT/FP loads. All runs (length of pipe between end joints) shall have one longitudinal brace minimum. Sway braces shall be constructed in accordance with the drawings. Branch lines, walls, or floors shall not be used as sway braces.

3.3.3 Vertical Runs

Run is defined as length of pipe between end joints. Vertical runs of piping shall be braced at not more than 10 foot vertical intervals. Braces for vertical runs shall be above the center of gravity of the segment being braced. All sway braces shall be constructed in accordance with the drawings. Sway branches shall not be connected to branch lines, walls, or floors.

3.3.4 Clamps and Hangers

Clamps or hangers on uninsulated pipes shall be applied directly to pipe. Insulated piping shall have clamps or hangers applied over insulation in accordance with Section 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.4 SWAY BRACES FOR DUCTS

3.4.1 Braced Ducts

Bracing details and spacing for rectangular and round ducts shall be in accordance with SMACNA Seismic Restraint Mnl, including Appendix E.

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SECTION 15080A

THERMAL INSULATION FOR MECHANICAL SYSTEMS
07/02

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. At the discretion of the Government, the manufacturer of any material supplied will be required to furnish test reports pertaining to any of the tests necessary to assure compliance with the standard or standards referenced in this specification.

ASTM INTERNATIONAL (ASTM)

ASTM A 167	(1999) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 580/A 580M	(1998) Stainless Steel Wire
ASTM B 209	(2002a) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM C 1126	(2000) Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation
ASTM C 1136	(1995) Flexible, Low Permeance Vapor Retarders for Thermal Insulation
ASTM C 1290	(2000e1) Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts
ASTM C 195	(1995) Mineral Fiber Thermal Insulating Cement
ASTM C 449/C 449M	(2000) Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement
ASTM C 533	(1995; R 2001) Calcium Silicate Block and Pipe Thermal Insulation
ASTM C 534	(2001a) Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
ASTM C 547	(2000) Mineral Fiber Pipe Insulation
ASTM C 552	(2000e1) Cellular Glass Thermal Insulation

ASTM C 553	(2002) Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM C 591	(2001) Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM C 610	(1999) Molded Expanded Perlite Block and Pipe Thermal Insulation
ASTM C 612	(2000a) Mineral Fiber Block and Board Thermal Insulation
ASTM C 647	(1995; R 2000) Properties and Tests of Mastics and Coating Finishes for Thermal Insulation
ASTM C 665	(2001e1) Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
ASTM C 795	(1992; R 1998el) Thermal Insulation for Use in Contact with Austenitic Stainless Steel
ASTM C 916	(1985; R 2001e1) Adhesives for Duct Thermal Insulation
ASTM C 920	(2002) Elastomeric Joint Sealants
ASTM C 921	(1989; R 1996) Determining the Properties of Jacketing Materials for Thermal Insulation
ASTM D 882	(1997) Tensile Properties of Thin Plastic Sheeting
ASTM E 84	(2001) Surface Burning Characteristics of Building Materials
ASTM E 96	(2000e1) Water Vapor Transmission of Materials

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-69	(2002) Pipe Hangers and Supports - Selection and Application

MIDWEST INSULATION CONTRACTORS ASSOCIATION (MICA)

MICA Insulation Stds	(1999) National Commercial & Industrial Insulation Standards

1.2 SYSTEM DESCRIPTION

Field-applied insulation and accessories on mechanical systems shall be as specified herein; factory-applied insulation is specified under the piping, duct or equipment to be insulated. Insulation of heat distribution systems

and chilled water systems outside of buildings shall be as specified in Section 02552A PRE-ENGINEERED UNDERGROUND HEAT DISTRIBUTION SYSTEM. Field applied insulation materials required for use on Government-furnished items as listed in the SPECIAL CONTRACT REQUIREMENTS shall be furnished and installed by the Contractor.

1.3 GENERAL QUALITY CONTROL

1.3.1 Standard Products

Materials shall be the standard products of manufacturers regularly engaged in the manufacture of such products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

1.3.2 Installer's Qualifications

Qualified installers shall have successfully completed three or more similar type jobs within the last 5 years.

1.3.3 Surface Burning Characteristics

Unless otherwise specified, insulation not covered with a jacket shall have a flame spread index no higher than 75 and a smoke developed index no higher than 150. Insulation systems which are located in air plenums, in ceiling spaces, and in attic spaces shall have a flame spread index no higher than 25 and a smoke developed index no higher than 50. Insulation materials located exterior to the building perimeter are not required to be fire-rated. Flame spread, and smoke developed indexes, shall be determined by ASTM E 84. Insulation shall be tested in the same density and installed thickness as the material to be used in the actual construction. Material supplied by a manufacturer with a jacket shall be tested as a composite material. Jackets, facings, and adhesives shall have a flame spread index no higher than 25 and a smoke developed index no higher than 50 when tested in accordance with ASTM E 84.

1.3.4 Identification of Materials

Packages or standard containers of insulation, jacket material, cements, adhesives, and coatings delivered for use, and samples required for approval shall have manufacturer's stamp or label attached giving the name of the manufacturer and brand, and a description of the material.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Mica Plates; G-AO.

After approval of materials and prior to applying insulation, a booklet shall be prepared and submitted for approval. The booklet shall contain marked-up MICA Insulation Stds plates (or detail drawings showing the insulation material and insulating system)

for each pipe, duct, or piece of equipment that must be insulated per this specification. The MICA plates shall be marked up showing the materials to be installed in accordance with the requirements of this specification for the specific insulation application. The Contractor shall submit all MICA Plates required to show the entire insulating system, including Plates required to show insulation penetrations, vessel bottom and top heads, legs, and skirt insulation as applicable. If the Contractor elects to submit detailed drawings instead of marked-up MICA Plates, the detail drawings shall show cut-away, section views, and details indicating each component of the insulation system and showing provisions for insulating jacketing, and sealing portions of the equipment. For each type of insulation installation on the drawings, provide a label that identifies each component in the installation (i.e., the duct, insulation, adhesive, vapor retarder, jacketing, tape, mechanical fasteners, etc.) Indicate insulation by type and manufacturer. Three copies of the booklet shall be submitted at the jobsite to the Contracting Officer. One copy of the approved booklet shall remain with the insulation Contractor's display sample and two copies shall be provided for Government use.

SD-03 Product Data

General Materials; G-AE.

A complete list of materials, including manufacturer's descriptive technical literature, performance data, catalog cuts, and installation instructions. The product number, k-value, thickness and furnished accessories for each mechanical system requiring insulation shall be included. Materials furnished under this section of the specification shall be submitted at one time.

1.5 STORAGE

Materials shall be delivered in the manufacturer's unopened containers. Materials delivered and placed in storage shall be provided with protection from weather, humidity, dirt, dust and other contaminants. The Contracting Officer may reject insulation material and supplies that become dirty, dusty, wet, or contaminated by some other means.

PART 2 PRODUCTS

2.1 GENERAL MATERIALS

Materials shall be compatible and shall not contribute to corrosion, soften, or otherwise attack surfaces to which applied in either the wet or dry state. Materials to be used on stainless steel surfaces shall meet ASTM C 795 requirements. Materials shall be asbestos free and conform to the following:

2.1.1 Adhesives

2.1.1.1 Acoustical Lining Insulation Adhesive

Adhesive shall be a nonflammable, fire-resistant adhesive conforming to ASTM C 916, Type I.

2.1.1.2 Mineral Fiber Insulation Cement

Cement shall be in accordance with ASTM C 195.

2.1.1.3 Lagging Adhesive

Lagging is the material used for thermal insulation, especially around a cylindrical object. This may include the insulation as well as the cloth/material covering the insulation. Lagging adhesives shall be nonflammable and fire-resistant and shall have a flame spread rating no higher than 25 and a smoke developed rating no higher than 50 when tested in accordance with ASTM E 84. Adhesive shall be pigmented white and be suitable for bonding fibrous glass cloth to faced and unfaced fibrous glass insulation board; for bonding cotton brattice cloth to faced and unfaced fibrous glass insulation board; for sealing edges of and bonding fibrous glass tape to joints of fibrous glass board; for bonding lagging cloth to thermal insulation; or for attaching fibrous glass insulation to metal surfaces. Lagging adhesives shall be applied in strict accordance with the manufacturer's recommendations.

2.1.2 Contact Adhesive

Adhesives may be dispersed in a volatile organic solvent. Adhesives may be any of, but not limited to, the neoprane based, rubber based, or elastomeric type that have a flame spread index no higher than 25 and a smoke developed index no higher than 50 when tested in the dry state in accordance with ASTM E 84. The adhesive shall not adversely affect, initially or in service, the insulation to which it is applied, nor shall it cause any corrosive effect on metal to which it is applied. Any solvent dispersing medium or volatile component of the adhesive shall have no objectionable odor and shall not contain any benzene or carbon tetrachloride. The dried adhesive shall not emit nauseous, irritating, or toxic volatile matters or aerosols when the adhesive is heated to any temperature up to 212 degrees F. The dried adhesive shall be nonflammable and fire resistant. Natural cross-ventilation, local (mechanical) pickup, and/or general area (mechanical) ventilation shall be used to prevent an accumulation of solvent vapors, keeping in mind the ventilation pattern must remove any heavier-than-air solvent vapors from lower levels of the workspaces. Gloves and spectacle-type safety glasses are recommended in accordance with safe installation practices.

2.1.3 Caulking

ASTM C 920, Type S, Grade NS, Class 25, Use A.

2.1.4 Corner Angles

Nominal 0.016 inch aluminum 1 x 1 inch with factory applied kraft backing. Aluminum shall be ASTM B 209, Alloy 3003, 3105, or 5005.

2.1.5 Finishing Cement

ASTM C 449/C 449M: Mineral fiber hydraulic-setting thermal insulating and finishing cement. All cements that may come in contact with Austenitic stainless steel must include testing per ASTM C 795.

2.1.6 Fibrous Glass Cloth and Glass Tape

Fibrous glass cloth and glass tape shall have flame spread and smoke developed ratings of no greater than 25/50 when measured in accordance with ASTM E 84. Tape shall be 4 inch wide rolls.

2.1.7 Staples

Outward clinching type monel or ASTM A 167, Type 304 or 316 stainless steel. Monel is a nickel rich alloy that has high strength, high ductility, and excellent resistance to corrosion.

2.1.8 Jackets

ASTM C 921, Type I, maximum moisture vapor transmission 0.02 perms, (measured before factory application or installation), minimum puncture resistance 50 Beach units on all surfaces except concealed ductwork, where a minimum puncture resistance of 25 Beach units is acceptable. Minimum tensile strength, 35 pounds/inch width. ASTM C 921, Type II, minimum puncture resistance 25 Beach units, tensile strength minimum 20 pounds/inch width. Jackets used on insulation exposed in finished areas shall have white finish suitable for painting without sizing. Based on the application, insulation materials that require factory applied jackets are mineral fiber, cellular glass, and phenolic foam. All non-metallic jackets shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E 84.

2.1.8.1 White Vapor Retarder All Service Jacket (ASJ)

For use on hot/cold pipes, ducts, or equipment vapor retarder jackets used on insulation exposed in finished areas shall have white finish suitable for painting without sizing.

2.1.8.2 Aluminum Jackets

Aluminum jackets shall be corrugated, embossed or smooth sheet, 0.016 inch nominal thickness; ASTM B 209, Temper H14, Temper H16, Alloy 3003, 5005, or 3105 with factory applied moisture retarder. Corrugated aluminum jacket shall not be used outdoors. Aluminum jacket securing bands shall be Type 304 stainless steel, 0.015 inch thick, 1/2 inch wide for pipe under 12 inch diameter and 3/4 inch wide for pipe over 12 inch and larger diameter. Aluminum jacket circumferential seam bands shall be 2 x 0.016 inch aluminum matching jacket material. Bands for insulation below ground shall be 3/4 x 0.020 inch) thick stainless steel, or fiberglass reinforced tape. The jacket may, at the option of the Contractor, be provided with a factory fabricated Pittsburg or "Z" type longitudinal joint. When the "Z" joint is used, the bands at the circumferential joints shall be designed by the manufacturer to seal the joints and hold the jacket in place.

2.1.8.3 Polyvinyl Chloride (PVC) Jackets

Polyvinyl chloride (PVC) jacket and fitting covers shall have high impact strength, UV resistant rating or treatment and moderate chemical resistance with minimum thickness 0.030 inch.

2.1.9 Vapor Retarder Required

2.1.9.1 Vapor Retarder Mastic Coatings

The vapor retarder coating shall be fire and water resistant and appropriately selected for either outdoor or indoor service. Color shall be white. The water vapor permeance of the compound shall be determined according to procedure B of ASTM E 96 utilizing apparatus described in ASTM E 96. The coating shall be a nonflammable, fire resistant type. All other application and service properties shall be in accordance with ASTM C 647.

2.1.9.2 Laminated Film Vapor Retarder

ASTM C 1136, Type I, maximum moisture vapor transmission 0.02 perms, minimum puncture resistance 50 Beach units on all surfaces except concealed ductwork, where Type II, maximum moisture vapor transmission 0.02 perms, a minimum puncture resistance of 25 Beach units is acceptable.

2.1.9.3 Polyvinylidene Chloride (PVDC) Film Vapor Retarder

The PVDC film vapor retarder shall have a maximum moisture vapor transmission of 0.02 perms, minimum puncture resistance of 150 Beach units, a minimum tensile strength in any direction of 30 lb/inch when tested per ASTM D 882, and a maximum flame spread/smoke developed index of 25/50 per ASTM E 84.

2.1.9.4 Polyvinylidene Chloride Vapor Retarder Adhesive Tape

Requirements must meet the same as specified for PVDC Film Vapor Retarder in paragraph 2.1.9.2 above.

2.1.10 Vapor Retarder Not Required

ASTM C 1136, Type III, maximum moisture vapor transmission 0.10 perms, minimum puncture resistance 50 Beach units on all surfaces except ductwork, where Type IV, maximum moisture vapor transmission 0.10, a minimum puncture resistance of 25 Beach units is acceptable.

2.1.11 Wire

Soft annealed ASTM A 580/A 580M Type 302, 304 or 316 stainless steel, 16 or 18 gauge.

2.1.12 Sealants

Sealants shall be chosen from the butyl polymer type, the styrene-butadiene rubber type, or the butyl type of sealants. Sealants shall have a maximum moisture vapor transmission of 0.02 perms, and a maximum flame spread/smoke developed index of 25/50 per ASTM E 84.

2.2 PIPE INSULATION MATERIALS

Pipe insulation materials shall be limited to those listed herein and shall meet the following requirements:

2.2.1 Aboveground Cold Pipeline

Insulation for minus 30 degrees to plus 60 degrees F for outdoor, indoor, exposed or concealed applications, shall be as follows:

a. Cellular Glass: ASTM C 552, Type II, and Type III. Supply the insulation with manufacturer's recommended factory-applied jacket.

b. Flexible Elastomeric Cellular Insulation: ASTM C 534, Type I or II. Type II shall have vapor retarder skin on both sides of the insulation.

c. Phenolic Insulation: ASTM C 1126, Type III. Phenolic insulations shall comply with ASTM C 795 and with the ASTM C 665 paragraph Corrosiveness. Supply the insulation with manufacturer's recommended factory-applied jacket.

d. Polyisocyanurate Insulation: ASTM C 591, type I. Supply the insulation with manufacturer's recommended factory-applied vapor retarder.

2.2.2 Aboveground Hot Pipeline

Insulation for above 60 degrees F, for outdoor, indoor, exposed or concealed applications shall meet the following requirements. Supply the insulation with manufacturer's recommended factory-applied jacket.

a. Mineral Fiber: ASTM C 547, Types I, II or III, supply the insulation with manufacturer's recommended factory-applied jacket.

b. Calcium Silicate: ASTM C 533, Type I indoor only, or outdoors above 250 degrees F pipe temperature. Supply insulation with the manufacturer's recommended factory-applied jacket.

c. Cellular Glass: ASTM C 552, Type II and Type III. Supply the insulation with manufacturer's recommended factory-applied jacket.

d. Flexible Elastomeric Cellular Insulation: ASTM C 534, Type I or II to 200 degrees F service.

e. Phenolic Insulation: ASTM C 1126 Type III to 250 F service shall comply with ASTM C 795. Supply the insulation with manufacturer's recommended factory-applied jacket.

f. Perlite Insulation: ASTM C 610

g. Polyisocyanurate Insulation: ASTM C 591, Type 1, to 300 degrees F service. Supply the insulation with manufacturer's recommended factory applied jacket.

2.3 DUCT INSULATION MATERIALS

Duct insulation materials shall be limited to those listed herein and shall meet the following requirements:

2.3.1 Rigid Mineral Fiber

ASTM C 612: Type IA, IB, II, III, & IV.

2.3.2 Flexible Mineral Fiber

ASTM C 553: Type I,or Type II up to 250 F. ASTM C 1290 Type III.

2.3.3 Cellular Glass

ASTM C 552, Type I.

2.3.4 Phenolic Foam

ASTM C 1126: Type II shall comply with ASTM C 795.

2.3.5 Flexible Elastomeric Cellular

ASTM C 534: Type II.

2.3.6 Polyisocyanurate

ASTM C 591: Type 1. Supply the insulation with manufacturer's recommended factory-applied jacket.

2.4 EQUIPMENT INSULATION MATERIALS

Equipment insulation materials shall be limited to those listed herein and shall meet the following requirements:

2.4.1 Cold Equipment Insulation

For equipment operating temperatures below 60 degrees F.

2.4.1.1 Cellular Glass

ASTM C 552: Type I, Type III, or Type IV as required.

2.4.1.2 Flexible Elastomeric Cellular Insulation

ASTM C 534, Type II.

2.4.1.3 Phenolic Foam

ASTM C 1126: Type II shall comply with ASTM C 795.

2.4.1.4 Polyisocyanurate Foam

ASTM C 591, Type I. Supply the insulation with manufacturer's factory-applied jacket.

2.4.2 Hot Equipment Insulation

For equipment operating temperatures above 60 degrees F.

2.4.2.1 Rigid Mineral Fiber

ASTM C 612: Type IA, IB, II, III, IV, or V as required for temperatures encountered to 1800 degrees F.

2.4.2.2 Flexible Mineral Fiber

ASTM C 553: Type I, II, III, IV, V, VI or VII as required for temperatures encountered to 1200 degrees F.

2.4.2.3 Calcium Silicate

ASTM C 533, Type I, in-doors only, or outdoors above 250 degrees F. Pipe shape may be used on diesel engine exhaust piping and mufflers to 1200 degrees F.

2.4.2.4 Cellular Glass

ASTM C 552: Type I, Type III, or Type IV as required.

2.4.2.5 Flexible Elastomeric Cellular Insulation

ASTM C 534, Type II, to 200 degrees F.

2.4.2.6 Phenolic Foam

ASTM C 1126, Type II, to 250 degrees F shall comply with ASTM C 795.

2.4.2.7 Molded Expanded Perlite

ASTM C 610.

2.4.2.8 Polyisocyanurate Foam:

ASTM C 591, Type I to 300 degrees F service. Supply the insulation with manufacturer's recommended factory-applied jacket.

PART 3 EXECUTION

3.1 APPLICATION - GENERAL

Insulation shall only be applied to unheated and uncooled piping and equipment. Flexible elastomeric cellular insulation shall not be compressed at joists, studs, columns, ducts, hangers, etc. The insulation shall not pull apart after a one hour period; any insulation found to pull apart after one hour, shall be replaced.

3.1.1 Installation

Except as otherwise specified, material shall be installed in accordance with the manufacturer's written instructions. Insulation materials shall not be applied until tests specified in other sections of this specification are completed. Material such as rust, scale, dirt and moisture shall be removed from surfaces to receive insulation. Insulation shall be kept clean and dry. Insulation shall not be removed from its shipping containers until the day it is ready to use and shall be returned to like containers or equally protected from dirt and moisture at the end of each workday. Insulation that becomes dirty shall be thoroughly cleaned prior to use. If insulation becomes wet or if cleaning does not restore the surfaces to like new condition, the insulation will be rejected, and shall be immediately removed from the jobsite. Joints shall be staggered on multi layer insulation. Mineral fiber thermal insulating cement shall be mixed with demineralized water when used on stainless steel surfaces. Insulation, jacketing and accessories shall be installed in accordance with MICA Insulation Stds plates except where modified herein or on the drawings.

3.1.2 Fire-stopping

Where pipes and ducts pass through fire walls, fire partitions, above grade

floors, and fire rated chase walls, the penetration shall be sealed with fire stopping materials as specified in Section 07840 FIRESTOPPING.

3.1.3 Painting and Finishing

Painting shall be as specified in Section 09900 PAINTS AND COATINGS.

3.1.4 Installation of Flexible Elastomeric Cellular Insulation

Flexible elastomeric cellular insulation shall be installed with seams and joints sealed with rubberized contact adhesive. Insulation with pre-applied adhesive is not permitted. Flexible elastomeric cellular insulation shall not be used on surfaces greater than 200 degrees F. Seams shall be staggered when applying multiple layers of insulation. Insulation exposed to weather and not shown to have jacketing shall be protected with two coats of UV resistant finish as recommended by the manufacturer after the adhesive is dry. A brush coating of adhesive shall be applied to both butt ends to be joined and to both slit surfaces to be sealed. The adhesive shall be allowed to set until dry to touch but tacky under slight pressure before joining the surfaces. Insulation seals at seams and joints shall not be capable of being pulled apart one hour after application. Insulation that can be pulled apart one hour after installation shall be replaced.

3.1.5 Welding

No welding shall be done on piping, duct or equipment without written approval of the Contracting Officer. The capacitor discharge welding process may be used for securing metal fasteners to duct.

3.1.6 Pipes/Ducts/Equipment which Require Insulation

Insulation is required on all pipes, ducts, or equipment, except for omitted items, as specified.

3.2 PIPE INSULATION INSTALLATION

3.2.1 Pipe Insulation

3.2.1.1 General

Pipe insulation shall be installed on aboveground hot and cold pipeline systems as specified below to form a continuous thermal retarder, including straight runs, fittings and appurtenances unless specified otherwise. Installation shall be with full length units of insulation and using a single cut piece to complete a run. Cut pieces or scraps abutting each other shall not be used. Pipe insulation shall be omitted on the following:

a. Pipe used solely for fire protection.

b. Chromium plated pipe to plumbing fixtures. However, fixtures for use by the physically handicapped shall have the hot water supply and drain, including the trap, insulated where exposed.

c. Sanitary drain lines.

d. Air chambers.

3.2.1.2 Pipes Passing Through Walls, Roofs, and Floors

a. Pipe insulation shall be continuous through the sleeve.

b. An aluminum jacket with factory applied moisture retarder shall be provided over the insulation wherever penetrations require sealing.

c. Where pipes penetrate interior walls, the aluminum jacket shall extend 2 inches beyond either side of the wall and shall be secured on each end with a band.

d. Where penetrating floors, the aluminum jacket shall extend from a point below the backup material to a point 10 inches above the floor with one band at the floor and one not more than 1 inch from the end of the aluminum jacket.

e. Where penetrating waterproofed floors, the aluminum jacket shall extend from below the backup material to a point 2 inchesabove the flashing with a band 1 inch from the end of the aluminum jacket.

f. Where penetrating exterior walls, the aluminum jacket required for pipe exposed to weather shall continue through the sleeve to a point 2 inches beyond the interior surface of the wall.

g. Where penetrating roofs, pipe shall be insulated as required for interior service to a point flush with the top of the flashing and sealed with vapor retarder coating. The insulation for exterior application shall butt tightly to the top of flashing and interior insulation. The exterior aluminum jacket shall extend 2 inches down beyond the end of the insulation to form a counter flashing. The flashing and counter flashing shall be sealed underneath with caulking.

h. For hot water pipes supplying lavatories or other similar heated service that requires insulation, the insulation shall be terminated on the backside of the finished wall. The insulation termination shall be protected with two coats of vapor barrier coating with a minimum total thickness of 1/16 inch applied with glass tape embedded between coats (if applicable). The coating shall extend out onto the insulation 2 inches and shall seal the end of the insulation. Glass tape seams shall overlap 1 inch. The annular space between the pipe and wall penetration shall be caulked with approved fire stop material. The pipe and wall penetration shall be covered with a properly sized (well fitting) escutcheon plate. The escutcheon plate shall overlap the wall penetration at least 3/8 inches.

i. For domestic cold water pipes supplying lavatories or other similar cooling service that requires insulation, the insulation shall be terminated on the finished side of the wall (i.e., insulation must cover the pipe throughout the wall penetration). The insulation shall be protected with two coats of vapor barrier coating with a minimum total thickness of 1/16 inch. The coating shall extend out onto the insulation 2 inches and shall seal the end of the insulation. The annular space between the outer surface of the pipe insulation and the wall penetration shall be caulked with an approved fire stop material having vapor retarder properties. The pipe and wall penetration shall be covered with a properly sized (well fitting) escutcheon plate. The escutcheon

plate shall overlap the wall penetration by at least 3/8 inches.

3.2.1.3 Pipes Passing Through Hangers

a. Insulation, whether hot or cold application, shall be continuous through hangers. All horizontal pipes 2 inches and smaller shall be supported on hangers with the addition of a Type 40 protection shield to protect the insulation in accordance with MSS SP-69. Whenever insulation shows signs of being compressed, or when the insulation or jacket shows visible signs of distortion at or near the support shield, insulation inserts as specified below for piping larger than 2 inches shall be installed.

b. Horizontal pipes larger than 2 inches at 60 degrees F and above shall be supported on hangers in accordance with MSS SP-69, and Section 15400A PLUMBING, GENERAL PURPOSE.

c. Horizontal pipes larger than 2 inches and below 60 degrees F shall be supported on hangers with the addition of a Type 40 protection shield in accordance with MSS SP-69. An insulation insert of cellular glass, calcium silicate (or perlite above 80 F), or the necessary strength polyisocyanurate shall be installed above each shield. The insert shall cover not less than the bottom 180-degree arc of the pipe. Inserts shall be the same thickness as the insulation, and shall extend 2 inches on each end beyond the protection shield. When insulation inserts are required per the above, and the insulation thickness is less than 1 inch, wooden or cork dowels or blocks may be installed between the pipe and the shield to prevent the weight of the pipe from crushing the insulation, as an option to installing insulation inserts. The insulation jacket shall be continuous over the wooden dowel, wooden block, or insulation insert.

d. Vertical pipes shall be supported with either Type 8 or Type 42 riser clamps with the addition of two Type 40 protection shields in accordance with MSS SP-69 covering the 360-degree arc of the insulation. An insulation insert of cellular glass or calcium silicate shall be installed between each shield and the pipe. The insert shall cover the 360-degree arc of the pipe. Inserts shall be the same thickness as the insulation, and shall extend 2 inches on each end beyond the protection shield. When insulation inserts are required per the above, and the insulation thickness is less than 1 inch, wooden or cork dowels or blocks may be installed between the pipe and the shield to prevent the hanger from crushing the insulation, as an option instead of installing insulation inserts. The insulation jacket shall be continuous over the wooden dowel, wooden block, or insulation insert. The vertical weight of the pipe shall be supported with hangers located in a horizontal section of the pipe. When the pipe riser is longer than 30 feet, the weight of the pipe shall be additionally supported with hangers in the vertical run of the pipe that are directly clamped to the pipe, penetrating the pipe insulation. These hangers shall be insulated and the insulation jacket sealed as indicated herein for anchors in a similar service.

e. Inserts shall be covered with a jacket material of the same appearance and quality as the adjoining pipe insulation jacket, shall overlap the adjoining pipe jacket 1-1/2 inches, and shall be sealed as required for the pipe jacket. The jacket material used

to cover inserts in flexible elastomeric cellular insulation shall conform to ASTM C 1136, Type 1, and is allowed to be of a different material than the adjoining insulation material.

3.2.1.4 Flexible Elastomeric Cellular Pipe Insulation

Flexible elastomeric cellular pipe insulation shall be tubular form for pipe sizes 6 inches and less. Type II sheet insulation used on pipes larger than 6 inches shall not be stretched around the pipe. On pipes larger than 12 inches, the insulation shall be adhered directly to the pipe on the lower 1/3 of the pipe. Seams shall be staggered when applying multiple layers of insulation. Sweat fittings shall be insulated with miter-cut pieces the same size as on adjacent piping. Screwed fittings shall be insulated with sleeved fitting covers fabricated from miter-cut pieces and shall be overlapped and sealed to the adjacent pipe insulation.

3.2.1.5 Pipes in high abuse areas.

In high abuse areas such as janitor closets and traffic areas in equipment rooms, kitchens, and mechanical rooms, aluminum jackets shall be utilized. Pipe insulation to the 6 foot level shall be protected.

3.2.2 Aboveground Cold Pipelines

The following cold pipelines shall be insulated per Table I minus 30 degrees to plus 60 degrees F:

a. Domestic cold and chilled drinking water.

b. Make-up water.

c. Horizontal and vertical portions of interior roof drains.

d. Refrigerant suction lines.

e. Air conditioner condensate drains.

f. Exposed lavatory drains and domestic water lines serving plumbing fixtures for handicap persons.

3.2.2.1 Insulation Thickness

Insulation thickness for cold pipelines shall be determined using Table I.

Table I - Cold Piping Insulation Thickness
Pipe Size (inches)

Type of Service	Material	Run-outs up to 2 in*	1 in & less	1.25 - 2 in	2.5 - 4 in	5 - 6 in	8 in & larger
Refrigerant suction piping	CG		1.5	1.5	1.5	1.5	1.5
	FC		1.0	1.0	1.0	1.0	1.0
	PF		1.5	1.5	1.5	1.5	1.5
	PC		1.0	1.0	1.0	1.0	1.0
Cold domestic water, above	CG	1.5	1.5	1.5	1.5	1.5	1.5
	FC	3/8	3/8	3/8	3/8	3/8	3/8

Table I - Cold Piping Insulation Thickness
Pipe Size (inches)

Type of Service	Material	Run-outs up to 2 in*	1 in & less	1.25 - 2 in	2.5 - 4 in	5 - 6 in	8 in & larger
and below ceilings & makeup water	PF	1.5	1.5	1.5	1.5	1.5	1.5
	PC	1.0	1.0	1.0	1.0	1.0	1.0
Exposed lavatory drains and domestic water lines serving& plumbing fixtures for handicap personnel	FC	0.5	0.5	0.5	0.5	3/4	3/4
	MF	0.5	1.0	1.0	1.5	1.5	1.5
Horizontal & vertical roof drain leaders (including underside of roof drain fitting)	FC		0.5	0.5	0.5	0.5	0.5
	PF		1.5	1.5	1.5	1.5	1.5
	CG		1.5	1.5	1.5	1.5	1.5
	PC		1.0	1.0	1.0	1.0	1.0
Air conditioning condensate drain located inside building	FC		3/8	0.5	0.5	N/A	N/A
	PF		1.5	1.5	1.5	N/A	N/A
	PC		1.0	1.0	1.0	N/A	N/A

*When run-outs to terminal units exceed 12 feet, the entire length of run-out shall be insulated like main feed pipe. Insulations may not be applied if their flame and smoke developed ratings exceed the requirements of 25/50 established in this guide specification. Layered insulations, or installation where multiple layers of the same insulation are used, must be checked for this (in particular if the insulation has been rated per ASTM E 84 for one thickness).

LEGEND:

PF - Phenolic Foam
CG - Cellular Glass
MF - Mineral Fiber
FC - Flexible Elastomeric Cellular
PC - Polyisocyanurate Foam

3.2.2.2 Jacket for Mineral Fiber, Cellular Glass, Phenolic Foam, and Polyisocyanurate Foam Insulated Pipe

Insulation shall be covered with a factory applied vapor retarder jacket or field applied seal welded PVC jacket. Insulation inside the building, to be protected with an aluminum jacket, shall have the insulation and vapor

retarder jacket installed as specified herein. The aluminum jacket shall be installed as specified for piping exposed to weather, except sealing of the laps of the aluminum jacket is not required. In high abuse areas such as janitor closets and traffic areas in equipment rooms, kitchens, and mechanical rooms, aluminum jackets shall be utilized. Pipe insulation to the 6 ft level shall be protected.

3.2.2.3 Insulation for Straight Runs (Mineral Fiber, Cellular Glass, Phenolic Foam and Polyisocyanurate Foam)

a. Insulation shall be applied to the pipe with joints tightly butted. All butted joints and ends shall be sealed with joint sealant and sealed with a vapor retarder coating or PVDC adhesive tape.

b. Longitudinal laps of the jacket material shall overlap not less than 1-1/2 inches. Butt strips 3 inches wide shall be provided for circumferential joints.

c. Laps and butt strips shall be secured with adhesive and stapled on 4 inch centers if not factory self-sealing. If staples are used, they shall be sealed per item "e." below. Note that staples are not required with cellular glass systems.

d. Factory self-sealing lap systems may be used when the ambient temperature is between 40 degrees and 120 degrees F during installation. The lap system shall be installed in accordance with manufacturer's recommendations. Stapler shall be used only if specifically recommended by the manufacturer. Where gaps occur, the section shall be replaced or the gap repaired by applying adhesive under the lap and then stapling.

e. All Staples, including those used to repair factory self-seal lap systems, shall be coated with a vapor retarder coating or PVDC adhesive tape. All seams, except those on factory self-seal systems shall be coated with vapor retarder coating or PVDC adhesive tape.

f. Breaks and punctures in the jacket material shall be patched by wrapping a strip of jacket material around the pipe and securing it with adhesive, stapling, and coating with vapor retarder coating or PVDC adhesive tape. The patch shall extend not less than 1-1/2 inches past the break.

g. At penetrations such as thermometers, the voids in the insulation shall be filled and sealed with vapor retarder coating or PVDC adhesive tape.

3.2.2.4 Insulation for Fittings and Accessories

a. Pipe insulation shall be tightly butted to the insulation of the fittings and accessories. The butted joints and ends shall be sealed with joint sealant and sealed with a vapor retarder coating or PVDC adhesive tape.

b. Precut or preformed insulation shall be placed around all fittings and accessories and shall conform to MICA plates except as modified herein: 5 for anchors; 10, 11, and 13 for fittings; 14 for valves; and 17 for flanges and unions. Insulation shall be

the same insulation as the pipe insulation, including same density, thickness, and thermal conductivity. Where precut/preformed is unavailable, rigid preformed pipe insulation sections may be segmented into the shape required. Insulation of the same thickness and conductivity as the adjoining pipe insulation shall be used. If nesting size insulation is used, the insulation shall be overlapped 2 inches or one pipe diameter. Elbows insulated using segments shall conform to MICA Tables 12.20 "Mitered Insulation Elbow'.

c. Upon completion of insulation installation on flanges, unions, valves, anchors, fittings and accessories, terminations, seams, joints and insulation not protected by factory vapor retarder jackets or PVC fitting covers shall be protected with PVDC adhesive tape or two coats of vapor retarder coating with a minimum total thickness of 1/16 inch, applied with glass tape embedded between coats. Tape seams shall overlap 1 inch. The coating shall extend out onto the adjoining pipe insulation 2 inches. Fabricated insulation with a factory vapor retarder jacket shall be protected with PVDC adhesive tape or two coats of vapor retarder coating with a minimum thickness of 1/16 inch and with a 2 inch wide glass tape embedded between coats. Where fitting insulation butts to pipe insulation, the joints shall be sealed with a vapor retarder coating and a 4 inch wide ASJ tape which matches the jacket of the pipe insulation.

d. Anchors attached directly to the pipe shall be insulated for a sufficient distance to prevent condensation but not less than 6 inches from the insulation surface.

e. Insulation shall be marked showing the location of unions, strainers, and check valves.

3.2.2.5 Optional PVC Fitting Covers

At the option of the Contractor, premolded, one or two piece PVC fitting covers may be used in lieu of the vapor retarder and embedded glass tape. Factory precut or premolded insulation segments shall be used under the fitting covers for elbows. Insulation segments shall be the same insulation as the pipe insulation including same density, thickness, and thermal conductivity. The covers shall be secured by PVC vapor retarder tape, adhesive, seal welding or with tacks made for securing PVC covers. Seams in the cover, and tacks and laps to adjoining pipe insulation jacket, shall be sealed with vapor retarder tape to ensure that the assembly has a continuous vapor seal.

3.2.3 Aboveground Hot Pipelines

The following hot pipelines above 60 degrees F shall be insulated per Table II:

a. Domestic hot water supply & re-circulating system.

b. Condensate discharge.

c. Hot water heating.

3.2.3.1 Insulation Thickness

Insulation thickness for hot pipelines shall be determined using Table II.

LEGEND:

PF - Phenolic Foam
CG - Cellular Glass
CS - Calcium Silicate
MF - Mineral Fiber
FC - Flexible Elastomeric Cellular
PL - Perlite
PC - Polyisocyanurate Foam

Table II - Hot Piping Insulation Thickness
Pipe Size (inches)

Type of Service (degrees F)	Material	Run-outs up to 2 in *	1 in & less	1.25 - 2 in	2.5 - 4 in	5 - 6 in	8 in & larger
Hot domestic water supply & re-circulating system**	CG	1.5	1.5	1.5	1.5	1.5	1.5
	FC	0.5	0.5	1.0	1.0	1.5	1.5
	PF	0.5	0.5	1.0	1.0	1.0	1.0
	MF	0.5	1.5	1.5	1.5	1.5	1.5
	PC	1.0	1.0	1.0	1.0	1.0	1.0
Heating hot water, supply & return (250 F max)	CG	1.5	1.5	2.0	2.0	2.5	3.0
	PF	0.5	1.0	1.0	1.0	1.0	1.5
	MF	0.5	1.5	1.5	2.0	2.5	3.0
	CS	1.0	1.5	2.0	2.5	2.5	3.0
	PC	1.0	1.0	1.0	1.0	1.0	1.0
High Temp Hot water (351 - 500 F)	CG	2.0	3.5	4.0	4.5	5.0	5.5
	MF	1.5	3.0	3.5	4.0	4.0	4.5
	CS/PL	2.0	3.5	4.0	4.5	5.0	5.5

* When run-outs to terminal units exceed 12 feet, the entire length of run-out shall be insulated like the main feed pipe.

** Applies to re-circulating sections of service or domestic hot water systems and first 8 feet from storage tank for non-re-circulating systems.

3.2.3.2 Jacket for Insulated Hot Pipe, Except Pipe Insulated with Flexible Elastomeric Cellular

Insulation shall be covered, in accordance with manufacturer's recommendations, with a factory applied Type II jacket or field applied aluminum where required or seal welded PVC.

3.2.3.3 Insulation for Straight Runs

a. Insulation shall be applied to the pipe with joints tightly butted.

b. Longitudinal laps of the jacket material shall overlap not less than 1-1/2 inches, and butt strips 3 inches wide shall be provided for circumferential joints.

c. Laps and butt strips shall be secured with adhesive and stapled on 4 inch centers if not factory self-sealing. Adhesive may be omitted where pipe is concealed.

d. Factory self-sealing lap systems may be used when the ambient temperature is between 40 degrees and 120 degrees F and shall be installed in accordance with manufacturer's instructions. Laps and butt strips shall be stapled whenever there is non-adhesion of the system. Where gaps occur, the section shall be replaced or the gap repaired by applying adhesive under the lap and then stapling.

e. Breaks and punctures in the jacket material shall be patched by either wrapping a strip of jacket material around the pipe and securing with adhesive and staple on 4 inch centers (if not factory self-sealing), or patching with tape and sealing with a brush coat of vapor retarder coating. Adhesive may be omitted where pipe is concealed. Patch shall extend not less than 1-1/2 inches past the break.

f. Installation of flexible elastomeric cellular pipe insulation shall be by slitting the tubular sections and applying them onto the piping or tubing. Alternately, whenever possible slide un-slit sections over the open ends of piping or tubing. All seams and butt joints shall be secured and sealed with adhesive. When using self seal products only the butt joints shall be secured with adhesive. Insulation shall be pushed on the pipe, never pulled. Stretching of insulation may result in open seams and joints. All edges shall be clean cut. Rough or jagged edges of the insulation shall not be permitted. Proper tools such as sharp knives shall be used. Type II sheet insulation when used on pipe larger than 6 inches shall not be stretched around the pipe. On pipes larger than 12 inches, adhere sheet insulation directly to the pipe on the lower 1/3 of the pipe.

3.2.3.4 Insulation for Fittings and Accessories

a. Pipe insulation shall be tightly butted to the insulation of the fittings and accessories.

b. Precut or preformed insulation shall be placed around all fittings and accessories and shall conform to MICA plates, except as modified herein: 5 for anchors; 10, 11, 12,and 13 for fittings; 14, 15 and 16 for valves; 17 for flanges and unions; and 18 for couplings. Insulation shall be the same as the pipe insulation, including same density, thickness, and thermal conductivity. Where precut/preformed is unavailable, rigid preformed pipe insulation sections may be segmented into the shape required. Insulation of the same thickness and conductivity as the adjoining pipe insulation shall be used. If nesting size insulation is used, the insulation shall be overlapped 2 inches or one pipe diameter. Elbows insulated using segments shall conform to MICA Tables 12.20 "Mitered Insulation Elbow".

c. Upon completion of installation of insulation on flanges, unions, valves, anchors, fittings and accessories, terminations and insulation not protected by factory jackets or PVC fitting covers shall be protected with two coats of adhesive applied with glass

tape embedded between coats. Tape seams shall overlap 1 inch. Adhesive shall extend onto the adjoining insulation not less than 2 inches. The total dry film thickness shall be not less than 1/16 inch.

d. Insulation terminations shall be tapered to unions at a 45-degree angle.

e. At the option of the Contractor, factory pre-molded one- or two-piece PVC fitting covers may be used in lieu of the adhesive and embedded glass tape. Factory pre-molded segments or factory or field cut blanket insert insulation segments shall be used under the cover and shall be the same thickness as adjoining pipe insulation. The covers shall be secured by PVC vapor retarder tape, adhesive, seal welding or with tacks made for securing PVC covers.

3.2.4 Piping Exposed to Weather

Piping exposed to weather shall be insulated and jacketed as specified for the applicable service inside the building. After this procedure, an aluminum jacket or PVC jacket shall be applied. PVC jacketing requires no factory-applied jacket beneath it, however an all service jacket shall be applied if factory applied jacketing is not furnished. Flexible elastomeric cellular insulation exposed to weather shall be treated in accordance with paragraph INSTALLATION OF FLEXIBLE ELASTOMERIC CELLULAR INSULATION.

3.2.4.1 Aluminum Jacket

The jacket for hot piping may be factory applied. The jacket shall overlap not less than 2 inches at longitudinal and circumferential joints and shall be secured with bands at not more than 12 inch centers. Longitudinal joints shall be overlapped down to shed water and located at 4 or 8 o'clock positions. Joints on piping 60 degrees F and below shall be sealed with caulking while overlapping to prevent moisture penetration. Where jacketing on piping 60 degrees F and below abuts an un-insulated surface, joints shall be caulked to prevent moisture penetration. Joints on piping above 60 degrees F shall be sealed with a moisture retarder.

3.2.4.2 Insulation for Fittings

Flanges, unions, valves, fittings, and accessories shall be insulated and finished as specified for the applicable service. Two coats of breather emulsion type weatherproof mastic (impermeable to water, permeable to air) recommended by the insulation manufacturer shall be applied with glass tape embedded between coats. Tape overlaps shall be not less than 1 inch and the adjoining aluminum jacket not less than 2 inches. Factory preformed aluminum jackets may be used in lieu of the above. Molded PVC fitting covers shall be provided when PVC jackets are used for straight runs of pipe. PVC fitting covers shall have adhesive welded joints and shall be weatherproof.

3.2.4.3 PVC Jacket

PVC jacket shall be ultraviolet resistant and adhesive welded weather tight with manufacturer's recommended adhesive. Installation shall include provision for thermal expansion.

3.3 DUCT INSULATION INSTALLATION

Except for oven hood exhaust duct insulation, corner angles shall be installed on external corners of insulation on ductwork in exposed finished spaces before covering with jacket. Duct insulation shall be omitted on exposed supply and return ducts in the conditioned spaces in which they serve, unless otherwise shown.

3.3.1 Duct Insulation Thickness

Duct insulation thickness shall be in accordance with Table III. Maximum thickness for flexible elastomeric cellular insulation shall not exceed 25 mm, and maximum thickness for polyisocyanurate foam insulation shall not exceed 40 mm to comply with ASTM E 84 flame spread/smoke developed ratings of 25/50

Table III - Minimum Duct Insulation (inches)

Cold Air Ducts	2.0
Relief Ducts	1.5
Fresh Air Intake Ducts	1.5
Warm Air Ducts	2.0
Relief Ducts	1.5
Fresh Air Intake Ducts	1.5

Exception: Exposed gymnasium supply air ducts do not require insulation. Maximum thickness for flexible elastomeric cellular insulation shall not exceed 1 inch and maximum thickness for polyisocyanurate foam insulation shall not exceed 1.5 inch, to comply with ASTM E 84 flame spread/smoke developed ratings of 25/50.

3.3.2 Insulation and Vapor Retarder for Cold Air Duct

Insulation and vapor retarder shall be provided for the following cold air ducts and associated equipment.

a. Supply ducts.

b. Return air ducts.

c. Relief ducts.

d. Flexible run-outs (field-insulated).

e. Plenums.

f. Duct-mounted coil casings.

g. Coil headers and return bends.

h. Coil casings.

i. Fresh air intake ducts.

j. Filter boxes.

k. Mixing boxes (field-insulated).

l. Supply fans (field-insulated).

m. Site-erected air conditioner casings.

n. Ducts exposed to weather.

o. Combustion air intake ducts.

Insulation for rectangular ducts shall be flexible type where concealed, minimum density 3/4 pcf and rigid type where exposed, minimum density 3 pcf. Insulation for round/oval ducts shall be flexible type, minimum density 3/4 pcf with a factory Type I or II jacket; or, a semi rigid board, minimum density 3 pcf, formed or fabricated to a tight fit, edges beveled and joints tightly butted and staggered, with a factory applied Type I or II all service jacket. Insulation for exposed ducts shall be provided with either a white, paint-able, factory-applied Type I jacket or a vapor retarder jacket coating finish as specified. Insulation on concealed duct shall be provided with a factory-applied Type I or II vapor retarder jacket. The total dry film thickness shall be approximately 1/16 inch.. Duct insulation shall be continuous through sleeves and prepared openings except firewall penetrations. Duct insulation terminating at fire dampers, shall be continuous over the damper collar and retaining angle of fire dampers, which are exposed to unconditioned air and which may be prone to condensate formation. Duct insulation and vapor retarder shall cover the collar, neck, and any un-insulated surfaces of diffusers, registers and grills. Vapor retarder materials shall be applied to form a complete unbroken vapor seal over the insulation. Sheet Metal Duct shall be sealed in accordance with Section 15895 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM.

3.3.2.1 Installation on Concealed Duct

a. For rectangular, oval or round ducts, insulation shall be attached by applying adhesive around the entire perimeter of the duct in 6 inch wide strips on 12 inch centers.

b. For rectangular and oval ducts, 24 inches and larger insulation shall be additionally secured to bottom of ducts by the use of mechanical fasteners. Fasteners shall be spaced on 16 inch centers and not more than 16 inches from duct corners.

c. For rectangular, oval and round ducts, mechanical fasteners shall be provided on sides of duct risers for all duct sizes. Fasteners shall be spaced on 16 inch centers and not more than 16 inches from duct corners.

d. Insulation shall be impaled on the mechanical fasteners (self stick pins) where used and shall be pressed thoroughly into the adhesive. Care shall be taken to ensure vapor retarder jacket joints overlap 2 inches. The insulation shall not be compressed to a thickness less than that specified. Insulation shall be carried over standing seams and trapeze-type duct hangers.

e. Self-locking washers shall be installed where mechanical fasteners are used. The pin shall be trimmed back and bent over.

f. Jacket overlaps shall be secured with staples and tape as necessary to ensure a secure seal. Staples, tape and seams shall

be coated with a brush coat of vapor retarder coating or PVDC adhesive tape.

g. Breaks in the jacket material shall be covered with patches of the same material as the vapor retarder jacket. The patches shall extend not less than 2 inches beyond the break or penetration in all directions and shall be secured with tape and staples. Staples and tape joints shall be sealed with a brush coat of vapor retarder coating or PVDC adhesive tape.

h. At jacket penetrations such as hangers, thermometers, and damper operating rods, voids in the insulation shall be filled and the penetration sealed with a brush coat of vapor retarder coating or PVDC adhesive tape.

i. Insulation terminations and pin punctures shall be sealed and flashed with a reinforced vapor retarder coating finish or tape with a brush coat of vapor retarder coating. The coating shall overlap the adjoining insulation and un-insulated surface 2 inches. Pin puncture coatings shall extend 2 inches from the puncture in all directions.

j. Where insulation standoff brackets occur, insulation shall be extended under the bracket and the jacket terminated at the bracket.

3.3.2.2 Installation on Exposed Duct Work

a. Provide aluminum jacket on all exposed outdoor intake ductwork for AHU-1 and AHU-2.

b. For rectangular ducts, rigid insulation shall be secured to the duct by mechanical fasteners on all four sides of the duct, spaced not more than 12 inches apart and not more than 3 inches from the edges of the insulation joints. A minimum of two rows of fasteners shall be provided for each side of duct 12 inches and larger. One row shall be provided for each side of duct less than 12 inches.

c. Duct insulation shall be formed with minimum jacket seams. Each piece of rigid insulation shall be fastened to the duct using mechanical fasteners. When the height of projections is less than the insulation thickness, insulation shall be brought up to standing seams, reinforcing, and other vertical projections and shall not be carried over. Vapor retarder jacket shall be continuous across seams, reinforcing, and projections. When height of projections is greater than the insulation thickness, insulation and jacket shall be carried over.

d. Insulation shall be impaled on the fasteners; self-locking washers shall be installed and the pin trimmed or bent over.

e. Joints in the insulation jacket shall be sealed with a 4 inchwide strip of tape. Tape seams shall be sealed with a brush coat of vapor retarder coating.

f. Breaks and ribs or standing seam penetrations in the jacket material shall be covered with a patch of the same material as the jacket. Patches shall extend not less than 2 inches beyond the

break or penetration and shall be secured with tape and stapled. Staples and joints shall be sealed with a brush coat of vapor retarder coating.

g. At jacket penetrations such as hangers, thermometers, and damper operating rods, the voids in the insulation shall be filled and the penetrations sealed with a brush coat of vapor retarder coating.

h. Insulation terminations and pin punctures shall be sealed and flashed with a reinforced vapor retarder coating finish. The coating shall overlap the adjoining insulation and un-insulated surface 2 inches. Pin puncture coatings shall extend 2 inches from the puncture in all directions.

i. Oval and round ducts, flexible type, shall be insulated with factory Type I jacket insulation with minimum density of 3/4 pcf, attached as per MICA standards.

3.3.3 Ducts Handling Air for Dual Purpose

For air handling ducts for dual purpose below and above 60 degrees F, ducts shall be insulated as specified for cold air duct.

3.3.4 Duct Test Holes

After duct systems have been tested, adjusted, and balanced, breaks in the insulation and jacket shall be repaired in accordance with the applicable section of this specification for the type of duct insulation to be repaired.

3.4 EQUIPMENT INSULATION INSTALLATION

3.4.1 General

Removable insulation sections shall be provided to cover parts of equipment that must be opened periodically for maintenance including vessel covers, fasteners, flanges and accessories. Equipment insulation shall be omitted on the following:

a. Hand-holes.

b. Cleanouts.

c. ASME stamps.

d. Manufacturer's nameplates.

3.4.2 Insulation for Cold Equipment

Cold equipment below 60 degrees F: Insulation shall be furnished on equipment handling media below 60 degrees F including the following:

a. Pumps.

b. Refrigeration equipment parts that are not factory insulated.

c. Drip pans under chilled equipment.

d. Duct mounted coils.

e. Cold and chilled water pumps.

f. Roof drain bodies.

g. Air handling equipment parts that are not factory insulated.

h. Expansion and air separation tanks.

3.4.2.1 Insulation Type

Insulation shall be suitable for the temperature encountered. Thicknesses shall be as follows:

a. Equipment handling media between 35 and 60 degrees F: 1.5 inch thick cellular glass, 1 inch thick flexible elastomeric cellular, 1.5 inch thick phenolic foam, or 1 inch thick polyisocyanurate foam.

b. Equipment handling media between 0 degree F and 34 degrees F: 3 inch thick cellular glass, 1 1/2 inch flexible elastomeric cellular, 1 1/2 inch thick phenolic foam, or 1 1/2 inch thick polyisocyanurate foam.

c. Equipment handling media between minus 30 degrees F and 1 degree F: 3 1/2 inch thick cellular glass 1 3/4 inch thick flexible elastomeric cellular, 1 1/2 inch thick phenolic foam, or 1 1/2 inch thick polyisocyanurate foam.

3.4.2.2 Pump Insulation

a. Insulate pumps by forming a box around the pump housing. The box shall be constructed by forming the bottom and sides using joints that do not leave raw ends of insulation exposed. Joints between sides and between sides and bottom shall be joined by adhesive with lap strips for rigid mineral fiber and contact adhesive for flexible elastomeric cellular insulation. The box shall conform to the requirements of MICA Insulation Stds plate No. 49 when using flexible elastomeric cellular insulation. Joints between top cover and sides shall fit tightly forming a female shiplap joint on the side pieces and a male joint on the top cover, thus making the top cover removable.

b. Exposed insulation corners shall be protected with corner angles.

c. Upon completion of installation of the insulation, including removable sections, two coats of vapor retarder coating shall be applied with a layer of glass cloth embedded between the coats. The total dry thickness of the finish shall be 1/16 inch. A parting line shall be provided between the box and the removable sections allowing the removable sections to be removed without disturbing the insulation coating. Caulking shall be applied to parting line, between equipment and removable section insulation, and at all penetrations.

3.4.2.3 Other Equipment

a. Insulation shall be formed or fabricated to fit the equipment. To

ensure a tight fit on round equipment, edges shall be beveled and joints shall be tightly butted and staggered.

b. Insulation shall be secured in place with bands or wires at intervals as recommended by the manufacturer but not more than 12 inch centers except flexible elastomeric cellular which shall be adhered. Insulation corners shall be protected under wires and bands with suitable corner angles.

c. Phenolic foam insulation shall be set in a coating of bedding compound and joints shall be sealed with bedding compound as recommended by the manufacturer. Cellular glass shall be installed in accordance with manufacturer's instructions. Joints and ends shall be sealed with joint sealant, and sealed with a vapor retarder coating.

d. Insulation on heads of heat exchangers shall be removable. Removable section joints shall be fabricated using a male-female shiplap type joint. The entire surface of the removable section shall be finished by applying two coats of vapor retarder coating with a layer of glass cloth embedded between the coats. The total dry thickness of the finish shall be 1/16 inch.

e. Exposed insulation corners shall be protected with corner angles.

f. Insulation on equipment with ribs shall be applied over 6 x 6 inches by 12 gauge welded wire fabric which has been cinched in place, or if approved by the Contracting Officer, spot welded to the equipment over the ribs. Insulation shall be secured to the fabric with J-hooks and 2 x 2 incheswashers or shall be securely banded or wired in place on 12 inch centers.

3.4.2.4 Vapor Retarder

Upon completion of installation of insulation, penetrations shall be caulked. Two coats of vapor retarder coating shall be applied over insulation, including removable sections, with a layer of open mesh synthetic fabric embedded between the coats. The total dry thickness of the finish shall be 1/16 inch. Caulking shall be applied to parting line between equipment and removable section insulation.

3.4.3 Insulation for Hot Equipment

Insulation shall be furnished on equipment handling media above 60 degrees F including the following:

a. Converters.

b. Heat exchangers.

c. Hot water generators.

d. Water heaters.

e. Pumps handling media above 130 degrees F.

e. Hot water storage tanks.

f. Air separation tanks.

g. Boiler flue gas connection from boiler to stack (if inside).

h. Induced draft fans.

i. Condensate receivers.

3.4.3.1 Insulation

Insulation shall be suitable for the temperature encountered. Shell and tube-type heat exchangers shall be insulated for the temperature of the shell medium.

Insulation thickness for hot equipment shall be determined using Table IV:

Legend

RMF: Rigid Mineral Fiber
FMF: Flexible Mineral Fiber
CS: Calcium Silicate
PL: Perlite
CG: Cellular Glass
FC: Flexible Elastomeric Cellular
PF: Phenolic Foam
PC: Polyisocyanurate Foam

TABLE IV
Insulation Thickness for Hot Equipment (Inches)

Equipment handling steam or media to indicated pressure or temperature limit:	Material	Thickness
15 psig	RMF	2.0 inches
or	FMF	2.0 inches
250F	CS/PL	4.0 inches
	CG	3.0 inches
	PF	1.5 inches
	FC (<200F)	1.0 inches
	PC	1.0 inches
200 psig	RMF	3.0 inches
or	FMF	3.0 inches
400 F	CS/PL	4.0 inches
	CG	4.0 inches
600 F	RMF	5.0 inches
	FMF	6.0 inches
	CS/PL	6.0 inches
	CG	6.0 inches

>600 F: Thickness necessary to limit the external temperature of the insulation to 120F, except that diesel engine exhaust piping and mufflers shall be covered with 6.0 inch thick material suitable for 1200 degrees F service. Heat transfer calculations shall be submitted to substantiate insulation and thickness selection.

3.4.3.2 Insulation of Pumps

Insulate pumps by forming a box around the pump housing. The box shall be constructed by forming the bottom and sides using joints that do not leave raw ends of insulation exposed. Bottom and sides shall be banded to form a rigid housing that does not rest on the pump. Joints between top cover and sides shall fit tightly. The top cover shall have a joint forming a female shiplap joint on the side pieces and a male joint on the top cover, making the top cover removable. Two coats of Class I adhesive shall be applied over insulation, including removable sections, with a layer of glass cloth embedded between the coats. A parting line shall be provided between the box and the removable sections allowing the removable sections to be removed without disturbing the insulation coating. The total dry thickness of the finish shall be 1/16 inch. Caulking shall be applied to parting line of the removable sections and penetrations.

3.4.3.3 Other Equipment

a. Insulation shall be formed or fabricated to fit the equipment. To ensure a tight fit on round equipment, edges shall be beveled and joints shall be tightly butted and staggered.

b. Insulation shall be secured in place with bands or wires at intervals as recommended by the manufacturer but not greater than 12 inch centers except flexible elastomeric cellular which shall be adhered. Insulation corners shall be protected under wires and bands with suitable corner angles.

c. On high vibration equipment, cellular glass insulation shall be set in a coating of bedding compound as recommended by the manufacturer, and joints shall be sealed with bedding compound. Mineral fiber joints shall be filled with finishing cement.

d. Insulation on heads of heat exchangers shall be removable. The removable section joint shall be fabricated using a male-female shiplap type joint. Entire surface of the removable section shall be finished as specified.

e. Exposed insulation corners shall be protected with corner angles.

f. On equipment with ribs, such as boiler flue gas connection, draft fans, and fly ash or soot collectors, insulation shall be applied over 6 x 6 inch by 12 gauge welded wire fabric which has been cinched in place, or if approved by the Contracting Officer, spot welded to the equipment over the ribs. Insulation shall be secured to the fabric with J-hooks and 2 x 2 inch washers or shall be securely banded or wired in place on 12 inch (maximum) centers.

g. On equipment handling media above 600 degrees F, insulation shall be applied in two or more layers with joints staggered.

h. Upon completion of installation of insulation, penetrations shall be caulked. Two coats of adhesive shall be applied over insulation, including removable sections, with a layer of glass cloth embedded between the coats. The total dry thickness of the finish shall be 1/16 inch. Caulking shall be applied to parting line between equipment and removable section insulation.

3.4.4 Equipment Handling Dual Temperature Media

Below and above 60 degrees F: equipment handling dual temperature media shall be insulated as specified for cold equipment.

3.4.5 Equipment Exposed to Weather

3.4.5.1 Installation

Equipment exposed to weather shall be insulated and finished in accordance with the requirements for ducts exposed to weather in paragraph DUCT INSULATION INSTALLATION.

3.4.5.2 Optional Panels

At the option of the Contractor, prefabricated metal insulation panels may be used in lieu of the insulation and finish previously specified. Thermal performance shall be equal to or better than that specified for field applied insulation. Panels shall be the standard catalog product of a manufacturer of metal insulation panels. Fastenings, flashing, and support system shall conform to published recommendations of the manufacturer for weatherproof installation and shall prevent moisture from entering the insulation. Panels shall be designed to accommodate thermal expansion and to support a 250 pound walking load without permanent deformation or permanent damage to the insulation. Exterior metal cover sheet shall be aluminum and exposed fastenings shall be stainless steel or aluminum.

-- End of Section --

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REFRIGERANT PIPING

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REFRIGERANT PIPING
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PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI 710	(1986) Liquid-Line Driers
ARI 720	(1997) Refrigerant Access Valves and Hose Connectors
ARI 750	(2001) Thermostatic Refrigerant Expansion Valves
ARI 760	(2001) Solenoid Valves for Use With Volatile Refrigerants

ASTM INTERNATIONAL (ASTM)

ASTM A 53/A 53M	(2002) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 653/A 653M	(2002a) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B 117	(1997) Operating Salt Spray (Fog) Apparatus
ASTM B 280	(2002) Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
ASTM B 32	(2000e1) Solder Metal
ASTM B 62	(2002) Composition Bronze or Ounce Metal Castings
ASTM B 75	(2002) Seamless Copper Tube
ASTM B 813	(2000e1) Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube
ASTM D 3308	(2001) PTFE Resin Skived Tape
ASTM D 520	(2000) Zinc Dust Pigment
ASTM E 84	(2001) Surface Burning Characteristics of

Building Materials

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 15	(2001; Errata 2002) Safety Standard for Refrigeration Systems
ASHRAE 17	(1998) Method of Testing Capacity of Thermostatic Refrigerant Expansion Valves

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8	(1992) Filler Metals for Brazing and Braze Welding
AWS BRH	(2002) Brazing Handbook
AWS Z49.1	(1999) Safety in Welding, Cutting and Allied Processes

ASME INTERNATIONAL (ASME)

ASME B16.22	(2002) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.26	(1988) Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B31.1	(2001) Power Piping
ASME B31.5	(2001) Refrigeration Piping and Heat Transfer Components
ASME B40.100	(2000) Pressure Gauges and Gauge Attachments

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58	(1993) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	(2002) Pipe Hangers and Supports - Selection and Application

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Refrigerant Piping System; G-AO

Drawings, at least 5 weeks prior to beginning construction, provided in adequate detail to demonstrate compliance with contract requirements. Drawings shall consist of:

a. Piping layouts which identify all valves and fittings.

b. Plans and elevations which identify clearances required for maintenance and operation.

SD-03 Product Data

Refrigerant Piping System

Manufacturer's standard catalog data, at least 5 weeks prior to the purchase or installation of a particular component, highlighted to show material, size, options, performance charts and curves, etc. in adequate detail to demonstrate compliance with contract requirements. Data shall include manufacturer's recommended installation instructions and procedures. Data shall be provided for the following components as a minimum:

a. Piping and Fittings

b. Valves

c. Piping Accessories

d Pipe Hangers, Inserts, and Supports

Spare Parts

Spare parts data for each different item of equipment specified in Army projects only.

Refrigerant Piping Tests; G-AO

A schedule, at least 2 weeks prior to the start of related testing, for each test. The schedules shall identify the proposed date, time, and location for each test.

Demonstrations; G-AO

A schedule, at least 2 weeks prior to the date of the proposed training course, which identifies the date, time, and location for the training.

Verification of Dimensions

A letter, at least 2 weeks prior to beginning construction, including the date the site was visited, conformation of existing conditions, and any discrepancies found.

SD-06 Test Reports

Refrigerant Piping Tests

Six copies of the report shall be provided in bound 8 1/2 x 11 inch booklets. Reports shall document all phases of the tests

performed. The report shall include initial test summaries, all repairs/adjustments made, and the final test results.

SD-07 Certificates

Service Organization; G-AO

A certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. The service organizations shall be reasonably convenient to the equipment installation and be able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

SD-10 Operation and Maintenance Data

Maintenance; G-AO
Operation and Maintenance Manuals; G-AO

Data Package 2 in accordance with Section 01781 OPERATION AND MAINTENANCE DATA.

Six complete copies of an operation manual in bound 8 1/2 x 11 inch booklets listing step-by-step procedures required for system startup, operation, abnormal shutdown, emergency shutdown, and normal shutdown at least 4 weeks prior to the first training course. The booklets shall include the manufacturer's name, model number, and parts list. The manuals shall include the manufacturer's name, model number, service manual, and a brief description of all equipment and their basic operating features.

Six complete copies of maintenance manual in bound 8 1/2 x 11 inch booklets listing routine maintenance procedures, possible breakdowns and repairs, and a trouble shooting guide. The manuals shall include piping layouts and simplified wiring and control diagrams of the system as installed.

1.3 SAFETY REQUIREMENTS

Exposed moving parts, parts that produce high operating temperature, parts which may be electrically energized, and parts that may be a hazard to operating personnel shall be insulated, fully enclosed, guarded, or fitted with other types of safety devices. Safety devices shall be installed so that proper operation of equipment is not impaired. Welding and cutting safety requirements shall be in accordance with AWS Z49.1.

1.4 DELIVERY, STORAGE, AND HANDLING

Stored items shall be protected from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Proper protection and care of all material both before and during installation shall be the Contractor's responsibility. Any materials found to be damaged shall be replaced at the Contractor's expense. During installation, piping and similar openings shall be capped to keep out dirt and other foreign matter.

1.5 PROJECT/SITE CONDITIONS

1.5.1 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

1.5.2 Contract Drawings

Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. The Contractor shall carefully investigate the plumbing, fire protection, electrical, structural and finish conditions that would affect the work to be performed and shall arrange such work accordingly, furnishing required offsets, fittings, and accessories to meet such conditions.

1.5.3 Spare Parts

The Contractor shall submit spare parts data for each different item of equipment specified, after approval of detail drawings and not later than 2 months prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, a recommended spare parts list for 1 year of operation, and a list of the parts recommended by the manufacturer to be replaced on a routine basis.

1.6 MAINTENANCE

Operation and maintenance data shall comply with the requirements of Section 01781 OPERATION AND MAINTENANCE DATA and as specified herein.

PART 2 PRODUCTS

2.1 STANDARD COMMERCIAL PRODUCTS

Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacturing of such products, which are of a similar material, design and workmanship. The standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2 year use shall include applications of equipment and materials under similar circumstances and of similar size. The 2 years experience shall be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturer's catalogs, or brochures. Products having less than a 2 year field service record shall be acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown. Products shall be supported by a service organization. System components shall be environmentally suitable for the indicated locations.

2.2 ELECTRICAL WORK

Electrical equipment and wiring shall be in accordance with Section 16415A ELECTRICAL WORK, INTERIOR. Field wiring shall be in accordance with manufacturer's instructions. Manual or automatic control and protective or signal devices required for the operation specified and any control wiring required for controls and devices specified, but not shown, shall be provided.

2.3 REFRIGERANT PIPING SYSTEM

Refrigerant piping, valves, fittings, and accessories shall be in accordance with ASHRAE 15 and ASME B31.5, except as specified herein. Refrigerant piping, valves, fittings, and accessories shall be compatible with the fluids used and capable of withstanding the pressures and temperatures of the service. Refrigerant piping, valves, and accessories used for refrigerant service shall be cleaned, dehydrated, and sealed (capped or plugged) prior to shipment from the manufacturer's plant.

2.4 PIPE, FITTINGS AND END CONNECTIONS (JOINTS)

2.4.1 Copper Tubing

Copper tubing shall conform to ASTM B 280 annealed or hard drawn as required. Copper tubing shall be soft annealed where bending is required and hard drawn where no bending is required. Soft annealed copper tubing shall not be used in sizes larger than 1-3/8 inches. Joints shall be brazed except that joints on lines 7/8 inchand smaller may be flared. Cast copper alloy fittings for flared copper tube shall conform to ASME B16.26 and ASTM B 62. Wrought copper and bronze solder-joint pressure fittings shall conform to ASME B16.22 and ASTM B 75. Joints and fittings for brazed joint shall be wrought-copper or forged-brass sweat fittings. Cast sweat-type joints and fittings shall not be allowed for brazed joints. Brass or bronze adapters for brazed tubing may be used for connecting tubing to flanges and to threaded ends of valves and equipment.

2.4.2 Solder

Solder shall conform to ASTM B 32, grade Sb5, tin-antimony alloy for service pressures up to 150 psig. Solder flux shall be liquid or paste form, non-corrosive and conform to ASTM B 813.

2.4.3 Brazing Filler Metal

Filler metal shall conform to AWS A5.8, Type BAg-5 with AWS Type 3 flux, except Type BCuP-5 or BCuP-6 may be used for brazing copper-to-copper joints.

2.5 VALVES

Valves shall be designed, manufactured, and tested specifically for refrigerant service. Valve bodies shall be of brass, bronze, steel, or ductile iron construction. Valves 1 inch and smaller shall have brazed or socket welded connections. Valves larger than 1 inch shall have tongue-and-groove flanged end connections. Threaded end connections shall not be used, except in pilot pressure or gauge lines where maintenance disassembly is required and welded flanges cannot be used. Internal parts shall be removable for inspection or replacement without applying heat or breaking pipe connections. Valve stems exposed to the atmosphere shall be stainless steel or corrosion resistant metal plated carbon steel. Direction of flow shall be legibly and permanently indicated on the valve body. Control valve inlets shall be fitted with integral or adapted strainer or filter where recommended or required by the manufacturer. Purge, charge and receiver valves shall be of manufacturer's standard configuration.

2.5.1 Refrigerant Stop Valves

Valve shall be the globe or full-port ball type with a back-seating stem especially packed for refrigerant service. Valve packing shall be replaceable under line pressure. Valve shall be provided with a handwheel or wrench operator and a seal cap. Valve shall be the straight or angle pattern design as indicated.

2.5.2 Check Valves

Valve shall be the swing or lift type as required to provide positive shutoff at the differential pressure indicated. Valve shall be provide with resilient seat.

2.5.3 Liquid Solenoid Valves

Valves shall comply with ARI 760 and be suitable for continuous duty with applied voltages 15 percent under and 5 percent over nominal rated voltage at maximum and minimum encountered pressure and temperature service conditions. Valves shall be direct-acting or pilot-operating type, packless, except that packed stem, seal capped, manual lifting provisions shall be furnished. Solenoid coils shall be moisture-proof, UL approved, totally encapsulated or encapsulated and metal jacketed as required. Valves shall have safe working pressure of 400 psi and a maximum operating pressure differential of at least 200 psi at 85 percent rated voltage. Valves shall have an operating pressure differential suitable for the refrigerant used.

2.5.4 Expansion Valves

Valve shall conform to ARI 750 and ASHRAE 17. Valve shall be the diaphragm and spring-loaded type with internal or external equalizers, and bulb and capillary tubing. Valve shall be provided with an external superheat adjustment along with a seal cap. Internal equalizers may be utilized where flowing refrigerant pressure drop between outlet of the valve and inlet to the evaporator coil is negligible and pressure drop across the evaporator is less than the pressure difference corresponding to 2 degrees F of saturated suction temperature at evaporator conditions. Bulb charge shall be determined by the manufacturer for the application and such that liquid will remain in the bulb at all operating conditions. Gas limited liquid charged valves and other valve devices for limiting evaporator pressure shall not be used without a distributor or discharge tube or effective means to prevent loss of control when bulb becomes warmer than valve body. Pilot-operated valves shall have a characterized plug to provide required modulating control. A de-energized solenoid valve may be used in the pilot line to close the main valve in lieu of a solenoid valve in the main liquid line. An isolatable pressure gauge shall be provided in the pilot line, at the main valve. Automatic pressure reducing or constant pressure regulating expansion valves may be used only where indicted or for constant evaporator loads.

2.5.5 Safety Relief Valves

Valve shall be the two-way type, unless indicated otherwise. Valve shall bear the ASME code symbol. Valve capacity shall be certified by the National Board of Boiler and Pressure Vessel Inspectors. Valve shall be of an automatically reseating design after activation.

2.5.6 Evaporator Pressure Regulators, Direct-Acting

Valve shall include a diaphragm/spring assembly, external pressure adjustment with seal cap, and pressure gauge port. Valve shall maintain a constant inlet pressure by balancing inlet pressure on diaphragm against an adjustable spring load. Pressure drop at system design load shall not exceed the pressure difference corresponding to a 2 degrees F change in saturated refrigerant temperature at evaporator operating suction temperature. Spring shall be selected for indicated maximum allowable suction pressure range.

2.5.7 Refrigerant Access Valves

Refrigerant access valves and hose connections shall be in accordance with ARI 720.

2.6 PIPING ACCESSORIES

2.6.1 Filter Driers

Driers shall conform to ARI 710. Sizes 5/8 inch and larger shall be the full flow, replaceable core type. Sizes 1/2 inch and smaller shall be the sealed type. Cores shall be of suitable desiccant that will not plug, cake, dust, channel, or break down, and shall remove water, acid, and foreign material from the refrigerant. Filter driers shall be constructed so that none of the desiccant will pass into the refrigerant lines. Minimum bursting pressure shall be 1,500 psi.

2.6.2 Sight Glass and Liquid Level Indicator

2.6.2.1 Assembly and Components

Assembly shall be pressure- and temperature-rated and constructed of materials suitable for the service. Glass shall be borosilicate type. Ferrous components subject to condensation shall be electro-galvanized.

2.6.2.2 Gauge Glass

Gauge glass shall include top and bottom isolation valves fitted with automatic checks, and packing followers; red-line or green-line gauge glass; elastomer or polymer packing to suit the service; and gauge glass guard.

2.6.2.3 Bull's-Eye and Inline Sight Glass Reflex Lens

Bull's-eye and inline sight glass reflex lens shall be provided for dead-end liquid service. For pipe line mounting, two plain lenses in one body suitable for backlighted viewing shall be provided.

2.6.2.4 Moisture Indicator

Indicator shall be a self-reversible action, moisture reactive, color changing media. Indicator shall be furnished with full-color-printing tag containing color, moisture and temperature criteria. Unless otherwise indicated, the moisture indicator shall be an integral part of each corresponding sight glass.

2.6.3 Vibration Dampeners

Dampeners shall be of the all-metallic bellows and woven-wire type.

2.6.4 Flexible Pipe Connectors

Connector shall be a composite of interior corrugated phosphor bronze or Type 300 Series stainless steel, as required for fluid service, with exterior reinforcement of bronze, stainless steel or monel wire braid. Assembly shall be constructed with a safety factor of not less than 4 at 300 degrees F. Unless otherwise indicated, the length of a flexible connector shall be as recommended by the manufacturer for the service intended.

2.6.5 Strainers

Strainers used in refrigerant service shall have brass or cast iron body, Y-or angle-pattern, cleanable, not less than 60-mesh noncorroding screen of an area to provide net free area not less than ten times the pipe diameter with pressure rating compatible with the refrigerant service. Screens shall be stainless steel or monel and reinforced spring-loaded where necessary for bypass-proof construction.

2.6.6 Pressure and Vacuum Gauges

Gauges shall conform to ASME B40.100 and shall be provided with throttling type needle valve or a pulsation dampener and shut-off valve. Gauge shall be a minimum of 3-1/2 inches in diameter with a range from 0 psig to approximately 1.5 times the maximum system working pressure. Each gauge range shall be selected so that at normal operating pressure, the needle is within the middle-third of the range.

2.6.7 Temperature Gauges

Temperature gauges shall be the industrial duty type and be provided for the required temperature range. Gauges shall have Fahrenheit scale in 2 degree graduations scale (black numbers) on a white face. The pointer shall be adjustable. Rigid stem type temperature gauges shall be provided in thermal wells located within 5 feet of the finished floor. Universal adjustable angle type or remote element type temperature gauges shall be provided in thermal wells located 5 to 7 feet above the finished floor. Remote element type temperature gauges shall be provided in thermal wells located 7 feet above the finished floor.

2.6.7.1 Stem Cased-Glass

Stem cased-glass case shall be polished stainless steel or cast aluminum, 9 inches long, with clear acrylic lens, and non-mercury filled glass tube with indicating-fluid column.

2.6.7.2 Bimetallic Dial

Bimetallic dial type case shall be not less than 3-1/2 inches, stainless steel, and shall be hermetically sealed with clear acrylic lens. Bimetallic element shall be silicone dampened and unit fitted with external calibrator adjustment. Accuracy shall be one percent of dial range.

2.6.7.3 Liquid-, Solid-, and Vapor-Filled Dial

Liquid-, solid-, and vapor-filled dial type cases shall be not less than 3-1/2 inches, stainless steel or cast aluminum with clear acrylic lens. Fill shall be nonmercury, suitable for encountered cross-ambients, and connecting capillary tubing shall be double-braided bronze.

2.6.7.4 Thermal Well

Thermal well shall be identical size, 1/2 or 3/4 inch NPT connection, brass or stainless steel. Where test wells are indicated, provide captive plug-fitted type 1/2 inch NPT connection suitable for use with either engraved stem or standard separable socket thermometer or thermostat. Mercury shall not be used in thermometers. Extended neck thermal wells shall be of sufficient length to clear insulation thickness by 1 inch.

2.6.8 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, guides, and supports shall conform to MSS SP-58 and MSS SP-69.

2.6.9 Escutcheons

Escutcheons shall be chromium-plated iron or chromium-plated brass, either one piece or split pattern, held in place by internal spring tension or set screws.

2.7 FABRICATION

2.7.1 Factory Coating

Unless otherwise specified, equipment and component items, when fabricated from ferrous metal, shall be factory finished with the manufacturer's standard finish, except that items located outside of buildings shall have weather resistant finishes that will withstand 500 hours exposure to the salt spray test specified in ASTM B 117 using a 5 percent sodium chloride solution. Immediately after completion of the test, the specimen shall show no signs of blistering, wrinkling, cracking, or loss of adhesion and no sign of rust creepage beyond 1/8 inch on either side of the scratch mark. Cut edges of galvanized surfaces where hot-dip galvanized sheet steel is used shall be coated with a zinc-rich coating conforming to ASTM D 520, Type I.

2.7.2 Factory Applied Insulation

Refrigerant suction lines between the cooler and each compressor shall be insulated with not less than 3/4 inch thick unicellular plastic foam. Factory insulated items installed outdoors are not required to be fire-rated. As a minimum, factory insulated items installed indoors shall have a flame spread index no higher than 75 and a smoke developed index no higher than 150. Factory insulated items (no jacket) installed indoors and which are located in air plenums, in ceiling spaces, and in attic spaces shall have a flame spread index no higher than 25 and a smoke developed index no higher than 50. Flame spread and smoke developed indexes shall be determined by ASTM E 84. Insulation shall be tested in the same density and installed thickness as the material to be used in the actual construction. Material supplied by a manufacturer with a jacket shall be tested as a composite material. Jackets, facings, and adhesives shall have a flame spread index no higher than 25 and a smoke developed index no

higher than 50 when tested in accordance with ASTM E 84.

2.8 FIELD APPLIED INSULATION

Field applied insulation shall be provided and installed in accordance with Section 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS.

PART 3 EXECUTION

3.1 INSTALLATION

Pipe and fitting installation shall conform to the requirements of ASME B31.1. Pipe shall be cut accurately to measurements established at the jobsite, and worked into place without springing or forcing, completely clearing all windows, doors, and other openings. Cutting or other weakening of the building structure to facilitate piping installation will not be permitted without written approval. Pipe or tubing shall be cut square, shall have burrs removed by reaming, and shall permit free expansion and contraction without causing damage to the building structure, pipe, joints, or hangers.

3.1.1 Directional Changes

Changes in direction shall be made with fittings, except that bending of pipe 4 inches and smaller will be permitted, provided a pipe bender is used and wide weep bends are formed. Mitering or notching pipe or other similar construction to form elbows or tees will not be permitted. The centerline radius of bends shall not be less than 6 diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be accepted.

3.1.2 Functional Requirements

Piping shall be installed 1/2 inch per 10 feet of pipe in the direction of flow to ensure adequate oil drainage. Open ends of refrigerant lines or equipment shall be properly capped or plugged during installation to keep moisture, dirt, or other foreign material out of the system. Piping shall remain capped until installation. Equipment piping shall be in accordance with the equipment manufacturer's recommendations and the contract drawings. Equipment and piping arrangements shall fit into space allotted and allow adequate acceptable clearances for installation, replacement, entry, servicing, and maintenance.

3.1.3 Fittings and End Connections

3.1.3.1 Threaded Connections

Threaded connections shall be made with tapered threads and made tight with PTFE tape complying with ASTM D 3308 or equivalent thread-joint compound applied to the male threads only. Not more than three threads shall show after the joint is made.

3.1.3.2 Brazed Connections

Brazing shall be performed in accordance with AWS BRH, except as modified herein. During brazing, the pipe and fittings shall be filled with a pressure regulated inert gas, such as nitrogen, to prevent the formation of scale. Before brazing copper joints, both the outside of the tube and the inside of the fitting shall be cleaned with a wire fitting brush until the

entire joint surface is bright and clean. Brazing flux shall not be used. Surplus brazing material shall be removed at all joints. Steel tubing joints shall be made in accordance with the manufacturer's recommendations. Joints in steel tubing shall be painted with the same material as the baked-on coating within 8 hours after joints are made. Tubing shall be protected against oxidation during brazing by continuous purging of the inside of the piping using nitrogen. Piping shall be supported prior to brazing and not be sprung or forced.

3.1.3.3 Flared Connections

When flared connections are used, a suitable lubricant shall be used between the back of the flare and the nut in order to avoid tearing the flare while tightening the nut.

3.1.3.4 Flanged Connections

When steel refrigerant piping is used, union or flange joints shall be provided in each line immediately preceding the connection to each piece of equipment requiring maintenance, such as compressors, coils, chillers, control valves, and other similar items. Flanged joints shall be assembled square end tight with matched flanges, gaskets, and bolts. Gaskets shall be suitable for use with the refrigerants to be handled.

3.1.4 Valves

3.1.4.1 General

Refrigerant stop valves shall be installed on each side of each piece of equipment such as compressors condensers, evaporators, receivers, and other similar items in multiple-unit installation, to provide partial system isolation as required for maintenance or repair. Stop valves shall be installed with stems horizontal unless otherwise indicated. Ball valves shall be installed with stems positioned to facilitate operation and maintenance. Isolating valves for pressure gauges and switches shall be external to thermal insulation. Safety switches shall not be fitted with isolation valves. Filter dryers having access ports may be considered a point of isolation. Purge valves shall be provided at all points of systems where accumulated noncondensible gases would prevent proper system operation. Valves shall be furnished to match line size, unless otherwise indicated or approved.

3.1.4.2 Expansion Valves

Expansion valves shall be installed with the thermostatic expansion valve bulb located on top of the suction line when the suction line is less than 2-1/8 inches in diameter and at the 4 o'clock or 8 o'clock position on lines larger than 2-1/8 inches. The bulb shall be securely fastened with two clamps. The bulb shall be insulated. The bulb shall installed in a horizontal portion of the suction line, if possible, with the pigtail on the bottom. If the bulb must be installed in a vertical line, the bulb tubing shall be facing up.

3.1.4.3 Valve Identification

Each system valve, including those which are part of a factory assembly, shall be tagged. Tags shall be in alphanumeric sequence, progressing in direction of fluid flow. Tags shall be embossed, engraved, or stamped plastic or nonferrous metal of various shapes, sized approximately 1-3/8

inch diameter, or equivalent dimension, substantially attached to a component or immediately adjacent thereto. Tags shall be attached with nonferrous, heavy duty, bead or link chain, 14 gauge annealed wire, nylon cable bands or as approved. Tag numbers shall be referenced in Operation and Maintenance Manuals and system diagrams.

3.1.5 Vibration Dampers

Vibration damper shall be provided in the suction and discharge lines on spring mounted compressors. Vibration dampers shall be installed parallel with the shaft of the compressor and shall be anchored firmly at the upstream end on the suction line and the downstream end in the discharge line.

3.1.6 Strainers

Strainers shall be provided immediately ahead of solenoid valves and expansion devices. Strainers may be an integral part of an expansion valve.

3.1.7 Filter Dryer

A liquid line filter dryer shall be provided on each refrigerant circuit located such that all liquid refrigerant passes through a filter dryer. Dryers shall be sized in accordance with the manufacturer's recommendations for the system in which it is installed. Dryers shall be installed such that it can be isolated from the system, the isolated portion of the system evacuated, and the filter dryer replaced. Dryers shall be installed in the horizontal position except replaceable core filter dryers may be installed in the vertical position with the access flange on the bottom.

3.1.8 Sight Glass

A moisture indicating sight glass shall be installed in all refrigerant circuits down stream of all filter dryers and where indicated. Site glasses shall be full line size.

3.1.9 Discharge Line Oil Separator

Discharge line oil separator shall be provided in the discharge line from each compressor. Oil return line shall be connected to the compressor as recommended by the compressor manufacturer.

3.1.10 Accumulator

Accumulators shall be provided in the suction line to each compressor.

3.1.11 Flexible Pipe Connectors

Connectors shall be installed perpendicular to line of motion being isolated. Piping for equipment with bidirectional motion shall be fitted with two flexible connectors, in perpendicular planes. Reinforced elastomer flexible connectors shall be installed in accordance with manufacturer's instructions. Piping guides and restraints related to flexible connectors shall be provided as required.

3.1.12 Temperature Gauges

Temperature gauges shall be located specifically on, but not limited to the following: the sensing element of each automatic temperature control

device where a thermometer is not an integral part thereof, the liquid line leaving a receiver, and the suction line at each evaporator or liquid cooler. Thermal wells for insertion thermometers and thermostats shall extend beyond thermal insulation surface not less than 1 inch.

3.1.13 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69, except as modified herein. Pipe hanger types 5, 12, and 26 shall not be used. Hangers used to support piping 2 inches and larger shall be fabricated to permit adequate adjustment after erection while still supporting the load. Piping subjected to vertical movement, when operating temperatures exceed ambient temperatures, shall be supported by variable spring hangers and supports or by constant support hangers.

3.1.13.1 Hangers

Type 3 shall not be used on insulated piping. Type 24 may be used only on trapeze hanger systems or on fabricated frames.

3.1.13.2 Inserts

Type 18 inserts shall be secured to concrete forms before concrete is placed. Continuous inserts which allow more adjustments may be used if they otherwise meet the requirements for Type 18 inserts.

3.1.13.3 C-Clamps

Type 19 and 23 C-clamps shall be torqued per MSS SP-69 and have both locknuts and retaining devices, furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.

3.1.13.4 Angle Attachments

Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.

3.1.13.5 Saddles and Shields

Where Type 39 saddle or Type 40 shield are permitted for a particular pipe attachment application, the Type 39 saddle, connected to the pipe, shall be used on all pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher. Type 40 shields shall be used on all piping less than 4 inches and all piping 4 inches and larger carrying medium less than 60 degrees F. A high density insulation insert of cellular glass shall be used under the Type 40 shield for piping 2 inches and larger.

3.1.13.6 Horizontal Pipe Supports

Horizontal pipe supports shall be spaced as specified in MSS SP-69 and a support shall be installed not over 1 foot from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 5 feet apart at valves. Pipe hanger loads suspended from steel joist with hanger loads between panel points in excess of 50 pounds shall have the excess hanger loads suspended from panel points.

3.1.13.7 Vertical Pipe Supports

Vertical pipe shall be supported at each floor, except at slab-on-grade,

and at intervals of not more than 15 feet, not more than 8 feetfrom end of risers, and at vent terminations.

3.1.13.8 Pipe Guides

Type 35 guides using, steel, reinforced polytetrafluoroethylene (PTFE) or graphite slides shall be provided where required to allow longitudinal pipe movement. Lateral restraints shall be provided as required. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered.

3.1.13.9 Steel Slides

Where steel slides do not require provisions for restraint of lateral movement, an alternate guide method may be used. On piping 4 inches and larger, a Type 39 saddle shall be used. On piping under 4 inches, a Type 40 protection shield may be attached to the pipe or insulation and freely rest on a steel slide plate.

3.1.13.10 High Temperature Guides with Cradles

Where there are high system temperatures and welding to piping is not desirable, then the Type 35 guide shall include a pipe cradle, welded to the guide structure and strapped securely to the pipe. The pipe shall be separated from the slide material by at least 4 inches, or by an amount adequate for the insulation, whichever is greater.

3.1.13.11 Multiple Pipe Runs

In the support of multiple pipe runs on a common base member, a clip or clamp shall be used where each pipe crosses the base support member. Spacing of the base support members shall not exceed the hanger and support spacing required for an individual pipe in the multiple pipe run.

3.1.13.12 Seismic Requirements

Piping and attached valves shall be supported and braced to resist seismic loads as specified under Sections 13080 ANTITERRORISM FORCE PROTECTION (AT/FP)FOR MISCELLANEOUS EQUIPMENT and 15070A SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT. Structural steel required for reinforcement to properly support piping, headers, and equipment but not shown shall be provided under this section. Material used for support shall be as specified under Section 05120 STRUCTURAL STEEL.

3.1.13.13 Structural Attachments

Attachment to building structure concrete and masonry shall be by cast-in concrete inserts, built-in anchors, or masonry anchor devices. Inserts and anchors shall be applied with a safety factor not less than 5. Supports shall not be attached to metal decking. Masonry anchors for overhead applications shall be constructed of ferrous materials only. Structural steel brackets required to support piping, headers, and equipment, but not shown, shall be provided under this section. Material used for support shall be as specified under Section 05120 STRUCTURAL STEEL.

3.1.14 Pipe Alignment Guides

Pipe alignment guides shall be provided where indicated for expansion loops, offsets, and bends and as recommended by the manufacturer for

expansion joints, not to exceed 5 feet on each side of each expansion joint, and in lines 4 inches or smaller not more than 2 feet on each side of the joint.

3.1.15 Pipe Anchors

Anchors shall be provided wherever necessary or indicated to localize expansion or to prevent undue strain on piping. Anchors shall consist of heavy steel collars with lugs and bolts for clamping and attaching anchor braces, unless otherwise indicated. Anchor braces shall be installed in the most effective manner to secure the desired results using turnbuckles where required. Supports, anchors, or stays shall not be attached where they will injure the structure or adjacent construction during installation or by the weight of expansion of the pipeline. Where pipe and conduit penetrations of vapor barrier sealed surfaces occur, these items shall be anchored immediately adjacent to each penetrated surface, to provide essentially zero movement within penetration seal. Detailed drawings of pipe anchors shall be submitted for approval before installation.

3.1.16 Building Surface Penetrations

Sleeves shall not be installed in structural members except where indicated or approved. Sleeves in nonload bearing surfaces shall be galvanized sheet metal, conforming to ASTM A 653/A 653M, Coating Class G-90, 20 gauge. Sleeves in load bearing surfaces shall be uncoated carbon steel pipe, conforming to ASTM A 53/A 53M, Schedule 20. Sealants shall be applied to moisture and oil-free surfaces and elastomers to not less than 1/2 inch depth. Sleeves shall not be installed in structural members.

3.1.16.1 General Service Areas

Each sleeve shall extend through its respective wall, floor, or roof, and shall be cut flush with each surface. Pipes passing through concrete or masonry wall or concrete floors or roofs shall be provided with pipe sleeves fitted into place at the time of construction. Sleeves shall be of such size as to provide a minimum of 1/4 inch all-around clearance between bare pipe and sleeves or between jacketed-insulation and sleeves. Except in pipe chases or interior walls, the annular space between pipe and sleeve or between jacket over-insulation and sleeve shall be sealed in accordance with Section 07920 JOINT SEALANTS.

3.1.16.2 Waterproof Penetrations

Pipes passing through roof or floor waterproofing membrane shall be installed through a 17 ounce copper sleeve, or a 0.032 inch thick aluminum sleeve, each within an integral skirt or flange. Flashing sleeve shall be suitably formed, and skirt or flange shall extend not less than 8 inches from the pipe and be set over the roof or floor membrane in a troweled coating of bituminous cement. The flashing sleeve shall extend up the pipe a minimum of 2 inches above the roof or floor penetration. The annular space between the flashing sleeve and the bare pipe or between the flashing sleeve and the metal-jacket-covered insulation shall be sealed as indicated. Penetrations shall be sealed by either one of the following methods.

a. Waterproofing Clamping Flange: Pipes up to and including 10 inches in diameter passing through roof or floor waterproofing membrane may be installed through a cast iron sleeve with caulking recess, anchor lugs, flashing clamp device, and pressure ring with brass

bolts. Waterproofing membrane shall be clamped into place and sealant shall be placed in the caulking recess.

b. Modular Mechanical Type Sealing Assembly: In lieu of a waterproofing clamping flange and caulking and sealing of annular space between pipe and sleeve or conduit and sleeve, a modular mechanical type sealing assembly may be installed. Seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe/conduit and sleeve with corrosion protected carbon steel bolts, nuts, and pressure plates. Links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and each nut. After the seal assembly is properly positioned in the sleeve, tightening of the bolt shall cause the rubber sealing elements to expand and provide a watertight seal rubber sealing elements to expand and provide a watertight seal between the pipe/conduit seal between the pipe/conduit and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe/conduit and sleeve involved. The Contractor electing to use the modular mechanical type seals shall provide sleeves of the proper diameters.

3.1.16.3 Fire-Rated Penetrations

Penetration of fire-rated walls, partitions, and floors shall be sealed as specified in Section 07840 FIRESTOPPING.

3.1.16.4 Escutcheons

Finished surfaces where exposed piping, bare or insulated, pass through floors, walls, or ceilings, except in boiler, utility, or equipment rooms, shall be provided with escutcheons. Where sleeves project slightly from floors, special deep-type escutcheons shall be used. Escutcheon shall be secured to pipe or pipe covering.

3.1.17 Access Panels

Access panels shall be provided for all concealed valves, vents, controls, and items requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced and maintained or completely removed and replaced. Access panels shall be as specified in Section 05500A MISCELLANEOUS METAL.

3.1.18 Field Applied Insulation

Field installed insulation shall be as specified in Section 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS, except as defined differently herein.

3.1.19 Field Painting

Painting required for surfaces not otherwise specified, and finish painting of items only primed at the factory are specified in Section 09900 PAINTS AND COATINGS.

3.2 CLEANING AND ADJUSTING

Clean uncontaminated system(s) by evacuation and purging procedures currently recommended by refrigerant and refrigerant equipment manufacturers, and as specified herein, to remove small amounts of air and

moisture. Systems containing moderate amounts of air, moisture, contaminated refrigerant, or any foreign matter shall be considered contaminated systems. Restoring contaminated systems to clean condition including disassembly, component replacement, evacuation, flushing, purging, and re-charging, shall be performed using currently approved refrigerant and refrigeration manufacturer's procedures. Restoring contaminated systems shall be at no additional cost to the Government as determined by the Contracting Officer. Water shall not be used in any procedure or test.

3.3 REFRIGERANT PIPING TESTS

After all components of the refrigerant system have been installed and connected, the entire refrigeration system shall be subjected to pneumatic, evacuation, and startup tests as described herein. Tests shall be conducted in the presence of the Contracting Officer. Water and electricity required for the tests will be furnished by the Government. Any material, equipment, instruments, and personnel required for the test shall be provided by the Contractor. The services of a qualified technician shall be provided as required to perform all tests and procedures indicated herein. Field tests shall be coordinated with Section 15990A TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS.

3.3.1 Preliminary Procedures

Prior to pneumatic testing, equipment which has been factory tested and refrigerant charged as well as equipment which could be damaged or cause personnel injury by imposed test pressure, positive or negative, shall be isolated from the test pressure or removed from the system. Safety relief valves and rupture discs, where not part of factory sealed systems, shall be removed and openings capped or plugged.

3.3.2 Pneumatic Test

Pressure control and excess pressure protection shall be provided at the source of test pressure. Valves shall be wide open, except those leading to the atmosphere. Test gas shall be dry nitrogen, with minus 70 degree F dewpoint and less than 5 ppm oil. Test pressure shall be applied in two stages before any refrigerant pipe is insulated or covered. First stage test shall be at 10 psi with every joint being tested with a thick soap or color indicating solution. Second stage tests shall raise the system to the minimum refrigerant leakage test pressure specified in ASHRAE 15 with a maximum test pressure 25 percent greater. Pressure above 100 psig shall be raised in 10 percent increments with a pressure acclimatizing period between increments. The initial test pressure shall be recorded along with the ambient temperature to which the system is exposed. Final test pressures of the second stage shall be maintained on the system for a minimum of 24 hours. At the end of the 24 hour period, the system pressure will be recorded along with the ambient temperature to which the system is exposed. A correction factor of 0.3 psi will be allowed for each degree F change between test space initial and final ambient temperature, plus for increase and minus for a decrease. If the corrected system pressure is not exactly equal to the initial system test pressure, then the system shall be investigated for leaking joints. To repair leaks, the joint shall be taken apart, thoroughly cleaned, and reconstructed as a new joint. Joints repaired by caulking, remelting, or back-welding/brazing shall not be acceptable. Following repair, the entire system shall be retested using the pneumatic tests described above. The entire system shall be reassembled once the pneumatic tests are satisfactorily completed.

3.3.3 Evacuation Test

Following satisfactory completion of the pneumatic tests, the pressure shall be relieved and the entire system shall be evacuated to an absolute pressure of 300 micrometers. During evacuation of the system, the ambient temperature shall be higher than 35 degrees F. No more than one system shall be evacuated at one time by one vacuum pump. Once the desired vacuum has been reached, the vacuum line shall be closed and the system shall stand for 1 hour. If the pressure rises over 500 micrometers after the 1 hour period, then the system shall be evacuated again down to 300 micrometers and let set for another 1 hour period. The system shall not be charged until a vacuum of at least 500 micrometers is maintained for a period of 1 hour without the assistance of a vacuum line. If during the testing the pressure continues to rise, check the system for leaks, repair as required, and repeat the evacuation procedure. During evacuation, pressures shall be recorded by a thermocouple-type, electronic-type, or a calibrated-micrometer type gauge.

3.3.4 System Charging and Startup Test

Following satisfactory completion of the evacuation tests, the system shall be charged with the required amount of refrigerant by raising pressure to normal operating pressure and in accordance with manufacturer's procedures. Following charging, the system shall operate with high-side and low-side pressures and corresponding refrigerant temperatures, at design or improved values. The entire system shall be tested for leaks. Fluorocarbon systems shall be tested with halide torch or electronic leak detectors.

3.3.5 Refrigerant Leakage

If a refrigerant leak is discovered after the system has been charged, the leaking portion of the system shall immediately be isolated from the remainder of the system and the refrigerant pumped into the system receiver or other suitable container. Under no circumstances shall the refrigerant be discharged into the atmosphere.

3.3.6 Contractor's Responsibility

The Contractor shall, at all times during the installation and testing of the refrigeration system, take steps to prevent the release of refrigerants into the atmosphere. The steps shall include, but not be limited to, procedures which will minimize the release of refrigerants to the atmosphere and the use of refrigerant recovery devices to remove refrigerant from the system and store the refrigerant for reuse or reclaim. At no time shall more than 3 ounces of refrigerant be released to the atmosphere in any one occurrence. Any system leaks within the first year shall be repaired in accordance with the requirements herein at no cost to the Government including material, labor, and refrigerant if the leak is the result of defective equipment, material, or installation.

3.4 DEMONSTRATIONS

Contractor shall conduct a training course for 4 members of the operating staff as designated by the Contracting Officer. The training period shall consist of a total 4 hours of normal working time and start after the system is functionally completed but prior to final acceptance tests. The field posted instructions shall cover all of the items contained in the approved operation and maintenance manuals as well as demonstrations of

routine maintenance operations.

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SECTION 15190A

GAS PIPING SYSTEMS
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PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by thebasic designation only.

AMERICAN GAS ASSOCIATION (AGA)

AGA XR0104	(2001) AGA Plastic Pipe Manual for Gas Service

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.24	(2001) Connectors for Gas Appliances
ANSI Z21.69	(2002) Connectors for Movable Gas Appliances

AMERICAN PETROLEUM INSTITUTE (API)

API Spec 6D	(2002) Specification for Pipeline Valves

ASME INTERNATIONAL (ASME)

ASME B1.20.1	(1983; R 2001) Pipe Threads, General Purpose, Inch
ASME B16.11	(2002) Forged Fittings, Socket-Welding and Threaded
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.3	(1998) Malleable Iron Threaded Fittings
ASME B16.33	(2002) Manually Operated Metallic Gas Valves for Use in Gas Piping Systems Up to 125 psig, Sizes NPS 1/2 - NPS 2
ASME B16.5	(1996) Pipe Flanges and Flanged Fittings
ASME B16.9	(2001) Factory-Made Wrought Steel Buttwelding Fittings
ASME B31.1	(2001) Power Piping
ASME B31.2	(1968) Fuel Gas Piping

ASME B36.10M	(2001) Welded and Seamless Wrought Steel Pipe
ASME BPVC SEC IX	(2001) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-25	(1998) Standard Marking System for Valves, Fittings, Flanges and Unions
MSS SP-58	(1993) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	(2002) Pipe Hangers and Supports - Selection and Application

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 54	(2002) National Fuel Gas Code
NFPA 70	(2002) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL Gas&Oil Dir	(2000) Gas and Oil Equipment Directory

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Gas Piping System; G-AO.

Drawings showing location, size and all branches of pipeline; location of all required shutoff valves; and instructions necessary for the installation of connectors and supports.

SD-03 Product Data

Welding; G-AO.

Qualified procedures and a list of names and identification symbols of qualified welders and welding operators.

SD-06 Test Reports

Testing; G-AO.
Pressure Tests; G-AO.

Test With Gas; G-AO.

Test reports in booklet form tabulating test and measurements performed. The reports shall be dated after award of this contract, shall state the contractor's name and address, shall name the project and location, and shall list the specific requirements which are being certified.

1.3 GENERAL REQUIREMENTS

1.3.1 Welding

Piping shall be welded in accordance with qualified procedures using performance qualified welders and welding operators. Procedures and welders shall be qualified in accordance with ASME BPVC SEC IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer may be accepted as permitted by ASME B31.1. The Contracting Officer shall be notified at least 24 hours in advance of tests and the tests shall be performed at the work site if practicable. The Contracting Officer shall be furnished with a copy of qualified procedures and a list of names and identification symbols of qualified welders and welding operators. The welder or welding operator shall apply his assigned symbol near each weld he makes as a permanent record. Structural members shall be welded in accordance with Section 05090A WELDING, STRUCTURAL.

1.3.2 Standard Products

Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Asbestos or products containing asbestos shall not be used. Manufacturer's descriptive data and installation instructions shall be submitted for approval for compression-type mechanical joints used in joining dissimilar materials and for insulating joints. Valves, flanges and fittings shall be marked in accordance with MSS SP-25.

1.3.3 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work.

PART 2 PRODUCTS

2.1 PIPE AND FITTINGS

2.1.1 Steel Pipe, Joints, and Fittings

Steel pipe shall conform to ASME B36.10M. Malleable-iron threaded fittings shall conform to ASME B16.3. Steel pipe flanges and flanged fittings including bolts, nuts, and bolt pattern shall be in accordance with ASME B16.5. Wrought steel buttwelding fittings shall conform to ASME B16.9. Socket welding and threaded forged steel fittings shall conform to ASME B16.11.

2.1.2 Sealants for Steel Pipe Threaded Joints

Joint sealing compound shall be listed in UL Gas&Oil Dir, Class 20 or less. Tetrafluoroethylene tape shall conform to UL Gas&Oil Dir.

2.1.3 Identification

Pipe flow markings and metal tags shall be provided as required.

2.1.4 Flange Gaskets

Gaskets shall be nonasbestos compressed material in accordance with ASME B16.21, 1/16 inch thickness, full face or self-centering flat ring type. The gaskets shall contain aramid fibers bonded with styrene butadiene rubber (SBR) or nitrile butadiene rubber (NBR) suitable for a maximum 600 degree F service. NBR binder shall be used for hydrocarbon service.

2.1.5 Pipe Threads

Pipe threads shall conform to ASME B1.20.1.

2.1.6 Escutcheons

Escutcheons shall be chromium-plated steel or chromium-plated brass, either one piece or split pattern, held in place by internal spring tension or set screw.

2.1.7 Gas Transition Fittings

Gas transition fittings shall be manufactured steel fittings approved for jointing metallic and thermoplastic or fiberglass pipe. Approved transition fittings are those that conform to AGA XR0104 requirements for transitions fittings.

2.1.8 Insulating Pipe Joints

2.1.8.1 Insulating Joint Material

Insulating joint material shall be provided between flanged or threaded metallic pipe systems where shown to control galvanic or electrical action.

2.1.8.2 Threaded Pipe Joints

Joints for threaded pipe shall be steel body nut type dielectric unions with insulating gaskets.

2.1.8.3 Flanged Pipe Joints

Joints for flanged pipe shall consist of full face sandwich-type flange insulating gasket of the dielectric type, insulating sleeves for flange bolts, and insulating washers for flange nuts.

2.1.9 Flexible Connectors

Flexible connectors for connecting gas utilization equipment to building gas piping shall conform to ANSI Z21.24. Flexible connectors for movable food service equipment shall conform to ANSI Z21.69.

2.2 VALVES

Valves shall be suitable for shutoff or isolation service and shall conform to the following:

2.2.1 Valves 2 Inches and Smaller

Valves 2 inches and smaller shall conform to ASME B16.33 and shall be of materials and manufacture compatible with system materials used.

2.2.2 Valves 2-1/2 Inches and Larger

Valves 2-1/2 inches and larger shall be carbon steel conforming to API Spec 6D, Class 150.

2.3 PIPE HANGERS AND SUPPORTS

Pipe hangers and supports shall conform to MSS SP-58 and MSS SP-69.

2.4 METERS, REGULATORS AND SHUTOFF VALVES

Meters, regulators and shutoff valves shall be as specified in Section 02556A GAS DISTRIBUTION SYSTEM.

PART 3 EXECUTION

3.1 EXCAVATION AND BACKFILLING

Earthwork shall be as specified in Section 02300 EARTHWORK.

3.2 GAS PIPING SYSTEM

Gas piping system shall be from the point of delivery, defined as the outlet of the service regulator, specified in Section 02556A GAS DISTRIBUTION SYSTEM, to the connections to each gas utilization device.

3.2.1 Protection of Materials and Components

Pipe and tube openings shall be closed with caps or plugs during installation. Equipment shall be protected from dirt, water, and chemical or mechanical damage. At the completion of all work, the entire system shall be thoroughly cleaned.

3.2.2 Workmanship and Defects

Piping, tubing and fittings shall be clear and free of cutting burrs and defects in structure or threading and shall be thoroughly brushed and chip-and scale-blown. Defects in piping, tubing or fittings shall not be repaired. When defective piping, tubing, or fittings are located in a system, the defective material shall be replaced.

3.3 PROTECTIVE COVERING

3.3.1 Underground Metallic Pipe

Buried metallic piping shall be protected from corrosion with protective coatings as specified in Section 02556A GAS DISTRIBUTION SYSTEM. When dissimilar metals are joined underground, gastight insulating fittings shall be used.

3.3.2 Aboveground Metallic Piping Systems

3.3.2.1 Ferrous Surfaces

Shop primed surfaces shall be touched up with ferrous metal primer. Surfaces that have not been shop primed shall be solvent cleaned. Surfaces that contain loose rust, loose mill scale and other foreign substances shall be mechanically cleaned by power wire brushing and primed with ferrous metal primer. Primed surface shall be finished with two coats of exterior oil paint.

3.4 INSTALLATION

Installation of the gas system shall be in conformance with the manufacturer's recommendations and applicable provisions of NFPA 54, AGA XR0104, and as indicated. Pipe cutting shall be done without damage to the pipe. Unless otherwise authorized, cutting shall be done by an approved type of mechanical cutter. Wheel cutters shall be used where practicable.

3.4.1 Metallic Piping Installation

Underground piping shall be buried a minimum of 18 inches below grade. Changes in direction of piping shall be made with fittings only; mitering or notching pipe to form elbows and tees or other similar type construction will not be permitted. Branch connection may be made with either tees or forged branch outlet fittings. Branch outlet fittings shall be forged, flared for improvement of flow where attached to the run, and reinforced against external strains.

3.4.2 Connections Between Metallic and Plastic Piping

Connections shall be made only outside, underground, and with approved transition fittings.

3.4.3 Concealed Piping in Buildings

When installing piping which is to be concealed, unions, tubing fittings, running threads, right- and left-hand couplings, bushings, and swing joints made by combinations of fittings shall not be used.

3.4.3.1 Piping in Partitions

Concealed piping shall be located in hollow rather than solid partitions. Tubing passing through walls or partitions shall be protected against physical damage.

3.4.4 Aboveground Piping

Aboveground piping shall be run as straight as practicable along the alignment indicated and with a minimum of joints. Piping shall be separately supported. Exposed horizontal piping shall not be installed farther than 6 inches from nearest parallel wall in laundry areas where clothes hanging could be attempted.

3.4.5 Final Gas Connections

Unless otherwise specified, final connections shall be made with rigid metallic pipe and fittings. Final connections to kitchen ranges shall be made using flexible connectors not less than 40 in. long. Flexible

connectors may be used for final connections to residential dryers. Provide accessible gas shutoff valve and coupling for each gas equipment item.

3.4.6 Seismic Requirements

Piping and attached valves shall be supported and braced to resist seismic loads as specified in Sections 13080 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT and 15070A SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT.

3.5 PIPE JOINTS

Pipe joints shall be designed and installed to effectively sustain the longitudinal pull-out forces caused by contraction of the piping or superimposed loads.

3.5.1 Threaded Metallic Joints

Threaded joints in metallic pipe shall have tapered threads evenly cut and shall be made with UL approved graphite joint sealing compound for gas service or tetrafluoroethylene tape applied to the male threads only. Threaded joints up to 1-1/2 inches in diameter may be made with approved tetrafluoroethylene tape. Threaded joints up to 2 inches in diameter may be made with approved joint sealing compound. After cutting and before threading, pipe shall be reamed and burrs shall be removed. Caulking of threaded joints to stop or prevent leaks shall not be permitted.

3.5.2 Welded Metallic Joints

Beveling, alignment, heat treatment, and inspection of welds shall conform to ASME B31.2. Weld defects shall be removed and repairs made to the weld, or the weld joints shall be entirely removed and rewelded. After filler metal has been removed from its original package, it shall be protected or stored so that its characteristics or welding properties are not affected adversely. Electrodes that have been wetted or have lost any of their coating shall not be used.

3.5.3 Joining Thermoplastic or Fiberglass to Metallic Piping or Tubing

When compression type mechanical joints are used, the gasket material in the fittings shall be compatible with the plastic piping and with the gas in the system. An internal tubular rigid stiffener shall be used in conjunction with the fitting, and the stiffener shall be flush with end of the pipe or tubing and shall extend at least to the outside end of the compression fitting when installed. The stiffener shall be free of rough or sharp edges and shall not be a force fit in the plastic. A split tubular stiffener shall not be used.

3.6 PIPE SLEEVES

Pipes passing through concrete or masonry walls or concrete floors or roofs shall be provided with pipe sleeves fitted into place at the time of construction. Sleeves shall not be installed in structural members except where indicated or approved. All rectangular and square openings shall be as detailed. Each sleeve shall extend through its respective wall, floor or roof, and shall be cut flush with each surface, except in mechanical room floors not located on grade where clamping flanges or riser pipe clamps are used. Sleeves in mechanical room floors above grade shall extend at least 4 inches above finish floor. Unless otherwise indicated, sleeves shall be large enough to provide a minimum clearance of 1/4 inch

all around the pipe. Sleeves in bearing walls, waterproofing membrane floors, and wet areas shall be steel pipe. Sleeves in nonbearing walls, floors, or ceilings may be steel pipe, galvanized sheet metal with lock-type longitudinal seam, or moisture-resistant fiber or plastic. For penetrations of fire walls, fire partitions and floors which are not on grade, the annular space between the pipe and sleeve shall be sealed with firestopping material and sealant that meet the requirement of Section 07840 FIRESTOPPING.

3.7 PIPES PENETRATING WATERPROOFING MEMBRANES

Pipes penetrating waterproofing membranes shall be installed as specified in Section 15400A PLUMBING, GENERAL PURPOSE.

3.8 FIRE SEAL

Penetrations of fire rated partitions, walls and floors shall be in accordance with Section 07840 FIRESTOPPING.

3.9 ESCUTCHEONS

Escutcheons shall be provided for all finished surfaces where gas piping passes through floors, walls, or ceilings except in boiler, utility, or equipment rooms.

3.10 SPECIAL REQUIREMENTS

Drips, grading of the lines, freeze protection, and branch outlet locations shall be as shown and shall conform to the requirements of NFPA 54.

3.11 BUILDING STRUCTURE

Building structure shall not be weakened by the installation of any gas piping. Beams or joists shall not be cut or notched. Piping supports shall not be attached to metal decking. Supports shall not be attached to the underside of concrete filled floors or concrete roof decks unless approved by the Contracting Officer.

3.12 PIPING SYSTEM SUPPORTS

Gas piping systems in buildings shall be supported with pipe hooks, metal pipe straps, bands or hangers suitable for the size of piping or tubing. Gas piping system shall not be supported by other piping. Spacing of supports in gas piping and tubing installations shall conform to the requirements of NFPA 54. The selection and application of supports in gas piping and tubing installations shall conform to the requirements of MSS SP-69. In the support of multiple pipe runs on a common base member, a clip or clamp shall be used where each pipe crosses the base support member. Spacing of the base support members shall not exceed the hanger and support spacing required for any of the individual pipes in the multiple pipe run. The clips or clamps shall be rigidly connected to the common base member. A clearance of 1/8 inch shall be provided between the pipe and clip or clamp for all piping which may be subjected to thermal expansion.

3.13 ELECTRICAL BONDING AND GROUNDING

The gas piping system within the building shall be electrically continuous and bonded to a grounding electrode as required by NFPA 70. Conventional

flange joints allow sufficient current flow to satisfy this requirement.

3.14 SHUTOFF VALVE

Main gas shutoff valve controlling the gas piping system shall be easily accessible for operation and shall be installed as indicated, protected from physical damage, and marked with a metal tag to clearly identify the piping system controlled.

3.15 CATHODIC PROTECTION

Cathodic protection shall be provided for underground ferrous gas piping as specified in Section 13110A CATHODIC PROTECTION SYSTEM (SACRIFICIAL ANODE).

3.16 TESTING

Before any section of a gas piping system is put into service, it shall be carefully tested to assure that it is gastight. Prior to testing, the system shall be blown out, cleaned and cleared of all foreign material. Each joint shall be tested by means of an approved gas detector, soap and water, or an equivalent nonflammable solution. Testing shall be completed before any work is covered, enclosed, or concealed. All testing of piping systems shall be done with due regard for the safety of employees and the public during the test. Bulkheads, anchorage and bracing suitably designed to resist test pressures shall be installed if necessary. Oxygen shall not be used as a testing medium.

3.16.1 Pressure Tests

Before appliances are connected, piping systems shall be filled with air or an inert gas and shall withstand a minimum pressure of 3 pounds gauge for a period of not less than 10 minutes as specified in NFPA 54 without showing any drop in pressure. Oxygen shall not be used. Pressure shall be measured with a mercury manometer, slope gauge, or an equivalent device so calibrated as to be read in increments of not greater than 0.1 pound. The source of pressure shall be isolated before the pressure tests are made.

3.16.2 Test With Gas

Before turning gas under pressure into any piping, all openings from which gas can escape shall be closed. Immediately after turning on the gas, the piping system shall be checked for leakage by using a laboratory-certified gas meter, an appliance orifice, a manometer, or equivalent device. All testing shall conform to the requirements of NFPA 54. If leakage is recorded, the gas supply shall be shut off, the leak shall be repaired, and the tests repeated until all leaks have been stopped.

3.16.3 Purging

After testing is completed, and before connecting any appliances, all gas piping shall be fully purged. Piping shall not be purged into the combustion chamber of an appliance. The open end of piping systems being purged shall not discharge into confined spaces or areas where there are ignition sources unless the safety precautions recommended in NFPA 54 are followed.

3.16.4 Labor, Materials and Equipment

All labor, materials and equipment necessary for conducting the testing and

purging shall be furnished by the Contractor.

3.17 PIPE COLOR CODE MARKING

Color code marking of piping shall be as specified in Section 09900 PAINTING, GENERAL.

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DIVISION 15 - MECHANICAL

SECTION 15400A

PLUMBING, GENERAL PURPOSE

01/04

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PLUMBING, GENERAL PURPOSE
01/04

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI 1010	(2002) Self-Contained, Mechanically Refrigerated Drinking-Water Coolers
ARI 700	(1999) Specifications for Fluorocarbon Refrigerants

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A117.1	(1998) Guidelines for Accessible and Usable Buildings and Facilities -- Providing Accessibility and Usability for Physically Handicapped People
ANSI Z21.10.1	(2001) Gas Water Heaters Vol. I, Storage Water Heaters with Input Ratings of 75,000 Btu Per Hour or Less
ANSI Z21.10.3	(2001) Gas Water Heaters Vol.III, Storage Water Heaters With Input Ratings Above 75,000 Btu Per Hour, Circulating and Instantaneous
ANSI Z21.22	(1999; A 2001) Relief Valves for Hot Water Supply Systems
ANSI Z124.5	(1997) Plastic Toilet (Water Closet) Seats
ANSI Z358.1	(1998) Emergency Eyewash and Shower Equipment

ASTM INTERNATIONAL (ASTM)

ASTM A 105/A 105M	(2002) Carbon Steel Forgings for Piping Applications
ASTM A 183	(1998) Carbon Steel Track Bolts and Nuts
ASTM A 193/A 193M	(2001b) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service

ASTM A 47/A 47M	(1999) Ferritic Malleable Iron Castings
ASTM A 515/A 515M	(2001) Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service
ASTM A 516/A 516M	(2001) Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
ASTM A 518/A 518M	(1999) Corrosion-Resistant High-Silicon Iron Castings
ASTM A 53/A 53M	(2002) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 536	(1984; R 1999e1) Ductile Iron Castings
ASTM A 733	(2001) Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
ASTM A 74	(2003b) Cast Iron Soil Pipe and Fittings
ASTM A 888	(2003) Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
ASTM B 152/B 152M	(2000) Copper Sheet, Strip, Plate, and Rolled Bar
ASTM B 306	(2002) Copper Drainage Tube (DWV)
ASTM B 32	(2000e1) Solder Metal
ASTM B 370	(1998) Copper Sheet and Strip for Building Construction
ASTM B 42	(2002) Seamless Copper Pipe, Standard Sizes
ASTM B 43	(1998) Seamless Red Brass Pipe, Standard Sizes
ASTM B 584	(2000) Copper Alloy Sand Castings for General Applications
ASTM B 75	(2002) Seamless Copper Tube
ASTM B 813	(2000e1) Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube
ASTM B 828	(2002) Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings
ASTM B 88	(2002) Seamless Copper Water Tube
ASTM B 88M	(1999) Seamless Copper Water Tube (Metric)
ASTM C 1053	(2000) Borosilicate Glass Pipe and

	Fittings for Drain, Waste, and Vent (DWV) Applications
ASTM C 564	(2003) Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM C 920	(2002) Elastomeric Joint Sealants
ASTM D 1248	(2002) Polyethylene Plastics Extrusion Materials for Wire and Cable
ASTM D 1785	(1999) Poly(Vinyl Chloride)(PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2000	(2001) Rubber Products in Automotive Applications
ASTM D 2235	(2001) Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings
ASTM D 2239	(2003) Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter
ASTM D 2241	(2000) Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D 2447	(2003) Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, Based on Outside Diameter
ASTM D 2464	(2002) Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2466	(2002) Poly(Vinyl Chloride)(PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2467	(2002) Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2564	(2002) Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D 2661	(2002) Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM D 2665	(2002ae1) Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM D 2672	(1996a) Joints for IPS PVC Pipe Using Solvent Cement
ASTM D 2683	(1998) Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing

ASTM D 2737	(2003) Polyethylene (PE) Plastic Tubing
ASTM D 2822	(1991; R 1997el) Asphalt Roof Cement
ASTM D 2846/D 2846M	(1999) Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems
ASTM D 2855	(1996; R 2002) Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D 2996	(2001) Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe
ASTM D 3035	(2001) Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter
ASTM D 3122	(1995; R 2002) Solvent Cements for Styrene-Rubber (SR) Plastic Pipe and Fittings
ASTM D 3138	(2002) Solvent Cements for Transition Joints Between Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Non-Pressure Piping Components
ASTM D 3139	(1998) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D 3212	(1996a) Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D 3261	(1997) Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
ASTM D 3308	(2001) PTFE Resin Skived Tape
ASTM D 3311	(2002) Drain, Waste, and Vent (DWV) Plastic Fittings Patterns
ASTM D 4101	(2002a) Propylene Injection and Extrusion Materials
ASTM E 1	(2003) ASTM Thermometers
ASTM F 1760	(2001) Coextruded Poly(Vinyl Chloride) (PVC) Non-Pressure Plastic Pipe Having Reprocessed-Recycled Content
ASTM F 409	(2002) Thermoplastic Accessible and Replaceable Plastic Tube and Tubular Fittings
ASTM F 437	(1999) Threaded Chlorinated Poly(Vinyl

	Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
ASTM F 438	(2002e1) Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40
ASTM F 439	(2002e1) Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
ASTM F 441/F 441M	(1999e1) Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80
ASTM F 442/F 442M	(1999) Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR)
ASTM F 477	(2002e1) Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F 493	(1997) Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings
ASTM F 628	(2001) Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe with a Cellular Core
ASTM F 877	(2002a) Crosslinked Polyethylene (PEX) Plastic Hot- and Cold- Water Distribution Systems
ASTM F 891	(2000e1) Coextruded Poly (Vinyl chloride) (PVC) Plastic Pipe with a Cellular Core

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 34	(2001; Errata 2002) Designation and Safety Classification of Refrigerants
ASHRAE 90.1	(2001; various Errata) Energy Standard for Buildings Except Low-Rise Residential Buildings

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1001	(2002) Atmospheric Type Vacuum Breakers
ASSE 1003	(2001) Water Pressure Reducing Valves
ASSE 1005	(1999) Water Heater Drain Valves
ASSE 1010	(1996) Water Hammer Arresters
ASSE 1011	(1993) Hose Connection Vacuum Breakers
ASSE 1012	(2002) Backflow Preventer with Intermediate Atmospheric Vent

ASSE 1013	(1999) Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers
ASSE 1018	(2001) Trap Seal Primer Valves - Potable, Water Supplied
ASSE 1020	(1998) Pressure Vacuum Breaker Assembly
ASSE 1037	(1990) Pressurized Flushing Devices (Flushometers) for Plumbing Fixtures

AMERICAN WATER WORKS ASSOCIATION(AWWA)

AWWA B300	(1999) Hypochlorites
AWWA B301	(1999) Liquid Chlorine
AWWA C203	(2002; A C203a-99) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied
AWWA C606	(1997) Grooved and Shouldered Joints
AWWA C651	(1999) Disinfecting Water Mains
AWWA C652	(2002) Disinfection of Water-Storage Facilities
AWWA D100	(1996) Welded Steel Tanks for Water Storage
AWWA EWW	(1998) Standard Methods for the Examination of Water and Wastewater

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8	(1992) Filler Metals for Brazing and Braze Welding
AWS B2.2	(1991) Brazing Procedure and Performance Qualification

ASME INTERNATIONAL (ASME)

ASME A112.1.2	(1991; R 2002) Air Gaps in Plumbing Systems
ASME A112.14.1	(1975; R 1998)Backwater Valves
ASME A112.18.1	(2003) Plumbing Fixture Fittings
ASME A112.19.1M	(1994; R 1999) Enameled Cast Iron Plumbing Fixtures
ASME A112.19.2M	(1998) Vitreous China Plumbing Fixtures
ASME A112.19.3	(2001) Stainless Steel Fixtures (Designed for Residential Use)
ASME A112.21.2M	(1983) Roof Drains

ASME A112.36.2M	(1991; R 2002) Cleanouts
ASME A112.6.1M	(1997; R 2002) Floor Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use
ASME A112.6.3	(2001) Floor and French Drains
ASME B1.20.1	(1983; R 2001) Pipe Threads, General Purpose, Inch
ASME B16.12	(1998) Cast Iron Threaded Drainage Fittings
ASME B16.15	(1985; R 1994) Cast Bronze Threaded Fittings Classes 125 and 250
ASME B16.18	(2002) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.22	(2002) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.23	(2002) Cast Copper Alloy Solder Joint Drainage Fittings - DWV
ASME B16.24	(2002) Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 400, 600, 900, 1500, and 2500
ASME B16.29	(2002) Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV
ASME B16.3	(1998) Malleable Iron Threaded Fittings
ASME B16.34	(1996) Valves Flanged, Threaded, and Welding End
ASME B16.39	(1998) Malleable Iron Threaded Pipe Unions
ASME B16.4	(1998) Gray Iron Threaded Fittings
ASME B16.5	(1996) Pipe Flanges and Flanged Fittings
ASME B31.1	(2001) Power Piping
ASME B31.5	(2001) Refrigeration Piping and Heat Transfer Components
ASME B40.100	(2000) Pressure Gauges and Gauge Attachments
ASME BPVC SEC IX	(2001) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications

ASME CSD-1	(2002) Control and Safety Devices for Automatically Fired Boilers

CAST IRON SOIL PIPE INSTITUTE (CISPI)

CISPI 301	(2000) Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
CISPI 310	(1997) Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications

COPPER DEVELOPMENT ASSOCIATION (CDA)

CDA A4015	(1994; R 1995) Copper Tube Handbook

FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH (FCCCHR)

FCCCHR Manual	(9th Edition) Manual of Cross-Connection Control

INTERNATIONAL CODE COUNCIL (ICC)

ICC A117.1	(2003) Accessible and Usable Buildings and Facilities
ICC IPC	(2000)International Plumbing Code

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-110	(1996) Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends
MSS SP-25	(1998) Standard Marking System for Valves, Fittings, Flanges and Unions
MSS SP-44	(1996; R 2001) Steel Pipe Line Flanges
MSS SP-58	(1993) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-67	(2002) Butterfly Valves
MSS SP-69	(2002) Pipe Hangers and Supports - Selection and Application
MSS SP-70	(1998) Cast Iron Gate Valves, Flanged and Threaded Ends
MSS SP-71	(1997) Gray Iron Swing Check Valves, Flanged and Threaded Ends
MSS SP-72	(1999) Ball Valves with Flanged or Butt-Welding Ends for General Service

MSS SP-73	(1991; R 1996) Brazing Joints for Copper and Copper Alloy Pressure Fittings
MSS SP-78	(1998) Cast Iron Plug Valves, Flanged and Threaded Ends
MSS SP-80	(1997) Bronze Gate, Globe, Angle and Check Valves
MSS SP-83	(2001) Class 3000 Steel Pipe Unions Socket-Welding and Threaded
MSS SP-85	(1994) Cast Iron Globe & Angle Valves, Flanged and Threaded Ends

NACE INTERNATIONAL (NACE)

NACE RP0169	(2002) Control of External Corrosion on Underground or Submerged Metallic Piping Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(1997) Enclosures for Electrical Equipment (1000 Volts Maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 54	(2002) National Fuel Gas Code
NFPA 90A	(2002) Installation of Air Conditioning and Ventilating Systems

NSF INTERNATIONAL (NSF)

NSF 14	(2003) Plastics Piping System Components and Related Materials
NSF 61	(2002e) Drinking Water System Components - Health Effects

PLASTIC PIPE AND FITTINGS ASSOCIATION (PPFA)

PPFA-01	(1998) Plastic Pipe in Fire Resistive Construction

PLUMBING AND DRAINAGE INSTITUTE (PDI)

PDI WH 201	(1992) Water Hammer Arresters

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE J1508	(1997) Hose Clamp Specifications

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

PL 93-523	(1974; A 1999) Safe Drinking Water Act

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

10 CFR 430	Energy Conservation Program for Consumer Products
40 CFR 50.12	National Primary and Secondary Ambient Air Quality Standards for Lead

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Plumbing System; G-AO

Detail drawings consisting of illustrations, schedules, performance charts, instructions, brochures, diagrams, and other information to illustrate the requirements and operations of each system. Detail drawings for the complete plumbing system including piping layouts and locations of connections; dimensions for roughing-in, foundation, and support points; schematic diagrams and wiring diagrams or connection and interconnection diagrams. Detail drawings shall indicate clearances required for maintenance and operation. Where piping and equipment are to be supported other than as indicated, details shall include loadings and proposed support methods. Mechanical drawing plans, elevations, views, and details, shall be drawn to scale.

Electrical Work; G-AO

Complete electrical schematic lineless or full line interconnection and connection diagram for each piece of mechanical equipment having more than one automatic or manual electrical control device.

SD-03 Product Data

Welding

A copy of qualified procedures and a list of names and identification symbols of qualified welders and welding operators.

Plumbing Fixture Schedule; G-AE

Catalog cuts of specified plumbing fixtures valves andrelated piping system and system location where installed.

Vibration-Absorbing Features; G-AO

Details of vibration-absorbing features, including arrangement, foundation plan, dimensions and specifications.

Plumbing System

Diagrams, instructions, and other sheets proposed for posting. Manufacturer's recommendations for the installation of bell and spigot and hubless joints for cast iron soil pipe.

SD-06 Test Reports

Tests, Flushing and Disinfection

Test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, completion and testing of the installed system. Each test report shall indicate the final position of controls.

Test of Backflow Prevention Assemblies; G-AO.

Certification of proper operation shall be as accomplished in accordance with state regulations by an individual certified by the state to perform such tests. If no state requirement exists, the Contractor shall have the manufacturer's representative test the device, to ensure the unit is properly installed and performing as intended. The Contractor shall provide written documentation of the tests performed and signed by the individual performing the tests.

SD-07 Certificates

Materials and Equipment

Where materials or equipment are specified to comply with requirements of AGA, ASME, or NSF proof of such compliance shall be included. The label or listing of the specified agency will be acceptable evidence. In lieu of the label or listing, a written certificate may be submitted from an approved, nationally recognized testing organization equipped to perform such services, stating that the items have been tested and conform to the requirements and testing methods of the specified agency. Where equipment is specified to conform to requirements of the ASME Boiler and Pressure Vessel Code, the design, fabrication, and installation shall conform to the code.

Bolts

Written certification by the bolt manufacturer that the bolts furnished comply with the specified requirements. The certification shall include illustrations of product-required markings, the date of manufacture, and the number of each type of bolt to be furnished based on this certification.

SD-10 Operation and Maintenance Data

Plumbing System; G-AO.

Six copies of the operation manual outlining the step-by-step procedures required for system startup, operation and shutdown. The manual shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Six copies of the maintenance

manual listing routine maintenance procedures, possible breakdowns and repairs. The manual shall include piping and equipment layout and simplified wiring and control diagrams of the system as installed.

1.3 STANDARD PRODUCTS

Specified materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products. Specified equipment shall essentially duplicate equipment that has performed satisfactorily at least two years prior to bid opening.

1.4 ELECTRICAL WORK

Motors, motor controllers and motor efficiencies shall conform to the requirements of Section 16415A ELECTRICAL WORK, INTERIOR. Electrical motor-driven equipment specified herein shall be provided complete with motors. Equipment shall be rated at 60 Hz, single phase, ac unless otherwise indicated. Where a motor controller is not provided in a motor-control center on the electrical drawings, a motor controller shall be as indicated. Motor controllers shall be provided complete with properly sized thermal-overload protection in each ungrounded conductor, auxiliary contact, and other equipment, at the specified capacity, and including an allowable service factor.

1.5 PERFORMANCE REQUIREMENTS

1.5.1 Welding

Piping shall be welded in accordance with qualified procedures using performance-qualified welders and welding operators. Procedures and welders shall be qualified in accordance with ASME BPVC SEC IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer, may be accepted as permitted by ASME B31.1. The Contracting Officer shall be notified 24 hours in advance of tests, and the tests shall be performed at the work site if practicable. Welders or welding operators shall apply their assigned symbols near each weld they make as a permanent record. Structural members shall be welded in accordance with Section 05090A WELDING, STRUCTURAL.

1.5.2 Cathodic Protection and Pipe Joint Bonding

Cathodic protection and pipe joint bonding systems shall be in accordance with Section 13110A CATHODIC PROTECTION SYSTEM (SACRIFICIAL ANODE).

1.6 REGULATORY REQUIREMENTS

Unless otherwise required herein, plumbing work shall be in accordance with ICC IPC.

1.7 PROJECT/SITE CONDITIONS

The Contractor shall become familiar with details of the work, verify dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

PART 2 PRODUCTS

2.1 MATERIALS

Materials for various services shall be in accordance with TABLES I and II. Pipe schedules shall be selected based on service requirements. Pipe fittings shall be compatible with the applicable pipe materials. Plastic pipe, fittings, and solvent cement shall meet NSF 14 and shall be NSF listed for the service intended. Plastic pipe, fittings, and solvent cement used for potable hot and cold water service shall bear the NSF seal "NSF-PW." Polypropylene pipe and fittings shall conform to dimensional requirements of Schedule 40, Iron Pipe size. Pipe threads (except dry seal) shall conform to ASME B1.20.1. Grooved pipe couplings and fittings shall be from the same manufacturer. Material or equipment containing lead shall not be used in any potable water system. In line devices such as water meters, building valves, check valves, meter stops, valves, fittings and back flow preventers shall comply with PL 93-523 and NSF 61, Section 8. End point devices such as drinking water fountains, lavatory faucets, kitchen and bar faucets, residential ice makers, supply stops and end point control valves used to dispense water for drinking must meet the requirements of NSF 61, Section 9. Hubless cast-iron soil pipe shall not be installed underground, under concrete floor slabs, or in crawl spaces below kitchen floors. Plastic pipe shall not be installed in air plenums. Plastic pipe shall not be installed in a pressure piping system in buildings greater than three stories including any basement levels.

2.1.1 Pipe Joint Materials

Grooved pipe and hubless cast-iron soil pipe shall not be used under ground. Joints and gasket materials shall conform to the following:

a. Coupling for Cast-Iron Pipe: for hub and spigot type ASTM A 74, AWWA C606. For hubless type: CISPI 310

b. Coupling for Steel Pipe: AWWA C606.

c. Couplings for Grooved Pipe: Ductile Iron ASTM A 536 (Grade 65-45-12) Malleable Iron ASTM A 47/A 47M, Grade 32510. Copper ASTM A 536.

d. Flange Gaskets: Gaskets shall be made of non-asbestos material in accordance with ASME B16.21. Gaskets shall be flat, 1/16 inch thick, and contain Aramid fibers bonded with Styrene Butadiene Rubber (SBR) or Nitro Butadiene Rubber (NBR). Gaskets shall be the full face or self centering flat ring type. Gaskets used for hydrocarbon service shall be bonded with NBR.

f. Brazing Material: Brazing material shall conform to AWS A5.8, BCuP-5.

g. Brazing Flux: Flux shall be in paste or liquid form appropriate for use with brazing material. Flux shall be as follows: lead-free; have a 100 percent flushable residue; contain slightly acidic reagents; contain potassium borides; and contain fluorides.

h. Solder Material: Solder metal shall conform to ASTM B 32.

i. Solder Flux: Flux shall be liquid form, non-corrosive, and conform to ASTM B 813, Standard Test 1.

j. PTFE Tape: PTFE Tape, for use with Threaded Metal or Plastic Pipe, ASTM D 3308.

k. Rubber Gaskets for Cast-Iron Soil-Pipe and Fittings (hub and spigot type and hubless type): ASTM C 564.

l. Rubber Gaskets for Grooved Pipe: ASTM D 2000, maximum temperature 230 degrees F.

m. Flexible Elastomeric Seals: ASTM D 3139, ASTM D 3212 or ASTM F 477.

n. Bolts and Nuts for Grooved Pipe Couplings: Heat-treated carbon steel, ASTM A 183.

o. Solvent Cement for Transition Joints between ABS and PVC Nonpressure Piping Components: ASTM D 3138.

p. Plastic Solvent Cement for ABS Plastic Pipe: ASTM D 2235.

q. Plastic Solvent Cement for PVC Plastic Pipe: ASTM D 2564 and ASTM D 2855.

r. Plastic Solvent Cement for CPVC Plastic Pipe: ASTM F 493.

s. Flanged fittings including flanges, bolts, nuts, bolt patterns, etc., shall be in accordance with ASME B16.5 class 150 and shall have the manufacturer's trademark affixed in accordance with MSS SP-25. Flange material shall conform to ASTM A 105/A 105M. Blind flange material shall conform to ASTM A 516/A 516M cold service and ASTM A 515/A 515M for hot service. Bolts shall be high strength or intermediate strength with material conforming to ASTM A 193/A 193M.

t. Plastic Solvent Cement for Styrene Rubber Plastic Pipe: ASTM D 3122.

2.1.2 Miscellaneous Materials

Miscellaneous materials shall conform to the following:

a. Water Hammer Arrester: PDI WH 201.

b. Copper, Sheet and Strip for Building Construction: ASTM B 370.

c. Asphalt Roof Cement: ASTM D 2822.

d. Hose Clamps: SAE J1508.

e. Supports for Off-The-Floor Plumbing Fixtures: ASME A112.6.1M.

f. Metallic Cleanouts: ASME A112.36.2M.

g. Plumbing Fixture Setting Compound: A preformed flexible ring seal molded from hydrocarbon wax material. The seal material shall be nonvolatile nonasphaltic and contain germicide and provide watertight, gastight, odorproof and verminproof properties.

h. Coal-Tar Protective Coatings and Linings for Steel Water Pipelines:

AWWA C203.

i. Hypochlorites: AWWA B300.

j. Liquid Chlorine: AWWA B301.

k. Gauges - Pressure and Vacuum Indicating Dial Type - Elastic Element: ASME B40.100.

l. Thermometers: ASTM E 1. Mercury shall not be used in thermometers.

2.1.3 Pipe Insulation Material

Insulation shall be as specified in Section 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.2 PIPE HANGERS, INSERTS, AND SUPPORTS

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69.

2.3 VALVES

Valves shall be provided on supplies to equipment and fixtures. Valves 2-1/2 inches and smaller shall be bronze with threaded bodies for pipe and solder-type connections for tubing. Valves 3 inches and larger shall have flanged iron bodies and bronze trim. Pressure ratings shall be based upon the application. Grooved end valves may be provided if the manufacturer certifies that the valves meet the performance requirements of applicable MSS standard. Valves shall conform to the following standards:

Description	Standard
Butterfly Valves	MSS SP-67
Cast-Iron Gate Valves, Flanged and Threaded Ends	MSS SP-70
Cast-Iron Swing Check Valves, Flanged and Threaded Ends	MSS SP-71
Ball Valves with Flanged Butt-Welding Ends for General Service	MSS SP-72
Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends	MSS SP-110
Cast-Iron Plug Valves, Flanged and Threaded Ends	MSS SP-78
Bronze Gate, Globe, Angle, and Check Valves	MSS SP-80
Steel Valves, Socket Welding and Threaded Ends	ASME B16.34
Cast-Iron Globe and Angle Valves, Flanged and Threaded Ends	MSS SP-85
Backwater Valves	ASME A112.14.1

Description	Standard
Vacuum Relief Valves	ANSI Z21.22
Water Pressure Reducing Valves	ASSE 1003
Water Heater Drain Valves	ASSE 1005
Trap Seal Primer Valves	ASSE 1018
Temperature and Pressure Relief Valves for Hot Water Supply Systems	ANSI Z21.22
Temperature and Pressure Relief Valves for Automatically Fired Hot Water Boilers	ASME CSD-1 Safety Code No., Part CW, Article 5

2.3.1 Backwater Valves

Backwater valves shall be either separate from the floor drain or a combination floor drain, P-trap, and backwater valve, as shown. Valves shall have cast-iron bodies with cleanouts large enough to permit removal of interior parts. Valves shall be of the flap type, hinged or pivoted, with revolving disks. Hinge pivots, disks, and seats shall be nonferrous metal. Disks shall be slightly open in a no-flow no-backwater condition. Cleanouts shall extend to finished floor and be fitted with threaded countersunk plugs.

2.3.2 Wall Faucets

Wall faucets with vacuum-breaker backflow preventer shall be brass with 3/4 inch male inlet threads, hexagon shoulder, and 3/4 inch hose connection. Faucet handle shall be securely attached to stem.

2.3.3 Wall Hydrants

Wall hydrants with vacuum-breaker backflow preventer shall have a nickel-brass or nickel-bronze wall plate or flange with nozzle and detachable key handle. A brass or bronze operating rod shall be provided within a galvanized iron casing of sufficient length to extend through the wall so that the valve is inside the building, and the portion of the hydrant between the outlet and valve is self-draining. A brass or bronze valve with coupling and union elbow having metal-to-metal seat shall be provided. Valve rod and seat washer shall be removable through the face of the hydrant. The hydrant shall have 3/4 inch exposed hose thread on spout and 3/4 inch male pipe thread on inlet.

2.3.4 Relief Valves

Water heaters and hot water storage tanks shall have a combination pressure and temperature (P&T) relief valve. The pressure relief element of a P&T relief valve shall have adequate capacity to prevent excessive pressure buildup in the system when the system is operating at the maximum rate of heat input. The temperature element of a P&T relief valve shall have a relieving capacity which is at least equal to the total input of the heaters when operating at their maximum capacity. Relief valves shall be rated according to ANSI Z21.22. Relief valves for systems where the

maximum rate of heat input is less than 200,000 Btuh shall have 3/4 inch minimum inlets, and 3/4 inch outlets. Relief valves for systems where the maximum rate of heat input is greater than 200,000 Btuh shall have 1 inch minimum inlets, and 1 inch outlets. The discharge pipe from the relief valve shall be the size of the valve outlet.

2.3.5 Thermostatic Mixing Valves

Mixing valves, thermostatic type, pressure-balanced or combination thermostatic and pressure-balanced shall be line size and shall be constructed with rough or finish bodies either with or without plating. Each valve shall be constructed to control the mixing of hot and cold water and to deliver water at a desired temperature regardless of pressure or input temperature changes. The control element shall be of an approved type. The body shall be of heavy cast bronze, and interior parts shall be brass, bronze, corrosion-resisting steel or copper. The valve shall be equipped with necessary stops, check valves, unions, and sediment strainers on the inlets. Mixing valves shall maintain water temperature within 5 degrees F of any setting.

2.4 FIXTURES

Fixtures shall be water conservation type, in accordance with ICC IPC. Fixtures for use by the physically handicapped shall be in accordance with ICC A117.1. Vitreous china, nonabsorbent, hard-burned, and vitrified throughout the body shall be provided. Porcelain enameled ware shall have specially selected, clear white, acid-resisting enamel coating evenly applied on surfaces. No fixture will be accepted that shows cracks, crazes, blisters, thin spots, or other flaws. Fixtures shall be equipped with appurtenances such as traps, faucets, stop valves, and drain fittings. Each fixture and piece of equipment requiring connections to the drainage system, except grease interceptors, shall be equipped with a trap. Brass expansion or toggle bolts capped with acorn nuts shall be provided for supports, and polished chromium-plated pipe, valves, and fittings shall be provided where exposed to view. Fixtures with the supply discharge below the rim shall be equipped with backflow preventers. Internal parts of flush and/or flushometer valves, shower mixing valves, shower head face plates, pop-up stoppers of lavatory waste drains, and pop-up stoppers and overflow tees and shoes of bathtub waste drains may contain acetal resin, fluorocarbon, nylon, acrylonitrile-butadiene-styrene (ABS) or other plastic material, if the material has provided satisfactory service under actual commercial or industrial operating conditions for not less than 2 years. Plastic in contact with hot water shall be suitable for 180 degrees F water temperature. Plumbing fixtures shall be as indicated in paragraph PLUMBING FIXTURE SCHEDULE.

2.4.1 Lavatories

Vitreous china lavatories shall be provided with two integral molded lugs on the back-underside of the fixture and drilled for bolting to the wall in a manner similar to the hanger plate.

2.4.2 Automatic Flushing System

Flushing system shall consist of solenoid-activated flush valve with light beam sensor. Provide for urinals only. Flushing devices shall be provided as described in paragraph FIXTURES AND FIXTURE TRIMMINGS.

2.5 BACKFLOW PREVENTERS

Backflow preventers shall be approved and listed by the Foundation For Cross-Connection Control & Hydraulic Research. Reduced pressure principle assemblies, double check valve assemblies, atmospheric (nonpressure) type vacuum breakers, and pressure type vacuum breakers shall be tested, approved, and listed in accordance with FCCCHR Manual. Backflow preventers with intermediate atmospheric vent shall conform to ASSE 1012. Reduced pressure principle backflow preventers shall conform to ASSE 1013. Hose connection vacuum breakers shall conform to ASSE 1011. Pipe applied atmospheric type vacuum breakers shall conform to ASSE 1001. Pressure vacuum breaker assembly shall conform to ASSE 1020. Air gaps in plumbing systems shall conform to ASME A112.1.2.

2.6 DRAINS

2.6.1 Floor and Shower Drains

Floor and shower drains shall consist of a galvanized body, integral seepage pan, and adjustable perforated or slotted chromium-plated bronze, nickel-bronze, or nickel-brass strainer, consisting of grate and threaded collar. Floor drains shall be cast iron except where metallic waterproofing membrane is installed. Drains shall be of double drainage pattern for embedding in the floor construction. The seepage pan shall have weep holes or channels for drainage to the drainpipe. The strainer shall be adjustable to floor thickness. A clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the flashing or waterproofing membrane shall be provided when required. Drains shall be provided with threaded connection. Between the drain outlet and waste pipe, a neoprene rubber gasket conforming to ASTM C 564 may be installed, provided that the drain is specifically designed for the rubber gasket compression type joint. Floor and shower drains shall conform to ASME A112.6.3.

2.6.1.1 Metallic Shower Pan Drains

Where metallic shower pan membrane is installed, polyethylene drain with corrosion-resistant screws securing the clamping device shall be provided. Polyethylene drains shall have fittings to adapt drain to waste piping. Polyethylene for floor drains shall conform to ASTM D 1248. Drains shall have separate cast-iron "P" trap, circular body, seepage pan, and strainer, unless otherwise indicated.

2.6.1.2 Drains and Backwater Valves

Drains and backwater valves installed in connection with waterproofed floors or shower pans shall be equipped with bolted-type device to securely clamp flashing.

2.6.2 Roof Drains and Expansion Joints

Roof drains shall conform to ASME A112.21.2M, with dome and integral flange, and shall have a device for making a watertight connection between roofing and flashing. The whole assembly shall be galvanized heavy pattern cast iron. For aggregate surface roofing, the drain shall be provided with a gravel stop. On roofs other than concrete construction, roof drains shall be complete with underdeck clamp, sump receiver, and an extension for the insulation thickness where applicable. A clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the

flashing or membrane shall be provided when required to suit the building construction. Strainer openings shall have a combined area equal to twice that of the drain outlet. The outlet shall be equipped to make a proper connection to threaded pipe of the same size as the downspout. An expansion joint of proper size to receive the conductor pipe shall be provided. The expansion joint shall consist of a heavy cast-iron housing, brass or bronze sleeve, brass or bronze fastening bolts and nuts, and gaskets or packing. The sleeve shall have a nominal thickness of not less than 0.134 inch. Gaskets and packing shall be close-cell neoprene, O-ring packing shall be close-cell neoprene of 70 durometer. Packing shall be held in place by a packing gland secured with bolts.

2.7 TRAPS

Unless otherwise specified, traps shall be plastic per ASTM F 409 or copper-alloy adjustable tube type with slip joint inlet and swivel. Traps shall be without a cleanout. Tubes shall be copper alloy with walls not less than 0.032 inch thick within commercial tolerances, except on the outside of bends where the thickness may be reduced slightly in manufacture by usual commercial methods. Inlets shall have rubber washer and copper alloy nuts for slip joints above the discharge level. Swivel joints shall be below the discharge level and shall be of metal-to-metal or metal-to-plastic type as required for the application. Nuts shall have flats for wrench grip. Outlets shall have internal pipe thread, except that when required for the application, the outlets shall have sockets for solder-joint connections. The depth of the water seal shall be not less than 2 inches. The interior diameter shall be not more than 1/8 inch over or under the nominal size, and interior surfaces shall be reasonably smooth throughout. A copper alloy "P" trap assembly consisting of an adjustable "P" trap and threaded trap wall nipple with cast brass wall flange shall be provided for lavatories. The assembly shall be a standard manufactured unit and may have a rubber-gasketed swivel joint.

2.8 WATER HEATERS

Water heater types and capacities shall be as indicated. Water heaters shall not require anode rods. No steel shall be exposed to water. Each primary water heater shall have controls with an adjustable range that includes 90 to 160 degrees F. Hot water systems utilizing recirculation systems shall be tied into building off-hour controls. The thermal efficiencies and standby heat losses shall conform to TABLE III for each type of water heater specified. The only exception is that storage water heaters and hot water storage tanks having more than 500 gallons storage capacity need not meet the standard loss requirement if the tank surface area is insulated to R-12.5 and if a standing light is not used. Plastic materials polyetherimide (PEI) and polyethersulfone (PES) are forbidden to be used for vent piping of combustion gases. A factory pre-charged expansion tank shall be installed on the cold water supply to each water heater. Expansion tanks shall be specifically designed for use on potable water systems and shall be rated for 200 degrees F water temperature and 150 psi working pressure. The expansion tank size and acceptance volume shall be 15 gallons.

2.8.1 Automatic Storage Type

Heaters shall be complete with control system, temperature gauge, and pressure gauge, and shall have ASME rated combination pressure and temperature relief valve. See Hot Water Storage Tanks for tank construction.

Storage tank, heating surfaces, and combustion chamber to have a ten year waranty against manufacturer's defects, leaks, and rusty water.

2.8.1.1 Gas-Fired Type

Gas-fired water heaters shall conform to ANSI Z21.10.1 when input is 75,000 BTU per hour or less or ANSI Z21.10.3 for heaters with input greater than 75,000 BTU per hour.

2.9 HOT-WATER STORAGE TANKS

Hot-water storage tanks shall be constructed by one manufacturer, ASME stamped for the working pressure, and shall have the National Board (ASME) registration. The tank shall be plated with electroless nickel, steel type in accordance with AWWA D100. Plating shall be high phosphorous and nonporous suitable for submersion service. No steel shall be exposed to water. The heat loss shall conform to TABLE III as determined by the requirements of ASHRAE 90.1. Each tank shall be equipped with a thermometer, conforming to ASTM E 1, Type I, Class 3, Range C, style and form as required for the installation, and with 7 inch scale. Thermometer shall have a separable socket suitable for a 3/4 inch tapped opening. Tanks shall be equipped with a pressure gauge 6 inch minimum diameter face. Insulation shall be as specified in Section 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS. Storage tank capacity shall be as shown.

2.10 PUMPS

2.10.1 Circulating Pumps

Domestic hot water circulating pumps shall be electrically driven, single-stage, centrifugal, with mechanical seals, suitable for the intended service. Pump capacities, efficiencies, motor sizes, speeds, and impeller types shall be as shown. Pump and motor shall be supported by the piping on which it is installed. The shaft shall be one-piece, heat-treated, corrosion-resisting steel with impeller and smooth-surfaced housing of bronze. Motor shall be totally enclosed, fan-cooled and shall have sufficient horsepower for the service required. Each pump motor shall be equipped with an across-the-line magnetic controller in a NEMA 250, Type 1 enclosure with "START-STOP" switch in cover. Pump motors smaller than Fractional horsepower pump motors shall have integral thermal overload protection in accordance with Section 16415A ELECTRICAL WORK, INTERIOR. Guards shall shield exposed moving parts.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Piping located in air plenums shall conform to NFPA 90A requirements. Plastic pipe shall not be installed in air plenums. Piping located in shafts that constitute air ducts or that enclose air ducts shall be noncombustible in accordance with NFPA 90A. Installation of plastic pipe where in compliance with NFPA may be installed in accordance with PPFA-01. The plumbing system shall be installed complete with necessary fixtures, fittings, traps, valves, and accessories. Water and drainage piping shall be extended 5 feet outside the building, unless otherwise indicated. A gate valve and drain shall be installed on the water service line inside the building approximately 6 inches above the floor from point of entry. Piping shall be connected to the exterior service lines or capped or

plugged if the exterior service is not in place. Sewer and water pipes shall be laid in separate trenches, except when otherwise shown. Exterior underground utilities shall be at least 4 feet below the finish grade (sewer) and 8 feet below finished grade for water piping, or as indicated on the drawings. If trenches are closed or the pipes are otherwise covered before being connected to the service lines, the location of the end of each plumbing utility shall be marked with a stake or other acceptable means. Valves shall be installed with control no lower than the valve body.

3.1.1 Water Pipe, Fittings, and Connections

3.1.1.1 Utilities

The piping shall be extended to fixtures, outlets, and equipment. The hot-water and cold-water piping system shall be arranged and installed to permit draining. The supply line to each item of equipment or fixture, except faucets, flush valves, or other control valves which are supplied with integral stops, shall be equipped with a shutoff valve to enable isolation of the item for repair and maintenance without interfering with operation of other equipment or fixtures. Supply piping to fixtures, faucets, hydrants, shower heads, and flushing devices shall be anchored to prevent movement.

3.1.1.2 Cutting and Repairing

The work shall be carefully laid out in advance, and unnecessary cutting of construction shall be avoided. Damage to building, piping, wiring, or equipment as a result of cutting shall be repaired by mechanics skilled in the trade involved.

3.1.1.3 Protection of Fixtures, Materials, and Equipment

Pipe openings shall be closed with caps or plugs during installation. Fixtures and equipment shall be tightly covered and protected against dirt, water, chemicals, and mechanical injury. Upon completion of the work, the fixtures, materials, and equipment shall be thoroughly cleaned, adjusted, and operated. Safety guards shall be provided for exposed rotating equipment.

3.1.1.4 Mains, Branches, and Runouts

Piping shall be installed as indicated. Pipe shall be accurately cut and worked into place without springing or forcing. Structural portions of the building shall not be weakened. Aboveground piping shall run parallel with the lines of the building, unless otherwise indicated. Branch pipes from service lines may be taken from top, bottom, or side of main, using crossover fittings required by structural or installation conditions. Supply pipes, valves, and fittings shall be kept a sufficient distance from other work and other services to permit not less than 1/2 inch between finished covering on the different services. Bare and insulated water lines shall not bear directly against building structural elements so as to transmit sound to the structure or to prevent flexible movement of the lines. Water pipe shall not be buried in or under floors unless specifically indicated or approved. Changes in pipe sizes shall be made with reducing fittings. Use of bushings will not be permitted except for use in situations in which standard factory fabricated components are furnished to accommodate specific accepted installation practice. Change in direction shall be made with fittings, except that bending of pipe 4 inches and smaller will be permitted, provided a pipe bender is used and

wide sweep bends are formed. The center-line radius of bends shall be not less than six diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be acceptable.

3.1.1.5 Pipe Drains

Pipe drains indicated shall consist of 3/4 inch hose bibb with renewable seat and gate valve ahead of hose bibb. At other low points, 3/4 inch brass plugs or caps shall be provided. Disconnection of the supply piping at the fixture is an acceptable drain.

3.1.1.6 Expansion and Contraction of Piping

Allowance shall be made throughout for expansion and contraction of water pipe. Each hot-water and hot-water circulation riser shall have expansion loops or other provisions such as offsets, changes in direction, etc., where indicated and/or required. Risers shall be securely anchored as required or where indicated to force expansion to loops. Branch connections from risers shall be made with ample swing or offset to avoid undue strain on fittings or short pipe lengths. Horizontal runs of pipe over 50 feet in length shall be anchored to the wall or the supporting construction about midway on the run to force expansion, evenly divided, toward the ends. Sufficient flexibility shall be provided on branch runouts from mains and risers to provide for expansion and contraction of piping. Flexibility shall be provided by installing one or more turns in the line so that piping will spring enough to allow for expansion without straining. If mechanical grooved pipe coupling systems are provided, the deviation from design requirements for expansion and contraction may be allowed pending approval of Contracting Officer.

3.1.1.7 Thrust Restraint

Plugs, caps, tees, valves and bends deflecting 11.25 degrees or more, either vertically or horizontally, in waterlines 4 inches in diameter or larger shall be provided with thrust blocks, where indicated, to prevent movement. Thrust blocking shall be concrete of a mix not leaner than: 1 cement, 2-1/2 sand, 5 gravel; and having a compressive strength of not less than 2000 psi after 28 days. Blocking shall be placed between solid ground and the fitting to be anchored. Unless otherwise indicated or directed, the base and thrust bearing sides of the thrust block shall be poured against undisturbed earth. The side of the thrust block not subject to thrust shall be poured against forms. The area of bearing will be as shown. Blocking shall be placed so that the joints of the fitting are accessible for repair. Steel rods and clamps, protected by galvanizing or by coating with bituminous paint, shall be used to anchor vertical down bends into gravity thrust blocks.

3.1.1.8 Commercial-Type Water Hammer Arresters

Commercial-type water hammer arresters shall be provided on hot- and cold-water supplies and shall be located as generally indicated, with precise location and sizing to be in accordance with PDI WH 201. Water hammer arresters, where concealed, shall be accessible by means of access doors or removable panels. Commercial-type water hammer arresters shall conform to ASSE 1010. Vertical capped pipe columns will not be permitted.

3.1.2 Joints

Installation of pipe and fittings shall be made in accordance with the

manufacturer's recommendations. Mitering of joints for elbows and notching of straight runs of pipe for tees will not be permitted. Joints shall be made up with fittings of compatible material and made for the specific purpose intended.

3.1.2.1 Threaded

Threaded joints shall have American Standard taper pipe threads conforming to ASME B1.20.1. Only male pipe threads shall be coated with graphite or with an approved graphite compound, or with an inert filler and oil, or shall have a polytetrafluoroethylene tape applied.

3.1.2.2 Mechanical Couplings

Grooved mechanical joints shall be prepared according to the coupling manufacturer's instructions. Pipe and groove dimensions shall comply with the tolerances specified by the coupling manufacturer. The diameter of grooves made in the field shall be measured using a "go/no-go" gauge, vernier or dial caliper, or narrow-land micrometer. Groove width and dimension of groove from end of the pipe shall be measured and recorded for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances. Grooved joints shall not be used in concealed locations, such as behind solid walls or ceilings, unless an access panel is shown on the drawings for servicing or adjusting the joint.

3.1.2.3 Unions and Flanges

Unions, flanges and mechanical couplings shall not be concealed in walls, ceilings, or partitions. Unions shall be used on pipe sizes 2-1/2 inches and smaller; flanges shall be used on pipe sizes 3 inches and larger.

3.1.2.4 Grooved Mechanical Joints

Grooves shall be prepared according to the coupling manufacturer's instructions. Grooved fittings, couplings, and grooving tools shall be products of the same manufacturer. Pipe and groove dimensions shall comply with the tolerances specified by the coupling manufacturer. The diameter of grooves made in the field shall be measured using a "go/no-go" gauge, vernier or dial caliper, narrow-land micrometer, or other method specifically approved by the coupling manufacturer for the intended application. Groove width and dimension of groove from end of pipe shall be measured and recorded for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances. Grooved joints shall not be used in concealed locations.

3.1.2.5 Cast Iron Soil, Waste and Vent Pipe

Bell and spigot compression and hubless gasketed clamp joints for soil, waste and vent piping shall be installed per the manufacturer's recommendations.

3.1.2.6 Copper Tube and Pipe

a. Brazed. Brazed joints shall be made in conformance with AWS B2.2, MSS SP-73, and CDA A4015 with flux and are acceptable for all pipe sizes. Copper to copper joints shall include the use of copper-phosphorus or copper-phosphorus-silver brazing metal without flux. Brazing of dissimilar metals (copper to bronze or brass) shall include the use of flux with either a

copper-phosphorus, copper-phosphorus-silver or a silver brazing filler metal.

b. Soldered. Soldered joints shall be made with flux and are only acceptable for piping 2 inches and smaller. Soldered joints shall conform to ASME B31.5 and CDA A4015. Soldered joints shall not be used in compressed air piping between the air comppressor and the receiver.

c. Copper Tube Extracted Joint. Mechanically extracted joints shall be made in accordance with ICC IPC.

3.1.2.7 Plastic Pipe

Acrylonitrile-Butadiene-Styrene (ABS) pipe shall have joints made with solvent cement. PVC and CPVC pipe shall have joints made with solvent cement elastomeric, threading, (threading of Schedule 80 Pipe is allowed only where required for disconnection and inspection; threading of Schedule 40 Pipe is not allowed), or mated flanged.

3.1.3 Dissimilar Pipe Materials

Connections between ferrous and non-ferrous copper water pipe shall be made with dielectric unions or flange waterways. Dielectric waterways shall have temperature and pressure rating equal to or greater than that specified for the connecting piping. Waterways shall have metal connections on both ends suited to match connecting piping. Dielectric waterways shall be internally lined with an insulator specifically designed to prevent current flow between dissimilar metals. Dielectric flanges shall meet the performance requirements described herein for dielectric waterways. Connecting joints between plastic and metallic pipe shall be made with transition fitting for the specific purpose.

3.1.4 Corrosion Protection for Buried Pipe and Fittings

Ductile iron, cast iron, and steel pipe, fittings, and joints shall have a protective coating. Additionally, ductile iron, cast iron, and steel pressure pipe shall have a cathodic protection system and joint bonding. The cathodic protection system, protective coating system, and joint bonding for cathodically protected pipe shall be in accordance with Section 13110A CATHODIC PROTECTION SYSTEM (SACRIFICIAL ANODE). Coatings shall be selected, applied, and inspected in accordance with NACE RP0169 and as otherwise specified. The pipe shall be cleaned and the coating system applied prior to pipe tightness testing. Joints and fittings shall be cleaned and the coating system applied after pipe tightness testing. For tape coating systems, the tape shall conform to AWWA C203 and shall be applied with a 50 percent overlap. Primer utilized with tape type coating systems shall be as recommended by the tape manufacturer.

3.1.5 Pipe Sleeves and Flashing

Pipe sleeves shall be furnished and set in their proper and permanent location.

3.1.5.1 Sleeve Requirements

Pipes passing through concrete or masonry walls or concrete floors or roofs shall be provided with pipe sleeves fitted into place at the time of construction. Sleeves are not required for supply, drainage, waste and

vent pipe passing through concrete slab on grade, except where penetrating a membrane waterproof floor. A modular mechanical type sealing assembly may be installed in lieu of a waterproofing clamping flange and caulking and sealing of annular space between pipe and sleeve. The seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and sleeve using galvanized steel bolts, nuts, and pressure plates. The links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and each nut. After the seal assembly is properly positioned in the sleeve, tightening of the bolt shall cause the rubber sealing elements to expand and provide a watertight seal between the pipe and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe and sleeve involved. Sleeves shall not be installed in structural members, except where indicated or approved. Rectangular and square openings shall be as detailed. Each sleeve shall extend through its respective floor, or roof, and shall be cut flush with each surface, except for special circumstances. Pipe sleeves passing through floors in wet areas such as mechanical equipment rooms, lavatories, kitchens, and other plumbing fixture areas shall extend a minimum of 4 inches above the finished floor. Unless otherwise indicated, sleeves shall be of a size to provide a minimum of 1/4 inch clearance between bare pipe or insulation and inside of sleeve or between insulation and inside of sleeve. Sleeves in bearing walls and concrete slab on grade floors shall be steel pipe or cast-iron pipe. Sleeves in nonbearing walls or ceilings may be steel pipe, cast-iron pipe, galvanized sheet metal with lock-type longitudinal seam, or plastic. Except as otherwise specified, the annular space between pipe and sleeve, or between jacket over insulation and sleeve, shall be sealed as indicated with sealants conforming to ASTM C 920 and with a primer, backstop material and surface preparation as specified in Section 07920 JOINT SEALANTS. The annular space between pipe and sleeve, between bare insulation and sleeve or between jacket over insulation and sleeve shall not be sealed for interior walls which are not designated as fire rated. Sleeves through below-grade walls in contact with earth shall be recessed 1/2 inch from wall surfaces on both sides. Annular space between pipe and sleeve shall be filled with backing material and sealants in the joint between the pipe and concrete or masonry wall as specified above. Sealant selected for the earth side of the wall shall be compatible with dampproofing/waterproofing materials that are to be applied over the joint sealant. Pipe sleeves in fire-rated walls shall conform to the requirements in Section 07840 FIRESTOPPING.

3.1.5.2 Flashing Requirements

Pipes passing through roof shall be installed through a 16 ounce copper flashing, each within an integral skirt or flange. Flashing shall be suitably formed, and the skirt or flange shall extend not less than 8 inches from the pipe and shall be set over the roof or floor membrane in a solid coating of bituminous cement. The flashing shall extend up the pipe a minimum of 10 inches. For cleanouts, the flashing shall be turned down into the hub and caulked after placing the ferrule. Pipes passing through pitched roofs shall be flashed, using lead or copper flashing, with an adjustable integral flange of adequate size to extend not less than 8 inches from the pipe in all directions and lapped into the roofing to provide a watertight seal. The annular space between the flashing and the bare pipe or between the flashing and the metal-jacket-covered insulation shall be sealed as indicated. Flashing for dry vents shall be turned down into the pipe to form a waterproof joint. Pipes, up to and including 10 inches in diameter, passing through roof or floor waterproofing membrane may be installed through a cast-iron sleeve with caulking recess, anchor

lugs, flashing-clamp device, and pressure ring with brass bolts. Flashing shield shall be fitted into the sleeve clamping device. Pipes passing through wall waterproofing membrane shall be sleeved as described above. A waterproofing clamping flange shall be installed.

3.1.5.3 Waterproofing

Waterproofing at floor-mounted water closets shall be accomplished by forming a flashing guard from soft-tempered sheet copper. The center of the sheet shall be perforated and turned down approximately 1-1/2 inches to fit between the outside diameter of the drainpipe and the inside diameter of the cast-iron or steel pipe sleeve. The turned-down portion of the flashing guard shall be embedded in sealant to a depth of approximately 1-1/2 inches; then the sealant shall be finished off flush to floor level between the flashing guard and drainpipe. The flashing guard of sheet copper shall extend not less than 8 inches from the drainpipe and shall be lapped between the floor membrane in a solid coating of bituminous cement. If cast-iron water closet floor flanges are used, the space between the pipe sleeve and drainpipe shall be sealed with sealant and the flashing guard shall be upturned approximately 1-1/2 inches to fit the outside diameter of the drainpipe and the inside diameter of the water closet floor flange. The upturned portion of the sheet fitted into the floor flange shall be sealed.

3.1.5.4 Optional Counterflashing

Instead of turning the flashing down into a dry vent pipe, or caulking and sealing the annular space between the pipe and flashing or metal-jacket-covered insulation and flashing, counterflashing may be accomplished by utilizing the following:

a. A standard roof coupling for threaded pipe up to 6 inches in diameter.

b. A tack-welded or banded-metal rain shield around the pipe.

3.1.5.5 Pipe Penetrations of Slab on Grade Floors

Where pipes, fixture drains, floor drains, cleanouts or similar items penetrate slab on grade floors, except at penetrations of floors with waterproofing membrane as specified in paragraphs Flashing Requirements and Waterproofing, a groove 1/4 to 1/2 inch wide by 1/4 to 3/8 inch deep shall be formed around the pipe, fitting or drain. The groove shall be filled with a sealant as specified in Section 07920 JOINT SEALANTS.

3.1.6 Fire Seal

Where pipes pass through fire walls, fire-partitions, fire-rated pipe chase walls or floors above grade, a fire seal shall be provided as specified in Section 07840 FIRESTOPPING.

3.1.7 Supports

3.1.7.1 General

Hangers used to support piping 2 inches and larger shall be fabricated to permit adequate adjustment after erection while still supporting the load. Pipe guides and anchors shall be installed to keep pipes in accurate alignment, to direct the expansion movement, and to prevent buckling,

swaying, and undue strain. Piping subjected to vertical movement when operating temperatures exceed ambient temperatures shall be supported by variable spring hangers and supports or by constant support hangers. In the support of multiple pipe runs on a common base member, a clip or clamp shall be used where each pipe crosses the base support member. Spacing of the base support members shall not exceed the hanger and support spacing required for an individual pipe in the multiple pipe run. Threaded sections of rods shall not be formed or bent.

3.1.7.2 Pipe Supports and Structural Bracing, Seismic Requirements

Piping and attached valves shall be supported and braced to resist seismic loads as specified in Sections 13080 ANTITERRORISM/FORCE PROTECTION (AT/FP) FOR MISCELLANEOUS EQUIPMENT and 15070A ANTITERRORISM/FORCE PROTECTION (AT/FP) FOR MECHANICAL EQUIPMENT. Structural steel required for reinforcement to properly support piping, headers, and equipment, but not shown, shall be provided. Material used for supports shall be as specified in Section 05120 STRUCTURAL STEEL.

3.1.7.3 Pipe Hangers, Inserts, and Supports

Installation of pipe hangers, inserts and supports shall conform to MSS SP-58 and MSS SP-69, except as modified herein.

a. Types 5, 12, and 26 shall not be used.

b. Type 3 shall not be used on insulated pipe.

c. Type 18 inserts shall be secured to concrete forms before concrete is placed. Continuous inserts which allow more adjustment may be used if they otherwise meet the requirements for type 18 inserts.

d. Type 19 and 23 C-clamps shall be torqued per MSS SP-69 and shall have both locknuts and retaining devices furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.

e. Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.

f. Type 24 may be used only on trapeze hanger systems or on fabricated frames.

g. Type 39 saddles shall be used on insulated pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher. Type 39 saddles shall be welded to the pipe.

h. Type 40 shields shall:

(1) Be used on insulated pipe less than 4 inches.

(2) Be used on insulated pipe 4 inches and larger when the temperature of the medium is 60 degrees F or less.

(3) Have a high density insert for all pipe sizes. High density inserts shall have a density of 8 pcf or greater.

i. Horizontal pipe supports shall be spaced as specified in MSS SP-69 and a support shall be installed not over 1 foot from the pipe

fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 5 feet apart at valves. Operating temperatures in determining hanger spacing for PVC or CPVC pipe shall be 120 degrees F for PVC and 180 degrees F for CPVC. Horizontal pipe runs shall include allowances for expansion and contraction.

j. Vertical pipe shall be supported at each floor, except at slab-on-grade, at intervals of not more than 15 feet nor more than 8 feet from end of risers, and at vent terminations. Vertical pipe risers shall include allowances for expansion and contraction.

k. Type 35 guides using steel, reinforced polytetrafluoroethylene (PTFE) or graphite slides shall be provided to allow longitudinal pipe movement. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered. Lateral restraints shall be provided as needed. Where steel slides do not require provisions for lateral restraint the following may be used:

(1) On pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher, a Type 39 saddle, welded to the pipe, may freely rest on a steel plate.

(2) On pipe less than 4 inches a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.

(3) On pipe 4 inches and larger carrying medium less that 60 degrees F a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.

l. Pipe hangers on horizontal insulated pipe shall be the size of the outside diameter of the insulation. The insulation shall be continuous through the hanger on all pipe sizes and applications.

m. Where there are high system temperatures and welding to piping is not desirable, the type 35 guide shall include a pipe cradle, welded to the guide structure and strapped securely to the pipe. The pipe shall be separated from the slide material by at least 4 inches or by an amount adequate for the insulation, whichever is greater.

n. Hangers and supports for plastic pipe shall not compress, distort, cut or abrade the piping, and shall allow free movement of pipe except where otherwise required in the control of expansion/contraction.

3.1.7.4 Structural Attachments

Attachment to building structure concrete and masonry shall be by cast-in concrete inserts, built-in anchors, or masonry anchor devices. Inserts and anchors shall be applied with a safety factor not less than 5. Supports shall not be attached to metal decking. Supports shall not be attached to the underside of concrete filled floor or concrete roof decks unless approved by the Contracting Officer. Masonry anchors for overhead applications shall be constructed of ferrous materials only.

3.1.8 Welded Installation

Plumbing pipe weldments shall be as indicated. Changes in direction of piping shall be made with welding fittings only; mitering or notching pipe to form elbows and tees or other similar type construction will not be permitted. Branch connection may be made with either welding tees or forged branch outlet fittings. Branch outlet fittings shall be forged, flared for improvement of flow where attached to the run, and reinforced against external strains. Beveling, alignment, heat treatment, and inspection of weld shall conform to ASME B31.1. Weld defects shall be removed and repairs made to the weld, or the weld joints shall be entirely removed and rewelded. After filler metal has been removed from its original package, it shall be protected or stored so that its characteristics or welding properties are not affected. Electrodes that have been wetted or that have lost any of their coating shall not be used.

3.1.9 Pipe Cleanouts

Pipe cleanouts shall be the same size as the pipe except that cleanout plugs larger than 4 inches will not be required. A cleanout installed in connection with cast-iron soil pipe shall consist of a long-sweep 1/4 bend or one or two 1/8 bends extended to the place shown. An extra-heavy cast-brass or cast-iron ferrule with countersunk cast-brass head screw plug shall be caulked into the hub of the fitting and shall be flush with the floor. Cleanouts in connection with other pipe, where indicated, shall be T-pattern, 90-degree branch drainage fittings with cast-brass screw plugs, except plastic plugs shall be installed in plastic pipe. Plugs shall be the same size as the pipe up to and including 4 inches. Cleanout tee branches with screw plug shall be installed at the foot of soil and waste stacks, at the foot of interior downspouts, on each connection to building storm drain where interior downspouts are indicated, and on each building drain outside the building. Cleanout tee branches may be omitted on stacks in single story buildings with slab-on-grade construction or where less than 18 inches of crawl space is provided under the floor. Cleanouts on pipe concealed in partitions shall be provided with chromium plated bronze, nickel bronze, nickel brass or stainless steel flush type access cover plates. Round access covers shall be provided and secured to plugs with securing screw. Square access covers may be provided with matching frames, anchoring lugs and cover screws. Cleanouts in finished walls shall have access covers and frames installed flush with the finished wall. Cleanouts installed in finished floors subject to foot traffic shall be provided with a chrome-plated cast brass, nickel brass, or nickel bronze cover secured to the plug or cover frame and set flush with the finished floor. Heads of fastening screws shall not project above the cover surface. Where cleanouts are provided with adjustable heads, the heads shall be cast iron.

3.2 WATER HEATERS AND HOT WATER STORAGE TANKS

3.2.1 Relief Valves

No valves shall be installed between a relief valve and its water heater or storage tank. The P&T relief valve shall be installed where the valve actuator comes in contact with the hottest water in the heater. Whenever possible, the relief valve shall be installed directly in a tapping in the tank or heater; otherwise, the P&T valve shall be installed in the hot-water outlet piping. A vacuum relief valve shall be provided on the cold water supply line to the hot-water storage tank or water heater and mounted above and within 6 inches above the top of the tank or water heater.

3.2.2 Installation of Gas- Fired Water Heater

Installation shall conform to NFPA 54 for gas fired water heaters. Storage water heaters that are not equipped with integral heat traps and having vertical pipe risers shall be installed with heat traps directly on both the inlet and outlet. Circulating systems need not have heat traps installed. An acceptable heat trap may be a piping arrangement such as elbows connected so that the inlet and outlet piping make vertically upward runs of not less than 24 inches just before turning downward or directly horizontal into the water heater's inlet and outlet fittings. Commercially available heat traps, specifically designed by the manufacturer for the purpose of effectively restricting the natural tendency of hot water to rise through vertical inlet and outlet piping during standby periods may also be approved.

3.2.3 Heat Traps

Piping to and from each water heater and hot water storage tank shall be routed horizontally and downward a minimum of 2 feet before turning in an upward direction.

3.2.4 Connections to Water Heaters

Connections of metallic pipe to water heaters shall be made with dielectric unions or flanges.

3.2.5 Expansion Tank

A pre-charged expansion tank shall be installed on the cold water supply between the water heater inlet and the cold water supply shut-off valve. The Contractor shall adjust the expansion tank air pressure, as recommended by the tank manufacturer, to match incoming water pressure.

3.3 FIXTURES AND FIXTURE TRIMMINGS

Polished chromium-plated pipe, valves, and fittings shall be provided where exposed to view. Angle stops, straight stops, stops integral with the faucets, or concealed type of lock-shield, and loose-key pattern stops for supplies with threaded, sweat or solvent weld inlets shall be furnished and installed with fixtures. Where connections between copper tubing and faucets are made by rubber compression fittings, a beading tool shall be used to mechanically deform the tubing above the compression fitting. Exposed traps and supply pipes for fixtures and equipment shall be connected to the rough piping systems at the wall, unless otherwise specified under the item. Floor and wall escutcheons shall be as specified. Drain lines and hot water lines of fixtures for handicapped personnel shall be insulated and do not require polished chrome finish. Plumbing fixtures and accessories shall be installed within the space shown.

3.3.1 Fixture Connections

Where space limitations prohibit standard fittings in conjunction with the cast-iron floor flange, special short-radius fittings shall be provided. Connections between earthenware fixtures and flanges on soil pipe shall be made gastight and watertight with a closet-setting compound or neoprene gasket and seal. Use of natural rubber gaskets or putty will not be permitted. Fixtures with outlet flanges shall be set the proper distance from floor or wall to make a first-class joint with the closet-setting

compound or gasket and fixture used.

3.3.2 Flushometer Valves

Flushometer valves shall be secured to prevent movement by anchoring the long finished top spud connecting tube to wall adjacent to valve with approved metal bracket. Flushometer valves for water closets shall be installed 39 inches above the floor, except at water closets intended for use by the physically handicapped where flushometer valves shall be mounted at approximately 30 inches above the floor and arranged to avoid interference with grab bars. In addition, for water closets intended for handicap use, the flush valve handle shall be installed on the wide side of the enclosure.

3.3.3 Height of Fixture Rims Above Floor

Lavatories shall be mounted with rim 31 inches above finished floor. Wall-hung drinking fountains and water coolers shall be installed with rim 42 inches above floor. Wall-hung service sinks shall be mounted with rim 28 inches above the floor. Installation of fixtures for use by the physically handicapped shall be in accordance with ICC A117.1.

3.3.4 Fixture Supports

Fixture supports for off-the-floor lavatories, urinals, water closets, and other fixtures of similar size, design, and use, shall be of the chair-carrier type. The carrier shall provide the necessary means of mounting the fixture, with a foot or feet to anchor the assembly to the floor slab. Adjustability shall be provided to locate the fixture at the desired height and in proper relation to the wall. Support plates, in lieu of chair carrier, shall be fastened to the wall structure only where it is not possible to anchor a floor-mounted chair carrier to the floor slab.

3.3.4.1 Support for Solid Masonry Construction

Chair carrier shall be anchored to the floor slab. Where a floor-anchored chair carrier cannot be used, a suitable wall plate shall be imbedded in the masonry wall.

3.3.4.2 Support for Concrete-Masonry Wall Construction

Chair carrier shall be anchored to floor slab. Where a floor-anchored chair carrier cannot be used, a suitable wall plate shall be fastened to the concrete wall using through bolts and a back-up plate.

3.3.4.3 Support for Steel Stud Frame Partitions

Chair carrier shall be used. The anchor feet and tubular uprights shall be of the heavy duty design; and feet (bases) shall be steel and welded to a square or rectangular steel tube upright. Wall plates, in lieu of floor-anchored chair carriers, shall be used only if adjoining steel partition studs are suitably reinforced to support a wall plate bolted to these studs.

3.3.4.4 Support for Wood Stud Construction

Where floor is a concrete slab, a floor-anchored chair carrier shall be used. Where entire construction is wood, wood crosspieces shall be installed. Fixture hanger plates, supports, brackets, or mounting lugs

shall be fastened with not less than No. 10 wood screws, 1/4 inch thick minimum steel hanger, or toggle bolts with nut. The wood crosspieces shall extend the full width of the fixture and shall be securely supported.

3.3.4.5 Wall-Mounted Water Closet Gaskets

Where wall-mounted water closets are provided, reinforced wax, treated felt, or neoprene gaskets shall be provided. The type of gasket furnished shall be as recommended by the chair-carrier manufacturer.

3.3.5 Backflow Prevention Devices

Plumbing fixtures, equipment, and pipe connections shall not cross connect or interconnect between a potable water supply and any source of nonpotable water. Backflow preventers shall be installed where indicated and in accordance with ICC IPC at all other locations necessary to preclude a cross-connect or interconnect between a potable water supply and any nonpotable substance. In addition backflow preventers shall be installed at all locations where the potable water outlet is below the flood level of the equipment, or where the potable water outlet will be located below the level of the nonpotable substance. Backflow preventers shall be located so that no part of the device will be submerged. Backflow preventers shall be of sufficient size to allow unrestricted flow of water to the equipment, and preclude the backflow of any nonpotable substance into the potable water system. Bypass piping shall not be provided around backflow preventers. Access shall be provided for maintenance and testing. Each device shall be a standard commercial unit.

3.3.6 Access Panels

Access panels shall be provided for concealed valves and controls, or any item requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced, maintained, or replaced. Access panels shall be as specified in Section 05500A MISCELLANEOUS METAL.

3.3.7 Traps

Each trap shall be placed as near the fixture as possible, and no fixture shall be double-trapped. Traps installed on cast-iron soil pipe shall be cast iron. Traps installed on steel pipe or copper tubing shall be recess-drainage pattern, or brass-tube type. Traps installed on plastic pipe may be plastic conforming to ASTM D 3311. Traps for acid-resisting waste shall be of the same material as the pipe.

3.4 VIBRATION-ABSORBING FEATURES

Mechanical equipment, including compressors and pumps, shall be isolated from the building structure by approved vibration-absorbing features, unless otherwise shown. Each foundation shall include an adequate number of standard isolation units. Each unit shall consist of machine and floor or foundation fastening, together with intermediate isolation material, and shall be a standard product with printed load rating. Piping connected to mechanical equipment shall be provided with flexible connectors.

3.5 ESCUTCHEONS

Escutcheons shall be provided at finished surfaces where bare or insulated piping, exposed to view, passes through floors, walls, or ceilings, except

in boiler, utility, or equipment rooms. Escutcheons shall be fastened securely to pipe or pipe covering and shall be satin-finish, corrosion-resisting steel, polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Escutcheons shall be either one-piece or split-pattern, held in place by internal spring tension or setscrew.

3.6 PAINTING

Painting of pipes, hangers, supports, and other iron work, either in concealed spaces or exposed spaces, is specified in Section 09900 PAINTS AND COATINGS.

3.7 TESTS, FLUSHING AND DISINFECTION

3.7.1 Plumbing System

The following tests shall be performed on the plumbing system in accordance with ICC IPC, except that the drainage and vent system final test shall include the smoke test. The Contractor has the option to perform a peppermint test in lieu of the smoke test. If a peppermint test is chosen, the Contractor must submit a testing procedure to the Contracting Officer for approval.

a. Drainage and Vent Systems Test. The final test shall include a smoke test.

b. Building Sewers Tests.

c. Water Supply Systems Tests.

3.7.1.1 Test of Backflow Prevention Assemblies

Backflow prevention assembly shall be tested using gauges specifically designed for the testing of backflow prevention assemblies. Gauges shall be tested annually for accuracy in accordance with the University of Southern California's Foundation of Cross Connection Control and Hydraulic Research or the American Water Works Association Manual of Cross Connection (Manual M-14). Report form for each assembly shall include, as a minimum, the following:

Data on Device	Data on Testing Firm
Type of Assembly	Name
Manufacturer	Address
Model Number	Certified Tester
Serial Number	Certified Tester No.
Size	Date of Test
Location	
Test Pressure Readings	Serial Number and Test Data of Gauges

If the unit fails to meet specified requirements, the unit shall be repaired and retested.

3.7.2 Defective Work

If inspection or test shows defects, such defective work or material shall be replaced or repaired as necessary and inspection and tests shall be repeated. Repairs to piping shall be made with new materials. Caulking of screwed joints or holes will not be acceptable.

3.7.3 System Flushing

3.7.3.1 During Flushing

Before operational tests or disinfection, potable water piping system shall be flushed with potable water. Sufficient water shall be used to produce a water velocity that is capable of entraining and removing debris in all portions of the piping system. This requires simultaneous operation of all fixtures on a common branch or main in order to produce a flushing velocity of approximately 4 fps through all portions of the piping system. In the event that this is impossible due to size of system, the Contracting Officer (or the designated representative) shall specify the number of fixtures to be operated during flushing. Contractor shall provide adequate personnel to monitor the flushing operation and to ensure that drain lines are unobstructed in order to prevent flooding of the facility. Contractor shall be responsible for any flood damage resulting from flushing of the system. Flushing shall be continued until entrained dirt and other foreign materials have been removed and until discharge water shows no discoloration. All faucets and drinking water fountains, to include any device considered as an end point device by NSF 61, Section 9, shall be flushed a minimum of 0.25 gallons per 24 hour period, ten times over a 14 day period.

3.7.3.2 After Flushing

System shall be drained at low points. Strainer screens shall be removed, cleaned, and replaced. After flushing and cleaning, systems shall be prepared for testing by immediately filling water piping with clean, fresh potable water. Any stoppage, discoloration, or other damage to the finish, furnishings, or parts of the building due to the Contractor's failure to properly clean the piping system shall be repaired by the Contractor. When the system flushing is complete, the hot-water system shall be adjusted for uniform circulation. Flushing devices and automatic control systems shall be adjusted for proper operation. Unless more stringent local requirements exist, lead levels shall not exceed limits established by 40 CFR 50.12 Part 141.80(c)(1). The water supply to the building shall be tested separately to ensure that any lead contamination found during potable water system testing is due to work being performed inside the building.

3.7.4 Operational Test

Upon completion of flushing and prior to disinfection procedures, the Contractor shall subject the plumbing system to operating tests to demonstrate satisfactory functional and operational efficiency. Such operating tests shall cover a period of not less than 8 hours for each system and shall include the following information in a report with conclusion as to the adequacy of the system:

a. Time, date, and duration of test.

b. Water pressures at the most remote and the highest fixtures.

c. Operation of each fixture and fixture trim.

d. Operation of each valve, hydrant, and faucet.

e. Pump suction and discharge pressures.

f. Temperature of each domestic hot-water supply.

g. Operation of each floor and roof drain by flooding with water.

h. Operation of each vacuum breaker and backflow preventer.

i. Complete operation of each water pressure booster system, including pump start pressure and stop pressure.

3.7.5 Disinfection

After operational tests are complete, the entire domestic hot- and cold-water distribution system shall be disinfected. System shall be flushed as specified, before introducing chlorinating material. The chlorinating material shall be hypochlorites or liquid chlorine. Except as herein specified, water chlorination procedure shall be in accordance with AWWA C651 and AWWA C652. The chlorinating material shall be fed into the water piping system at a constant rate at a concentration of at least 50 parts per million (ppm). A properly adjusted hypochlorite solution injected into the main with a hypochlorinator, or liquid chlorine injected into the main through a solution-feed chlorinator and booster pump, shall be used. The chlorine residual shall be checked at intervals to ensure that the proper level is maintained. Chlorine application shall continue until the entire main is filled. The water shall remain in the system for a minimum of 24 hours. Each valve in the system being disinfected shall be opened and closed several times during the contact period to ensure its proper disinfection. Following the 24-hour period, no less than 25 ppm chlorine residual shall remain in the system. Water tanks shall be disinfected by the addition of chlorine directly to the filling water. Following a 6 hour period, no less than 50 ppm chlorine residual shall remain in the tank. If after the 24 hour and 6 hour holding periods, the residual solution contains less than 25 ppm and 50 ppm chlorine respectively, flush the piping and tank with potable water, and repeat the above procedures until the required residual chlorine levels are satisfied. The system including the tanks shall then be flushed with clean water until the residual chlorine level is reduced to less than one part per million. During the flushing period each valve and faucet shall be opened and closed several times. Samples of water in disinfected containers shall be obtained from several locations selected by the Contracting Officer. The samples of water shall be tested for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with AWWA EWW. The testing method used shall be either the multiple-tube fermentation technique or the membrane-filter technique. Disinfection shall be repeated until tests indicate the absence of coliform organisms (zero mean coliform density per 100 milliliters) in the samples for at least 2 full days. The system will not be accepted until satisfactory bacteriological results have been obtained.

3.8 PLUMBING FIXTURE SCHEDULE

P-1 WATER CLOSET:

Siphon-jet, elongated bowl, top supply spud, ASME A112.19.2M, wall mounted.

Seat - ANSI Z124.5, white plastic, elongated, open front.

Flushometer Valve - ASSE 1037, large diaphragm type with non-hold-open

feature, backcheck angle control stop, and vacuum breaker. Minimum upper chamber inside diameter of not less than 2-5/8 inches at the point where the diaphragm is sealed between the upper and lower chambers. The maximum water use shall be 1.6 gallons per flush. Manual type valves .

P-2 WATER CLOSET HANDICAPPED:

Height of top rim of bowl shall be in accordance with ICC A117.1; other features are the same as P-1.

P-3 URINAL:

Wall hanging, with integral trap and extended shields, ASME A112.19.2M siphon jet. Top supply connection, back outlet.

Flushometer Valve - Autoflush type, hard wired with infrared sensor. The maximum water use shall be 1 gallon per flush. Transformer anad wiring to be completely concealed.

Vitreous china urinal shall be in accordance with ASME A112.19.2M and ANSI A117.1.

P-4 LAVATORY:

Manufacturer's standard sink depth, vitreous china ASME A112.19.2M countertop.

Faucet - Faucets shall meet the requirements of NSF 61, Section 9. Faucets shall be single control, mixing type. Faucets shall have replaceable seats and washers. Valves and handles shall be copper alloy. Connection between valve and spout for center-set faucet shall be of rigid metal tubing. Flow shall be limited to 0.25 gallon per cycle at a flowing water pressure of 80 psi if a metering device or fitting is used that limits the period of water discharge such as a foot switch or fixture occupancy sensor. If a metering device is not used, the flow shall be limited to 2.5 gpm at a flowing pressure of 80 psi.

Handles - Lever type. Cast, formed, or drop forged copper alloy.

Drain - Strainer shall be copper alloy or stainless steel Pop-up drain shall include stopper, lift rods, jam nut, washer, and tail piece. See paragraph FIXTURES for optional plastic accessories.

P-5 LAVATORY:

Manufacturer's standard sink depth, vitreous china ASME A112.19.2M countertop.

Faucet - Faucets shall meet the requirements of NSF 61, Section 9. Faucets shall be automatic, tempered water, mixing type. Faucets shall have replaceable seats and washers. Valves and handles shall be copper alloy. Connection between valve and spout for center-set faucet shall be of rigid metal tubing. Flow shall be limited to 0.25 gallon per cycle at a flowing water pressure of 80 psi if a metering device or fitting is used that limits the period of water discharge such as a foot switch or fixture occupancy sensor. If a metering device is not used, the flow shall be limited to 2.5 gpm at a flowing pressure of 80 psi. Auto sensor transformer and power wiring to be concealed.

Drain - Strainer shall be copper alloy or stainless steel Pop-up drain shall include stopper, lift rods, jam nut, washer, and tail piece. See paragraph FIXTURES for optional plastic accessories.

P-6 WHEELCHAIR LAVATORY:

Vitreous china, ASME A112.19.2M, wheelchair lavatory with automatic mixing valve controls 20 inches wide x 27 inches deep with gooseneck spout. Flow shall be limited to 0.25 gallon per cycle at a flowing water pressure of 80 psi if a metering device or fitting is used that limits the period of water discharge such as foot switch or fixture occupancy sensor. If a metering device is not used, the flow shall be limited to 2.5 gpm at a flowing water pressure of 80 psi. Auto sensor transformer and power wiring to be concealed.

Drain - Strainer shall be copper alloy or stainless steel.

P-7 BREAK SINK:

Ledge back with holes for faucet and spout single bowl 24 x 21 inches stainless steel ASME A112.19.3.

Faucet and Spout - Faucets shall meet the requirements of NSF 61, Section 9. Cast or wrought copper alloy. Aerator shall have internal threads. Flow shall be limited to 0.25 gallon per cycle at a flowing water pressure of 80 psi if a metering device or fitting is used that limits the period of water discharge such as a foot switch or fixture occupancy sensor. If a metering device is not used, the flow shall be limited to 2.5 gpm at a flowing water pressure of 80 psi.

Handle - Cast copper alloy, wrought copper alloy, or stainless steel. Single lever type.

Drain Assembly - Plug, cup strainer, crossbars, jam nuts, washers, couplings, stopper, etc., shall be copper alloy or stainless steel.

P-8 KITCHEN SINK:

Ledge back with holes for faucet and spout double bowl 32 x 21 inches stainless steel ASME A112.19.3.

Faucet and Spout - Faucets shall meet the requirements of NSF 61, Section 9. Cast or wrought copper alloy. Aerator shall have internal threads. Flow shall be limited to 0.25 gallon per cycle at a flowing water pressure of 80 psi if a metering device or fitting is used that limits the period of water discharge such as a foot switch or fixture occupancy sensor. If a metering device is not used, the flow shall be limited to 2.5 gpm at a flowing water pressure of 80 psi.

Handle - Cast copper alloy, wrought copper alloy, or stainless steel. Single lever type.

Drain Assembly - Plug, cup strainer, crossbars, jam nuts, washers, couplings, stopper, etc., shall be copper alloy or stainless steel.

P-9 SERVICE SINK:

Enameled cast iron ASME A112.19.1M, copper alloy or stainless steel ASME A112.19.3 corner, floor mounted 28 inches square, 6-3/4 inches deep.

Faucet and Spout - Cast or wrought copper alloy, with top or bottom brace, with backflow preventer. Faucets shall have replaceable seat and the washer shall rotate onto the seat. Handles shall be lever type. Strainers shall have internal threads.

Drain Assembly - Plug, cup strainer, crossbars, jam nuts, washers, couplings, stopper, etc., shall be copper alloy or stainless steel.

Trap - Cast iron, minimum 3 inch diameter.

P-10 COMBINATION SINK AND LAUNDRY TRAY:

Ledge back 42 x 25 inch), 4 inch splash back, sink 8 inches deep, tray 12 inches deep)left handenameled cast iron ASME A112.19.1M.

Faucet and Spout - Cast or wrought copper alloy, with top or bottom brace, with backflow preventer. Faucets shall have replaceable seat and the washer shall rotate onto the seat. Strainers shall have internal threads. Combination faucets with two valves and spouts shall be provided.

Handles - Cast or wrought copper alloy. Lever type.

P-11 SHOWER:

Shower heads, ASME A112.18.1 other than emergency showers, shall be adjustable spray type and shall include a non-removable, tamperproof device to limit water flow to 2.5 gpm when tested in accordance with ASME A112.18.1.

Wall Mounted: Shower head shall be adjustable spray, stainless steel or chromium plated brass with ball joint. Handles shall be chrome-plated die cast zinc alloy. Pressure balancing mix control valves shall be copper alloy and have metal integral parts of copper alloy, nickel alloy, or stainless steel. Valves shall be single lever type with integral stops. Shower head shall be vandalproof with integral back.

P-12 HANDICAP SHOWER:

Similar to P-11. Pressure balancing valve shall be copper aloy and have metal integral parts of copper alloy, nickel alloy or stainless steel. Valve shall be single lever type with integral stops. Hand held shower head with 60 inches stainless steel flexible hose.

P-13 EMERGENCY SHOWERS:

Head for Emergency shower and Emergency Eye and Face Wash. Shower control shall be 1 inch or 1-1/2 inch stay-open type control valve. Unit shall be corrosion-resisting steel and shall be pedestal mounted. Emergency showers shall comply with ANSI Z358.1.

Emergency Eye Wash: Fountain, ANSI Z358.1, eye wash, wall mounted self-cleaning, non-clogging eye and face wash with quick opening, full-flow valves, corrosion-resisting steel eye and face wash receptor. Unit shall deliver 3 gpm of aerated water at 30 psig flow pressure, with eye and face wash nozzles 33 to 45 inches above finished floor. Copper alloy control valves shall be provided. An air-gap shall be provided with the lowest

potable eye and face wash water outlet located above the overflow rim by not less than the ICC IPC minimum per IPC Table 608.15.1. The Contractor shall provide packaged, U.L. listed, alarm system; including an amber strobe lamp, horn with externally adjustable loudness and horn silencing switch, mounting hardware, and waterflow switch, assembled and prewired for NEMA 3 waterproof service, a pressure-compensated tempering valve, with leaving water temperature setpoint adjustable throughout the range 60 to 95 degrees F, complete with 1/2 inch pipe connection and 1-1/4 inch standard chrome drain fitting.

P-14 WATER COOLER DRINKING FOUNTAINS:

Water cooler drinking fountains shall meet the requirements of NSF 61, Section 9, shall be self contained, conform to ARI 1010, and use one of the fluorocarbon gases conforming to ARI 700 and ASHRAE 34 which has an Ozone Depletion Potential of less than or equal to 0.05. Shall deliver not less than 8 gph of water at 50 degrees F with an inlet water temperature of 80 degrees F and ambient air temperature of 90 degrees F. Drinking fountains shall have a self-closing valve with automatic stream regulator, flow control capability, an in-line inlet strainer, and have push-button or bar actuation. Exposed surfaces of stainless steel shall have a satin finish. Waste strainers shall be made of chrome plated brass or stainless steel.

Surface wall-mounted units shall have a bowl and splash back made of stainless steel. The unit shall have concealed fasteners and be for interior installation.

Handicapped units shall be surface wall-mounted. The unit shall clear the floor or ground by at least 8 inches. A clear knee space shall exist between the bottom of the bowl and the floor or ground of at least 27 inches and between the front edge of the bowl and the body of the unit of at least 8 inches. A 8 inch wide clear space shall exist on both sides of the unit. The spout height shall be no more than 36 inches above the floor or ground. The spout shall be at the front of the unit and direct the water flow in a trajectory that is parallel or nearly parallel to the front of the unit. The bowl and splash back shall be made of stainless steel and be for interior installation.

P-15 FOOD WASTE DISPOSER:

See Section 11401N ELECTRIC KITCHEN EQUIPMENT, paragraph 2.1.6.

P-16 DISHWASHING MACHINES:

See Section 11401N ELECTRIC KITCHEN EQUIPMENT, paragraph 2.1.5.

P-17 WASHING MACHINE WALL BOX

3.9 POSTED INSTRUCTIONS

Framed instructions under glass or in laminated plastic, including wiring and control diagrams showing the complete layout of the entire system, shall be posted where directed. Condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system shall be prepared in typed form, framed as specified

above for the wiring and control diagrams and posted beside the diagrams. The framed instructions shall be posted before acceptance testing of the systems.

3.10 PERFORMANCE OF WATER HEATING EQUIPMENT

Standard rating condition terms are as follows:

EF = Energy factor, overall efficiency.

ET = Thermal efficiency with 70 degrees F delta T.

EC = Combustion efficiency, 100 percent - flue loss when smoke = o (trace is permitted).

SL = Standby loss in W/sq. ft. based on 80 degrees F delta T, or in percent per hour based on nominal 90 degrees F delta T.

HL = Heat loss of tank surface area.

V = Storage volume in liters

3.10.1 Storage Water Heaters

3.10.1.1 Gas

a. Storage capacity of 100 gallons or less, and input rating of 75,000 Btu/h or less: minimum EF shall be 0.62-0.0019V per 10 CFR 430.

b. Storage capacity of more than 100 gallons - or input rating more than 75,000 Btu/h: Et shall be 77 percent; maximum SL shall be 1.3+38/V, per ANSI Z21.10.3.

3.10.2 Unfired Hot Water Storage

Volumes and inputs: maximum HL shall be 6.5 Btu/h/sq. ft.

3.11 TABLES

TABLE I
PIPE AND FITTING MATERIALS FOR
DRAINAGE, WASTE, AND VENT PIPING SYSTEMS

		SERVICE					
Item #	Pipe and Fitting Materials	A	B	C	D	E	F
1	Cast iron soil pipe and fittings, hub and spigot, ASTM A 74 with compression gaskets. Pipe and fittings shall be marked with the CISPI trademark.	X	X	X	X	X	
2	Cast iron soil pipe and fittings hubless, CISPI 301 and ASTM A 888. Pipe and fittings shall be marked with the CISPI trademark.		X	X	X	X	
3	Cast iron drainage fittings, threaded, ASME B16.12 for use with Item 10	X		X	X		
4	Cast iron screwed fittings (threaded) ASME B16.4 for use with Item 10				X	X	
5	Grooved pipe couplings, ferrous and non-ferrous pipe ASTM A 536 and ASTM A 47/A 47M	X	X		X	X	
6	Ductile iron grooved joint fittings for ferrous pipe ASTM A 536 and ASTM A 47/A 47M for use with Item 5	X	X		X	X	
7	Bronze sand casting grooved joint pressure fittings for non-ferrous pipe ASTM B 584, for use with Item 5	X	X		X	X	
8	Wrought copper grooved joint pressure pressure fittings for non-ferrous pipe ASTM B 75 C12200, ASTM B 152/B 152M, C11000, ASME B16.22 ASME B16.22 for use with Item 5	X	X				
9	Malleable-iron threaded fittings, galvanized ASME B16.3 for use with Item 10				X	X	
10	Steel pipe, seamless galvanized, ASTM A 53/A 53M, Type S, Grade B	X			X	X	
11	Seamless red brass pipe, ASTM B 43		X	X			

TABLE I
PIPE AND FITTING MATERIALS FOR
DRAINAGE, WASTE, AND VENT PIPING SYSTEMS

		SERVICE					
Item #	Pipe and Fitting Materials	A	B	C	D	E	F
12	Bronzed flanged fittings, ASME B16.24 for use with Items 11 and 14				X	X	
13	Cast copper alloy solder joint pressure fittings, ASME B16.18 for use with Item 14				X	X	
14	Seamless copper pipe, ASTM B 42			X			
15	Cast bronze threaded fittings, ASME B16.15				X	X	
16	Copper drainage tube, (DWV), ASTM B 306	X*	X	X*	X	X	
17	Wrought copper and wrought alloy solder-joint drainage fittings. ASME B16.29	X	X	X	X	X	
18	Cast copper alloy solder joint drainage fittings, DWV, ASME B16.23	X	X	X	X	X	
19	Acrylonitrile-Butadiene-Styrene (ABS) plastic drain, waste, and vent pipe and fittings ASTM D 2661, ASTM F 628	X	X	X	X	X	X
20	Polyvinyl Chloride plastic drain, waste and vent pipe and fittings, ASTM D 2665, ASTM F 891, (Sch 40) ASTM F 1760	X	X	X	X	X	X
21	Process glass pipe and fittings, ASTM C 1053						X
22	High-silicon content cast iron pipe and fittings (hub and spigot, and mechanical joint), ASTM A 518/A 518M		X			X	X
23	Polypropylene (PP) waste pipe and fittings, ASTM D 4101						X
24	Filament-wound reinforced thermosetting resin (RTRP) pipe, ASTM D 2996						X

SERVICE:

TABLE I
PIPE AND FITTING MATERIALS FOR
DRAINAGE, WASTE, AND VENT PIPING SYSTEMS

		SERVICE					
Item #	Pipe and Fitting Materials	A	B	C	D	E	F

A - Underground Building Soil, Waste and Storm Drain
B - Aboveground Soil, Waste, Drain In Buildings
C - Underground Vent
D - Aboveground Vent
E - Interior Rainwater Conductors Aboveground
F - Corrosive Waste And Vent Above And Belowground
* - Hard Temper

TABLE II
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

		SERVICE			
Item No.	Pipe and Fitting Materials	A	B	C	D
1	Malleable-iron threaded fittings, a. Galvanized, ASME B16.3 for use with Item 4a	X	X	X	X
	b. Same as "a" but not galvanized for use with Item 4b			X	
2	Grooved pipe couplings, ferrous pipe ASTM A 536 and ASTM A 47/A 47M, non-ferrous pipe, ASTM A 536 and ASTM A 47/A 47M,	X	X	X	
3	Ductile iron grooved joint fittings for ferrous pipe ASTM A 536 and ASTM A 47/A 47M, for use with Item 2	X	X	X	
4	Steel pipe: a. Seamless, galvanized, ASTM A 53/A 53M, Type S, Grade B	X	X	X	X
	b. Seamless, black, ASTM A 53/A 53M, Type S, Grade B			X	
5	Seamless red brass pipe, ASTM B 43	X	X		X
6	Bronze flanged fittings, ASME B16.24 for use with Items 5 and 7	X	X		X
7	Seamless copper pipe, ASTM B 42	X	X		X
8	Seamless copper water tube, ASTM B 88, ASTM B 88M	X**	X**	X**	X***
9	Cast bronze threaded fittings, ASME B16.15 for use with Items 5 and 7	X	X		X
10	Wrought copper and bronze solder-joint pressure fittings, ASME B16.22 for use with Items 5, 7 and 8	X	X	X	X
11	Cast copper alloy solder-joint pressure fittings,	X	X	X	X

TABLE II
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

		SERVICE			
Item No.	Pipe and Fitting Materials	A	B	C	D
	ASME B16.18 for use with Item 8				
12	Bronze and sand castings grooved joint pressure fittings for non-ferrous pipe ASTM B 584, for use with Item 2	X	X	X	
13	Polyethylene (PE) plastic pipe, Schedules 40 and 80, based on outside diameter ASTM D 2447	X			X
14	Polyethylene (PE) plastic pipe (SDR-PR), based on controlled outside diameter, ASTM D 3035	X			X
15	Polyethylene (PE) plastic pipe (SIDR-PR), based on controlled inside diameter, ASTM D 2239	X			X
16	Butt fusion polyethylene (PE) plastic pipe fittings, ASTM D 3261 for use with Items 14, 15, and 16	X			X
17	Socket-type polyethylene fittings for outside diameter-controlled polyethylene pipe, ASTM D 2683 for use with Item 15	X			X
18	Polyethylene (PE) plastic tubing, ASTM D 2737	X			X
19	Chlorinated polyvinyl chloride (CPVC) plastic hot and cold water distribution system, ASTM D 2846/D 2846M	X	X		X
20	Chlorinated polyvinyl chloride (CPVC) plastic pipe, Schedule 40 and 80, ASTM F 441/F 441M	X	X		X
21	Chlorinated polyvinyl chloride (CPVC) plastic pipe (SDR-PR) ASTM F 442/F 442M	X	X		X
22	Threaded chlorinated polyvinyl chloride (chloride CPVC) plastic pipe fittings,	X	X		X

TABLE II
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

		SERVICE			
Item No.	Pipe and Fitting Materials	A	B	C	D
	Schedule 80, ASTM F 437, for use with Items 20, and 21				
23	Socket-type chlorinated polyvinyl chloride (CPVC) plastic pipe fittings, Schedule 40, ASTM F 438 for use with Items 20, 21, and 22	X	X		X
24	Socket-type chlorinated polyvinyl chloride (CPVC) plastic pipe fittings Schedule 80, ASTM F 439 for use with Items 20, 21, and 22	X	X		X
25	Polyvinyl chloride (PVC) plastic pipe, Schedules 40, 80, and 120, ASTM D 1785	X			X
26	Polyvinyl chloride (PVC) pressure-rated pipe (SDR Series), ASTM D 2241	X			X
27	Polyvinyl chloride (PVC) plastic pipe fittings, Schedule 40, ASTM D 2466	X			X
28	Socket-type polyvinyl chloride (PVC) plastic pipe fittings, schedule 80, ASTM D 2467 for use with Items 26 and 27	X			X
29	Threaded polyvinyl chloride (PVC) plastic pipe fittings, schedule 80, ASTM D 2464	X			X
30	Joints for IPS pvs pipe using solvent cement, ASTM D 2672	X			X
31	Filament-wound reinforced thermosetting resin (RTRP) pipe, ASTM D 2996	X	X		
32	Steel pipeline flanges, MSS SP-44	X	X		
33	Fittings: brass or bronze; ASME B16.15, and ASME B16.18 ASTM B 828	X	X		
34	Carbon steel pipe unions,	X	X	X	

TABLE II
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

		SERVICE			
Item No.	Pipe and Fitting Materials	A	B	C	D
	socket-welding and threaded, MSS SP-83				
35	Malleable-iron threaded pipe unions ASME B16.39	X	X		
36	Nipples, pipe threaded ASTM A 733	X	X	X	
37	Crosslinked Polyethylene (PEX) Plastic Pipe ASTM F 877.	X			X

A - Cold Water Service Aboveground
B - Hot and Cold Water Distribution 180 degrees F Maximum Aboveground
C - Compressed Air Lubricated
D - Cold Water Service Belowground
Indicated types are minimum wall thicknesses.
** - Type L - Hard
*** - Type K - Hard temper with brazed joints only or type K-soft temper without joints in or under floors
**** - In or under slab floors only brazed joints

TABLE III
STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE RATINGS FOR WATER HEATING EQUIPMENT

A. STORAGE WATER HEATERS

FUEL	STORAGE CAPACITY GALLONS	INPUT RATING	TEST PROCEDURE	REQUIRED PERFORMANCE
Gas	100 min. OR	75,000 Btu/h	ANSI Z21.10.3	ET = 94 percent; SL = 1.3+38/V max.

TERMS:

EF = Energy factor, overall efficiency.
ET = Thermal efficiency with 70 degrees F delta T.
EC = Combustion efficiency, 100 percent - flue loss when smoke = 0 (trace is permitted).
SL = Standby loss in W/sq. ft. based on 80 degrees F delta T, or in percent per hour based on nominal 90 degrees F delta T.
HL = Heat loss of tank surface area
V = Storage volume in gallons

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SECTION 15556A

FORCED HOT WATER HEATING SYSTEMS USING WATER AND STEAM HEAT EXCHANGERS

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SECTION 15556A

FORCED HOT WATER HEATING SYSTEMS USING WATER AND STEAM HEAT EXCHANGERS
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PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designations only.

AMERICAN WATER WORKS ASSOCIATION(AWWA)

AWWA C606	(1997) Grooved and Shouldered Joints

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8	(1992) Filler Metals for Brazing and Braze Welding

ASME INTERNATIONAL (ASME)

ASME B1.20.1	(1983; R 2001) Pipe Threads, General Purpose, Inch
ASME B16.1	(1998) Cast Iron Pipe Flanges and Flanged Fittings
ASME B16.11	(2002) Forged Fittings, Socket-Welding and Threaded
ASME B16.15	(1985; R 1994) Cast Bronze Threaded Fittings Classes 125 and 250
ASME B16.18	(2002) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.22	(2002) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.26	(1988) Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B16.3	(1998) Malleable Iron Threaded Fittings
ASME B16.34	(1996) Valves Flanged, Threaded, and Welding End
ASME B16.39	(1998) Malleable Iron Threaded Pipe Unions
ASME B16.4	(1998) Gray Iron Threaded Fittings

ASME B16.5	(1996) Pipe Flanges and Flanged Fittings
ASME B16.9	(2001) Factory-Made Wrought Steel Buttwelding Fittings
ASME B31.1	(2001) Power Piping
ASME B40.1	(1991) Gauges - Pressure Indicating Dial Type - Elastic Element **
ASME BPVC SEC IX	(2001) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications
ASME BPVC SEC VIII D1	(2001) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage

ASTM INTERNATIONAL (ASTM)

ASTM A 105/A 105M	(2002) Carbon Steel Forgings for Piping Applications
ASTM A 106	(2002a) Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A 183	(1998) Carbon Steel Track Bolts and Nuts
ASTM A 193/A 193M	(2001b) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 234/A 234M	(2002) Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
ASTM A 366/A 366M	(1997e1) Commercial Steel, Sheet, Carbon,(0.15 Maximum Percent Cold-Rolled**
ASTM A 47/A 47M	(1999) Ferritic Malleable Iron Castings
ASTM A 515/A 515M	(2001) Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service
ASTM A 516/A 516M	(2001) Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
ASTM A 53/A 53M	(2002) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 536	(1984; R 1999e1) Ductile Iron Castings
ASTM A 569/A 569M	(1998) Steel, Carbon (0.15 Maximum Percent), Hot-Rolled Sheet and Strip, Commercial

ASTM A 653/A 653M	(2002a) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 733	(2001) Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
ASTM B 32	(2000e1) Solder Metal
ASTM B 395/B 395M	(1995) U-Bend Seamless Copper and Copper Alloy Heat Exchanger and Condenser Tubes
ASTM B 395M	(1995) U-Bend Seamless Copper and Copper Alloy Heat Exchanger and Condenser Tubes (Metric)
ASTM B 62	(2002) Composition Bronze or Ounce Metal Castings
ASTM B 687	(1999) Brass, Copper, and Chromium-Plated Pipe Nipples
ASTM B 75	(2002) Seamless Copper Tube
ASTM B 813	(2000e1) Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube
ASTM B 828	(2002) Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings
ASTM B 88	(2002) Seamless Copper Water Tube
ASTM B 88M	(1999) Seamless Copper Water Tube (Metric)
ASTM D 1248	(2002) Polyethylene Plastics Extrusion Materials for Wire and Cable
ASTM D 1384	(2001) Corrosion Test for Engine Coolants in Glassware
ASTM D 2000	(2001) Rubber Products in Automotive Applications
ASTM D 3308	(2001) PTFE Resin Skived Tape
ASTM D 596	(2001) Reporting Results of Analysis of Water

HYDRONICS INSTITUTE DIVISION OF GAMA (HYI)

HYI Ratings	(2002) I=B=R Ratings for Boilers, Baseboard Radiation and Finned Tube (Commercial)

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-25	(1998) Standard Marking System for Valves,

	Fittings, Flanges and Unions
MSS SP-58	(1993) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	(2002) Pipe Hangers and Supports - Selection and Application
MSS SP-70	(1998) Cast Iron Gate Valves, Flanged and Threaded Ends
MSS SP-71	(1997) Gray Iron Swing Check Valves, Flanged and Threaded Ends
MSS SP-80	(1997) Bronze Gate, Globe, Angle and Check Valves
MSS SP-85	(1994) Cast Iron Globe & Angle Valves, Flanged and Threaded Ends

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(1997) Enclosures for Electrical Equipment (1000 Volts Maximum)

PLUMBING-HEATING-COOLING CONTRACTORS NATIONAL ASSOCIATION (PHCC)

NAPHCC NSPC	(2000) National Standard Plumbing Code

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Heating System; G-AO

Detail drawings consisting of a complete list of equipment and material, including manufacturer's descriptive and technical literature, performance charts and curves, catalog cuts, and installation instructions. Drawings shall also contain complete wiring and schematic diagrams and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Drawings shall show proposed layout and anchorage of equipment and appurtenances and equipment relationship to other parts of the work including clearances for maintenance and operation.

SD-03 Product Data

Equipment; G-AE

Cutsheets including pumps heat exchangers, expansion tank, air separator, performance data.

Spare Parts

Spare parts data for each different item of material and equipment specified , after approval of the related submittals and not later than 1 month prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply.

Welding

Three copies of qualified procedures and list of names and identification symbols of qualified welders and welding operators, prior to welding operations.

Framed Instructions

Proposed diagrams, instructions, and other sheets, prior to posting. The instructions shall show wiring and control diagrams and complete layout of the entire system. The instructions shall include, in typed form, condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation and procedures for safely starting and stopping the system.

SD-06 Test Reports

Testing and Cleaning; G-AO

Performance test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall indicate the final position of controls.

Water Treatment Testing; G-AO

The water quality test report shall identify the chemical composition of the heating water. The report shall include a comparison of the condition of the water with the chemical company's recommended conditions. Any required corrective action shall be documented within the report.

SD-07 Certificates

Bolts

Written certification that the bolts furnished comply with the requirements of this specification, provided by the bolt manufacturer. The certification shall include illustrations of product-required markings, the date of manufacture, and the number of each type of bolt to be furnished based on this certification.

SD-10 Operation and Maintenance Data

Heating System; G-AO

Six copies of operation and six copies of maintenance manuals for the equipment furnished. One complete set, prior to performance testing and the remainder upon acceptance. Operating

manuals shall detail the step-by-step procedures required for system startup, operation, and shutdown. Operating manuals shall include the manufacturer's name, model number, parts list, and brief description of all equipment and their basic operating features. Maintenance manuals shall list routine maintenance procedures, water treatment procedures, possible breakdowns and repairs, and troubleshooting guides. Maintenance manuals shall include piping and equipment layout and simplified wiring and control diagrams of the system as installed. Manuals shall be provided prior to the field training course.

1.3 QUALIFICATIONS

Procedures and welders shall be qualified in accordance with the code under which the welding is specified to be accomplished.

1.4 DELIVERY AND STORAGE

All equipment delivered and placed in storage shall be stored with protection from the weather, excessive humidity and excessive temperature variation; and dirt, dust, or other contaminants.

1.5 FIELD MEASUREMENTS

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work.

PART 2 PRODUCTS

2.1 GENERAL MATERIAL AND EQUIPMENT REQUIREMENTS

2.1.1 Standard Products

Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Equipment shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site.

2.1.2 Nameplates

Each major item of equipment shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the item of equipment.

2.1.3 Equipment Guards and Access

Belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts exposed to personnel contact shall be fully enclosed or guarded in accordance with OSHA requirements. High temperature equipment and piping exposed to contact by personnel or where it creates a potential fire hazard shall be properly guarded or covered with insulation of a type specified.

2.1.4 Asbestos Prohibition

Asbestos and asbestos-containing products shall not be used.

2.1.5 Electrical Work

Electrical motor driven equipment specified shall be provided complete with motors, motor starters, and controls. Electric equipment (including motor efficiencies), and wiring shall be in accordance with Section 16415A ELECTRICAL WORK, INTERIOR. High efficiency motors shall be used. Electrical characteristics shall be as specified or indicated. Motor starters shall be provided complete with thermal overload protection and other appurtenances necessary for the motor control specified. Each motor shall be of sufficient size to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor. Manual or automatic control and protective or signal devices required for the operation specified, and any control wiring, conduit, and connection to power required for controls and devices but not shown shall be provided.

2.2 PIPING, TUBING, AND FITTINGS

2.2.1 General

Piping, tubing, and fittings shall be as follows:

a. Low temperature water piping shall be black steel or copper tubing with cast iron, malleable iron or steel, solder-joint, or flared-tube.

b. High temperature water piping shall be black steel, Schedule 40.

c. Vent piping shall be black steel, Schedule 40, with black malleable iron fittings.

2.2.2 Steel Pipe

Pipe shall conform to ASTM A 53/A 53M or ASTM A 106, Grade A or B, black steel, Schedule 40, unless otherwise specified. Steel pipe to be bent shall be ASTM A 53/A 53M, Grade A, standard, or Grade B, extra strong weight.

2.2.3 High Temperature Water Piping

Piping shall be Type S for 1-1/2 inches and smaller, Type S or Type E for pipe 2 inches and larger, schedule 40 steel conforming to ASTM A 53/A 53M, Grade B; or to ASTM A 106, Grade B.

2.2.4 Gauge Piping

Piping shall be copper tubing for low temperature water. Black steel, ASTM A 106, seamless, Grade A pipe shall be used for high temperature.

2.2.5 Copper Tubing

Tubing shall conform to ASTM B 88, ASTM B 88M, Type K or L.

2.2.6 High Temperature Water Fittings

Fittings shall be steel welding fittings conforming in physical and chemical properties to ASTM A 234/A 234M. Buttwelding fittings shall conform to ASME B16.9. Socket welded fittings shall conform to ASME B16.1.

Screwed fittings, when required, shall be black forged steel, 2000-pound class, conforming to ASME B16.11. Flanges shall be serrated or raised-faced type.

2.2.7 Malleable Iron Pipe Fittings

Fittings shall conform to ASME B16.3, type required to match adjacent piping.

2.2.8 Cast Iron Pipe Fittings

Fittings shall conform to ASME B16.1 or ASME B16.4 type required to match adjacent piping.

2.2.9 Steel Pipe Fittings

Fittings shall have the manufacturer's trademark affixed in accordance with MSS SP-25 so as to permanently identify the manufacturer.

2.2.9.1 Welded Fittings

Welded fittings shall conform to ASTM A 234/A 234M with WPA marking. Butt welded fittings shall conform to ASME B16.9, and socket welded fittings shall conform to ASME B16.11.

2.2.9.2 Grooved Mechanical Fittings

Standard fittings shall be of malleable iron conforming to ASTM A 47/A 47M, Grade 32510, or ductile iron conforming to ASTM A 536, Grade 65-45-12. Fittings may also be constructed of steel, conforming to ASTM A 106, Grade B or ASTM A 53/A 53M.

2.2.10 Joints and Fittings for Copper Tubing

Wrought copper and bronze fittings shall conform to ASME B16.22 and ASTM B 75. Cast copper alloy fittings shall conform to ASME B16.18 and ASTM B 828. Flared fittings shall conform to ASME B16.26 and ASTM B 62. Adaptors may be used for connecting tubing to flanges and threaded ends of valves and equipment. Extracted brazed tee joints produced with an acceptable tool and installed as recommended by the manufacturer may be used. Cast bronze threaded fittings shall conform to ASME B16.15. Grooved mechanical joints and fittings shall be designed for not less than 125 psig service and shall be the product of the same manufacturer. Grooved fitting and mechanical coupling housing shall be ductile iron conforming to ASTM A 536. Gaskets for use in grooved joints shall be molded synthetic polymer of pressure responsive design and shall conform to ASTM D 2000 for circulating medium up to 230 degrees F. Grooved joints shall conform to AWWA C606. Coupling nuts and and bolts for use in grooved joints shall be steel and shall conform to ASTM A 183.

2.2.11 Steel Flanges

Flanged fittings including flanges, bolts, nuts, bolt patterns., etc. shall be in accordance with ASME B16.5 class 150 and shall have the manufacturers trademark affixed in accordance with MSS SP-25. Flange material shall conform to ASTM A 105/A 105M. Flanges for high temperature water systems shall be serrated or raised-face type. Blind flange material shall conform to ASTM A 516/A 516M cold service and ASTM A 515/A 515M for hot service. Bolts shall be high strength or intermediate strength with material

conforming to ASTM A 193/A 193M.

2.2.12 Pipe Threads

Pipe threads shall conform to ASME B1.20.1.

2.2.13 Nipples

Nipples shall conform to ASTM A 733 or ASTM B 687, standard weight.

2.2.14 Unions

Unions shall conform to ASME B16.39, type to match adjacent piping.

2.2.15 Adapters

Adapters for copper tubing shall be brass or bronze for soldered fittings.

2.2.16 Dielectric Waterways

Dielectric waterways shall conform to the tensile strength and dimensional requirements specified in ASME B16.39. Waterways shall have metal connections on both ends to match adjacent piping. Metal parts of dielectric waterways shall be separated so that the electrical current is below 1 percent of the galvanic current which would exist upon metal-to-metal contact. Dielectric waterways shall have temperature and pressure rating equal to or greater than that specified for the connecting piping. Dielectric waterways shall be internally lined with an insulator specifically designed to prevent current flow between dissimilar metals. Dielectric flanges shall meet the performance requirements described herein for dielectric waterways.

2.2.17 Flexible Pipe Connectors

Flexible pipe connectors shall be designed for 125 psi or 150 psi service as appropriate for the static head plus the system head, and 250 degrees F. Connectors shall be installed where indicated. The flexible section shall be constructed of rubber, tetrafluoroethylene resin, or corrosion-resisting steel, bronze, monel, or galvanized steel. Materials used and the configuration shall be suitable for the pressure, vacuum, temperature, and circulating medium. The flexible section may have threaded, welded, soldered, flanged, grooved, or socket ends. Flanged assemblies shall be equipped with limit bolts to restrict maximum travel to the manufacturer's standard limits. Unless otherwise indicated, the length of the flexible connectors shall be as recommended by the manufacturer for the service intended. Internal sleeves or liners, compatible with circulating medium, shall be provided when recommended by the manufacturer. Covers to protect the bellows shall be provided where indicated.

2.3 MATERIALS AND ACCESSORIES

2.3.1 Iron and Steel Sheets

2.3.1.1 Galvanized Iron and Steel

Galvanized iron and steel shall conform to ASTM A 653/A 653M, with general requirements conforming to ASTM A 653/A 653M. Gauge numbers specified are Manufacturer's Standard Gauge.

2.3.1.2 Uncoated (Black) Steel

Uncoated (black) steel shall conform to ASTM A 366/A 366M or ASTM A 569/A 569M, composition, condition, and finish best suited to the intended use. Gauge numbers specified refer to Manufacturer's Standard Gauge.

2.3.2 Solder

Solder shall conform to ASTM B 32. Solder and flux shall be lead free. Solder flux shall be liquid or paste form, non-corrosive and conform to ASTM B 813.

2.3.3 Solder, Silver

Silver solder shall conform to AWS A5.8.

2.3.4 Thermometers

Mercury shall not be used in thermometers. Thermometers shall have brass, malleable iron, or aluminum alloy case and frame, clear protective face, permanently stabilized glass tube with indicating-fluid column, white face, black numbers, and a 9 inch scale, and thermometers shall have rigid stems with straight, angular, or inclined pattern.

2.3.5 Gauges

Gauges shall conform to ASME B40.1.

2.3.6 Gaskets for Flanges

Composition gaskets shall conform to ASME B16.21. Gaskets shall be nonasbestos compressed material in accordance with ASME B16.21, 1/16 inch thickness, full face or self-centering flat ring type. Gaskets shall contain aramid fibers bonded with styrene butadiene rubber (SBR) or nitrile butadiene rubber (NBR). NBR binder shall be used for hydrocarbon service. Gaskets shall be suitable for pressure and temperatures of piping system.

2.3.7 Polyethylene Tubing

Low-density virgin polyethylene shall conform to ASTM D 1248, Type I, Category 5, Class B or C.

2.3.8 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69.

2.4 VALVES FOR LOW TEMPERATURE WATER HEATING SYSTEMS

2.4.1 Check Valves

Sizes 2-1/2 inches and less, bronze shall conform to MSS SP-80, Type 3 or 4, Class 125. Sizes 3 inches through 24 inches, cast iron shall conform to MSS SP-71, Type III or IV, Class 125.

2.4.2 Globe Valves

Sizes 2-1/2 inches and less, bronze shall conform to MSS SP-80, Type 1, 2 or 3, Class 125. Sizes 3 inches through 12 inches, cast iron shall conform to MSS SP-85, Type III, Class 125.

2.4.3 Angle Valves

Sizes 2-1/2 inches and less, bronze shall conform to MSS SP-80, Type 1, 2 or 3, Class 125. Sizes 3 inches through 12 inches, cast iron shall conform to MSS SP-85, Type III, Class 125.

2.4.4 Gate Valves

Sizes 2-1/2 inches and less, bronze shall conform to MSS SP-80, Type 1 or 2, Class 125. Sizes 3 inches through 48 inches, cast iron shall conform to MSS SP-70, Type I, Class 125, Design OT or OF (OS&Y), bronze trim.

2.4.5 Air Vents

Air vents shall be provided at all piping high points in water systems, with block valve in inlet and internal check valve to allow air vent to be isolated for cleaning and inspection. Outlet connection shall be piped to nearest open site or suitable drain, or terminated 12 inches above finished grade. Pressure rating of air vent shall match pressure rating of piping system. Body and cover shall be cast iron or semi-steel with stainless steel or copper float and stainless steel or bronze internal parts. Air vents installed in piping in chase walls or other inaccessible places shall be provided with an access panel.

2.4.6 Balancing Valves

Balancing valves shall have meter connections with positive shutoff valves. An integral pointer shall register degree of valve opening. Valves shall be calibrated so that flow in gpm can be determined when valve opening in degrees and pressure differential across valve is known. Each balancing valve shall be constructed with internal seals to prevent leakage and shall be supplied with preformed insulation. Valves shall be suitable for 250 degrees F temperature and working pressure of the pipe in which installed. Valve bodies shall be provided with tapped openings and pipe extensions with shutoff valves outside of pipe insulation. The pipe extensions shall be provided with quick connecting hose fittings for a portable meter to measure the pressure differential. One portable differential meter shall be furnished. The meter suitable for the operating pressure specified shall be complete with hoses, vent, and shutoff valves and carrying case. In lieu of the balancing valve with integral metering connections, a ball valve or plug valve with a separately installed orifice plate or venturi tube may be used for balancing. Plug valves and ball valves 8 inches or larger shall be provided with manual gear operators with position indicators.

2.4.7 Gravity Flow Control Valves

Ends shall be soldered, threaded, or flanged type as applicable, and designed for easy cleaning without disconnecting piping. Valves for copper tubing shall be bronze. Valves shall prevent flow due to gravity when circulators are off.

2.5 VALVES FOR HIGH AND MEDIUM TEMPERATURE WATER SYSTEMS

2.5.1 Check Valves

Sizes 2-1/2 inches and less, bronze shall conform to MSS SP-80, Class 300
Sizes 2-1/2 inches and less, bronze shall conform to MSS SP-80, Class 300

minimum. Sizes 3 inches through 24 inches, steel shall conform to ASME B16.34, Class 300 minimum, flanged ends, swing disc; water, oil gas or steam service to 850 degrees F.

2.5.2 Globe Valves

Sizes 2-1/2 inches and less, bronze shall conform to MSS SP-80, Type 1, 2 or 3, Class 300 minimum. Sizes 3 inches through 24 inches, steel shall conform to ASME B16.34, Class 300 minimum, flanged ends; water, oil, gas, or steam service to 850 degrees F.

2.5.3 Angle Valves

Sizes 2-1/2 inches and less, bronze shall conform to MSS SP-80, Type 1, 2 or 3, Class 300 minimum. Sizes 3 inches through 24 inches, steel shall conform to ASME B16.34, Class 300 minimum, flanged ends; water, oil, gas, or steam service to 850 degrees F.

2.5.4 Gate Valves

Sizes 2-1/2 inches and less, bronze shall conform to MSS SP-80, Type 1, or 2, Class 300 minimum. Sizes 3 inchesthrough 24 inches, steel shall conform to ASME B16.34, Class 300 minimum, flanged ends; water, oil, gas or steam service to 850 degrees F. Gate shall be split wedge (double disc) type.

2.6 COLD WATER CONNECTIONS

Connections shall be provided which include consecutively in line a strainer, backflow prevention device, and water pressure regulator. The backflow prevention device shall be provided as indicated and in compliance with Section 15400A PLUMBING, GENERAL PURPOSE.

2.6.1 Strainers

Basket or Y-type strainers shall be the same size as the pipelines in which they are installed. Strainer bodies shall be rated for 125 pound service, with bottoms drilled and plugged. Bodies shall have arrows cast on the sides to indicate the direction of flow. Each strainer shall be equipped with a removable cover and sediment basket. Basket shall not be less than 22 gauge and shall have perforations to provide a net free area through the basket of at least four times that of the entering pipe.

2.6.2 Pressure Regulating Valve

Valve shall be a type that will not stick nor allow pressure to build up on the low side. Valve shall be set to maintain a terminal pressure approximately 5 psi in excess of the static head on the system and shall operate within a 20 psi variation regardless of initial pressure and without objectionable noise under any condition of operation.

2.7 EXPANSION TANK

Pressurization system shall include a replaceable diaphragm-type captive air expansion tank which will accommodate the expanded water of the system generated within the normal operating temperature range, limiting this pressure increase at all components in the system to the maximum allowable pressure at those components. The only air in the system shall be the permanent sealed-in air cushion contained in the diaphragm-type tank.

Sizes shall be as indicated. Expansion tank shall be welded steel, constructed, tested and stamped in accordance with ASME BPVC SEC VIII D1 for a working pressure of 125 psig and precharged to the minimum operating pressure. Tank air chamber shall be fitted with an air charging valve. Tank shall be supported by steel legs or bases for vertical installation or steel saddles for horizontal installations.

2.8 AIR SEPARATOR TANK

External air separation tank shall be steel, constructed, tested, and stamped in accordance with ASME BPVC SEC VIII D1 for a working pressure of 125 psi. The capacity of the air separation tank indicated is minimum.

2.9 HEAT EXCHANGERS

Heat exchangers shall be multiple pass shell and U-tube type as indicated, to provide low temperature hot water for the heating system when supplied with high temperature hot water at the temperatures and pressures indicated. Temperature and pressure for shell and U-tube exchangers shall not exceed 430 degrees F and 400 psig for high temperature hot water. Exchangers shall be constructed in accordance with ASME BPVC SEC VIII D1 and certified with ASME stamp secured to unit. U-tube bundles shall be completely removable for cleaning and tube replacement and shall be free to expand with shell. Shells shall be of seamless steel pipe or welded steel construction and tubes shall be seamless tubing as specified below unless otherwise indicated. Tube connections to plates shall be leakproof. Saddles or cradles shall be provided to mount shell and U-tube exchangers. Design fouling factor shall be .001.

2.9.1 High Temperature Water Heat Exchangers, Shell and U-tube Type

Exchangers shall operate with low temperature water in shell and high temperature water in tubes. Shell side shall be designed for 150 psig working pressure and factory tested at 300 psig. Shell fouling factor shall be .0001. Tubes shall be designed for 400 psig working pressure and an operating temperature of 450 degrees F. High and low temperature water and pressure relief connections shall be located in accordance with the manufacturer's standard practice. Water connections larger than 3 inches shall be ASME 600 pound flanged for high temperature water, and ASME 150 pound flanged for low temperature water. Water pressure loss through clean tubes shall not exceed 6 psig unless otherwise indicated. Minimum water velocity in tubes shall be 1 fps and assure turbulent flow. Maximum velocity in shell not to exceed 6 fps. Tubes shall be cupronickel or inhibited admiralty, constructed in accordance with ASTM B 395/B 395M, ASTM B 395M, suitable for the temperatures and pressures specified. Tubes shall be not less than 3/4 inch 16 B.W.G. unless otherwise indicated. Provide socket for water temperature control sensing element in upper part of converter shell.

2.10 SYSTEM EQUIPMENT AND ACCESSORIES

2.10.1 Circulating Pumps

Pumps for hot water shall be of the single-stage centrifugal type, electrically driven. Pumps shall be supported on a concrete foundation. Pumps shall be either integrally mounted with the motor or direct-connected by means of a flexible-shaft coupling on a cast iron, or steel sub-base. Pump housing shall be of close grained cast iron. Shaft shall be carbon or alloy steel, turned and ground. Shaft seal shall be mechanical-seal or

stuffing-box type. Impeller, impeller wearing rings, glands, casing wear rings, and shaft sleeve shall be bronze. Bearings shall be ball-, roller-, or oil-lubricated, bronze-sleeve type, and shall be sealed or isolated to prevent loss of oil or entrance of dirt or water. Motor shall be of a type approved by the manufacturer of the pump.

2.10.2 Pressure Gauges and Thermometers

Gauges shall be provided for each heat exchanger and piping as indicated. A thermometer and pressure gauge shall be provided on the high temperature water supply and return mains. Thermometers shall be separable socket type.

2.10.3 Vacuum Relief Valve

Vacuum relief valve shall be installed on the shell of each shell and U-tube steam heat exchanger.

2.10.4 Pressure Relief Valves

One or more pressure relief valves shall be provided for each heat exchanger in accordance with ASME BPVC SEC VIII D1. The aggregate relieving capacity of the relief valves shall be not less than that required by the above code. Discharge from the valves shall be installed as indicated. Relief valves for high temperature water heat exchanger shall be installed on the heat exchanger shall.

2.10.5 Drains

A drain connection with 3/4 inch hose bib shall be installed at the lowest point in the low temperature water return main near the heat exchanger. In addition, threaded drain connections with threaded cap or plug shall be installed wherever required for thorough draining of the low temperature water system.

2.10.6 Strainers

Basket or Y-type strainer-body connections shall be the same size as the pipe lines in which the connections are installed. The bodies shall have arrows clearly cast on the sides to indicate the direction of flow. Each strainer shall be equipped with an easily removable cover and sediment basket. The body or bottom opening shall be equipped with nipple and gate valve for blowdown. The basket shall be of not less than 0.025 inch thick stainless steel, or monel with small perforations of sufficient number to provide a net free area through the basket of at least 2.5 times that of the entering pipe. The flow shall be into the basket and out through the perforations. For high temperature water systems, only cast steel bodies shall be used.

2.11 INSULATION

Shop and field applied insulation shall be as specified in Section 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.12 FACTORY PAINTED EXPOSED SPACE HEATING EQUIPMENT

Radiator and convector enclosures shall be coated with the manufacturer's standard rust inhibiting primer for painting in the field as specified in Section 09900 PAINTS COATINGS. All other exposed heating equipment shall be painted at the factory with the manufacturer's standard primer and

enamel finish.

2.13 RADIATORS AND CONVECTORS

The radiator and convector shall be the type and size indicated. The supply and return connections shall be the same size. Cast iron radiators and nonferrous convectors shall be tested hydrostatically at the factory and proved tight under a pressure of not less than 125 psig. A certified report of these tests shall be furnished in accordance with paragraph SUBMITTALS.

2.13.1 Extended-Surface, Steel, or Nonferrous Tube-Type Radiators

Radiators shall consist of metal fins permanently bonded to steel or nonferrous pipe cores, with threaded or sweat fittings at each end for connecting to external piping. Radiators shall have capacities not less than those indicated, determined in accordance with HYI Ratings. Radiators shall be equipped with solid-front, slotted horizontal-top cover grilles fabricated from black steel sheets not less than 18 gauge, secured either directly to the radiators or to independent brackets.

2.13.2 Convectors

Convectors shall be constructed of cast iron or of nonferrous alloys, and shall be installed where indicated. Capacity of convectors shall be as indicated. Overall space requirements for convectors shall not be greater than the space provided. Convectors shall be complete with heating elements and enclosing cabinets having bottom recirculating opening, manual control damper and top supply grille. Convector cabinets shall be constructed of black sheet steel not less than 20 gauge.

2.13.3 Radiators and Convectors Control

Controls shall be provided as specified in Section 15951A DIRECT DIGITAL CONTROL FOR HVAC.

2.14 UNIT HEATERS

Heaters shall be as specified below, and shall have a heating capacity not in excess of 125 percent of the capacity indicated.

2.14.1 Propeller Fan Heaters

Heaters shall be designed for suspension and arranged for horizontal or vertical discharge of air as indicated. Casings shall be not less than 20 gauge black steel and finished with lacquer or enamel. Suitable stationary deflectors shall be provided to assure proper air and heat penetration capacity at floor level based on established design temperature. Suspension from heating pipes will not be permitted. Fans for vertical discharge type heaters shall operate at speeds not in excess of 1,200 rpm, except that units with 80,000 Btu output capacity or less may operate at speeds up to 1,800 rpm. Horizontal discharge type unit heaters shall have discharge or face velocities not in excess of the following:

Unit Capacity, cfm	Face Velocity, fpm
Up to 1,000	800
1,001 to 3,000	900

Unit Capacity, cfm	Face Velocity, fpm
3,001 and over	1,000

2.14.2 Centrifugal Fan Heaters

Heaters shall be arranged for floor or ceiling mounting as indicated. Heating elements and fans shall be housed in steel cabinets of sectionalized steel plates or reinforced with angle-iron frames. Cabinets shall be constructed of not lighter than 18 gauge black steel. Each unit heater shall be provided with a means of diffusing and distributing the air. Fans shall be mounted on a common shaft, with one fan to each air outlet. Fan shaft shall be equipped with self-aligning ball, roller, or sleeve bearings and accessible means of lubrication. Fan shaft may be either directly connected to the driving motor or indirectly connected by adjustable V-belt drive rated at 150 percent of motor capacity. All fans in any one unit heater shall be the same size.

2.14.3 Motors

Motors shall be provided with NEMA 250 general purpose enclosure. Motors and motor controls shall otherwise be as specified in Section 16415A ELECTRICAL WORK, INTERIOR.

2.14.4 Motor Switches

Motors shall be provided with manual selection switches with "Off," and "Automatic" positions and shall be equipped with thermal overload protection.

2.14.5 Controls

Controls shall be provided as specified in Section 15951A DIRECT DIGITAL CONTROL FOR HVAC.

2.15 HEATING AND VENTILATING UNITS

Heating and ventilating units shall be as specified in Section 15895 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM.

2.16 WATER TREATMENT SYSTEM

The water treatment system shall be capable of manually feeding chemicals into the heating system to prevent corrosion and scale within the heat exchanger and piping system. All water treatment equipment and chemicals shall be furnished and installed by a water treatment company regularly engaged in the installation of water treatment equipment and the provision of water treatment chemicals based upon water condition analyses. The water treatment company shall provide a water sample analysis taken from the building site, each month for one year.

2.16.1 Chemical Shot Feeder

A shot feeder shall be provided as indicated. Size and capacity of feeder shall be based upon local requirements and water analysis. The feeder shall be furnished with an air vent, gauge glass, funnel, valves, fittings, and piping. All materials of construction shall be compatible with the chemicals being used.

2.16.2 Make Up Water Analysis

Perform water quality analysis and record the following information. The make up water conditions reported per ASTM D 596 are as follows:

Date of Sample	_____	
Temperature	_____	degrees F
Silica (SiO2)	_____	ppm (mg/1)
Insoluble	_____	ppm (mg/1)
Iron and Aluminum Oxides	_____	ppm (mg/1)
Calcium (Ca)	_____	ppm (mg/1)
Magnesium (Mg)	_____	ppm (mg/1)
Sodium and Potassium (Na and K)	_____	ppm (mg/1)
Carbonate (HCO3)	_____	ppm (mg/1)
Sulfate (SO4)	_____	ppm (mg/1)
Chloride (C1)	_____	ppm (mg/1)
Nitrate (NO3)	_____	ppm (mg/1)
Turbidity	_____	unit
pH	_____	
Residual Chlorine	_____	ppm (mg/1)
Total Alkalinity	_____	ppm (meq/1)
Noncarbonate Hardness	_____	epm (meq/1)
Total Hardness	_____	epm (meq/1)
Dissolved Solids	_____	ppm (mg/1)
Fluorine	_____	ppm (mg/1)
Conductivity	_____	microsiemens/cm

2.16.3 Chemicals

The chemical company shall provide pretreatment chemicals that will remove and permit flushing of mill scale, oil, grease, and other foreign matter from the water heating system. The chemical company shall also provide all treatment chemicals required for the initial fill of the system and for a period of one year of operation. The chemical company shall determine the correct chemicals and concentrations required for the water treatment. The chemicals shall not be proprietary and shall meet required federal, state, and local environmental regulations for the treatment of heating water systems and discharge to the sanitary sewer. The chemicals shall remain stable throughout the operating temperature range of the system, and shall be compatible with pump seals and other elements of the system.

2.16.4 Glycol Solutions

A 55 percent concentration by volume of industrial grade propylene glycol shall be provided. The glycol shall be tested in accordance with ASTM D 1384 with less than 0.5 mils penetration per year for all system metals. The glycol shall contain corrosion inhibitors. Silicate based inhibitors shall not be used. The solution shall be compatible with pump seals, other elements of the system, and all water treatment chemicals used within the system.

2.16.5 Test Kits

All required test kits and reagents for determining the proper water conditions shall be provided.

PART 3 EXECUTION

3.1 INSTALLATION

All work shall be installed as indicated and in accordance with the manufacturer's diagrams and recommendations.

3.2 COLOR CODE MARKING AND FIELD PAINTING

Color code marking, field painting of exposed pipe, and field painting of factory primed equipment shall be as specified in Section 09900 PAINTS AND COATINGS.

3.3 WELDING

Piping shall be welded in accordance with qualified procedures using performance qualified welders and welding operators. Procedures and welders shall be qualified in accordance with ASME BPVC SEC IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer may be accepted as permitted by ASME B31.1. The Contracting Officer shall be notified 24 hours in advance of tests and the tests shall be performed at the work site if practical. The welder or welding operator shall apply his assigned symbol near each weld he makes as a permanent record. Structural members shall be welded in accordance with Section 05090A WELDING, STRUCTURAL.

3.4 PIPING

Unless otherwise specified, pipe and fittings installation shall conform to the requirements of ASME B31.1. Pipe shall be cut accurately to measurements established at the job site and worked into place without springing or forcing, completely clearing all windows, doors, and other openings. Cuttings or other weakening of the building structure to facilitate piping installation will not be permitted without written approval. Pipe or tubing shall be cut square, shall have burrs removed by reaming, and shall be so installed as to permit free expansion and contraction without causing damage to building structure, pipe, joints, or hangers. Changes in direction shall be made with factory made fittings, except that bending of pipe up to 4 inches will be permitted, provided a pipe bender is used and wide sweep bends are formed. The center line radius of bends shall not be less than six diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be accepted. Vent pipes shall be installed through the roof as indicated and shall be flashed as specified. Horizontal mains shall pitch up or down in the direction of flow as indicated. The grade shall be not less than 1 inch in 40 feet. Reducing fittings shall be used for changes in pipe sizes. Open ends of pipelines and equipment shall be capped or plugged during installation to keep dirt or other foreign materials out of the systems. Pipe not otherwise specified shall be uncoated. Unions and other components for copper pipe or tubing shall be brass or bronze. Connections between ferrous and copper piping shall be electrically isolated using dielectric unions.

3.4.1 Joints

Except as otherwise specified, joints used on steel pipe shall be threaded for fittings 1 inch and smaller; threaded or welded for 1-1/4 inches up through 2-1/2 inches; and flanged or welded for 3 inches and larger. Joints between sections of copper tubing or copper pipe shall be flared or

sweated. Pipe and fittings 1-1/4 inches and larger installed in inaccessible conduits or trenches beneath concrete floor slabs shall be welded. Unless otherwise specified, connections to equipment shall be made with black malleable iron unions for pipe 2-1/2 inches or smaller in diameter, and with flanges for pipe 3 inches or larger in diameter.

3.4.2 Low Temperature Systems

Piping may have threaded, welded, flanged or flared, sweated, or grooved mechanical joints as applicable and as specified. Reducing fittings shall be used for changes in pipe sizes. In horizontal lines, reducing fittings shall be the eccentric type to maintain the top of the adjoining pipes at the same level.

3.4.3 High And Medium Temperature Systems

Temperature systems shall have welded joints to the maximum extent practicable, except screwed joints and fittings may be used at connections to equipment and on piping 2-1/2 inches and smaller. Equipment connections 3 inches and larger shall be flanged. Piping connections 3 inches and larger may be welded or flanged. In horizontal lines, reducing fittings shall be the eccentric type to maintain the tops of adjoining pipes at the same level. Grooved mechanical joints shall not be used.

3.4.4 Threaded Joints

Threaded joints shall be made with tapered threads properly cut, and shall be made tight with PTFE tape complying with ASTM D 3308, or equivalent thread joint compound applied to the male threads only, and in no case to the fittings.

3.4.5 Welded Joints

Joints shall be fusion-welded unless otherwise required. Changes in direction of piping shall be made with welding fittings only. Branch connection may be made with either welding tees or branch outlet fittings. Branch outlet fittings shall be forged, flared for improvement of flow where attached to the run, and reinforced against external strains.

3.4.6 Flanged Joints or Unions

Flanged joints or unions shall be provided in each line immediately preceding the connection to each piece of equipment or material requiring maintenance such as coils, pumps, control valves, and similar items. Flanged joints shall be faced true, provided with gaskets, and made square and tight. Full-faced gaskets shall be used with cast iron flanges.

3.4.7 Flared and Sweated Pipe and Tubing

Pipe and tubing shall be cut square and burrs shall be removed. Both inside of fittings and outside of tubing shall be cleaned with an abrasive before sweating. Care shall be taken to prevent annealing of fittings and hard drawn tubing when making connection. Installation shall be made in accordance with the manufacturer's recommendations. Changes in direction of piping shall be made with flared or soldered fittings only. Solder and flux shall be lead free. Joints for soldered fittings shall be made with silver solder or 95:5 tin-antimony solder. Cored solder shall not be used. Joints for flared fittings shall be of the compression pattern. Swing joints or offsets shall be provided on all branch connections, mains, and

risers to provide for expansion and contraction forces without undue stress to the fittings or to short lengths of pipe or tubing.

3.4.8 Mechanical Tee Joint

An extracted mechanical tee joint may be made in copper tube. Joint shall be produced with an appropriate tool by drilling a pilot hole and drawing out the tube surface to form a collar having a minimum height of three times the thickness of the tube wall. To prevent the branch tube from being inserted beyond the depth of the extracted joint, dimpled depth stops shall be provided. The branch tube shall be notched for proper penetration into fitting to assure a free flow joint. Joints shall be brazed in accordance with NAPHCC NSPC. Soldered joints will not be permitted.

3.5 CONNECTIONS TO EQUIPMENT

Supply and return connections shall be provided by the Contractor unless otherwise indicated. Valves and traps shall be installed in accordance with the manufacturer's recommendations. Unless otherwise indicated, the size of the supply and return pipes to each piece of equipment shall be not smaller than the connections on the equipment. No bushed connections shall be permitted. Change in sizes shall be made with reducers or increasers only.

3.5.1 Low Temperature Water

Connections, unless otherwise indicated, shall be made with malleable iron unions for piping 2-1/2 inches or less in diameter and with flanges for pipe 3 inches or more in diameter.

3.5.2 High And Medium Temperature Water Connections

Connections shall be made with 2000 pound black malleable iron unions for pipe 3/4 inch or less in diameter and with flanges for pipe 1 inch and larger in diameter.

3.6 BRANCH CONNECTIONS

Branches shall pitch up or down as indicated, unless otherwise specified. Connection shall be made to insure unrestricted circulation, eliminate air pockets, and permit drainage of the system.

3.6.1 Low Temperature Water Branches

Branches taken from mains shall pitch with a grade of not less than 1 inch in 10 feet.

3.6.2 High And Medium Temperature Water Branches

Branches shall take off at 45 degrees in the direction of the fluid flow from the supply and return lines and should be branched from the top or upper half of the main line unless otherwise indicated. Abrupt reduction in pipe sizes shall be avoided.

3.7 RISERS

The location of risers is approximate. Exact locations of the risers shall be as approved.

3.8 SUPPORTS

3.8.1 General

Hangers used to support piping 2 inches and larger shall be fabricated to permit adequate adjustment after erection while supporting the load. Pipe guides and anchors shall be installed to keep pipes in accurate alignment, to direct the expansion movement, and to prevent buckling, swaying, and undue strain. All piping subjected to vertical movement when operating temperatures exceed ambient temperatures, shall be supported by variable spring hangers and supports or by constant support hangers. Where threaded rods are used for support, they shall not be formed or bent.

3.8.1.1 Antiterrorism/Force Protection (AT/FP) Requirements for Pipe Supports, Standard Bracing

All piping and attached valves shall be supported and braced to resist AT/FP loads as specified under Sections 13080 ANTITERRORISM/FORCE PROTECTION (AT/FP) FOR MISCELLANEOUS EQUIPMENT and 15070A ANTITERRORISM/FORCE PROTECTION (AT/FP) FOR MECHANICAL EQUIPMENT as shown on the drawings. Structural steel required for reinforcement to properly support piping, headers, and equipment but not shown shall be provided under this section. Material used for supports shall be as specified under Section 05120 STRUCTURAL STEEL.

3.8.1.2 Structural Attachments

Structural steel brackets required to support piping, headers, and equipment, but not shown, shall be provided under this section. Material and installation shall be as specified under Section 05120 STRUCTURAL STEEL. Pipe hanger loads shall be suspended from panel points.

3.8.1.3 Multiple Pipe Runs

In the support of multiple pipe runs on a common base member, a clip or clamp shall be used where each pipe crosses the base support member. Spacing of the base support members shall not exceed the hanger and support spacing required for any individual pipe in the multiple pipe run.

3.8.2 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts and supports shall conform to MSS SP-58 and MSS SP-69, except as specified as follows:

a. Types 5, 12, and 26 shall not be used.

b. Type 3 shall not be used on insulated pipe which has a vapor barrier. Type 3 may be used on insulated pipe that does not have a vapor barrier if clamped directly to the pipe and if the clamp bottom does not extend through the insulation and the top clamp attachment does not contact the insulation during pipe movement.

c. Type 18 inserts shall be secured to concrete forms before concrete is placed. Continuous inserts which allow more adjustment may be used if they otherwise meet the requirements for Type 18 inserts.

d. Type 19 and 23 C-clamps shall be torqued per MSS SP-69 and have both locknuts and retaining devices, furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining

devices are not acceptable.

e. Type 20 attachments used on angles and channels shall be furnished with an added malleable iron heel plate or adapter.

f. Type 24 may be used only on trapeze hanger systems or on fabricated frames.

g. Where Type 39 saddle or Type 40 shield are permitted for a particular pipe attachment application, the Type 39 saddle shall be used on all pipe 4 inches and larger.

h. Horizontal pipe supports shall be spaced as specified in MSS SP-69 and a support shall be installed not over 1 foot from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 5 feet apart at valves.

i. Vertical pipe shall be supported at each floor, except at slab-on-grade, and at intervals of not more than 15 feet,except that pipe shall be supported not more than 8 feet from end of risers, and at vent terminations.

j. Type 35 guides using steel, reinforced PTFE or graphite slides shall be provided where required to allow longitudinal pipe movement. Lateral restraints shall be provided as required. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions and bearing loads encountered. Where steel slides do not require provision for restraint or lateral movement, an alternate guide method may be used. On piping 4 inches and larger, a Type 39 saddle may be welded to the pipe and freely rest on a steel plate. On piping under 4 inches, a Type 40 protection shield may be attached to the pipe or insulation and freely rest on a steel slide plate. Where there are high system temperatures and welding to piping is not desirable, then the Type 35 guide shall include a pipe cradle, welded to the guide structure and strapped securely to the pipe. The pipe shall be separated from the slide material by at least 4 inches, or by an amount adequate for the insulation, which ever is greater.

k. Except for Type 3, pipe hangers on horizontal insulated pipe shall be the size of the outside diameter of the insulation.

3.9 PIPE SLEEVES

3.9.1 Pipe Passing Through Concrete or Masonry

Pipe passing through concrete or masonry walls or concrete floors or roofs shall be provided with pipe sleeves fitted into place at the time of construction. Sleeves shall not be installed in structural members except where indicated or approved. Rectangular and square openings shall be as detailed. Each sleeve shall extend through its respective wall, floor, or roof, and shall be cut flush with each surface. Unless otherwise indicated, sleeves shall provide a minimum of 1/4 inch annular space between bare pipe or insulation surface and sleeves. Sleeves in bearing walls, waterproofing membrane floors, and wet areas shall be steel pipe or cast iron pipe. Sleeves in nonbearing walls, floors, or ceilings may be steel pipe, cast iron pipe, or galvanized sheet metal with lock-type longitudinal seam and of the metal thickness indicated. Except in pipe chases or interior walls, the annular space between pipe and sleeve or

between jacket over insulation and sleeve in nonfire rated walls and floors shall be sealed as indicated and specified in Section 07920 JOINT SEALANTS. Penetrations in fire walls and floors shall be sealed in accordance with Section 07840 FIRESTOPPING.

3.9.2 Pipes Passing Through Waterproofing Membranes

Pipes passing through waterproofing membranes shall be installed through a 4 pound lead-flashing sleeve, a 16 ounce copper sleeve, or a 0.032 inch thick aluminum sleeve, each having an integral skirt or flange. Flashing sleeve shall be suitably formed, and the skirt or flange shall extend 8 inches or more from the pipe and shall be set over the roof or floor membrane in a troweled coating of bituminous cement. The flashing sleeve shall extend up the pipe a minimum of 2 inches above the highest flood level of the roof or a minimum of 10 inches above the roof, whichever is greater, or 10 inches above the floor. The annular space between the flashing sleeve and the bare pipe or between the flashing sleeve and the metal-jacket-covered insulation shall be sealed as indicated. At the Contractor's option, pipes up to and including 10 inches in diameter passing through roof or floor waterproofing membrane may be installed through a cast iron sleeve with caulking recess, anchor lugs, flashing clamp device, and pressure ring with brass bolts. Waterproofing membrane shall be clamped into place and sealant shall be placed in the caulking recess.

3.9.3 Mechanical Seal Assembly

In lieu of a waterproofing clamping flange and caulking and sealing of annular space between pipe and sleeve or conduit and sleeve, a modular mechanical type sealing assembly may be installed. The seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe/conduit and sleeve with corrosion protected carbon steel bolts, nuts, and pressure plates. The links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and each nut. After the seal assembly is properly positioned in the sleeve, tightening of the bolts shall cause the rubber sealing elements to expand and provide a watertight seal between the pipe/conduit and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe/conduit and sleeve involved. The Contractor electing to use the modular mechanical type seals shall provide sleeves of the proper diameters.

3.9.4 Counterflashing Alternate

As an alternate to caulking and sealing the annular space between the pipe and flashing sleeve or metal-jacket-covered insulation and flashing sleeve, counterflashing may be by standard roof coupling for threaded pipe up to 6 inches in diameter; lead-flashing sleeve for dry vents and turning the sleeve down into the pipe to form a waterproof joint; or tack-welded or banded-metal rain shield round the pipe and sealing as indicated.

3.9.5 Waterproofing Clamping Flange

Pipe passing through wall waterproofing membrane shall be sleeved as specified. In addition, a waterproofing clamping flange shall be installed as indicated.

3.9.6 Fire Seal

Where pipes pass through fire walls, fire partitions, fire rated pipe chase walls or floors above grade, a fire seal shall be provided as specified in Section 07840 FIRESTOPPING.

3.9.7 Escutcheons

Escutcheons shall be provided at all finished surfaces where exposed piping, bare or covered, passes through floors, walls, or ceilings, except in boiler, utility, or equipment rooms. Escutcheons shall be fastened securely to pipe sleeves or to extensions of sleeves without any part of sleeves being visible. Where sleeves project slightly from floors, special deep-type escutcheons shall be used. Escutcheons shall be chromium-plated iron or chromium-plated brass, either one-piece or split pattern, held in place by internal spring tension or setscrew.

3.10 ANCHORS

Anchors shall be provided where necessary or indicated to localize expansion or prevent undue strain on piping. Anchors shall consist of heavy steel collars with lugs and bolts for clamping and attaching anchor braces, unless otherwise indicated. Anchor braces shall be installed using turnbuckles where required. Supports, anchors, or stays shall not be attached in places where construction will be damaged by installation operations or by the weight or expansion of the pipeline.

3.11 PIPE EXPANSION

The expansion of supply and return pipes shall be provided for by changes in the direction of the run of pipe or by expansion loops as indicated.

3.11.1 Expansion Loops

Expansion loops shall provide adequate expansion of the main straight runs of the system within the stress limits specified in ASME B31.1. The loops shall be cold-sprung and installed where indicated. Pipe guides shall be provided as indicated.

3.12 VALVES AND EQUIPMENT ACCESSORIES

3.12.1 Valves and Equipment

Valves shall be installed at the locations shown or specified, and where required for the proper functioning of the system as directed. Gate valves shall be used unless otherwise indicated, specified, or directed. Valves shall be installed with their stems horizontal to or above the main body of the valve. Valves used with ferrous piping shall have threaded or flanged ends and sweat-type connections for copper tubing.

3.12.2 Thermometer Socket

A thermometer well shall be provided in each return line for each circuit in multicircuit systems.

3.12.3 Air Vents

Vents shall be installed where indicated, and on all high points and piping offsets where air can collect or pocket.

3.12.3.1 Water Air Vents

High temperature water air vents shall be as indicated. Vent discharge lines shall be double-valved with globe valves and shall discharge into a funnel drain.

3.13 UNIT HEATERS

Unit heaters shall be installed as indicated and in accordance with the manufacturer's instructions.

3.14 INSULATION

Thickness of insulation materials for piping and equipment and application shall be in accordance with Section 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.15 TESTING AND CLEANING

3.15.1 Pressure Testing

The Contractor shall notify the Contracting Officer 10 days before the tests are to be conducted. The tests shall be performed in the presence of the Contracting Officer. The Contractor shall furnish all instruments and personnel required for the tests. Electricity, and water will be furnished by the Government. All test results shall be accepted before thermal insulation is installed. The entire low temperature heating system, including heat exchanger, radiators and fittings, shall be hydrostatically tested and proved tight under a pressure of 45 psig for a period of four hours.

3.15.2 Test of Backflow Prevention Assemblies

Backflow prevention assemblies shall be tested in accordance with Section 15400A PLUMBING, GENERAL PURPOSE.

3.15.3 Cleaning

After the hydrostatic and backflow prevention tests have been made and prior to the operating tests, the heat exchanger and piping shall be thoroughly cleaned by filling the system with a solution of 1 pound of caustic soda or 1 pound of trisodium phosphate per 50 gallons of water. Observe the proper safety precautions in the handling and use of these chemicals. The water shall be heated to approximately 150 degrees F, and the solution circulated in the system for a period of 48 hours, then drained and the system thoroughly flushed out with fresh water. Equipment shall be wiped clean, with all traces of oil, dust, dirt, or paint spots removed. The Contractor shall be responsible for maintaining the system in a clean condition until final acceptance. Bearings shall be lubricated with oil or grease as recommended by the manufacturer.

3.15.4 Water Treatment Testing

3.15.4.1 Water Quality Test

The heating water shall be analyzed prior to the acceptance of the facility and a minimum of once a month for a period of one year by the water treatment company. The analysis shall include the following information

recorded in accordance with ASTM D 596.

Date of Sample	_____
Temperature	_____ degrees F
Silica (SiO2)	_____ ppm (mg/1)
Insoluble	_____ ppm (mg/1)
Iron and Aluminum Oxides	_____ ppm (mg/1)
Calcium (Ca)	_____ ppm (mg/1)
Magnesium (Mg)	_____ ppm (mg/1)
Sodium and Potassium (Na and K)	_____ ppm (mg/1)
Carbonate (HCO3)	_____ ppm (mg/1)
Sulfate (SO4)	_____ ppm (mg/1)
Chloride (C1)	_____ ppm (mg/1)
Nitrate (NO3)	_____ ppm (mg/1)
Turbidity	_____ unit
pH	_____
Residual Chlorine	_____ ppm (mg/1)
Total Alkalinity	_____ ppm (meq/1)
Noncarbonate Hardness	_____ epm (meq/1
Total Hardness	_____ epm (meq/1)
Dissolved Solids	_____ ppm (mg/1)
Fluorine	_____ppm (mg/1)
Conductivity	_____ microsiemens/cm

3.16 TESTING, ADJUSTING AND BALANCING

Except as specified herein, testing, adjusting, and balancing shall be in accordance with Section 15990A TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS.

3.17 MANUFACTURER'S SERVICES

Services of a manufacturer's representative who is experienced in the installation, adjustment, and operation of the equipment specified shall be provided. The representative shall supervise the installation, adjustment, and testing of the equipment.

3.18 FRAMED INSTRUCTIONS

Framed instructions containing wiring and control diagrams under glass or in laminated plastic shall be posted where directed. Condensed operating instructions, prepared in typed form, shall be framed as specified above and posted beside the diagrams. The framed instructions shall be posted before acceptance testing of the system.

3.19 FIELD TRAINING

A field training course shall be provided for designated operating and maintenance staff members. Training shall be provided for a total period of 16 hours of normal working time and shall start after the system is functionally complete but prior to final acceptance tests. Field training shall cover all of the items contained in the approved operation and maintenance manuals. Provide spare parts data and instruction on routine parts replacement.

-- End of Section --

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SECTION 15700A

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12/01

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SECTION 15700A

UNITARY HEATING AND COOLING EQUIPMENT
12/01

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI 460	(2000) Remote Mechanical-Draft Air-Cooled Refrigerant Condensers
ARI 495	(1999) Refrigerant Liquid Receivers
ARI 500	(2000) Variable Capacity Positive Displacement Refrigerant Compressors and Compressor Units for Air-Conditioning and Heat Pump Applications
ARI 700	(1999) Specifications for Fluorocarbon Refrigerants

ASTM INTERNATIONAL (ASTM)

ASTM A 307	(2002) Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM B 117	(1997) Operating Salt Spray (Fog) Apparatus
ASTM D 520	(2000) Zinc Dust Pigment
ASTM F 104	(1995) Nonmetallic Gasket Materials

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 15	(2001; Errata 2002) Safety Standard for Refrigeration Systems
ASHRAE 34	(2001; Errata 2002) Designation and Safety Classification of Refrigerants

AMERICAN WELDING SOCIETY (AWS)

AWS Z49.1	(1999) Safety in Welding, Cutting and Allied Processes

ASME INTERNATIONAL (ASME)

ASME BPVC SEC IX	(2001) Boiler and Pressure Vessel Code;

	Section IX, Welding and Brazing Qualifications
ASME BPVC SEC VIII D1	(2001) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 6	(1993; R 2001) Industrial Control and Systems: Enclosures
NEMA MG 1	(1998) Motors and Generators
NEMA MG 2	(1989) Safety Standard for Construction and Guide for Selection, Installation, and Use of Electric Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2002) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 1995	(1995; Rev thru Aug 1999) Heating and Cooling Equipment
UL 207	(1993; Rev thru Oct 1997) Refrigerant-Containing Components and Accessories, Nonelectrical

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Drawings; G-AO

Drawings provided in adequate detail to demonstrate compliance with contract requirements. Drawings shall consist of:

a. Equipment layouts which identify assembly and installation details.

b. Plans and elevations which identify clearances required for maintenance and operation.

c. Wiring diagrams which identify each component individually and interconnected or interlocked relationships between components.

d. Foundation drawings, bolt-setting information, and foundation bolts prior to concrete foundation construction for equipment indicated or required to have concrete foundations.

e. Details, if piping and equipment are to be supported other than as indicated, which include loadings and type of frames, brackets, stanchions, or other supports.

f. Automatic temperature control diagrams and control sequences.

g. Installation details which includes the amount of factory set superheat and corresponding refrigerant pressure/temperature.

SD-03 Product Data

Unitary Equipment; G-AE

Manufacturer's standard catalog data, at least 5 weeks prior to the purchase or installation of a particular component, highlighted to show material, size, options, performance charts and curves, etc. in adequate detail to demonstrate compliance with contract requirements. Data shall include manufacturer's recommended installation instructions and procedures. If vibration isolation is specified for a unit, vibration isolator literature shall be included containing catalog cuts and certification that the isolation characteristics of the isolators provided meet the manufacturer's recommendations. Data shall be submitted for each specified component.

Spare Parts Data

Spare parts data for each different item of equipment specified, after approval of detail drawings and not later than 1month prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, a recommended spare parts list for 1 year of operation, and a list of the parts recommended by the manufacturer to be replaced on a routine basis.

Posted Instructions

Posted instructions, at least 2 weeks prior to construction completion, including equipment layout, wiring and control diagrams, piping, valves and control sequences, and typed condensed operation instructions. The condensed operation instructions shall include preventative maintenance procedures, methods of checking the system for normal and safe operation, and procedures for safely starting and stopping the system. The posted instructions shall be framed under glass or laminated plastic and be posted where indicated by the Contracting Officer.

Verification of Dimensions

A letter, at least 2 weeks prior to beginning construction, including the date the site was visited, conformation of existing conditions, and any discrepancies found.

System Performance Tests

A schedule, at least 2 weeks prior to the start of related testing, for the system performance tests. The schedules shall identify the proposed date, time, and location for each test.

Demonstrations; G-AO

A schedule, at least 2 weeks prior to the date of the proposed training course, which identifies the date, time, and location for the training.

SD-06 Test Reports

Refrigerant Tests, Charging, and Start-Up; G-AO

Six copies of each test containing the information described below in bound 8-1/2 x 11 inch booklets. Individual reports shall be submitted for the refrigerant system tests.

a. The date the tests were performed.

b. A list of equipment used, with calibration certifications.

c. Initial test summaries.

d. Repairs/adjustments performed.

e. Final test results.

System Performance Tests; G-AO

Six copies of the report provided in bound 8-1/2 x 11 inch booklets. The report shall document compliance with the specified performance criteria upon completion and testing of the system. The report shall indicate the number of days covered by the tests and any conclusions as to the adequacy of the system. The report shall also include the following information and shall be taken at least three different times at outside dry-bulb temperatures that are at least 5 degrees F apart:

a. Date and outside weather conditions.

b. The load on the system based on the following:

(1) The refrigerant used in the system.
(2) Condensing temperature and pressure.
(3) Suction temperature and pressure.
(4) Ambient, condensing and coolant temperatures.
(5) Running current, voltage and proper phase sequence for each phase of all motors.

c. The actual on-site setting of operating and safety controls.

d. Thermostatic expansion valve superheat - value as determined by field test.

e. Subcooling.

f. High and low refrigerant temperature switch set-points

g. Low oil pressure switch set-point.

h. Defrost system timer and thermostat set-points.

i. Moisture content.

j. Capacity control set-points.

k. Field data and adjustments which affect unit performance and energy consumption.

l. Field adjustments and settings which were not permanently marked as an integral part of a device.

SD-07 Certificates

Unitary Equipment

Where the system, components, or equipment are specified to comply with requirements of ARI, ASHRAE, ASME, or UL, proof of such compliance shall be provided. The label or listing of the specified agency shall be acceptable evidence. In lieu of the label or listing, a written certificate from an approved, nationally recognized testing organization equipped to perform such services, stating that the items have been tested and conform to the requirements and testing methods of the specified agency may be submitted. When performance requirements of this project's drawings and specifications vary from standard ARI rating conditions, computer printouts, catalog, or other application data certified by ARI or a nationally recognized laboratory as described above shall be included. If ARI does not have a current certification program that encompasses such application data, the manufacturer may self certify that his application data complies with project performance requirements in accordance with the specified test standards.

Service Organization

A certified list of qualified permanent service organizations, which includes their addresses and qualifications, for support of the equipment. The service organizations shall be reasonably convenient to the equipment installation and be able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

SD-10 Operation and Maintenance Data

Operation Manuals; G-AO

Six complete copies of an operation manual in bound 8 1/2 x 11 inch booklets listing step-by-step procedures required for system startup, operation, abnormal shutdown, emergency shutdown, and normal shutdown at least 4 weeks prior to the first training course. The booklets shall include the manufacturer's name, model number, and parts list. The manuals shall include the manufacturer's name, model number, service manual, and a brief description of all equipment and their basic operating features.

Maintenance Manuals; G-AO

Six complete copies of maintenance manual in bound 8-1/2 x 11 inch booklets listing routine maintenance procedures, possible

breakdowns and repairs, and a trouble shooting guide. The manuals shall include piping and equipment layouts and simplified wiring and control diagrams of the system as installed.

1.3 SAFETY REQUIREMENTS

Exposed moving parts, parts that produce high operating temperature, parts which may be electrically energized, and parts that may be a hazard to operating personnel shall be insulated, fully enclosed, guarded, or fitted with other types of safety devices. Safety devices shall be installed so that proper operation of equipment is not impaired. Welding and cutting safety requirements shall be in accordance with AWS Z49.1.

1.4 DELIVERY, STORAGE, AND HANDLING

Stored items shall be protected from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Proper protection and care of all material both before and during installation shall be the Contractor's responsibility. Any materials found to be damaged shall be replaced at the Contractor's expense. During installation, piping and similar openings shall be capped to keep out dirt and other foreign matter.

1.5 PROJECT/SITE CONDITIONS

1.5.1 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

1.5.2 Drawings

Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. The Contractor shall carefully investigate the plumbing, fire protection, electrical, structural and finish conditions that would affect the work to be performed and arrange such work accordingly, furnishing required offsets, fittings, and accessories to meet such conditions.

PART 2 PRODUCTS

2.1 STANDARD COMMERCIAL PRODUCTS

Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacturing of such products, which are of a similar material, design and workmanship. The standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2 year use shall include applications of equipment and materials under similar circumstances and of similar size. The 2 years experience shall be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturer's catalogs, or brochures. Products having less than a 2 year field service record shall be acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown. Products shall be supported by a service organization. System components shall be environmentally suitable for the indicated locations.

2.2 NAMEPLATES

Major equipment including compressors, condensers, receivers, heat exchanges, fans, and motors shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the item of equipment. Plates shall be durable and legible throughout equipment life and made of anodized aluminum. Plates shall be fixed in prominent locations with nonferrous screws or bolts.

2.3 ELECTRICAL WORK

Electrical equipment, motors, motor efficiencies, and wiring shall be in accordance with Section 16415A ELECTRICAL WORK, INTERIOR. Electrical motor driven equipment specified shall be provided complete with motors, motor starters, and controls. Electrical characteristics shall be as shown, and unless otherwise indicated, all motors of 1 horsepower and above with open, dripproof, totally enclosed, or explosion proof fan cooled enclosures, shall be high efficiency type. Field wiring shall be in accordance with manufacturer's instructions. Each motor shall conform to NEMA MG 1 and NEMA MG 2 and be of sufficient size to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor. Motors shall be continuous duty with the enclosure specified. Motor starters shall be provided complete with thermal overload protection and other appurtenances necessary for the motor control indicated. Motors shall be furnished with a magnetic across-the-line or reduced voltage type starter as required by the manufacturer. Motor duty requirements shall allow for maximum frequency start-stop operation and minimum encountered interval between start and stop. Motors shall be sized for the applicable loads. Motor torque shall be capable of accelerating the connected load within 20 seconds with 80 percent of the rated voltage maintained at motor terminals during one starting period. Motor bearings shall be fitted with grease supply fittings and grease relief to outside of enclosure. Manual or automatic control and protective or signal devices required for the operation specified and any control wiring required for controls and devices specified, but not shown, shall be provided.

2.4 REMOTE CONDENSER OR CONDENSING UNIT

Each remote condenser coil shall be fitted with a manual isolation valve and an access valve on the coil side. Saturated refrigerant condensing temperature shall not exceed 120 degrees F at 95 degrees F ambient. Unit shall be provided with low ambient condenser controls to ensure proper operation in an ambient temperature of 30 degrees F. Fan and cabinet construction shall be provided as specified in paragraph "Unitary Equipment Components". Fan and condenser motors shall have open, dripproof enclosures.

2.4.1 Air-Cooled Condenser

Unit shall be rated in accordance with ARI 460 and conform to the requirements of UL 1995. Unit shall be factory fabricated, tested, packaged, and self-contained. Unit shall be complete with casing, propeller or centrifugal type fans, heat rejection coils, connecting piping and wiring, and all necessary appurtenances.

2.4.1.1 Connections

Interconnecting refrigeration piping, electrical power, and control wiring between the condensing unit and the indoor unit shall be provided as

required and as indicated. Electrical and refrigeration piping terminal connections between condensing unit and evaporator units shall be provided.

2.4.1.2 Head Pressure Control and Liquid Subcooling

Low ambient control for multi-circuited units serving more than one evaporator coil shall provide independent condenser pressure controls for each refrigerant circuit. Controls shall be set to produce a minimum of 95 degrees F saturated refrigerant condensing temperature. Unit shall be provided with a liquid subcooling circuit which shall ensure proper liquid refrigerant flow to the expansion device over the specified application range of the condenser. Unit shall be provided with not less than 15 degrees F liquid subcooling. Subcooling circuit shall be liquid sealed.

2.4.1.3 Condensing Coil

Coils shall have copper or aluminum tubes of 3/8 inch minimum diameter with copper or aluminum fins that are mechanically bonded or soldered to the tubes. Casing shall be galvanized steel or aluminum. Contact of dissimilar metals shall be avoided. Coils shall be tested in accordance with ASHRAE 15 at the factory and be suitable for the working pressure of the installed system. Each coil shall be dehydrated and sealed after testing and prior to evaluation and charging. Each unit shall be provided with a factory operating charge of refrigerant and oil or a holding charge. Unit shipped with a holding charge shall be field charged. Separate expansion devices shall be provided for each compressor circuit.

2.4.1.4 Unit Controls

The control system shall be complete with required accessories for regulating condenser pressure by fan cycling, flooding the condenser, or a combination of the above. Unit mounted control panels or enclosures shall be constructed in accordance with applicable requirements of NFPA 70 and housed in NEMA ICS 6, Class 1 or 3A enclosures. Controls shall include control transformer, fan motor starters, time delay start-up, overload protective devices, interface with local and remote components, and intercomponent wiring to terminal block points.

2.4.2 Compressor

Unit shall be rated in accordance with ARI 500. Compressor shall be direct drive, semi-hermetic or hermetic reciprocating, or scroll type capable of operating at partial load conditions. Compressor shall be capable of continuous operation down to the lowest step of unloading as specified. Units 120,000 Btuh and larger shall be provided with capacity reduction devices to produce automatic capacity reduction of at least 50 percent. See Schedules. Two or more compressors must be used in lieu of a single compressor with unloading capabilities, in which case the compressors will operate in sequence. Provide a minimum of two independent refrigeration circuits through the condenser and evaporator. Each compressor shall start in the unloaded position. Each compressor shall be provided with vibration isolators, crankcase heater, thermal overloads, and high and low pressure safety cutoffs and protection against short cycling.

2.5 EQUIPMENT EFFICIENCY

Unit shall have a minimum efficiency as indicated on the drawing schedules.

2.6 UNITARY EQUIPMENT COMPONENTS

2.6.1 Refrigerant and Oil

Refrigerant shall be one of the fluorocarbon gases. Refrigerants shall have number designations and safety classifications in accordance with ASHRAE 34. Refrigerants shall meet the requirements of ARI 700 as a minimum. Refrigerants shall have an Ozone Depletion Potential (ODP) of less than or equal to 0.05. Contractor shall provide and install a complete charge of refrigerant for the installed system as recommended by the manufacturer. Except for factory sealed units, two complete charges of lubricating oil for each compressor crankcase shall be furnished. One charge shall be used during the system performance testing period. Following the satisfactory completion of the performance testing, the oil shall be drained and replaced with a second charge. Lubricating oil shall be of a type and grade recommended by the manufacturer for each compressor. Where color leak indicator dye is incorporated, charge shall be in accordance with manufacturer's recommendation.

2.6.2 Fans

Fan wheel shafts shall be supported by either maintenance-accessible lubricated antifriction block-type bearings, or permanently lubricated ball bearings. Unit fans shall be selected to produce the cfm required at the fan total pressure. Motor starters, if applicable, shall be magnetic across-the-line type with a open dripproof enclosure. Thermal overload protection shall be of the manual or automatic-reset type. Fan wheels or propellers shall be constructed of aluminum or galvanized steel. Both centrifugal and propeller fan casings shall be constructed of aluminum or galvanized steel. Steel elements of fans, except fan shafts, shall be hot-dipped galvanized after fabrication or fabricated of mill galvanized steel. Mill-galvanized steel surfaces and edges damaged or cut during fabrication by forming, punching, drilling, welding, or cutting shall be recoated with an approved zinc-rich compound. Fan wheels or propellers shall be statically and dynamically balanced. Propeller fans shall be direct-drive type with fixed pitch blades. Each drive will be independent of any other drive. Drive bearings shall be protected with water slingers or shields.

2.6.3 Coil Frost Protection

Provide hot gas bypass system and piping as shown on drawings.

2.6.4 Pressure Vessels

Pressure vessels shall conform to ASME BPVC SEC VIII D1 or UL 207, as applicable for maximum and minimum pressure or temperature encountered. Where referenced publications do not apply, pressure components shall be tested at 1-1/2 times design working pressure. Refrigerant wetted carbon steel surfaces shall be pickled or abrasive blasted free of mill scale, cleaned, dried, charged, and sealed.

2.6.4.1 Hot Gas Muffler

Unit shall be selected by the manufacturer for maximum noise attenuation. Units rated for 30 tons capacity and under may be field tunable type.

2.6.4.2 Liquid Receiver

A liquid receiver shall be provided when a system's condenser or compressor does not contain a refrigerant storage capacity of at least 20 percent in excess of a fully charged system. Receiver shall be designed, filled, and rated in accordance with the recommendations of ARI 495, except as modified herein. Receiver shall be fitted to include an inlet connection; an outlet drop pipe with oil seal and oil drain where necessary; two bull's-eye liquid level sight glass in same vertical plane, 90 degrees apart and perpendicular to axis of receiver or external gauge glass with metal guard and automatic stop valves; float switch column; and purge, charge, equalizing, pressurizing, plugged drain and service valves on the inlet and outlet connections. Receiver shall be provided with a relief valve of capacity and setting in accordance with ASHRAE 15.

2.6.4.3 Oil Separator

Separator shall be the high efficiency type and be provided with removable flanged head for ease in removing float assembly and removable screen cartridge assembly. Pressure drop through a separator shall not exceed 10 psi during the removal of hot gas entrained oil. Connections to compressor shall be as recommended by the compressor manufacturer. Separator shall be provided with an oil float valve assembly or needle valve and orifice assembly, drain line shutoff valve, sight glass, filter for removal of all particulate sized 10 microns and larger, and strainer.

2.6.4.4 Oil Reservoir

Reservoir capacity shall equal one charge of all connected compressors. Reservoir shall be provided with an external liquid gauge glass, plugged drain, and isolation valves. Vent piping between the reservoir and the suction header shall be provided with a 5 psi pressure differential relief valve. Reservoir shall be provided with the manufacturer's standard filter on the oil return line to the oil level regulators.

2.7 ACCESSORIES

2.7.1 Refrigerant Relief Valve/Rupture Disc Assembly

The assembly shall be a combination pressure relief valve and rupture disc designed for refrigerant usage. The assembly shall be in accordance with ASME BPVC SEC VIII D1 and ASHRAE 15. The assembly shall be provided with a pressure gauge assembly which will provide local indication if a rupture disc is broken. Rupture disc shall be the non-fragmenting type.

2.7.2 Refrigerant Signs

Refrigerant signs shall be a medium-weight aluminum type with a baked enamel finish. Signs shall be suitable for indoor or outdoor service. Signs shall have a white background with red letters not less than 0.5 inches in height.

2.7.2.1 Installation Identification

Each new refrigeration system shall be provided with a refrigerant sign which indicates the following as a minimum:

a. Contractor's name

b. Refrigerant number and amount of refrigerant.

c. The lubricant identity and amount.

d. Field test pressure applied.

2.7.3 Gaskets

Gaskets shall conform to ASTM F 104 - classification for compressed sheet with nitrile binder and acrylic fibers for maximum 700 degrees F service.

2.7.4 Bolts and Nuts

Bolts and nuts shall be in accordance with ASTM A 307. The bolt head shall be marked to identify the manufacturer and the standard with which the bolt complies in accordance with ASTM A 307.

2.8 FABRICATION

2.8.1 Factory Coating

Unless otherwise specified, equipment and component items, when fabricated from ferrous metal, shall be factory finished with the manufacturer's standard finish, except that items located outside of buildings shall have weather resistant finishes that will withstand 500 hours exposure to the salt spray test specified in ASTM B 117 using a 5 percent sodium chloride solution. Immediately after completion of the test, the specimen shall show no signs of blistering, wrinkling, cracking, or loss of adhesion and no sign of rust creepage beyond 1/8 inch on either side of the scratch mark. Cut edges of galvanized surfaces where hot-dip galvanized sheet steel is used shall be coated with a zinc-rich coating conforming to ASTM D 520, Type I.

2.8.2 Factory Applied Insulation

Refrigeration equipment shall be provided with factory installed insulation on surfaces subject to sweating including the suction line piping. Where motors are the gas-cooled type, factory installed insulation shall be provided on the cold-gas inlet connection to the motor per manufacturer's standard practice. Factory insulated items installed outdoors are not required to be fire-rated.

2.9 SUPPLEMENTAL COMPONENTS/SERVICES

2.9.1 Refrigerant Piping

Refrigerant piping for split-system unitary equipment shall be provided and installed in accordance with Section 15182 REFRIGERANT PIPING.

PART 3 EXECUTION

3.1 INSTALLATION

Work shall be performed in accordance with the manufacturer's published diagrams, recommendations, and equipment warranty requirements. Where equipment is specified to conform to the requirements of ASME BPVC SEC VIII D1and ASME BPVC SEC IX, the design, fabrication, and installation of the system shall conform to ASME BPVC SEC VIII D1 and ASME BPVC SEC IX.

3.1.1 Equipment

Refrigeration equipment and the installation thereof shall conform to ASHRAE 15. Necessary supports shall be provided for all equipment, appurtenances, and pipe as required, including frames or supports for compressors, and similar items.. Concrete for foundations shall be as specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. Equipment shall be properly leveled, aligned, and secured in place in accordance with manufacturer's instructions.

3.1.2 Field Applied Insulation

Field applied insulation shall be as specified in Section 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS, except as defined differently herein.

3.1.3 Field Painting

Painting required for surfaces not otherwise specified, and finish painting of items only primed at the factory are specified in Section 09900 PAINTING, GENERAL.

3.2 CLEANING AND ADJUSTING

Equipment shall be wiped clean, with all traces of oil, dust, dirt, or paint spots removed. Temporary filters shall be provided for all fans that are operated during construction, and new filters shall be installed after all construction dirt has been removed from the building. System shall be maintained in this clean condition until final acceptance. Bearings shall be properly lubricated with oil or grease as recommended by the manufacturer. Belts shall be tightened to proper tension. Control valves and other miscellaneous equipment requiring adjustment shall be adjusted to setting indicated or directed. Fans shall be adjusted to the speed indicated by the manufacturer to meet specified conditions. Testing, adjusting, and balancing shall be as specified in Section 15990A TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS.

3.3 REFRIGERANT TESTS, CHARGING, AND START-UP

Split-system refrigerant piping systems shall be tested and charged as specified in Section 15182 REFRIGERANT PIPING. Packaged refrigerant systems which are factory charged shall be checked for refrigerant and oil capacity to verify proper refrigerant levels per manufacturer's recommendations. Following charging, packaged systems shall be tested for leaks with a halide torch or an electronic leak detector.

3.3.1 Refrigerant Leakage

If a refrigerant leak is discovered after the system has been charged, the leaking portion of the system shall immediately be isolated from the remainder of the system and the refrigerant pumped into the system receiver or other suitable container. Under no circumstances shall the refrigerant be discharged into the atmosphere.

3.3.2 Contractor's Responsibility

The Contractor shall, at all times during the installation and testing of the refrigeration system, take steps to prevent the release of refrigerants into the atmosphere. The steps shall include, but not be limited to, procedures which will minimize the release of refrigerants to the

atmosphere and the use of refrigerant recovery devices to remove refrigerant from the system and store the refrigerant for reuse or reclaim. At no time shall more than 3 ounces of refrigerant be released to the atmosphere in any one occurrence. Any system leaks within the first year shall be repaired in accordance with the requirements herein at no cost to the Government including material, labor, and refrigerant if the leak is the result of defective equipment, material, or installation.

3.4 SYSTEM PERFORMANCE TESTS

Before each refrigeration system is accepted, tests to demonstrate the general operating characteristics of all equipment shall be conducted by a registered professional engineer or an approved manufacturer's start-up representative experienced in system start-up and testing, at such times as directed. Tests shall cover a period of not less than 48 hours for each system and shall demonstrate that the entire system is functioning in accordance with the drawings and specifications. Corrections and adjustments shall be made as necessary and tests shall be re-conducted to demonstrate that the entire system is functioning as specified. Prior to acceptance, service valve seal caps and blanks over gauge points shall be installed and tightened. Any refrigerant lost during the system startup shall be replaced. If tests do not demonstrate satisfactory system performance, deficiencies shall be corrected and the system shall be retested. Tests shall be conducted in the presence of the Contracting Officer. Water and electricity required for the tests will be furnished by the Government. Any material, equipment, instruments, and personnel required for the test shall be provided by the Contractor. Field tests shall be coordinated with Section 15990A TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS.

3.5 DEMONSTRATIONS

Contractor shall conduct a training course for the operating staff as designated by the Contracting Officer. The training period shall consist of a total 4 hours of normal working time and start after the system is functionally completed but prior to final acceptance tests. The field posted instructions shall cover all of the items contained in the approved operation manuals and maintenance manuals as well as demonstrations of routine maintenance operations.

3.6 SPARE PARTS DATA

Provide spare parts data and list of parts required for routine replacement.

-- End of Section --

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SECTION 15895

AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM
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PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI 260	(2001) Sound Rating of Ducted Air Moving and Conditioning Equipment
ARI 410	(2001) Forced-Circulation Air-Cooling and Air-Heating Coils
ARI 430	(1999) Central-Station Air-Handling Units
ARI 880	(1998) Air Terminals
ARI Guideline D	(1996) Application and Installation of Central Station Air-Handling Units

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL (AMCA)

AMCA 210	(1999) Laboratory Methods of Testing Fans for Aerodynamic Performance Rating
AMCA 300	(1996) Reverberant Room Method for Sound Testing of Fans

AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABMA)

ABMA 9	(1990; R 2000) Load Ratings and Fatigue Life for Ball Bearings
ABMA 11	(1990; R 1999) Load Ratings and Fatigue Life for Roller Bearings

ASTM INTERNATIONAL (ASTM)

ASTM A 53/A 53M	(2002) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 123/A 123M	(2002) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 924/A 924M	(1999) General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process

ASTM B 117	(1997) Operating Salt Spray (Fog) Apparatus
ASTM C 553	(2002) Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM C 916	(1985; R 2001e1) Adhesives for Duct Thermal Insulation
ASTM C 920	(2002) Elastomeric Joint Sealants
ASTM C 1071	(2000) Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material)
ASTM D 520	(2000) Zinc Dust Pigment
ASTM D 1654	(1992; R 2000) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D 3359	(2002) Measuring Adhesion by Tape Test
ASTM E 84	(2001) Surface Burning Characteristics of Building Materials

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 52.2	(1999) Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size
ASHRAE 68	(1997) Laboratory Method of Testing to Determine the Sound Power in a Duct
ASHRAE 70	(1991) Method of Testing for Rating the Performance of Air Outlets and Inlets
ASHRAE 84	(1991) Method of Testing Air-to-Air Heat Exchangers

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(1998) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A	(2002) Installation of Air Conditioning and Ventilating Systems
NFPA 96	(2001) Ventilation Control and Fire Protection of Commercial Cooking Equipment

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA Arch. Manual	(1993; Errata; Addenda Oct 1997; 4th Printing 1999) Architectural Sheet Metal Manual
SMACNA HVAC Duct Const Stds	(1995; Addenda Nov 1997; 6th Printing 2001) HVAC Duct Construction Standards - Metal and Flexible
SMACNA Install Fire Damp HVAC	(1992; 5th edition, 2002) Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems
SMACNA Leakage Test Mnl	(1985; 6th Printing 1997) HVAC Air Duct Leakage Test Manual

UNDERWRITERS LABORATORIES (UL)

UL 181	(1996; Rev thru May 2003) Factory-Made Air Ducts and Air Connectors
UL 214	(1997; Rev thru Aug 2001) Tests for Flame-Propagation of Fabrics and Films
UL 555	(1999; Rev thru Jan 2002) Fire Dampers
UL 586	(1996; Rev thru Apr 2000) High-Efficiency, Particulate, Air Filter Units
UL 705	(1994; Rev thru Feb 1999) Power Ventilators
UL 723	(1996; Rev thru Sep 2001) Test for Surface Burning Characteristics of Building Materials
UL 900	(1994; Rev thru Oct 1999) Air Filter Units
UL Bld Mat Dir	(2003) Building Materials Directory
UL Elec Const Dir	(2003) Electrical Construction Equipment Directory
UL Fire Resist Dir	(2003) Fire Resistance Directory (Vol 1, 2A, 2B & 3)

1.2 COORDINATION OF TRADES

Ductwork, piping offsets, fittings, and accessories shall be furnished as required to provide a complete installation and to eliminate interference with other construction.

1.3 DELIVERY AND STORAGE

Equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Additionally, all pipes shall either be capped or plugged until installed.

1.4 FIELD MEASUREMENTS

After becoming familiar with all details of the work, the Contractor shall verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Drawings; G-AO
Installation; G-AO

Drawings showing equipment layout, including assembly and installation details and electrical connection diagrams; ductwork layout showing the location of all supports and hangers, typical hanger details, gauge reinforcement, reinforcement spacing rigidity classification, and static pressure and seal classifications; and piping layout showing the location of all guides and anchors, the load imposed on each support or anchor, and typical support details. Drawings shall include any information required to demonstrate that the system has been coordinated and will properly function as a unit and shall show equipment relationship to other parts of the work, including clearances required for operation and maintenance.

SD-03 Product Data

Components and Equipment; G-AE

Manufacturer's catalog data included with the detail drawings for the following items. The data shall be highlighted to show model, size, options, etc., that are intended for consideration. Data shall be adequate to demonstrate compliance with contract requirements for the following:

a. Piping Components

b. Ductwork Components

c. Air Systems Equipment

d. Air Handling Units

e. Energy Recovery Devices

f. Terminal Units

Test Procedures; G-AO

Proposed test procedures for ductwork leak test, and performance

tests of systems, at least 2 weeks prior to the start of related testing.

Diagrams; G-AO

Proposed diagrams, at least 2 weeks prior to start of related testing. System diagrams that show the layout of equipment, piping, and ductwork, and typed condensed operation manuals explaining preventative maintenance procedures, methods of checking the system for normal, safe operation, and procedures for safely starting and stopping the system shall be framed under glass or laminated plastic. After approval, these items shall be posted where directed.

Manufacturer's Experience

Statement demonstrating successful completion of similar services on at least 5 projects of similar size and scope, at least 2 weeks prior to submittal of other items required by this section.

Performance Tests; G-AO

Proposed test schedules for hydrostatic test of piping, ductwork leak test, and performance tests, at least 2 weeks prior to the start of related testing.

Field Training; G-AO

Proposed schedule for field training, at least 2 weeks prior to the start of related training.

SD-06 Test Reports

Performance Tests; G-AO
Testing, Adjusting, and Balancing; G-AO

Test reports for the piping hydrostatic test, ductwork leak test, and performance tests in booklet form, upon completion of testing. Reports shall document phases of tests performed including initial test summary, repairs/adjustments made, and final test results.

SD-10 Operation and Maintenance Data

Operating and Maintenance Instructions; G-AO

Six manuals listing step-by-step procedures required for system startup, operation, shutdown, and routine maintenance, at least 2 weeks prior to field training. The manuals shall include the manufacturer's name, model number, parts list, list of parts and tools that should be kept in stock by the owner for routine maintenance including the name of a local supplier, simplified wiring and controls diagrams, troubleshooting guide, and recommended service organization (including address and telephone number) for each item of equipment. Each service organization

submitted shall be capable of providing 4 hour onsite response to a service call on an emergency basis.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Components and equipment shall be standard products of a manufacturer regularly engaged in the manufacturing of products that are of a similar material, design and workmanship. The standard products shall have been in satisfactory commercial or industrial use for 2 years before bid opening. The 2-year manufacturer's experience shall include applications of components and equipment under similar circumstances and of similar size. The 2 years must be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures. Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown. The equipment items shall be supported by a service organization.

2.2 ASBESTOS PROHIBITION

Asbestos and asbestos-containing products shall not be used.

2.3 NAMEPLATES

Equipment shall have a nameplate installed by the manufacturer that identifies the manufacturer's name, address, type or style, model or serial number, and catalog number.

2.4 EQUIPMENT GUARDS AND ACCESS

Belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts exposed to personnel contact shall be fully enclosed or guarded according to OSHA requirements. High temperature equipment and piping exposed to contact by personnel or where it creates a potential fire hazard shall be properly guarded or covered with insulation of a type specified.

2.5 ELECTRICAL WORK

Electrical motor-driven equipment specified shall be provided complete with motor, motor starter, and controls. Unless otherwise specified, electric equipment, including wiring and motor efficiencies, shall be according to Section 16415A ELECTRICAL WORK, INTERIOR. Electrical characteristics and enclosure type shall be as shown. Unless otherwise indicated, motors of 1 hp and above shall be high efficiency type. Motor starters shall be provided complete with thermal overload protection and other appurtenances necessary. Each motor shall be according to NEMA MG 1 and shall be of sufficient size to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor. Manual or automatic control and protective or signal devices required for the operation specified, and any control wiring required for controls and devices, but not shown, shall be provided. Where two-speed or variable-speed motors are indicated, solid-state variable-speed controller may be provided to accomplish the same function. Solid-state variable-speed controllers shall be utilized for motors rated 10 hp or less. Adjustable frequency drives shall be used for larger motors.

2.6 CONTROLS

Controls shall be provided as specified in Section 15951A DIRECT DIGITAL CONTROL FOR HVAC.

2.7 DUCTWORK COMPONENTS

2.7.1 Metal Ductwork

Pool unit, AHU-5, supply and return ductwork to be aluminum. Kitchen hood exhaust duct to be stainless steel. All other ductwork to be galvanized steel. All aspects of metal ductwork construction, including all fittings and components, shall comply with SMACNA HVAC Duct Const Stds unless otherwise specified. Elbows shall be radius type with a centerline radius of 1.5 times the width or diameter of the duct where space permits. Otherwise, elbows having a minimum radius equal to the width or diameter of the duct or square elbows with factory fabricated turning vanes may be used. Static pressure 1/2, 1, and 2 inch w.g. ductwork shall meet the requirements of Seal Class C. 3 through 10 inch w. g. shall meet the requirements of Seal Class A. All ductwork in VAV systems upstream of the VAV boxes shall meet the requirements of Seal Class A. Sealants shall conform to fire hazard classification specified in Section 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS and shall be suitable for the range of air distribution and ambient temperatures that it will be exposed to. Pressure sensitive tape shall not be used as a sealant. Spiral lock seam duct, and flat oval shall be made with duct sealant and locked with not less than 3 equally spaced drive screws or other approved methods indicated in SMACNA HVAC Duct Const Stds. The sealant shall be applied to the exposed male part of the fitting collar so that the sealer will be on the inside of the joint and fully protected by the metal of the duct fitting. One brush coat of the sealant shall be applied over the outside of the joint to at least 2 inch band width covering all screw heads and joint gap. Dents in the male portion of the slip fitting collar will not be acceptable. Outdoor air intake ducts and plenums shall be fabricated with watertight soldered or brazed joints and seams.

2.7.1.1 Transitions

Diverging air flow transitions shall be made with each side pitched out a maximum of 15 degrees, for an included angle of 30 degrees. Transitions for converging air flow shall be made with each side pitched in a maximum of 30 degrees, for an included angle of 60 degrees, or shall be as indicated. Factory-fabricated reducing fittings for systems using round duct sections when formed to the shape of the ASME short flow nozzle, need not comply with the maximum angles specified.

2.7.1.2 Metallic Flexible Duct

Metallic type duct shall be single-ply galvanized steel. Duct shall be of corrugated/interlocked, folded and knurled type seam construction, bendable without damage through 180 degrees with a throat radius equal to 0.5 duct diameter. Duct shall conform to UL 181 and shall be rated for positive or negative working pressure of 15 inches water gauge at 350 degrees F when duct is aluminum, and 650 degrees F when duct is galvanized steel or stainless steel.

2.7.1.3 Insulated Nonmetallic Flexible Duct Runouts

Flexible duct runouts shall be used only where indicated. Runout length shall be as shown on the drawings, but shall in no case exceed 10 feet. Runouts shall be preinsulated, factory fabricated, and shall comply with NFPA 90A and UL 181. Either field or factory applied vapor barrier shall be provided. Where coil induction or high velocity units are supplied with vertical air inlets, a streamlined and vaned and mitered elbow transition piece shall be provided for connection to the flexible duct or hose. The last elbow to these units, other than the vertical air inlet type, shall be a die-stamped elbow and not a flexible connector. Insulated flexible connectors may be used as runouts. The insulated material and vapor barrier shall conform to the requirements of Section 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS. The insulation material surface shall not be exposed to the air stream.

2.7.1.4 General Service Duct Connectors

A flexible duct connector approximately 6 inches in width shall be provided where sheet metal connections are made to fans or where ducts of dissimilar metals are connected. For round/oval ducts, the flexible material shall be secured by stainless steel or zinc-coated, iron clinch-type draw bands. For rectangular ducts, the flexible material locked to metal collars shall be installed using normal duct construction methods. The composite connector system shall comply with UL 214 and be classified as "flame-retarded fabrics" in UL Bld Mat Dir.

2.7.1.5 High Temperature Service Duct Connections

Material shall be approximately 3/32 inch thick, 35 to 40-ounce per square yard weight, plain weave fibrous glass cloth with, nickel/chrome wire reinforcement for service in excess of 1200 degrees F.

2.7.2 Ductwork Accessories

2.7.2.1 Duct Access Doors

Access doors shall be provided in ductwork and plenums where indicated and at all air flow measuring primaries, automatic dampers, fire dampers, coils, thermostats, and other apparatus requiring service and inspection in the duct system, and unless otherwise shown, shall conform to SMACNA HVAC Duct Const Stds. Access doors shall be provided upstream and downstream of air flow measuring primaries and heating and cooling coils. Doors shall be minimum 15 x 18 inches, unless otherwise shown. Where duct size will not accommodate this size door, the doors shall be made as large as practicable. Doors 24 x 24 inches or larger shall be provided with fasteners operable from both sides. Doors in insulated ducts shall be the insulated type.

2.7.2.2 Fire Dampers

Fire dampers shall be 1.5 hour fire rated unless otherwise indicated. Fire dampers shall conform to the requirements of NFPA 90A and UL 555. The Contractor shall perform the fire damper test as outlined in NFPA 90A. A pressure relief damper shall be provided upstream of the fire damper. If the ductwork connected to the fire damper is to be insulated then this pressure relief damper shall be factory insulated. Fire dampers shall be automatic operating type and shall have a dynamic rating suitable for the maximum air velocity and pressure differential to which it will be

subjected. Fire dampers shall be approved for the specific application, and shall be installed according to their listing. Fire dampers shall be equipped with a steel sleeve or adequately sized frame installed in such a manner that disruption of the attached ductwork, if any, will not impair the operation of the damper. Sleeves or frames shall be equipped with perimeter mounting angles attached on both sides of the wall or floor opening. Ductwork in fire-rated floor-ceiling or roof-ceiling assembly systems with air ducts that pierce the ceiling of the assemblies shall be constructed in conformance with UL Fire Resist Dir. Fire dampers shall be curtain type with damper blades out of the air stream. Dampers shall not reduce the duct or the air transfer opening cross-sectional area. Dampers shall be installed so that the centerline of the damper depth or thickness is located in the centerline of the wall, partition or floor slab depth or thickness. Unless otherwise indicated, the installation details given in SMACNA Install Fire Damp HVAC and in manufacturer's instructions for fire dampers shall be followed. Acceptance testing of fire dampers shall be performed per paragraph Fire Damper Acceptance Test and NFPA 90A.

2.7.2.3 Splitters and Manual Balancing Dampers

Splitters and manual balancing dampers shall be furnished with accessible operating mechanisms. Where operators occur in finished portions of the building, operators shall be chromium plated with all exposed edges rounded. Splitters shall be operated by quadrant operators or 3/16 inch rod brought through the side of the duct with locking setscrew and bushing. Two rods are required on splitters over 8 inches. Manual volume control dampers shall be operated by locking-type quadrant operators. Dampers and splitters shall be 2 gauges heavier than the duct in which installed. Unless otherwise indicated, multileaf dampers shall be opposed blade type with maximum blade width of 12 inches. Access doors or panels shall be provided for all concealed damper operators and locking setscrews. Unless otherwise indicated, the locking-type quadrant operators for dampers, when installed on ducts to be thermally insulated, shall be provided with stand-off mounting brackets, bases, or adapters to provide clearance between the duct surface and the operator not less than the thickness of the insulation. Stand-off mounting items shall be integral with the operator or standard accessory of the damper manufacturer. Volume dampers shall be provided where indicated.

2.7.2.4 Air Deflectors and Branch Connections

Air deflectors shall be provided at duct mounted supply outlets, at takeoff or extension collars to supply outlets, at duct branch takeoff connections, and at 90 degree elbows, as well as at locations as indicated on the drawings or otherwise specified. Conical branch connections or 45 degree entry connections may be used in lieu of deflectors or extractors for branch connections. All air deflectors, except those installed in 90 degree elbows, shall be provided with an approved means of adjustment. Adjustment shall be made from easily accessible means inside the duct or from an adjustment with sturdy lock on the face of the duct. When installed on ducts to be thermally insulated, external adjustments shall be provided with stand-off mounting brackets, integral with the adjustment device, to provide clearance between the duct surface and the adjustment device not less than the thickness of the thermal insulation. Air deflectors shall be factory-fabricated units consisting of curved turning vanes or louver blades designed to provide uniform air distribution and change of direction with minimum turbulence or pressure loss. Air deflectors shall be factory or field assembled. Blade air deflectors, also called blade air extractors, shall be approved factory fabricated units

consisting of equalizing grid and adjustable blade and lock. Adjustment shall be easily made from the face of the diffuser or by position adjustment and lock external to the duct. Stand-off brackets shall be provided on insulated ducts and are described herein. Fixed air deflectors, also called turning vanes, shall be provided in 90 degree elbows.

2.7.3 Duct Sleeves, Framed Prepared Openings, Closure Collars

2.7.3.1 Duct Sleeves

Duct sleeves shall be provided for round ducts 15 inches in diameter or less passing through floors, walls, ceilings, or roof, and installed during construction of the floor, wall, ceiling, or roof. Round ducts larger than 15 inches in diameter and square, rectangular, and oval ducts passing through floors, walls, ceilings, or roof shall be installed through framed prepared openings. The Contractor shall be responsible for the proper size and location of sleeves and prepared openings. Sleeves and framed openings are also required where grilles, registers, and diffusers are installed at the openings. Framed prepared openings shall be fabricated from 20 gauge galvanized steel, unless otherwise indicated. Where sleeves are installed in bearing walls or partitions, black steel pipe, ASTM A 53/A 53M, Schedule 20 shall be used. Sleeve shall provide 1 inch clearance between the duct and the sleeve or 1 inch clearance between the insulation and the sleeve for insulated ducts.

2.7.3.2 Framed Prepared Openings

Openings shall have 1 inch clearance between the duct and the opening or 1 inch clearance between the insulation and the opening for insulated ducts.

2.7.3.3 Closure Collars

Collars shall be fabricated of galvanized sheet metal not less than 4 inches wide, unless otherwise indicated, and shall be installed on exposed ducts on each side of walls or floors where sleeves or prepared openings are provided. Collars shall be installed tight against surfaces. Collars shall fit snugly around the duct or insulation. Sharp edges of the collar around insulated duct shall be ground smooth to preclude tearing or puncturing the insulation covering or vapor barrier. Collars for round ducts 15 inches in diameter or less shall be fabricated from 20 gauge galvanized steel. Collars for round ducts larger than 15 inches and square, and rectangular ducts shall be fabricated from 18 gauge galvanized steel. Collars shall be installed with fasteners on maximum 6 inch centers, except that not less than 4 fasteners shall be used.

2.7.4 Sound Attenuation Equipment

a. Systems With Total Pressure Above 4 Inches Water Gauge:

Sound attenuators shall be provided on the discharge duct of each fan operating at a total pressure above 4 inch water gauge, and, when indicated, at the intake of each fan system. Sound attenuators shall be provided elsewhere as indicated. The sound attenuators shall be factory fabricated and shall be tested by an independent laboratory for sound and performance characteristics. Net sound reduction shall be as indicated. Maximum permissible pressure drop shall not exceed 0.63 inch water gauge. Traps shall be constructed to be airtight when operating under an internal static pressure of 10 inch water gauge. Air-side surface shall be capable

of withstanding air velocity of 10,000 fpm. The Contractor shall certify that the sound reduction values specified will be obtained after the equipment is installed in the system and coordinated with the sound information of the system fan to be provided. Sound absorbing material shall conform to ASTM C 1071, Type I or II. Sound absorbing material shall meet the fire hazard rating requirements for insulation specified in Section 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS. A duct transition section shall be provided for connection to ductwork. Factory fabricated double-walled internally insulated spiral lock seam and round duct and fittings designed for high pressure air system may be provided in lieu of factory fabricated sound attenuators, and shall comply with requirements specified for factory fabricated sound attenuators. The double-walled duct and fittings shall be constructed of an outer metal pressure shell of zinc-coated steel sheet, 1 inch thick acoustical blanket insulation, and an internal perforated zinc-coated metal liner. Sufficient length of run shall be provided to obtain the noise reduction coefficient specified. The Contractor shall certify that the sound reduction value specified will be obtained within the length of duct run provided. The outer sheet metal of the double-walled duct shall have welded, or spiral lock, seams to prevent water vapor penetration. The outer sheet of the duct and fittings shall conform to the metal thickness of high pressure spiral and round ducts and fittings shown in SMACNA HVAC Duct Const Stds. The acoustical insulation shall have a thermal conductivity "k" of not more than 0.27 Btu/inch/square foot/hour/degree F at 75 degrees F mean temperature. The internal perforated zinc-coated metal liner shall be not less than 24 gauge with perforations not larger than 1/4 inch in diameter providing a net open area not less than 10 percent of the surface.

b. System With Total Pressure of 4 Inch Water Gauge and Lower:

Sound attenuators shall be provided only where indicated, or in lieu of lined ducts. Factory fabricated sound attenuators shall be constructed of galvanized steel sheets. Outer casing shall be not less than 22 gauge. Acoustical fill shall be fibrous glass. Net sound reduction shall be as indicated. Values shall be obtained on a test unit not less than 24 by 24 inches outside dimensions made by a certified nationally recognized independent acoustical laboratory. Air flow capacity shall be as indicated or required. Pressure drop through the attenuator shall not exceed the value indicated, or shall not be in excess of 15 percent of the total external static pressure of the air handling system, whichever is less. Sound attenuators shall be acoustically tested with metal duct inlet and outlet sections while under the rated air flow conditions. Noise reduction data shall include the effects of flanking paths and vibration transmission. Sound attenuators shall be constructed to be airtight when operating at the internal static pressure indicated or specified for the duct system, but in no case less than 2 inch water gauge.

c. Acoustical Duct Liner:

Acoustical duct lining shall be fibrous glass designed exclusively for lining ductwork and shall conform to the requirements of ASTM C 1071, Type I and II. Liner composition may be uniform density, graduated density, or dual density, as standard with the manufacturer. Lining shall be coated, not less than 1 inch thick. Where acoustical duct liner is used, liner or combination of liner and insulation applied to the exterior of the ductwork shall be the thermal equivalent of the insulation specified in Section 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS. Duct sizes shown shall be increased to compensate for the thickness of the lining used. In lieu of sheet metal duct with field-applied acoustical lining, acoustically

equivalent lengths of fibrous glass duct or factory fabricated double-walled internally insulated duct with perforated liner may be provided. Net insertion loss value, static pressure drop, and air flow velocity capacity data shall be certified by a nationally recognized independent acoustical laboratory.

2.7.5 Diffusers, Registers, and Grilles

Units shall be factory-fabricated of steel, corrosion-resistant steel, or aluminum and shall distribute the specified quantity of air evenly over space intended without causing noticeable drafts, air movement faster than 50 fpm in occupied zone, or dead spots anywhere in the conditioned area. Outlets for diffusion, spread, throw, and noise level shall be as required for specified performance. Performance shall be certified according to ASHRAE 70. Inlets and outlets shall be sound rated and certified according to ASHRAE 70. Sound power level shall be as indicated. Diffusers and registers shall be provided with volume damper with accessible operator, unless otherwise indicated; or if standard with the manufacturer, an automatically controlled device will be acceptable. Volume dampers shall be opposed blade type for all diffusers and registers, except linear slot diffusers. Linear slot diffusers shall be provided with round or elliptical balancing dampers. Where the inlet and outlet openings are located less than 7 feet above the floor, they shall be protected by a grille or screen according to NFPA 90A.

2.7.5.1 Diffusers

Diffuser types shall be as indicated. Ceiling mounted units shall be furnished with anti-smudge devices, unless the diffuser unit minimizes ceiling smudging through design features. Diffusers shall be provided with air deflectors of the type indicated. Air handling troffers or combination light and ceiling diffusers shall conform to the requirements of UL Elec Const Dir for the interchangeable use as cooled or heated air supply diffusers or return air units. Ceiling mounted units shall be installed with rims tight against ceiling. Sponge rubber gaskets shall be provided between ceiling and surface mounted diffusers for air leakage control. Suitable trim shall be provided for flush mounted diffusers. Duct collar connecting the duct to diffuser shall be airtight and shall not interfere with volume controller. Return or exhaust units shall be similar to supply diffusers.

2.7.5.2 Registers and Grilles

Units shall be four-way directional-control type, except that return and exhaust registers may be fixed horizontal or vertical louver type similar in appearance to the supply register face. Registers shall be provided with sponge-rubber gasket between flanges and wall or ceiling. Wall supply registers shall be installed at least 6 inches below the ceiling unless otherwise indicated. Return and exhaust registers shall be located 6 inches above the floor unless otherwise indicated. Four-way directional control may be achieved by a grille face which can be rotated in 4 positions or by adjustment of horizontal and vertical vanes. Grilles shall be as specified for registers, without volume control damper.

2.7.6 Louvers

Louvers for installation in exterior walls which are associated with the air supply and distribution system shall be as specified in SMACNA Arch. Manual.

2.7.7 Air Vents, Penthouses, and Goosenecks

Air vents, penthouses, and goosenecks shall be fabricated from aluminum sheets with aluminum structural shapes. Sheet metal thickness, reinforcement, and fabrication shall conform to SMACNA HVAC Duct Const Stds. Louver blades shall be accurately fitted and secured to frames. Edges of louver blades shall be folded or beaded for rigidity and baffled to exclude driving rain. Air vents, penthouses, and goosenecks shall be provided with bird screen.

2.7.8 Bird Screens and Frames

Bird screens shall be No. 2 mesh, aluminum or stainless steel. Aluminum screens shall be rated "medium-light". Stainless steel screens shall be rated "light". Frames shall be removable type, or stainless steel or extruded aluminum.

2.8 AIR SYSTEMS EQUIPMENT

2.8.1 Fans

Fans shall be tested and rated according to AMCA 210. Fans may be connected to the motors either directly or indirectly with V-belt drive. V-belt drives shall be designed for not less than 150 percent of the connected driving capacity. Motor sheaves shall be variable pitch for 15 hp and below and fixed pitch as defined by ARI Guideline D. Variable pitch sheaves shall be selected to drive the fan at a speed which will produce the specified capacity when set at the approximate midpoint of the sheave adjustment. When fixed pitch sheaves are furnished, a replaceable sheave shall be provided when needed to achieve system air balance. Motors for V-belt drives shall be provided with adjustable rails or bases. Removable metal guards shall be provided for all exposed V-belt drives, and speed-test openings shall be provided at the center of all rotating shafts. Fans shall be provided with personnel screens or guards on both suction and supply ends, except that the screens need not be provided, unless otherwise indicated, where ducts are connected to the fan. Fan and motor assemblies shall be provided with vibration-isolation supports or mountings as indicated. Vibration-isolation units shall be standard products with published loading ratings. Each fan shall be selected to produce the capacity required at the fan static pressure indicated. Sound power level shall be as indicated. The sound power level values shall be obtained according to AMCA 300. Standard AMCA arrangement, rotation, and discharge shall be as indicated.

2.8.1.1 Centrifugal Fans

Centrifugal fans shall be fully enclosed, single-width single-inlet, or double-width double-inlet, AMCA Pressure Class I, II, or III as required or indicated for the design system pressure. Impeller wheels shall be rigidly constructed, accurately balanced both statically and dynamically. Fan blades may be forward curved or backward-inclined airfoil design in wheel sizes up to 30 inches. Fan blades for wheels over 30 inches in diameter shall be backward-inclined airfoil design Fan wheels over 36 inches in diameter shall have overhung pulleys and a bearing on each side of the wheel. Fan wheels 36 inches or less in diameter may have one or more extra long bearings between the fan wheel and the drive. Bearings shall be sleeve type, self-aligning and self-oiling with oil reservoirs, or precision self-aligning roller or ball-type with accessible grease fittings

or permanently lubricated type. Grease fittings shall be connected to tubing and serviceable from a single accessible point. Bearing life shall be L50 rated at not less than 200,000 hours as defined by ABMA 9 and ABMA 11. Fan shafts shall be steel, accurately finished, and shall be provided with key seats and keys for impeller hubs and fan pulleys. Each fan outlet shall be of ample proportions and shall be designed for the attachment of angles and bolts for attaching flexible connections. Motors, unless otherwise indicated, shall not exceed 1800 rpm and shall have open dripproof enclosures.

2.8.1.2 In-Line Centrifugal Fans

In-line fans shall have centrifugal backward inclined blades, stationary discharge conversion vanes, internal and external belt guards, and adjustable motor mounts. Fans shall be mounted in a welded tubular casing. Air shall enter and leave the fan axially. Inlets shall be streamlined with conversion vanes to eliminate turbulence and provide smooth discharge air flow. Fan bearings and drive shafts shall be enclosed and isolated from the air stream. Fan bearings shall be sealed against dust and dirt and shall be permanently lubricated, and shall be precision self aligning ball or roller type. Bearing life shall be L50 rated at not less than 200,000 hours as defined by ABMA 9 and ABMA 11. Motors shall have open dripproof enclosure.

2.8.1.3 Panel Type Power Wall Ventilators

Fans shall be propeller type, assembled on a reinforced metal panel with venturi opening spun into panel. Fans with wheels less than 24 inches in diameter shall be direct or V-belt driven and fans with wheels 24 inches diameter and larger shall be V-belt drive type. Fans shall be furnished with wall mounting collar. Lubricated bearings shall be provided. Fans shall be fitted with wheel and motor side metal or wire guards which have a corrosion-resistant finish. Motor enclosure shall be dripproof type. Motor operated dampers shall be provided where indicated.

2.8.1.4 Centrifugal Type Power Wall Ventilators

Fans shall be direct or V-belt as scheduled driven centrifugal type with backward inclined, non-overloading wheel. Motor housing shall be removable and weatherproof. Unit housing shall be designed for sealing to building surface and for discharge and condensate drippage away from building surface. Housing shall be constructed of heavy gauge aluminum. Unit shall be fitted with an aluminum or plated steel wire discharge bird screen, anodized aluminum wall grille, manufacturer's standard motor-operated damper, an airtight and liquid-tight metallic wall sleeve. Motor enclosure shall be dripproof type. Lubricated bearings shall be provided.

2.8.1.5 Centrifugal Type Power Roof Ventilators

Fans shall be direct or V-belt driven as scheduledwith backward inclined, non-overloading wheel. Motor compartment housing shall be hinged or removable and weatherproof, constructed of heavy gauge aluminum. Fans shall be provided with birdscreen, disconnect switch, motorized dampers, roof curb,. Motors enclosure shall be dripproof type. Grease-laden kitchen exhaust fans shall be centrifugal type according to UL 705 and fitted with V-belt drive, round hood, and windband upblast discharge configuration, integral residue trough and collection device, motor and power transmission components located in outside positively air ventilated compartment. Lubricated bearings shall be provided.

2.8.1.6 Ceiling Exhaust Fans

Suspended cabinet-type ceiling exhaust fans shall be centrifugal type, direct-driven. Fans shall have acoustically insulated housing. Integral backdraft damper shall be chatter-proof. The integral face grille shall be of egg-crate design or louver design. Fan motors shall be mounted on vibration isolators. Unit shall be provided with mounting flange for hanging unit from above. Fans shall be U.L. listed.

2.8.2 Coils

Coils shall be fin-and-tube type constructed of seamless copper tubes and aluminum or copper fins mechanically bonded or soldered to the tubes. Casing and tube support sheets shall be not lighter than 16 gauge galvanized steel, formed to provide structural strength. When required, multiple tube supports shall be provided to prevent tube sag. Each coil shall be tested at the factory under water at not less than 400 psi air pressure and shall be suitable for 200 psi working pressure. Coils shall be mounted for counterflow service. Coils shall be rated and certified according to ARI 410.

2.8.2.1 Direct-Expansion Coils

Direct-expansion coils shall be suitable for the refrigerant involved. Suction headers shall be seamless copper tubing or seamless or resistance welded steel tube with copper connections. Supply headers shall consist of a distributor which shall distribute the refrigerant through seamless copper tubing equally to all circuits in the coil. See coil schedule for coil circuting. Tubes shall be circuited to ensure minimum pressure drop and maximum heat transfer. Circuiting shall permit refrigerant flow from inlet to suction outlet without causing oil slugging or restricting refrigerant flow in coil. Each coil to be field installed shall be completely dehydrated and sealed at the factory upon completion of pressure tests.

2.8.2.2 Water/Glycol Coils

Water coils shall be installed with a pitch of not less than 1/8 inch per foot of the tube length toward the drain end. Headers shall be constructed of cast iron, welded steel or copper. Each coil shall be provided with a plugged vent and drain connection extending through the unit casing.

2.8.3 Air Filters

Air filters shall be listed according to requirements of UL 900, except high efficiency particulate air filters of 99.97 percent efficiency by the DOP Test method shall be as listed under the Label Service and shall meet the requirements of UL 586.

2.8.3.1 Extended Surface Pleated Panel Filters

Filters shall be 2 inch depth, sectional, disposable type of the size indicated and shall have an average efficiency of 25 to 30 percent when tested according to ASHRAE 52.2. Initial resistance at 500 feet per minute shall not exceed 0.36 inches water gauge. Filters shall be UL Class 2. Media shall be nonwoven cotton and synthetic fiber mat. A wire support grid bonded to the media shall be attached to a moisture resistant fiberboard frame. All four edges of the filter media shall be bonded to

the inside of the frame to prevent air bypass and increase rigidity.

2.8.3.2 Cartridge Type Filters

Filters shall be 12 inch depth, sectional, replaceable dry media type of the size indicated and shall have an average efficiency of 80 to 85 percent when tested according to ASHRAE 52.2. Initial resistance at 500 feet per minute shall not exceed 0.56 inches, water gauge. Filters shall be UL class 1. Media shall be pleated microglass paper media with corrugated aluminum separators, sealed inside the filter cell to form a totally rigid filter assembly. Fluctuations in filter face velocity or turbulent airflow will have no effect on filter integrity or performance. Each filter shall be installed with an extended surface pleated media panel filter as a prefilter in a factory preassembled side access housing, or a factory-made sectional frame bank, as indicated.

2.8.3.3 Range and Griddle Hood Service

Filter shall be sectional, permanent, washable, all metallic media type, nominal 2 inches thick, with suitable metal frames, designed for extraction of grease from grease-laden air.

2.8.3.4 Holding Frames

Frames shall be fabricated from not lighter than 16 gauge sheet steel with rust-inhibitor coating. Each holding frame shall be equipped with suitable filter holding devices. Holding frame seats shall be gasketed. All joints shall be airtight.

2.8.3.5 Filter Gauges

Filter gauges shall be dial type, diaphragm actuated draft and shall be provided for all filter stations, including those filters which are furnished as integral parts of factory fabricated air handling units. Gauges shall be at least 3-7/8 inches in diameter, shall have white dials with black figures, and graduations and shall have a minimum range of 1 inch beyond the specified final resistance for the filter bank on which each gauge is applied. Each gauge shall incorporate a screw operated zero adjustment and shall be furnished complete with two static pressure tips with integral compression fittings, two molded plastic vent valves, two 5 foot minimum lengths of 1/4 inch diameter aluminum tubing, and all hardware and accessories for gauge mounting.

2.9 AIR HANDLING UNITS

2.9.1 Factory-Fabricated Air Handling Units

Units shall have sections as indicated on schedules. Units shall include fans, coils, airtight insulated casing, prefilters, secondary filter sections, adjustable V-belt drives, belt guards for externally mounted motors, access sections where indicated, mixing box economizer dampers, vibration-isolators, and appurtenances required for specified operation. Vibration isolators shall be as indicated. Each air handling unit shall have physical dimensions suitable to fit space allotted to the unit and shall have the capacity indicated. Air handling unit shall have published ratings based on tests performed according to ARI 430.

2.9.1.1 Casings

Casing sections shall be 2 inch double wall type constructed of a minimum 18 gauge galvanized steel, or 18 gauge steel outer casing protected with a corrosion resistant paint finish according to paragraph FACTORY PAINTING. Inner casing of double-wall units shall be minimum 20 gauge solid galvanized steel. Pool air handling unit to have .063 inch aluminum inner wall. Casing shall be designed and constructed with an integral insulated structural steel frame such that exterior panels are non-load bearing. Exterior panels shall be individually removable. Removal shall not affect the structural integrity of the unit. Casings shall be provided with inspection doors, access sections, and access doors as indicated. Inspection and access doors shall be insulated, fully gasketed, double-wall type, of a minimum 18 gauge outer and 20 gauge inner panels. Doors shall be rigid and provided with heavy duty hinges and latches. Inspection doors shall be a minimum 12 inches wide by 12 inches high. Access doors shall be minimum 24 inches wide and shall be the full height of the unit casing or a minimum of 6 foot, whichever is less. A minimum 8 by 8 inches sealed glass window suitable for the intended application shall be installed in all access doors. Access Sections shall be according to paragraph AIR HANDLING UNITS. Drain pan shall be double-wall insulated type constructed of 16 gauge stainless steel, pitched to the drain connection. Drain pans shall be constructed water tight, treated to prevent corrosion, and designed for positive condensate drainage. When 2 or more cooling coils are used, with one stacked above the other, condensate from the upper coils shall not flow across the face of lower coils. Intermediate drain pans or condensate collection channels and downspouts shall be provided, as required to carry condensate to the unit drain pan out of the air stream and without moisture carryover. Drain pan shall be constructed so that the pan may be visually inspected easily including underneath the coil without removal of the coil and so that the pan may be physically cleaned completely and easily underneath the coil without removal of the coil. Casing insulation shall conform to NFPA 90A double-wall casing sections and shall be insulated with not less than 2 inch thick, 1-1/2 pound density coated fibrous glass material having a thermal conductivity not greater than 0.23 Btu/hr-sf-F. Foil-faced insulation shall not be an acceptable substitute for use with double wall casing. Double wall insulation must be completely sealed by inner and outer panels. Factory applied fibrous glass insulation shall conform to ASTM C 1071, except that the minimum thickness and density requirements do not apply, and shall meet the requirements of NFPA 90A. Air handling unit casing insulation shall be uniform over the entire casing. Foil-faced insulation shall not be an acceptable substitute for use on double-wall access doors and inspections doors and casing sections. Duct liner material, coating, and adhesive shall conform to fire-hazard requirements specified in Section 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS. Exposed insulation edges and joints where insulation panels are butted together shall be protected with a metal nosing strip or shall be coated to conform to meet erosion resistance requirements of ASTM C 1071. A latched and hinged inspection door, shall be provided in the fan and coil sections. Additional inspection doors, access doors and access sections shall be provided where indicated. For Gym Units AHU-1 and AHU-2: Provide minimum 16 gage outer and 22 gage inner casings and 12 gage floor. Provide unit construction that allows no more than 1/2% leakage at operating conditions. Provide 1-1/2 inch perimeter collar in floor to make unit floor water tight. Provide drains in side of collar such that unit can be hosed down and drained.

2.9.1.2 Heating and Cooling Coils

Coils shall be provided as specified in paragraph AIR SYSTEMS EQUIPMENT, for types indicated.

2.9.1.3 Air Filters

Air filters shall be as specified in paragraph AIR SYSTEMS EQUIPMENT for types and thickness indicated.

2.9.1.4 Fans

Fans shall be double-inlet, centrifugal type with each fan in a separate scroll. Fans and shafts shall be dynamically balanced prior to installation into air handling unit, then the entire fan assembly shall be statically and dynamically balanced at the factory after it has been installed in the air handling unit. Fans shall be mounted on steel shafts accurately ground and finished. Fan bearings shall be sealed against dust and dirt and shall be precision self-aligning ball or roller type. Bearing life shall be L50 rated at not less than 200,000 hours as defined by ABMA 9 and ABMA 11. Bearings shall be permanently lubricated or lubricated type with lubrication fittings readily accessible at the drive side of the unit. Bearings shall be supported by structural shapes, or die formed sheet structural members, or support plates securely attached to the unit casing. Bearings may not be fastened directly to the unit sheet metal casing. Fans and scrolls shall be furnished with coating indicated. Fans shall be driven by a unit-mounted or a floor-mounted motor connected to fans by V-belt drive complete with belt guard for externally mounted motors. Belt guards shall be the three sided enclosed type with solid or expanded metal face. Belt drives shall be designed for not less than a 1.3 service factor based on motor nameplate rating. Motor sheaves shall be variable pitch for 15 hp and below and fixed pitch above 15 hp as defined by ARI Guideline D. Where fixed sheaves are required, variable pitch sheaves may be used during air balance, but shall be replaced with an appropriate fixed sheave after air balance is completed. Variable pitch sheaves shall be selected to drive the fan at a speed that will produce the specified capacity when set at the approximate midpoint of the sheave adjustment. Motors for V-belt drives shall be provided with adjustable bases. Fan motors shall have open dripproof enclosures. Unit fan or fans shall be selected to produce the required capacity at the fan static pressure. Sound power level shall be as indicated. The sound power level values shall be obtained according to AMCA 300, ASHRAE 68, or ARI 260.

2.9.1.5 Access Sections and Filter/Mixing Boxes

Access sections shall be provided where indicated and shall be furnished with access doors as shown. Access sections and filter/mixing boxes shall be constructed in a manner identical to the remainder of the unit casing and shall be equipped with access doors. Mixing boxes shall be designed to minimize air stratification and to promote thorough mixing of the air streams.

2.9.1.6 Dampers

Dampers shall be as specified in paragraph CONTROLS.

2.10 TERMINAL UNITS

2.10.1 Variable Air Volume (VAV) Terminal Units

VAV terminal units shall be the type, size, and capacity shown and shall be mounted in the ceiling or wall cavity and shall be suitable for single duct system applications. Actuators and controls shall be as specified in paragraph CONTROLS. Unit enclosures shall be constructed of galvanized steel not lighter than 22 gauge or aluminum sheet not lighter than 18 gauge. Single or multiple discharge outlets shall be provided as required. Units with flow limiters are not acceptable. Unit air volume shall be factory preset and readily field adjustable without special tools. Reheat coils shall be provided as indicated. A flow chart shall be attached to each unit. Acoustic performance of the terminal units shall be based upon units tested according to ARI 880. Sound power level shall be as indicated. Discharge sound power shall be shown for minimum and 1-1/2 inches water gauge inlet static pressure. Acoustical lining shall be according to NFPA 90A.

2.10.1.1 Constant Volume, Single Duct

Constant volume, single duct, terminal units shall contain within the casing, a mechanical or pneumatic constant volume regulator. Volume regulators shall control air delivery to within plus or minus 5 percent of specified air flow subjected to inlet pressure from 3/4 to 6 inch water gauge.

2.10.1.2 Variable Volume, Single Duct

Variable volume, single duct, terminal units shall be provided with a calibrated air volume sensing device, air valve or damper, actuator, and accessory relays. Units shall control air volume to within plus or minus 5 percent of each air set point volume as determined by the thermostat with variations in inlet pressures from 3/4 to 6 inch water gauge. Internal resistance of units shall not exceed 0.4 inch water gauge at maximum flow range. External differential pressure taps separate from the control pressure taps shall be provided for air flow measurement with a 0 to 1 inch water gauge range. Unit volume controller shall be normally open upon loss of power.

2.10.1.3 Reheat Units

a. Hot Water Coils: Hot-water coils shall be fin-and-tube type constructed of seamless copper tubes and copper or aluminum fins mechanically bonded or soldered to the tubes. Headers shall be constructed of cast iron, welded steel or copper. Casing and tube support sheets shall be 16 gauge, galvanized steel, formed to provide structural strength. Tubes shall be correctly circuited for proper water velocity without excessive pressure drop and they shall be drainable where required or indicated. At the factory, each coil shall be tested at not less than 250 psi air pressure and shall be suitable for 200 psi working pressure. Drainable coils shall be installed in the air handling units with a pitch of not less than 1/8 inch per foot of tube length toward the drain end. Coils shall conform to the provisions of ARI 410.

2.11 ENERGY RECOVERY DEVICES

2.11.1 Rotary Wheel

Unit shall be a factory fabricated and tested assembly for air-to-air energy recovery by transfer of total heat from exhaust air to supply air stream. Device performance shall be according to ASHRAE 84-78P . Device shall deliver an energy transfer effectiveness of not less than 70 percent with cross-contamination not in excess of 0.1 percent of exhaust airflow rate at system design differential pressure, including purging sector if provided with wheel. Exchange media shall be chemically inert, moisture-resistant, fire-retardant, laminated, nonmetallic material which complies with NFPA 90A. Exhaust and supply streams shall be isolated by seals which are static, field adjustable, and replaceable. Chain drive mechanisms shall be fitted with ratcheting torque limiter or slip-clutch protective device. Enclosure shall be fabricated from galvanized steel and shall include maintenance access provisions. Recovery control and rotation failure provisions shall be as indicated.

2.11.2 Air-to-Air Heat Exchanger

Provide energy transfer ratings test in accordance with ASHRAE 84 Standard.

2.11.2.1 Flat Plate Type Heat Exchanger

Flat plate type heat exchanger shall be pressed and formed aluminum plates with aluminum spacers and framing (99.5% pure aluminum plates). Pressure differential between air flows of 10 inches w.g. without deformation. Operating temperature range minus 40 degrees F to 220 degrees F. Counterflow design is unacceptable due to high pressure drop and fouling. Vertical or horizontal mounting with no deformation or settling of individual plates. Cross contamination between airflow's of maximum 0.01 percent of total flow. Sealing surface between plates shall be adhesive sealant with minimum width 5 times plate separation distance. Entire heat transfer surface shall be visible for inspection and cleaning without dis-assembly.

2.11.2.2 Certification

Heat exchanger performance certified with documentation by independent test laboratory in accordance with ASHRAE 84 Test Standard (1991).

2.11.2.3 Filters

Filter outdoor air and exhaust air with 2 inches deep, pleated, 30 percent effective disposable filter. Factory install filter rack internal to unit. Face and bypass dampers will be of the low leak type. Factory controls for freeze prevention and bypass of unit when supply discharge is below setpoint. Factory controls shall control face and bypass dampers for economy bypass of unit.

2.12 FACTORY PAINTING

Units which are not of galvanized construction according to ASTM A 123/A 123M or ASTM A 924/A 924M shall be factory painted with a corrosion resisting paint finish. Internal and external ferrous metal surfaces shall be cleaned, phosphatized and coated with a paint finish which has been tested according to ASTM B 117, ASTM D 1654, and ASTM D 3359. Evidence of satisfactory paint performance for a minimum of 125 hours for units to be

installed indoors and 500 hours for units to be installed outdoors shall be submitted. Rating of failure at the scribe mark shall be not less than 6, average creepage not greater than 1/8 inch. Rating of the inscribed area shall not be less than 10, no failure. On units constructed of galvanized steel which have been welded, exterior surfaces of welds or welds that have burned through from the interior shall receive a final shop docket of zinc-rich protective paint according to ASTM D 520 Type I.

PART 3 EXECUTION

3.1 INSTALLATION

Work shall be installed as shown and according to the manufacturer's diagrams and recommendations.

3.1.1 Penetrations

3.1.1.1 Ducts

Provide sleeves and prepared openings for duct mains, branches, and other item penetrations, and install during the construction of the surface to be penetrated. Cut sleeves flush with each surface; sleeves for round duct shall be 15 inches and smaller; provide framed prepared openings for round duct larger than 15 inches and square, rectangular or oval ducts. Sleeves and framed openings are also required where grilles, registers, and diffusers are installed at the openings. Provide 1 inch clearance between penetrating and penetrated surfaces except at grilles, registers, and diffusers. Pack spaces between sleeve or opening and duct or duct insulation with mineral fiber conforming to ASTM C 553, Type 1, Class B-2.

a. Sleeve Fabrication: Fabricate sleeves, except as otherwise specified or indicated, from 20 gauge 0.0396 inch thick minimum galvanized steel sheet. Where sleeves are installed in bearing walls or partitions, provide black steel pipe conforming to ASTM A 53/A 53M, Schedule 40.

b. Framed Prepared Openings: Fabricate framed prepared openings from 20 gauge 0.0396 inch minimum galvanized steel sheet, unless otherwise indicated. Reinforce all around openings with 1 x 1 x 0.125 inch galvanized steel angles, tack welded to wall side of openings; angle leg shall be flush with ends of opening.

c. Closure Collars: Provide closure collars of a minimum 4 inches width, unless otherwise indicated, for exposed ducts and items on each side of penetrated surface, except where equipment is installed. Install collar tight against the surface and fit snugly around the duct or insulation. Grind sharp edges smooth to prevent damage to penetrating surface. Fabricate collars for round ducts 15 inches in diameter or less from 20 gauge, 0.0396 inch minimum galvanized steel. Fabricate collars for square and rectangular ducts, or round ducts with a minimum dimension over 15 inches from 18 gauge 0.0516 inch galvanized steel. Fabricate collars for square and rectangular ducts with a maximum side of 15 inches or less from 20 gauge 0.0396 inch galvanized steel. Install collars with fasteners a maximum of 6 inches on centers; attach to collars a minimum of 4 fasteners where opening is 12 inches in diameter or less, and a minimum of 8 fasteners where the opening is 20 inches in diameter or less.

3.1.1.2 Packing and Sealant

Pack the space between the pipe or tubing and the sleeve firmly with mineral wool insulation. Except as otherwise specified, the annular space at both ends of the sleeve shall be sealed as indicated with sealants conforming to ASTM C 920 and with primer, backstop material and surface preparation as specified in Section 07920 JOINT SEALANTS. The annular space shall not be sealed for interior walls and chase walls that are not designated as fire rated or requiring acoustical attenuation. In waterproofed construction, caulk both ends of the sleeve with plastic waterproof cement that will dry to a firm but pliable mass. In lieu of plastic waterproof cement and mineral wool insulation, a mechanically adjustable, segmented, elastomeric seal may be used; if used, seal segments shall be interlocking and shaped to continuously fill the annular space between the pipe and sleeve to provide a watertight seal when expanded by tightening fasteners. Fasteners shall be galvanized. Where sleeves are installed in below-grade walls in contact with earth, fill the annular space between pipe and sleeve with backing material and sealants in the joint between the pipe and concrete or masonry. Sealant selected for the earth side of the wall shall be compatible with dampproofing/waterproofing materials that are to be applied over the joint sealant. Where pipes pass through fire-rated walls, fire-partitions, fire-rated chase walls or floors above grade, the penetration shall be sealed with firestopping materials as specified in Sectio 07840 FIRESTOPPING.

3.1.1.3 Fire Seal

Where pipes pass through firewalls, fire partitions, or floors, a fire seal shall be provided as specified in Section 07840 FIRESTOPPING.

3.1.1.4 Escutcheons

Escutcheons shall be provided at finished surfaces where exposed piping, bare or insulated, passes through floors, walls, or ceilings except in boiler, utility, or equipment rooms. Where sleeves project slightly from floors, special deep-type escutcheons shall be used. Escutcheons shall be secured to pipe or pipe covering. Escutcheons shall be satin-finish, corrosion-resisting steel, polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Escutcheons shall be either one-piece or split-pattern, held in place by internal spring tension or setscrew.

3.1.2 Condensate Drain Lines

Water seals shall be provided in the condensate drain from all units. The depth of each seal shall be 2 inches plus the number of inches, measured in water gauge, of the total static pressure rating of the unit to which the drain is connected. Water seals shall be constructed of 2 tees and an appropriate U-bend with the open end of each tee plugged. Pipe cap or plug cleanouts shall be provided where indicated. Drains indicated to connect to the sanitary waste system shall be connected by an indirect waste fitting. Air conditioner drain lines shall be insulated as specified in Section 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.1.3 Pipe-Alignment Guides

Pipe-alignment guides shall be provided where indicated for expansion loops, offsets, and bends and as recommended by the manufacturer for expansion joints, not to exceed 5 feet on each side of each expansion joint, and in lines 4 inches or smaller not more than 2 feet on each side

of the joint.

3.1.4 Air Vents and Drains

3.1.4.1 Vents

Air vents shall be provided at high points, on water coils, and where indicated to ensure adequate venting of the piping system.

3.1.4.2 Drains

Drains shall be provided at low points and where indicated to ensure complete drainage of the piping. Drains shall be accessible, and shall consist of nipples and caps or plugged tees unless otherwise indicated.

3.1.5 Valves

Isolation gate or ball valves shall be installed on each side of each piece of equipment such as pumps, heaters, heating or cooling coils, and other similar items, at the midpoint of all looped mains, and at any other points indicated or required for draining, isolating, or sectionalizing purposes. Isolation valves may be omitted where balancing cocks are installed to provide both balancing and isolation functions. Each valve except check valves shall be identified. Valves in horizontal lines shall be installed with stems horizontal or above.

3.1.6 Equipment and Installation

Frames and supports shall be provided for tanks, compressors, pumps, valves, air handling units, fans, coils, dampers, and other similar items requiring supports. Air handling units shall be floor mounted or ceiling hung, as indicated. The method of anchoring and fastening shall be as detailed. Floor-mounted equipment, unless otherwise indicated, shall be set on not less than 4 inch concrete pads or curbs doweled in place. Concrete foundations for circulating pumps shall be heavy enough to minimize the intensity of the vibrations transmitted to the piping and the surrounding structure, as recommended in writing by the pump manufacturer. In lieu of a concrete pad foundation, a concrete pedestal block with isolators placed between the pedestal block and the floor may be provided. The concrete foundation or concrete pedestal block shall be of a mass not less than three times the weight of the components to be supported. Lines connected to the pump mounted on pedestal blocks shall be provided with flexible connectors. Foundation drawings, bolt-setting information, and foundation bolts shall be furnished prior to concrete foundation construction for all equipment indicated or required to have concrete foundations. Concrete for foundations shall be as specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE.

3.1.7 Access Panels

Access panels shall be provided for concealed valves, vents, controls, dampers, and items requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced and maintained or completely removed and replaced. Access panels shall be as specified in Section 05500A MISCELLANEOUS METALS.

3.1.8 Flexible Connectors

Pre-insulated flexible connectors and flexible duct shall be attached to

other components in accordance with the latest printed instructions of the manufacturer to ensure a vapor tight joint. Hangers, when required to suspend the connectors, shall be of the type recommended by the connector or duct manufacturer and shall be provided at the intervals recommended.

3.1.9 Sleeved and Framed Openings

Space between the sleeved or framed opening and the duct or the duct insulation shall be packed as specified in Section 07840 FIRESTOPPING for fire rated penetrations. For non-fire rated penetrations, the space shall be packed as specified in Section 07920 JOINT SEALANTS.

3.1.10 Metal Ductwork

Installation shall be according to SMACNA HVAC Duct Const Stds unless otherwise indicated. Duct supports for sheet metal ductwork shall be according to SMACNA HVAC Duct Const Stds, unless otherwise specified. Friction beam clamps indicated in SMACNA HVAC Duct Const Stds shall not be used. Risers on high velocity ducts shall be anchored in the center of the vertical run to allow ends of riser to move due to thermal expansion. Supports on the risers shall allow free vertical movement of the duct. Supports shall be attached only to structural framing members and concrete slabs. Supports shall not be anchored to metal decking unless a means is provided and approved for preventing the anchor from puncturing the metal decking. Where supports are required between structural framing members, suitable intermediate metal framing shall be provided. Where C-clamps are used, retainer clips shall be provided.

3.1.11 Ductwork Construction

SYSTEM		PRESSURE CLASS	SEAL TYPE
AHU-1	Supply	+3"	A
AHU-1	Return	-1"	C
AHU-2	Supply	+3"	A
AHU-2	Return	-1"	C
AHU-3	Supply*	+3"	A
AHU-3	Supply*	-1"	C
AHU-3	Return	-2"	A
AHU-4	Supply	+2"	C
AHU-4	Return	-2"	A
AHU-5	Supply	+2"	C
AHU-5	Return	-1"	C
EF-2	Exhaust	-1"	A
ALL OTHER EF'S		-1/2"	A

* Upstream of VAV Boxes
** Downstream of VAV Boxes

3.1.12 Kitchen Exhaust Ductwork

3.1.12.1 Ducts Conveying Smoke and Grease Laden Vapors

Ducts conveying smoke and grease laden vapors shall conform to requirements of NFPA 96. Seams, joints, penetrations, and duct-to-hood collar connections shall have a liquid tight continuous external weld. Duct material shall be minimum 18 gauge, Type 304L, stainless steel. Provide factory pre-piped wet mist type fire extinguishing system. Follow International Mechanical Code requirements.

3.1.12.2 Exposed Ductwork

Exposed ductwork shall be fabricated from minimum 18 gauge, Type 304L or 316L, stainless steel with continuously welded joints and seams. Ducts shall be pitched to drain at hoods and low points indicated. Surface finish shall match hoods.

3.1.12.3 Concealed Ducts Conveying Moisture Laden Air

Concealed ducts conveying moisture laden air shall be fabricated from minimum 18 gauge, Type 300 series, stainless steel. Joints shall be continuously welded, brazed, or soldered to be liquid tight. Duct shall be pitched to drain at points indicated. Transitions to other metals shall be liquid tight, companion angle bolted and gasketed.

3.1.13 Acoustical Duct Lining

Lining shall be applied in cut-to-size pieces attached to the interior of the duct with nonflammable fire resistant adhesive conforming to ASTM C 916, Type I, NFPA 90A, UL 723, and ASTM E 84. Top and bottom pieces shall lap the side pieces and shall be secured with welded pins, adhered clips of metal, nylon, or high impact plastic, and speed washers or welding cup-head pins installed according to SMACNA HVAC Duct Const Stds. Welded pins, cup-head pins, or adhered clips shall not distort the duct, burn through, nor mar the finish or the surface of the duct. Pins and washers shall be flush with the surfaces of the duct liner and all breaks and punctures of the duct liner coating shall be sealed with the nonflammable, fire resistant adhesive. Exposed edges of the liner at the duct ends and at other joints where the lining will be subject to erosion shall be coated with a heavy brush coat of the nonflammable, fire resistant adhesive, to prevent delamination of glass fibers. Duct liner may be applied to flat sheet metal prior to forming duct through the sheet metal brake. Lining at the top and bottom surfaces of the duct shall be additionally secured by welded pins or adhered clips as specified for cut-to-size pieces. Other methods indicated in SMACNA HVAC Duct Const Stds to obtain proper installation of duct liners in sheet metal ducts, including adhesives and fasteners, will be acceptable.

3.1.14 Dust Control

To prevent the accumulation of dust, debris and foreign material during construction, temporary dust control protection shall be provided. The distribution system (supply and return) shall be protected with temporary seal-offs at all inlets and outlets at the end of each day's work. Temporary protection shall remain in place until system is ready for startup.

3.1.15 Insulation

Thickness and application of insulation materials for ductwork, piping, and equipment shall be according to Section 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS. Outdoor air intake ducts and plenums shall be externally insulated up to the point where the outdoor air reaches the conditioning unit.

3.1.16 Duct Test Holes

Holes with closures or threaded holes with plugs shall be provided in ducts and plenums as indicated or where necessary for the use of pitot tube in

balancing the air system. Extensions, complete with cap or plug, shall be provided where the ducts are insulated.

3.1.17 Power Roof Ventilator Mounting

Foamed 1/2 inch thick, closed-cell, flexible elastomer insulation shall cover width of roof curb mounting flange. Where wood nailers are used, holes shall be pre-drilled for fasteners.

3.1.18 Power Transmission Components Adjustment

V-belts and sheaves shall be tested for proper alignment and tension prior to operation and after 72 hours of operation at final speed. Belts on drive side shall be uniformly loaded, not bouncing. Alignment of direct driven couplings shall be to within 50 percent of manufacturer's maximum allowable range of misalignment.

3.2 FIELD PAINTING

3.2.1 Finish Painting

Finish painting of items only primed at the factory, surfaces not specifically noted otherwise, and color code marking for piping shall be as specified in Section 09900 PAINTS AND COATINGS.

3.3 DUCTWORK LEAK TEST

Ductwork leak test shall be performed for the entire air distribution and exhaust system, including fans, coils, filters, etc. Test procedures, apparatus, and report shall conform to SMACNA Leakage Test Mnl. Ductwork leak test shall be completed with satisfactory results prior to applying insulation to ductwork exterior.

3.4 DAMPER ACCEPTANCE TEST

All fire dampers and smoke dampers shall be operated under normal operating conditions, prior to the occupancy of a building to determine that they function properly. Fire dampers equipped with fusible links shall be tested by having the fusible link cut in place. Dynamic fire dampers shall be tested with the air handling and distribution system running. All fire dampers shall be reset with the fusible links replaced after acceptance testing. To ensure optimum operation and performance, the damper must be installed so it is square and free from racking.

3.5 TESTING, ADJUSTING, AND BALANCING

Testing, adjusting, and balancing shall be as specified in Section 15990A TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS. Testing, adjusting, and balancing shall begin only when the air supply and distribution, including controls, has been completed, with the exception of performance tests.

3.6 PERFORMANCE TESTS

After testing, adjusting, and balancing has been completed as specified, each system shall be tested as a whole to see that all items perform as integral parts of the system and temperatures and conditions are evenly controlled throughout the building. Corrections and adjustments shall be made as necessary to produce the conditions indicated or specified. Capacity tests and general operating tests shall be conducted by an

experienced engineer. Tests shall cover a period of not less than 1 days for each system and shall demonstrate that the entire system is functioning according to the specifications. Coincidental chart recordings shall be made at points indicated on the drawings for the duration of the time period and shall record the temperature at space thermostats or space sensors, the humidity at space humidistats or space sensors and the ambient temperature and humidity in a shaded and weather protected area.

3.7 CLEANING AND ADJUSTING

Pipes shall be cleaned free of scale and thoroughly flushed of foreign matter. A temporary bypass shall be provided for water coils to prevent flushing water from passing through coils. Strainers and valves shall be thoroughly cleaned. Prior to testing and balancing, air shall be removed from water systems by operating the air vents. Temporary measures, such as piping the overflow from vents to a collecting vessel shall be taken to avoid water damage during the venting process. Air vents shall be plugged or capped after the system has been vented. Inside of air terminal units, ducts, plenums, and casing shall be thoroughly cleaned of debris and blown free of small particles of rubbish and dust and then shall be vacuum cleaned before installing outlet faces. Equipment shall be wiped clean, with traces of oil, dust, dirt, or paint spots removed. Temporary filters shall be provided prior to startup of all fans that are operated during construction, and new filters shall be installed after all construction dirt has been removed from the building, and the ducts, plenums, casings, and other items specified have been vacuum cleaned. System shall be maintained in this clean condition until final acceptance. Bearings shall be properly lubricated with oil or grease as recommended by the manufacturer. Belts shall be tightened to proper tension. Control valves and other miscellaneous equipment requiring adjustment shall be adjusted to setting indicated or directed. Fans shall be adjusted to the speed indicated by the manufacturer to meet specified conditions.

3.8 FIELD TRAINING

The Contractor shall conduct a training course for operating and maintenance personnel as designated by the Contracting Officer. Training shall be provided for a period of 24 hours of normal working time and shall start after the system is functionally complete but prior to the performance tests. The field instruction shall cover all of the items contained in the approved Operating and Maintenance Instructions.

-- End of Section --

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DIVISION 15 - MECHANICAL

SECTION 15951A

DIRECT DIGITAL CONTROL FOR HVAC

11/03

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SECTION 15951A

DIRECT DIGITAL CONTROL FOR HVAC
11/03

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL (AMCA)

AMCA 500-D	(1998) Laboratory Methods of Testing Dampers for Rating

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C12.1	(2001) Electric Meters Code for Electricity Metering

ASTM INTERNATIONAL (ASTM)

ASTM A 269	(2002) Seamless and Welded Austenitic Stainless Steel Tubing for General Service
ASTM B 88	(2002) Seamless Copper Water Tube
ASTM B 88M	(1999) Seamless Copper Water Tube (Metric)
ASTM D 1693	(2001) Environmental Stress-Cracking of Ethylene Plastics
ASTM D 635	(1998) Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position

ASME INTERNATIONAL (ASME)

ASME B40.100	(2000) Pressure Gauges and Gauge Attachments

ELECTRONIC INDUSTRIES ALLIANCE (EIA)

EIA ANSI/EIA/TIA-232-F	(2002) Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41	(1991) Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits

IEEE Std 142	(1992) Recommended Practice for Grounding of Industrial and Commercial Power Systems - Green Book

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(1997) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ICS 1	(2000) Industrial Control and Systems: General Requirements
NEMA ST 1	(1988; R 1994; R 1997) Specialty Transformers (Except General-Purpose Type)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A	(2002) Installation of Air Conditioning and Ventilating Systems

UNDERWRITERS LABORATORIES (UL)

UL 508	(1999; Rev thru Dec 2002) Industrial Control Equipment
UL 555S	(1999; Rev thru Apr 2003) Smoke Dampers
UL 94	(1996; Rev thru May 2001) Tests for Flammability of Plastic Materials for Parts in Devices and Appliances

1.2 GENERAL REQUIREMENTS

The direct digital control (DDC) shall be a complete system suitable for the heating, ventilating and air-conditioning (HVAC) system. System to be Johnson Controls metasys version 12.01, using network control module 350, with connection to base LAN system. Provide programming to add new M5 graphics for all new systems for fitness building.

1.2.1 Nameplates, Lens Caps, and Tags

Nameplates and lens caps bearing legends as shown and tags bearing device-unique identifiers as shown shall have engraved or stamped characters. A plastic or metal tag shall be mechanically attached directly to each device or attached by a metal chain or wire. Each airflow measurement station shall have a tag showing flow rate range for signal output range, duct size, and identifier as shown.

1.2.2 Verification of Dimensions

After becoming familiar with all details of the work, the Contractor shall verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing any work.

1.2.3 Drawings

Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. The Contractor shall carefully investigate the mechanical, electrical, and

finish conditions that could affect the work to be performed, shall arrange such work accordingly, and shall furnish all work necessary to meet such conditions.

1.2.4 Power-Line Surge Protection

Equipment connected to ac circuits shall be protected from power-line surges. Equipment protection shall meet the requirements of IEEE C62.41. Fuses shall not be used for surge protection.

1.2.5 Surge Protection for Transmitter and Control Wiring

DDC system control-panel equipment shall be protected against surges induced on control and transmitter wiring installed outside and as shown. The equipment protection shall be tested in the normal mode and in the common mode, using the following two waveforms:

a. A 10-microsecond by 1,000-microsecond waveform with a peak voltage of 1,500 volts and a peak current of 60 amperes.

b. An eight microsecond by 20-microsecond waveform with a peak voltage of 1,000 volts and a peak current of 500 amperes.

1.2.6 System Overall Reliability Requirement

The system shall be configured and installed to yield a mean time between failure (MTBF) of at least 40,000 hours. Each DDC controller shall be designed, configured, installed and programmed to provide for stand alone operation with minimal performance degradation on failure of other system components to which it is connected or with which it communicates.

1.2.7 DDC System Network Accessibility

Where the systems to be controlled by the DDC system are located in multiple mechanical rooms, each mechanical room shall have at least one communication port for the portable workstation/tester. DDC controllers shall be located in the same room as the equipment being controlled or in an adjacent space which has direct access to the equipment room.

1.2.8 System Accuracy and Display

The system shall maintain an end-to-end accuracy for one year from sensor to operator's console display for the applications specified and shall display the value as specified. Each temperature shall be displayed and printed to nearest 0.1 degree F.

1.2.8.1 Space Temperature

Space temperature with a range of 50 to 85 degrees F plus or minus 0.75 degree F for conditioned space; 30 to 130 degrees F plus or minus 1 degree F for unconditioned space.

1.2.8.2 Duct Temperature

Duct temperature with a range of 40 to 140 degrees F plus or minus 2 degrees F.

1.2.8.3 Outside Air Temperature

Outside air (OA) temperature with a range of minus 40 to plus 130 degrees F plus or minus 2 degrees F; with a subrange of 30 to 100 degrees F plus or minus 1 degree F.

1.2.8.4 Water Temperature

Water temperature with a range of 30 to 100 degrees F plus or minus 0.75 degree F; the range of 100 to 250 degrees F plus or minus 2 degrees F; and water temperatures for the purpose of performing Btu calculations using differential temperatures to plus or minus 0.5 degree F using matched sensors.

1.2.8.5 High Temperature

High temperature with a range of 200 to 500 degrees F plus or minus 2.0 degrees F.

1.2.8.6 Relative Humidity

Relative humidity, within a range of 20 to 80 percent, plus or minus 6.0 percent of range (display and print to nearest 1.0 percent).

1.2.8.7 Pressure

Pressure with a range for the specific application plus or minus 2.0 percent of range (display and print to nearest psi).

1.2.8.8 Flow

Flow with a range for the specific application plus or minus 3.0 percent of range, and flows for the purpose of thermal calculations to plus or minus 2.0 percent of actual flow (display and print to nearest unit, such as gpm).

1.2.8.9 KWh and kW Demand

KWh and kW demand with a range for the specific application plus or minus 1.0 percent of reading (display and print to nearest kWh or kW).

1.2.8.10 Analog Value Input

An analog value input to the system's equipment via an AI with a maximum error of 0.50 percent of range, not including the sensor or transmitter error. This accuracy shall be maintained over the specified environmental conditions.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

HVAC Control System; G-AE

Drawings shall be on 34 by 22 inch sheets in the form and arrangement shown. The drawings shall use the same abbreviations, symbols, nomenclature and identifiers shown. Each control system element on a drawing shall have a unique identifier as shown. The HVAC Control System Drawings shall be delivered together as a complete submittal. Deviations must be approved by the Contracting Officer. Drawings shall be submitted along with Submittal SD-03 Product Data.

a. HVAC Control System Drawings shall include the following:

Sheet One: Drawing Index, HVAC Control System Legend.
Sheet Two: Valve Schedule, Damper Schedule.

Sheet Four: Control System Schematic and Equipment Schedule.
Sheet Five: Sequence of Operation and Data Terminal Strip Layout.
Sheet Six: Control Loop Wiring Diagrams.
Sheet Seven: Motor Starter and Relay Wiring Diagram.
Sheet Eight: Communication Network and Block Diagram.
Sheet Nine: DDC Panel Installation and Block Diagram.
(Repeat Sheets Four through Seven for each AHU System.)

b. The HVAC Control System Drawing Index shall show the name and number of the building, military site, State or other similar designation, and Country. The Drawing Index shall list HVAC Control System Drawings, including the drawing number, sheet number, drawing title, and computer filename when used. The HVAC Control System Legend shall show generic symbols and the name of devices shown on the HVAC Control System Drawings.

c. The valve schedule shall include each valve's unique identifier, size, flow coefficient Cv, pressure drop at specified flow rate, spring range, positive positioner range, actuator size, close-off pressure data, dimensions, and access and clearance requirements data. Valve schedules may be submitted in advance but shall be included in the complete submittal.

d. The damper schedule shall contain each damper's and each actuator's identifier, nominal and actual sizes, orientation of axis and frame, direction of blade rotation, spring ranges, operation rate, positive positioner ranges, locations of actuators and damper end switches, arrangement of sections in multi-section dampers, and methods of connecting dampers, actuators, and linkages. The Damper Schedule shall include the maximum leakage rate at the operating static-pressure differential. The Damper Schedule shall contain actuator selection data supported by calculations of the torque required to move and seal the dampers, access and clearance requirements. Damper schedules may be submitted in advance but shall be included in the complete submittal.

f. The HVAC control system schematics shall be in the form shown, and shall show all control and mechanical devices associated with the HVAC system. A system schematic drawing shall be submitted for each HVAC system.

g. The HVAC control system equipment Schedule shall be in the form shown. All devices shown on the drawings having unique identifiers shall be referenced in the equipment schedule. Information to be included in the equipment schedule shall be the control loop, device unique identifier, device function, setpoint, input range, and additional important parameters (i.e., output range). An equipment schedule shall be submitted for each HVAC system.

h. The HVAC control system sequence of operation shall reflect the language and format of this specification, and shall refer to the devices by their unique identifiers as shown. No operational deviations from specified sequences will be permitted without prior written approval of the Contracting Officer. Sequences of operation shall be submitted for each HVAC control system including each type of terminal unit control system.

i. The HVAC control system wiring diagrams shall be functional wiring diagrams which show the interconnection of conductors and cables to HVAC control panel terminal blocks and to the identified terminals of devices, starters and package equipment. The wiring diagrams shall show necessary jumpers and ground connections. The wiring diagrams shall show the labels of all conductors. Sources of power required for HVAC control systems and for packaged equipment control systems shall be identified back to the panel board circuit breaker number, HVAC system control panel, magnetic starter, or packaged equipment control circuit. Each power supply and transformer not integral to a controller, starter, or packaged equipment shall be shown. The connected volt-ampere load and the power supply volt-ampere rating shall be shown. Wiring diagrams shall be submitted for each HVAC control system.

SD-03 Product Data

Service Organizations; G-AO

Six copies of a list of service organizations qualified to service the HVAC control system. The list shall include the service organization name, address, technical point of contact and telephone number, and contractual point of contact and telephone number.

Equipment Compliance Booklet; G-AO

The HVAC Control System Equipment Compliance Booklet (ECB) shall be in booklet form and indexed, with numbered tabs separating the information on each device. It shall consist of, but not be limited to, data sheets and catalog cuts which document compliance of all devices and components with the specifications. The ECB shall be indexed in alphabetical order by the unique identifiers. Devices and components which do not have unique identifiers shall follow the devices and components with unique identifiers and shall be indexed in alphabetical order according to their functional name. The ECB shall include a Bill of Materials for each HVAC Control System. The Bill of Materials shall function as the Table of Contents for the ECB and shall include the device's unique identifier, device function, manufacturer, model/part/catalog number used for ordering, and tab number where the device information is located in the ECB. The ECB shall be

submitted along with Submittal SD-02 Shop Drawings.

Commissioning Procedures; G-AO

Six copies of the HVAC control system commissioning procedures, in booklet form and indexed, 60 days prior to the scheduled start of commissioning. Commissioning procedures shall be provided for each HVAC control system, and for each type of terminal unit control system. The Commissioning procedures shall reflect the format and language of this specification, and refer to devices by their unique identifiers as shown. The Commissioning procedures shall be specific for each HVAC system, and shall give detailed step-by-step procedures for commissioning of the system.

a. The Commissioning procedures shall include detailed, product specific set-up procedures, configuration procedures, adjustment procedures, and calibration procedures for each device. Where the detailed product specific commissioning procedures are included in manufacturer supplied manuals, reference may be made in the HVAC control system commissioning procedures to the manuals.

b. An HVAC control system commissioning procedures equipment list shall be included that lists the equipment to be used to accomplish commissioning. The list shall include manufacturer name, model number, equipment function, the date of the latest calibration, and the results of the latest calibration.

Performance Verification Test Procedures; G-AO

Six copies of the HVAC Control System Performance Verification Test Procedures, in booklet form and indexed, 60 days before the Contractor's scheduled test dates. The performance verification test procedures shall refer to the devices by their unique identifiers as shown, shall explain, step-by-step, the actions and expected results that will demonstrate that the HVAC control system performs in accordance with the sequences of operation, and other contract documents. An HVAC control system performance verification test equipment list shall be included that lists the equipment to be used during performance verification testing. The list shall include manufacturer name, model number, equipment function, the date of the latest calibration, and the results of the latest calibration.

Training; G-AO

An outline for the HVAC control system training course with a proposed time schedule. Approval of the planned training schedule shall be obtained from the Government at least 60 days prior to the start of the training. Six copies of HVAC control system training course material 30 days prior to the scheduled start of the training course. The training course material shall include the operation manual, maintenance and repair manual, and paper copies of overheads used in the course.

SD-06 Test Reports

Commissioning Report; G-AO

Six copies of the HVAC Control System Commissioning Report, in

booklet form and indexed, within 30 days after completion of the system commissioning. The commissioning report shall include data collected during the HVAC control system commissioning procedures and shall follow the format of the commissioning procedures. The commissioning report shall include all configuration checksheets with final values listed for all parameters, setpoints, P, I, D setting constants, calibration data for all devices, results of adjustments, and results of testing.

Performance Verification Test; G-AO

Six copies of the HVAC Control System Performance Verification Test Report, in booklet form and indexed, within 30 days after completion of the test. The HVAC control system performance verification test report shall include data collected during the HVAC control system performance verification test. The original copies of all data gathered during the performance verification test shall be turned over to the Government after Government approval of the test results.

SD-10 Operation and Maintenance Data

Operation Manual; G-AO
Maintenance and Repair Manual; G-AO

Six copies of the HVAC Control System Operation Manual and HVAC Control System Maintenance and Repair Manual, for each HVAC control system, 30 days before the date scheduled for the training course.

1.4 DELIVERY AND STORAGE

Products shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, and other contaminants, within the storage condition limits published by the equipment manufacturer. Dampers shall be stored so that seal integrity, blade alignment and frame alignment are maintained.

1.5 OPERATION MANUAL

An HVAC control system operation manual in indexed booklet form shall be provided for each HVAC control system. The operation manual shall include the HVAC control system sequence of operation, and procedures for the HVAC system start-up, operation and shut-down. The operation manual shall include as-built HVAC control system detail drawings. The operation manual shall include the as-built configuration checksheets, the procedures for changing HVAC control system setpoints, and the procedures for placing HVAC system controllers in the manual control mode.

a. The procedures for changing HVAC control system setpoints shall describe the step-by-step procedures required to change the process variable setpoints, the alarm setpoints, the bias settings, and setpoint reset schedules.

b. The procedures for placing HVAC system controllers in the manual control mode shall describe step-by-step procedures required to obtain manual control of each controlled device and to manually adjust their positions.

1.6 MAINTENANCE AND REPAIR MANUAL

An HVAC control system maintenance and repair manual in indexed booklet form in hardback binders shall be provided for each HVAC control system. The maintenance and repair manual shall include the routine maintenance checklist, a recommended repair methods list, a list of recommended maintenance and repair tools, the qualified service organization list, the as-built commissioning procedures and report, the as-built performance verification test procedures and report, and the as-built equipment data booklet.

a. The routine maintenance checklist shall be arranged in a columnar format. The first column shall list all devices listed in the equipment compliance booklet, the second column shall state the maintenance activity or state no maintenance required, the third column shall state the frequency of the maintenance activity, and the fourth column for additional comments or reference.

b. The recommended repair methods list shall be arranged in a columnar format and shall list all devices in the equipment data compliance booklet and state the guidance on recommended repair methods, either field repair, factory repair, or whole-item replacement.

c. The as-built equipment data booklet shall include the equipment compliance booklet and manufacturer supplied user manuals and information.

d. If the operation manual and the maintenance and repair manual are provided in a common volume, they shall be clearly differentiated and separately indexed.

1.7 MAINTENANCE AND SERVICE

Services, materials and equipment shall be provided as necessary to maintain the entire system in an operational state as specified for a period of one year after successful completion and acceptance of the Performance Verification Test. Impacts on facility operations shall be minimized.

1.7.1 Description of Work

The adjustment and repair of the system shall include the manufacturer's required adjustments of computer equipment, software updates, transmission equipment and instrumentation and control devices.

1.7.2 Personnel

Service personnel shall be qualified to accomplish work promptly and satisfactorily. The Government shall be advised in writing of the name of the designated service representative, and of any changes in personnel. The Contractor shall submit a list of Service Organizations as specified in the Submittals paragraph.

1.7.3 Scheduled Inspections

Two inspections shall be performed at six-month intervals and all work

required shall be performed. Inspections shall be scheduled in June and December. These inspections shall include:

a. Visual checks and operational tests of equipment.

b. Fan checks and filter changes for control system equipment.

c. Clean control system equipment including interior and exterior surfaces.

d. Check and calibrate each field device. Check and calibrate 50 percent of the total analog points during the first inspection. Check and calibrate the remaining 50 percent of the analog points during the second major inspection. Certify analog test instrumentation accuracy to be twice that of the device being calibrated. Randomly check at least 25 percent of all digital points for proper operation during the first inspection. Randomly check at least 25 percent of the remaining digital points during the second inspection.

e. Run system software diagnostics and correct diagnosed problems.

f. Resolve any previous outstanding problems.

1.7.4 Scheduled Work

This work shall be performed during regular working hours, Monday through Friday, excluding legal holidays.

1.7.5 Emergency Service

The Government will initiate service calls when the system is not functioning properly. Qualified personnel shall be available to provide service to the system. A telephone number where the service supervisor can be reached at all times shall be provided. Service personnel shall be at the site within 24 hours after receiving a request for service. The control system shall be restored to proper operating condition within three calendar days after receiving a request for service.

1.7.6 Operation

Scheduled adjustments and repairs shall include verification of the control system operation as demonstrated by the applicable tests of the performance verification test.

1.7.7 Records and Logs

Dated records and logs shall be kept of each task, with cumulative records for each major component, and for the complete system chronologically. A continuous log shall be maintained for all devices. The log shall contain initial analog span and zero calibration values and digital points. Complete logs shall be kept and shall be available for inspection onsite, demonstrating that planned and systematic adjustments and repairs have been accomplished for the control system.

1.7.8 Work Requests

Each service call request shall be recorded as received and shall include the serial number identifying the component involved, its location, date

and time the call was received, nature of trouble, names of the service personnel assigned to the task, instructions describing what has to be done, the amount and nature of the materials to be used, the time and date work started, and the time and date of completion. A record of the work performed shall be submitted within 5 days after work is accomplished.

1.7.9 System Modifications

Recommendations for system modification shall be submitted in writing. No system modifications, including operating parameters and control settings, shall be made without prior approval of the Government. Any modifications made to the system shall be incorporated into the operations and maintenance manuals, and other documentation affected.

1.7.10 Software

Updates to the software shall be provided for system, operating and application software, and operation in the system shall be verified. Updates shall be incorporated into operations and maintenance manuals, and software documentation. There shall be at least one scheduled update near the end of the first year's warranty period, at which time the latest released version of the Contractor's software shall be installed and validated.

PART 2 PRODUCTS

2.1 GENERAL EQUIPMENT REQUIREMENTS

Units of the same type of equipment shall be products of a single manufacturer. Each major component of equipment shall have the manufacturer's name and address, and the model and serial number in a conspicuous place. Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacturing of such products, which are of a similar material, design and workmanship. The standard products shall have been in a satisfactory commercial or industrial use for two years prior to use on this project. The two years' use shall include applications of equipment and materials under similar circumstances and of similar size. The two years' experience shall be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures. Products having less than a two-year field service record will be acceptable if a certified record of satisfactory field operation, for not less than 6,000 hours exclusive of the manufacturer's factory tests, can be shown. The equipment items shall be supported by a service organization. Items of the same type and purpose shall be identical, including equipment, assemblies, parts and components. Automatic temperature controls shall be direct digital controls that will provide the required sequence of operation.

2.1.1 Electrical and Electronic Devices

Electrical and electronic devices not located within a DDC panel shall have a NEMA ICS 1 enclosure in accordance with NEMA 250 unless otherwise shown.

2.1.2 Standard Signals

Except for air distribution terminal unit control equipment, the output of all analog transmitters and the analog input and output of all DDC controllers shall be 4-to-20 mAdc signals. The signal shall originate from

current-sourcing devices and shall be received by current-sinking devices.

2.1.3 Ambient Temperature Limits

DDC panels shall have ambient condition ratings of 35 to 120 degrees F and 10 to 95 percent relative humidity, noncondensing. Devices installed outdoors shall operate within limit ratings of minus 40 to plus 150 degrees F. Instrumentation and control elements shall be rated for continuous operation under the ambient environmental temperature, pressure, humidity, and vibration conditions specified or normally encountered for the installed location.

2.2 TUBING

2.2.1 Copper

Copper tubing shall conform to ASTM B 88, ASTM B 88M and shall have sweat fittings and valves.

2.2.2 Stainless Steel

Stainless steel tubing shall conform to ASTM A 269 and shall have stainless steel compression fittings.

2.2.3 Plastic

Plastic tubing shall have barbed fittings and valves. Plastic tubing shall have the burning characteristics of linear low-density polyethylene tubing, shall be self-extinguishing when tested in accordance with ASTM D 635, shall have UL 94 V-2 flammability classification, and shall withstand stress cracking when tested in accordance with ASTM D 1693. Plastic-tubing bundles shall be provided with Mylar barrier and flame-retardant polyethylene jacket.

2.3 WIRING

2.3.1 Terminal Blocks

Terminal blocks shall be insulated, modular, feed-through, clamp style with recessed captive screw-type clamping mechanism, shall be suitable for rail mounting, and shall have end plates and partition plates for separation or shall have enclosed sides.

2.3.2 Control Wiring for 24-Volt Circuits

Control wiring for 24-volt circuits shall be 18 AWG minimum, stranded copper and shall be rated for 300-volt service.

2.3.3 Wiring for 120-Volt Circuits

Wiring for 120-volt circuits shall be 18 AWG minimum, stranded copper and shall be rated for 600-volt service.

2.3.4 Instrumentation Cable

Instrumentation cable shall be 18 AWG, stranded copper, single- or multiple-twisted, minimum 2 inch lay of twist, 100 percent shielded pairs, and shall have a 300-volt insulation. Each pair shall have a 20 AWG tinned-copper drain wire and individual overall pair insulation. Cables

shall have an overall aluminum-polyester or tinned-copper cable-shield tape, overall 20 AWG tinned-copper cable drain wire, and overall cable insulation.

2.3.5 Transformers

Step down transformers shall be utilized where control equipment operates at lower than line circuit voltage. Transformers, other than transformers in bridge circuits, shall have primaries wound for the voltage available and secondaries wound for the correct control circuit voltage. Transformer shall be sized so that the connected load is 80 percent of the rated capacity or less. Transformers shall conform to UL 508 and NEMA ST 1.

2.4 ACTUATORS

Actuators shall be electric or electronic as shown and shall be provided with mounting and connecting hardware. Electric or electronic actuators shall be used for variable air volume (VAV) air terminal units. Actuators shall fail to their spring-return positions on signal or power failure, except that VAV terminal unit actuators may be of the floating type. The actuator stroke shall be limited in the direction of power stroke by an adjustable stop. Actuators shall have a visible position indicator. Actuators shall smoothly open or close the devices to which they are applied and shall have a full stroke response time of 90 seconds or less. Electric actuators shall have an oil-immersed gear train. Electric or electronic actuators operating in series shall have an auxiliary actuator driver. Electric or electronic actuators used in sequencing applications shall have an adjustable operating range and start point.

2.4.1 Valve Actuators

Valve actuators shall be selected to provide a minimum of 125 percent of the motive power necessary to operate the valve over its full range of operation.

2.5 AUTOMATIC CONTROL VALVES

Valves shall have stainless-steel stems and stuffing boxes with extended necks to clear the piping insulation. Unless otherwise stated, valves shall have globe style bodies. Valve bodies shall be designed for not less than 125 psig working pressure or 150 percent of the system operating pressure, whichever is greater. Valve leakage rating shall be 0.01 percent of rated Cv. Unless otherwise specified, bodies for valves 1-1/2 inches and smaller shall be brass or bronze, with threaded or union ends; bodies for 2 inch valves shall have threaded ends; and bodies for valves 2 to 3 inches shall be of brass, bronze or iron. Bodies for valves 2-1/2 inches and larger shall be provided with flanged-end connections. Valve Cv shall be within 100 to 125 percent of the Cv shown.

2.5.1 Butterfly Valve Assembly

Butterfly valves shall be threaded lug type suitable for dead-end service and modulation to the fully-closed position, with carbon-steel bodies and noncorrosive discs, stainless steel shafts supported by bearings, and EPDM seats suitable for temperatures from minus 20 to plus 250 degrees F. Valves shall have a manual means of operation independent of the actuator. The rated Cv for butterfly valves shall be the value Cv at 70% open (60 degrees open).

2.5.2 Two-Way Valves

Two-way modulating valves shall have equal-percentage characteristics.

2.5.3 Three-Way Valves

Three-way valves shall provide linear flow control with constant total flow throughout full plug travel.

2.5.4 Duct-Coil and Terminal-Unit-Coil Valves

Control valves with either flare-type or solder-type ends shall be provided for duct or terminal-unit coils. Flare nuts shall be furnished for each flare-type end valve.

2.5.5 Valves for Hot-Water and Dual Temperature Service

For hot water service below 250 degrees F and dual-temperature service, internal trim (including seats, seat rings, modulating plugs, and springs) of valves controlling water hotter than 210 degrees F shall be Type 316 stainless steel. Internal trim for valves controlling water 210 degrees F or less shall be brass or bronze. Nonmetallic parts of hot-water control valves shall be suitable for a minimum continuous operating temperature of 250 degrees F or 50 degrees F above the system design temperature, whichever is higher. Valves 4 inches and larger shall be butterfly valves.

2.5.6 Valves for High-Temperature Hot-Water Service

HTW control valves shall be two-way pattern of the proportioning type as indicated for the sequence specified. Valves bodies shall be rated for note less than 300 psig. Valves shall be tight closing type. Valve actuator for HTW shall be NC with proportional operator and adjustable stroke. Ambient temperature range is -25 - 150 degrees F. Body shall be carbon steel, globe type and flanged end. Packing shall be Teflon-impregnated asbestos. Valve trim shall be Type 316 stainless steel. Valve shall have lose-off rating for pressure and temperature of 300-40 psig, inlet and 250 degrees F, 400 psig for return side. Each valve for proportioning service shall have a contoured plug with equal percentage characteristics and a range ability of 50:1 minimum. Each valve shall be provided with valve-stem travel indicator or means of indicating position of the plug.

2.6 DAMPERS

2.6.1 Damper Assembly

A single damper section shall have blades no longer than 48 inches and shall be no higher than 72 inches. Maximum damper blade width shall be 8 inches. Larger sizes shall be made from a combination of sections. Dampers shall be steel, or other materials where shown. Flat blades shall be made rigid by folding the edges. Blade-operating linkages shall be within the frame so that blade-connecting devices within the same damper section shall not be located directly in the air stream. Damper axles shall be 0.5 inch minimum, plated steel rods supported in the damper frame by stainless steel or bronze bearings. Blades mounted vertically shall be supported by thrust bearings. Pressure drop through dampers shall not exceed 0.04 inch water gauge at 1,000 feet per minute in the wide-open position. Frames shall not be less than 2 inches in width. Dampers shall be tested in accordance with AMCA 500-D.

2.6.2 Operating Links

Operating links external to dampers, such as crankarms, connecting rods, and line shafting for transmitting motion from damper actuators to dampers, shall withstand a load equal to at least twice the maximum required damper-operating force. Rod lengths shall be adjustable. Links shall be brass, bronze, zinc-coated steel, or stainless steel. Working parts of joints and clevises shall be brass, bronze, or stainless steel. Adjustments of crankarms shall control the open and closed positions of dampers.

2.6.3 Damper Types

Dampers shall be parallel-blade type.

2.6.3.1 Outside Air, Return Air, and Relief Air Dampers

Outside air, return air and relief air dampers shall be provided where shown. Blades shall have interlocking edges and shall be provided with compressible seals at points of contact. The channel frames of the dampers shall be provided with jamb seals to minimize air leakage. Dampers shall not leak in excess of 20 cfm per square foot at 4 inches water gauge static pressure when closed. Seals shall be suitable for an operating temperature range of minus 40 to plus 200 degrees F. Dampers shall be rated at not less than 2,000 feet per minute air velocity.

2.6.3.2 Mechanical and Electrical Space Ventilation Dampers

Mechanical and electrical space ventilation dampers shall be as shown. Dampers shall not leak in excess of 80 cfm square foot at 4 inches water gauge static pressure when closed. Dampers shall be rated at not less than 1,500 feet per minute air velocity.

2.6.3.3 Smoke Dampers

Smoke-damper and actuator assembly required per NFPA 90A shall meet the Class II leakage requirements of UL 555S. Dampers shall be rated at not less than 2000 fpm air velocity.

2.6.4 Damper End Switches

Each end switch shall be a hermetically sealed switch with a trip lever and over-travel mechanism. The switch enclosure shall be suitable for mounting on the duct exterior and shall permit setting the position of the trip lever that actuates the switch. The trip lever shall be aligned with the damper blade.

2.7 INSTRUMENTATION

2.7.1 Measurements

Transmitters shall be calibrated to provide the following measurements, over the indicated ranges, for an output of 4 to 20 mAdc:

a. Conditioned space temperature, from 50 to 85 degrees F.

b. Duct temperature, from 40 to 140 degrees F.

c. High-temperature hot-water temperature, from 200 to 500 degrees F.

d. Heating hot-water temperature, from 50 to 250 degrees F.

e. Outside-air temperature, from minus 40 to 130 degrees F.

f. Differential pressure for VAV supply-duct static pressure from 0 to 2.0 inches water gauge.

g. Electronic air-flow measurement station and transmitter, from 125 to 2500 fpm.

2.7.2 Temperature Instruments

2.7.2.1 Resistance Temperature Detectors (RTD)

Temperature sensors shall be 100 ohms 3- or 4-wire RTD. Each RTD shall be platinum with a tolerance of 0.54 degrees F at 32 degrees F with a temperature coefficient of resistance (TCR) of 0.00214 ohms/ohm/deg F and shall be encapsulated in epoxy, series 300 stainless steel, anodized aluminum, or copper. Each RTD shall be furnished with an RTD transmitter as specified, integrally mounted unless otherwise shown.

2.7.2.2 Continuous Averaging RTD

Continuous averaging RTDs shall have a tolerance of plus or minus 1.0 degree F at the reference temperature, and shall be of sufficient length to ensure that the resistance represents an average over the cross section in which it is installed. The sensing element shall have a bendable copper sheath. Each averaging RTD shall be furnished with an RTD transmitter to match the resistance range of the averaging RTD.

2.7.2.3 RTD Transmitter

The RTD transmitter shall match the resistance range of the RTD. The transmitter shall be a two-wire, loop powered device. The transmitter shall produce a linear 4-to-20 mAdc output corresponding to the required temperature measurement. The output error shall not exceed 0.1 percent of the calibrated measurement.

2.7.3 Electronic Airflow Measurement Stations and Transmitters

2.7.3.1 Stations

Each station shall consist of an array of velocity sensing elements and an air-flow straightener. Air-flow straightener shall be contained in a flanged sheet metal or aluminum casing. The velocity sensing elements shall be of the vortex shedding, differential pressure, RTD or thermistor type. The sensing elements shall be distributed across the duct cross section in the quantity and pattern specified by the published application data of the station manufacturer. The resistance to air flow through the airflow measurement station shall not exceed 0.08 inch water gauge at an airflow of 2,000 fpm. Station construction shall be suitable for operation at airflows of up to 5,000 fpm over a temperature range of minus 40 to 120

degrees F, and accuracy shall be plus or minus three percent over a range of 125 to 2,500 fpm. In outside air measurement or in low-temperature air delivery applications, the station shall be certified by the manufacturer to be accurate as specified over a temperature range of minus 40 to plus 120 degrees F. In outside air measurement applications,the air flow straightener shall be constructed of 1/8 inch aluminum honeycomb and the depth of the straightener shall not be less than 1.5 inches.

2.7.3.2 Transmitters

Each transmitter shall produce a linear, 4-to-20 mAdc, output corresponding to the required velocity pressure measurement. The transmitter shall be a two-wire, loop powered device. The output error of the transmitter shall not exceed 0.5 percent of the calibrated measurement.

2.7.4 Differential Pressure Instruments

The instrument shall be a pressure transmitter with an integral sensing element. The instrument over pressure rating shall be 300 percent of the operating pressure. The sensor/transmitter assembly accuracy shall be plus or minus two percent of full scale. The transmitter shall be a two-wire, loop-powered device. The transmitter shall produce a linear 4-to-20 mAdc output corresponding to the required pressure measurement.

2.7.5 Thermowells

Thermowells shall be Series 300 stainless steel with threaded brass plug and chain, 2 inch lagging neck and extension type well. Inside diameter and insertion length shall be as required for the application.

2.7.6 Sunshields

Sunshields for outside air temperature sensing elements shall prevent the sun from directly striking the temperature sensing elements. The sunshields shall be provided with adequate ventilation so that the sensing element responds to the ambient temperature of the surroundings. The top of each sunshield shall have a galvanized metal rainshield projecting over the face of the sunshield. The sunshields shall be painted white.

2.8 THERMOSTATS

Thermostat ranges shall be selected so that the setpoint is adjustable without tools between plus or minus 10 degrees F of the setpoint shown. Thermostats shall be electronic or electric.

2.8.1 Nonmodulating Room Thermostats

Contacts shall be single-pole double-throw (SPDT), hermetically sealed, and wired to identified terminals. Maximum differential shall be 5 degrees F. Room thermostats shall be enclosed with separate locking covers (guards).

2.8.2 Microprocessor Based Room Thermostats

Microprocessor based thermostats shall have built-in keypads for scheduling of day and night temperature settings. When out of the scheduling mode, thermostats shall have continuous display of time, with AM and PM indicator, continuous display of day of week, and either continuous display of room temperature with display of temperature setpoint on demand, or continuous display of temperature setpoint with display of room temperature

on demand. In the programmable mode, the display shall be used for interrogating time program ON-OFF setpoints for all seven days of the week. The time program shall allow two separate temperature setback intervals per day. The thermostats shall have a means for temporary and manual override of the program schedule, with automatic program restoration on the following day. Thermostats shall have a replaceable battery to maintain the timing and maintain the schedule in memory for one year in the event of a power outage. Maximum differential shall be 2 degrees F. When used for heat pump applications, the thermostat shall have an emergency heat switch.

2.8.3 Modulating Room Thermostats

Modulating room thermostats shall have either one output signal, two output signals operating in unison, or two output signals operating in sequence, as required for the application. Each thermostat shall have an adjustable throttling range of 4 to 8 degrees F for each output. Room thermostats shall be enclosed with separate locking covers (guards).

2.8.4 Nonmodulating Capillary Thermostats and Aquastats

Each thermostat shall have a capillary length of at least 5 feet, shall have adjustable direct-reading scales for both setpoint and differential, and shall have a differential adjustable from 6 to 16 degrees F. Aquastats shall be of the strap on type, with 10 degrees F fixed differential.

2.8.5 Freezestats

Freezestats shall be manual reset, low temperature safety thermostats, with NO and NC contacts and a 20 foot element which shall respond to the coldest 18 inch segment.

2.8.6 Modulating Capillary Thermostats

Each thermostat shall have either one output signal, two output signals operating in unison, or two output signals operating in sequence, as required for the application. Thermostats shall have adjustable throttling ranges of 4 to 8 degrees F for each output.

2.9 PRESSURE SWITCHES AND SOLENOID VALVES

2.9.1 Pressure Switches

Each switch shall have an adjustable setpoint with visible setpoint scale. Range shall be as shown. Differential adjustment shall span 20 to 40 percent of the range of the device.

2.9.2 Differential-Pressure Switches

Each switch shall be an adjustable diaphragm-operated device with two SPDT contacts, with taps for sensing lines to be connected to duct pressure fittings designed to sense air pressure. These fittings shall be of the angled-tip type with tips pointing into the air stream. The setpoint shall not be in the upper or lower quarters of the range and the range shall not be more than three times the setpoint. Differential shall be a maximum of 0.15 inch water gauge at the low end of the range and 0.35 inch water gauge at the high end of the range.

2.10 INDICATING DEVICES

2.10.1 Thermometers

Mercury shall not be used in thermometers.

2.10.1.1 Piping System Thermometers

Piping system thermometers shall have brass, malleable iron or aluminum alloy case and frame, clear protective face, permanently stabilized glass tube with indicating-fluid column, white face, black numbers, and a 9 inch scale. Thermometers for piping systems shall have rigid stems with straight, angular, or inclined pattern.

2.10.1.2 Piping System Thermometer Stems

Thermometer stems shall have expansion heads as required to prevent breakage at extreme temperatures. On rigid-stem thermometers, the space between bulb and stem shall be filled with a heat-transfer medium.

2.10.1.3 Nonaveraging Air-Duct Thermometers

Air-duct thermometers shall have perforated stem guards and 45-degree adjustable duct flanges with locking mechanism.

2.10.1.4 Averaging Air-Duct Thermometers

Averaging thermometers shall have a 3-1/2 inch (nominal) dial, with black legend on white background, and pointer traveling through a 270-degree arc.

2.10.1.5 Accuracy

Thermometers shall have an accuracy of plus or minus one percent of scale range. Thermometers shall have a range suitable for the application.

2.10.2 Pressure Gauges

Gauges shall be 2 inch (nominal) size, back connected, suitable for field or panel mounting as required, shall have black legend on white background, and shall have a pointer traveling through a 270-degree arc. Accuracy shall be plus or minus three percent of scale range. Gauges shall meet requirements of ASME B40.100.

2.10.2.1 Hydronic System Gauges

Gauges for hydronic system applications shall have ranges and graduations as shown.

2.10.3 Low Differential Pressure Gauges

Gauges for low differential pressure measurements shall be a minimum of 3.5 inch (nominal) size with two sets of pressure taps, and shall have a diaphragm-actuated pointer, white dial with black figures, and pointer zero adjustment. Gauges shall have ranges and graduations as shown. Accuracy shall be plus or minus two percent of scale range.

2.11 CONTROL DEVICES AND ACCESSORIES

2.11.1 Relays

Control relay contacts shall have utilization category and ratings selected for the application, with a minimum of two sets of contacts (two normally open, two normally closed) enclosed in a dustproof enclosure. Relays shall be rated for a minimum life of one million operations. Operating time shall be 20 milliseconds or less. Relays shall be equipped with coil transient suppression devices to limit transients to 150 percent of rated coil voltage. Time delay relays shall be 2PDT with eight-pin connectors, dust cover, and a matching rail-mounted socket. Adjustable timing range shall be 0 to 5 minutes. Power consumption shall not be greater than three watts.

2.11.2 Joule or Watthour Meters

Watthour meters shall be in accordance with ANSI C12.1 and have pulse initiators for remote monitoring of Watthour consumption. Pulse initiator shall consist of form C contacts with a current rating not to exceed two amperes and voltage not to exceed 500 V, with combinations of VA not to exceed 100 VA, and a life rating of one billion operations. Meter sockets shall be in accordance with ANSI C12.1.

2.11.3 Joule or Watthour Meters with Demand Register

Meters shall be in accordance with ANSI C12.1 and shall have pulse initiators for remote monitoring of Watthour consumption and instantaneous demand. Pulse initiators shall consist of form C contacts with a current rating not to exceed two amperes and voltage not to exceed 500 V, with combinations of VA not to exceed 100 VA, and a life rating of one billion operations. Meter sockets shall be in accordance with ANSI C12.1

2.11.4 Joule or Watthour Transducers

Watthour transducers shall have an accuracy of plus or minus 0.25 percent for kW and kWh outputs from full lag to full lead power factor. Input ranges for kW and kWh transducers shall be selectable without requiring the changing of current or potential transformers. The output shall be 4 to 20 mAdc.

2.11.5 Current Sensing Relays

Current sensing relays shall provide a normally-open contact rated at a minimum of 50 volts peak and 1/2 ampere or 25 VA, noninductive. There shall be a single hole for passage of current carrying conductors. The devices shall be sized for operation at 50 percent rated current based on the connected load. Voltage isolation shall be a minimum of 600 volts.

2.11.6 Power-Line Conditioners (PLC)

Power line conditioners shall be furnished for each DDC panel. The PLCs shall provide both voltage regulation and noise rejection. The PLCs shall be of the ferro-resonant design, with no moving parts and no tap switching, while electrically isolating the secondary from the power-line side. The PLCs shall be sized for 125 percent of the actual connected kVA load. Characteristics of the PLC shall be as follows:

a. At 85 percent load, the output voltage shall not deviate by

more than plus or minus one percent of nominal when the input voltage fluctuates between minus 20 percent to plus 10 percent of nominal.

b. During load changes of zero to full load, the output voltage shall not deviate by more than plus or minus three percent of nominal voltage. Full correction of load switching disturbances shall be accomplished within five cycles, and 95 percent correction shall be accomplished within two cycles of the onset of the disturbance.

c. Total harmonic distortion shall not exceed 3-1/2 percent at full load.

2.12 DIRECT DIGITAL CONTROL (DDC) HARDWARE

All functions, constraints, data base parameters, operator developed programs and any other data shall be downloadable from a portable workstation/tester or the central workstation/tester to network control panels, RIU's, universal programmable controllers, and unitary controllers. Download shall be accomplished through both the primary network and the local DDC portable workstation/tester port.

2.12.1 Network Control Panel

Network control panels shall be microcomputer-based with sufficient memory provided to perform all specified and shown network control panel functions and operations, including spare capacity for all spares and its I/O functions specified. Each network control panel and remote I/O units (RIU) shall have a minimum of 10% of its I/O functions as spare capacity but not less than 2 of each type used in each. The type of spares shall be in the same proportion as the implemented I/O functions on the panel, but in no case shall there be less than two spare points of each type. The panel I/O functions shall be furnished complete, with no changes or additions necessary to support implementation of spare functions. Output relays associated with digital signals shall be considered part of the I/O function, whether physically mounted in the enclosure or separately mounted. Implementation of spare points shall necessitate only providing the additional field sensor or control device, field wiring including connection to the system, and point definition assignment by the operator using the central workstation/tester or portable workstation/tester. The panel shall contain all necessary I/O functions to connect to field sensors and control panels. I/O function operation shall be fully supervised to detect I/O function failures. Network control panels shall operate in an independent stand-alone mode, which is defined as all network control panel operations performed by the network control panel without any continuing input from other Direct digital controls or portable workstation/tester. The network control panel shall be capable of controlling a mix of at least 32 RIUs, unitary controllers, and universal programmable controllers.

2.12.1.1 Integral Features

The network control panel shall include:

a. Main power switch.

b. Power on indicator.

c. Portable workstation/tester port, connector, and if necessary

power supply.

d. Manufacturers control network port.

e. On-Off-Auto switches for each DO which controls a device. These switches shall be mounted in the field panel, with the exception of motors, for which the switch shall be mounted at the motor control center. On-Off-Auto switches are not required for DO associated with a status or alarm such as pilot lights. The status of these switches shall be available to the panel for further processing.

f. Minimum-Maximum-Auto switches, or Auto-Manual switches with manual output override, for each AO. The status of these shall be available to the panel for further processing.

g. An intrusion detection device, connected as an alarm.

2.12.1.2 Communication Interfaces

The following communication capabilities shall function simultaneously.

a. Manufacturers Control Network. Manufacturers control network communications interfaces for each data transmission systems (DTS) circuit between network control panels and RIUs, unitary controllers, and universal programmable controllers, shall be provided. Communication interfaces shall be provided between each network control panel and associated I/O functions. The DTS will provide for transmission speeds necessary to comply with performance requirements specified. DTS equipment shall be installed in the network control panel enclosure.

b. Portable Workstation/Tester Port. A communications port for interfacing to a portable workstation/tester shall be provided. Network control panel workstation/tester port other than RS-232,shall be converted to RS-232, including cabling and power supply, and shall be permanently installed in the panel.

c. Primary Network Port. The network control panel shall have a built in primary network Port for networking to a base wide utility monitoring and control system (UMCS).

2.12.1.3 Memory and Real Time Clock (RTC) Backup

The network control panel memory and real time clock functions shall continue to operate for a minimum of 72 hours in the event of a power failure. If rechargeable batteries are provided, automatic charging of batteries shall be provided. Whenever either a permanent workstation/tester or portable workstation/tester is monitoring the network control panel, a low battery alarm message shall be sent to it.

2.12.1.4 Duplex Outlet

A single phase, 120 Vac electrical service outlet for use with test equipment shall be furnished either inside or within 6 feet of the network control panel enclosure.

2.12.1.5 Locking Enclosures

Locking type mounting cabinets with common keying shall be furnished for each network control panel.

2.12.1.6 Failure Mode

Upon failure of the network control panel, either due to failure of the network control panel hardware or of the manufacturers control network, the network control panel shall revert to the failure mode as shown.

a. Manufacturers Control Network Failure: Upon failure of the manufacturers control network, the network control panel shall operate in an independent stand-alone mode.

b. Network Control Panel Hardware Failure: Upon failure of the network control panel hardware, the network control panel shall cease operation and stop communications with other network control panels, RIUs, unitary controllers and universal programmable controllers connected to the affected network control panel. The affected network control panel shall respond to this failure as specified and shown.

2.12.2 RIU

The RIU shall be functionally a part of the network control panel as specified, but may be remotely located from the network control panel and communicate over a dedicated communication circuit. When remotely located, the I/O functions shall be subject to the same requirements as for the network control panel hardware. RIUs shall be used to connect remote inputs and outputs to a network control panel and shall contain all necessary I/O functions to connect to field sensors and control devices. RIU operation shall be fully supervised by the network control panel to detect failures. Each RIU shall have a minimum of 10 % of its I/O functions as spare capacity. The type of spares shall be in the same proportion as the implemented I/O functions on the RIU, but in no case shall there be less than two spare points of each type. The RIU shall be furnished complete, with no changes or additions necessary to support implementation of spare functions. Output relays associated with digital signals shall be considered part of the I/O function, whether physically mounted in the enclosure or separately mounted. Implementation of spare points by others shall require only providing the additional field sensor or control device, field wiring including connection to the system, and point definition assignment by the operator. The RIU shall either report the status of all connected points on each scan, or report the status of all points which have changed state or value since the previous scan.

2.12.2.1 Integral Features

The RIU shall include:

a. Main power switch.

b. Power on indicator.

c. Portable workstation/tester port, connector, and if necessary power supply.

d. Manufacturers control network port.

e. An intrusion detection device, connected as an alarm.

2.12.2.2 Duplex Outlet

A single phase, 120 Vac electrical service outlet for use with test equipment shall be furnished either inside or within 6 feet of the RIU.

2.12.2.3 Locking Enclosures

Locking type mounting cabinets with common keying shall be furnished for each RIU.

2.12.2.4 Failure Mode

Upon failure of the RIU, either due to failure of the RIU hardware or of the DTS, the RIU shall revert to the failure mode shown.

2.12.3 Universal Programmable Controller (UPC)

The universal programmable controller shall be a microprocessor based controller designed and programmed to control and monitor systems as shown. Resident programs shall be contained in reprogramable nonvolatile memory. Each universal programmable controller shall contain necessary power supplies, transformers, memory, I/O functions and communications interfaces necessary to perform its required functions and to provide control and monitoring of connected equipment and devices. It shall contain all necessary I/O functions to connect to field sensors and controls. I/O operation shall be fully supervised to detect I/O function failures. It shall provide for operation as a device connected to the system via the manufacturers control network.

2.12.3.1 Integral Features

The universal programmable controller shall include as a minimum:

a. Main power switch.

b. Power on indicator.

c. Portable workstation/tester port, connector, and if necessary power supply.

d. Manufacturers control network port.

e. I/O functions:

(1) 8 DI
(2) 4 DO
(3) 8 AI
(4) 4 AO
(5) 1 PA

2.12.3.2 Communication Interfaces

The UPC shall have the following communication capabilities which shall function simultaneously.

a. Manufacturers Control Network. The manufacturers control network communications interface for a data transmission systems (DTS) circuit between the UPC and a network control panels shall be provided. The DTS will provide for transmission speeds necessary to comply with performance requirements specified. DTS equipment shall be installed in the UPC Panel enclosure.

b. Portable Workstation/Tester Port. A communications port for interfacing to a portable workstation/tester shall be provided. A UPC workstation/tester port other than RS-232, shall be converted to RS-232, including cabling and power supply, and shall be permanently installed in the panel.

2.12.3.3 Memory and RTC Backup

The UPC memory and real time clock functions shall continue to operate for a minimum of 72 hours in the event of a power failure. If rechargeable batteries are provided, automatic charging of batteries shall be provided. Whenever a either a permanent workstation/tester or portable workstation/tester is monitoring the network control panel, a low battery alarm message shall be sent to it.

2.12.3.4 Specific Requirements

Each universal programmable controller shall be accessible for purposes of application selection, control parameters, set point adjustment, and monitoring from any DDC controller connected to the same manufacturers control network as the universal programmable controller. This shall be done using a portable workstation/tester connected to a portable workstation/tester port either directly or via modem.

2.12.3.5 Locking Enclosures

Locking type mounting cabinets with common keying shall be furnished for each enclosure.

2.12.3.6 Failure Mode

Upon failure of the universal programmable controller, it shall revert to the failure mode of operation as shown.

2.12.4 Unitary Controller

The unitary controller shall be a microprocessor based, stand-alone, dedicated purpose controller, communicating with the network control panel, designed and programmed to control air distribution system mixing boxes, terminal units, heat pumps, fan coil units, self-contained DX units or VAV boxes as shown. Each unitary controller shall contain resident programs in nonvolatile memory for each specific application implemented. Each unitary controller shall contain necessary power supplies, transformers, memory, I/O functions and communications interfaces necessary to perform its required functions and to provide control and monitoring of connected equipment and devices. It shall contain all necessary I/O functions to connect to field sensors and controls. I/O operation shall be fully supervised to detect I/O function failures and shall provide for operation as a device connected to the network control panel via the manufacturers control network.

2.12.4.1 Integral Features

The unitary controller shall include:

a. Main power switch.

b. Power on indicator.

c. Portable workstation/tester port, connector, and power supply.

d. Manufacturers control network port.

e. All I/O functions required to implement the requirements as shown.

f. On-Off-Auto switches for each DO which controls a device. These switches shall be mounted in the field panel, with the exception of motors, for which the switch shall be mounted at the motor control center. On-Off-Auto switches are not required for DO associated with a status or alarm such as pilot lights. The status of these switches shall be available to the panel for further processing.

g. Minimum-Maximum-Auto switches, or Auto-Manual switches with manual output override, for each AO. The status of these shall be available to the panel for further processing.

2.12.4.2 Communication Interfaces

The unitary controller shall have the following communication capabilities which shall function simultaneously.

a. Manufacturers Control Network. The manufacturers control network communications interface for a data transmission systems (DTS) circuit between the unitary controller and a network control panel shall be provided. The DTS will provide for transmission speeds necessary to comply with performance requirements specified. DTS equipment shall be installed in the unitary control panel enclosure.

b. Portable Workstation/Tester Port. A communications port for interfacing to a portable workstation/tester shall be provided. A unitary controller workstation/tester port other than RS-232, shall be converted to RS-232, including cabling and power supply, and shall be permanently installed in the panel. For unitary controller applications where the controller is not mounted in an enclosure, such as for fan-coil units or VAV terminal units, a portable conversion device for an RS-232 connection to the portable workstation/tester may be provided.

2.12.4.3 Specific Requirements

Unitary controller components for new air distribution terminal units shall be furnished to the air distribution terminal unit manufacturer for factory mounting and calibration.

a. Accessibility and Interfaces: Each unitary controller shall be accessible for purposes of application selection, control parameters, set point adjustment, and monitoring using a portable

workstation/tester connected to the manufacturers control network. They shall also be accessible with a portable workstation/tester connected to the unitary controller portable workstation/tester port.

b. Air Distribution Terminal Unit Controls - Pressure Independent: Controls shall consist of a transducer for connection to the velocity-sensing device provided by the terminal unit supplier in the primary air entering the terminal unit, a room temperature sensor, a damper actuator, and an adjustable microprocessor-based controller. The room temperature sensor shall have temperature display, timed override of unoccupied mode, and a communication port. The controller shall operate the damper for cooling and heating and provide control outputs for duct heating coil if applicable. This controller capability shall allow the sequencing of the damper and the heating coil to maintain conditions in the space.

c. Air Distribution Terminal Unit Controls - Pressure Independent with Recirculating Fan: Controls for pressure-independent boxes with recirculating fans shall consist of a transducer for connection to the velocity-sensing device provided by the terminal unit supplier in the primary air entering the terminal unit, a room temperature sensing element, a damper actuator, an adjustable microprocessor-based terminal unit controller, and a switch to operate the recirculation fan, provided by the terminal unit supplier. The room temperature sensor shall have temperature display, timed override of unoccupied mode, and a communication port. The controller shall operate the damper for cooling and shall provide outputs for controlling the recirculation fan and duct heating coil in sequence for heating.

d. Air Distribution Terminal Unit Damper Actuator: Air distribution terminal unit damper actuator shall open or close the device to which it is connected within 60 seconds.

2.12.4.4 Failure Mode

Upon failure of the unitary controller, it shall revert to the failure mode of operation as shown.

2.12.5 I/O Functions

2.12.5.1 DDC Hardware I/O Functions

I/O Functions shall be provided as part of the DDC system and shall be in accordance with the following:

a. The analog input (AI) function shall monitor each analog input, perform A-to-D conversion, and hold the digital value in a buffer for interrogation. The A-to-D conversion shall have a minimum resolution of 10 bits plus sign. Signal conditioning shall be provided for each analog input. Analog inputs shall be individually calibrated for zero and span, in hardware or in software. The AI shall incorporate common mode noise rejection of 50 dB from 0 to 100 Hz for differential inputs, and normal mode noise rejection of 20 dB at 60 Hz from a source impedance of 10,000 ohms. Input ranges shall be within the range of 4-to-20 mAdc.

b. The analog output (AO) function shall accept digital data, perform D-to-A conversion, and output a signal within the range of 4-to-20 mAdc. D-to-A conversion shall have a minimum resolution of eight bits plus sign. Analog outputs shall be individually calibrated for zero and span. Short circuit protection on voltage outputs and open circuit protection on current outputs shall be provided.

c. The digital input (DI) function shall accept on-off, open-close, or other change of state (two state data) indications. Isolation and protection against an applied steady-state voltage up to 180 Vac peak shall be provided.

d. The digital output (DO) function shall provide contact closures for momentary and maintained operation of output devices. Closures shall have a minimum duration of 0.1 second. DO relays shall have an initial breakdown voltage between contacts and coil of at least 500 V peak. Electromagnetic interference suppression shall be furnished on all output lines to limit transients to nondamaging levels. Protection against an applied steady-state voltage up to 180 Vac peak shall be provided. Minimum contact rating shall be one ampere at 24 Vac.

e. The pulse accumulator function shall have the same characteristics as the DI. In addition, a buffer shall be provided to totalize pulses and allow for interrogation by the DDC system. The pulse accumulator shall accept rates up to 20 pulses per second. The totalized value shall be reset to zero upon operator's command.

f. Signal conditioning for sensors shall be provided as specified.

g. The binary coded decimal (BCD) function: The BCD function shall have the same characteristics as the DI, except that, in addition, a buffer shall be provided to totalize inputs and allow for interrogation by the network control panel. The BCD function shall have 16-channel optically isolated buffered inputs to read four digit numbers. The BCD function shall accumulate inputs at rates up to 10 inputs per second.

2.12.5.2 Failure Mode

Upon failure of the I/O function, including data transmission failure, logic power supply failure, DDC processor malfunction, software failure, interposing relay power failure, or any other failure which prevents stand alone operation of any DDC normally capable of stand alone operation, connected outputs shall be forced to the failure mode shown.

2.12.6 Portable Workstation/Tester Connections

Provide portable workstation/tester connectionson all DDC hardware. The connection shall provide capability such that the workstation/tester can:

a. Run DDC diagnostics.

b. Load all DDC memory resident programs and information, including parameters and constraints.

c. Display any AI, DI, AO, DO, or PA point in engineering units for analog points or status for digital points.

d. Control any AO or DO.

e. Provide an operator interface, contingent on password level, allowing the operator to use full English language words and acronyms, or an object oriented graphical user interface.

f. Display database parameters.

g. Modify database parameters.

h. Accept DDC software and information for subsequent loading into a specific DDC. Provide all necessary software and hardware required to support this function, including an EIA ANSI/EIA/TIA-232-F port.

i. Disable/enable each DDC.

j. Perform all workstation functions as specified.

2.12.7 Central Workstation/Tester (Provided by Owner)

AThe central workstation/tester shall:

a. Run DDC diagnostics.

b. Load all DDC memory resident programs and information, including parameters and constraints.

c. Display any AI, DI, AO, DO, or PA point in engineering units for analog points or status for digital points.

d. Control any AO or DO.

e. Provide an operator interface, contingent on password level, allowing the operator to use full English language words and acronyms, or an object oriented graphical user interface.

f. Display database parameters.

g. Modify database parameters.

h. Accept DDC software and information for subsequent loading into a specific DDC. Provide all necessary software and hardware required to support this function, including an EIA ANSI/EIA/TIA-232-F port.

i. Disable/enable each DDC.

j. Perform all workstation functions as specified.

2.13 DDC SOFTWARE

All DDC software described in this specification shall be furnished as part of the complete DDC System.

2.13.1 Operating System

Each DDC shall contain an operating system that controls and schedules that DDC's activities in real time. The DDC shall maintain a point database in its memory that includes all parameters, constraints, and the latest value or status of all points connected to that DDC. The execution of DDC application programs shall utilize the data in memory resident files. The operating system shall include a real time clock function that maintains the seconds, minutes, hours, date and month, including day of the week. Each DDC real time clock shall be automatically synchronized with the network control panel real time clock at least once per day to plus or minus 10 seconds. When the network control panel is connected to a central workstation/tester, the network control panel RTC shall be updated by the central workstation/tester RTC. The time synchronization shall be accomplished without operator intervention and without requiring system shutdown. The operating system shall allow loading of software, data files data entry, and diagnostics from the central workstation/tester both locally through the central workstation/tester port and remotely through a network control panel and the manufacturers control network.

2.13.1.1 Startup

The DDC shall have startup software that causes automatic commencement of operation without human intervention, including startup of all connected I/O functions. A DDC restart program based on detection of power failure at the DDC shall be included in the DDC software. Upon restoration of power to the DDC, the program shall restart equipment and restore loads to the state at time of power failure, or to the state as commanded by time programs or other overriding programs. The restart program shall include start time delays between successive commands to prevent demand surges or overload trips. The startup software shall initiate operation of self-test diagnostic routines. Upon failure of the DDC, if the database and application software are no longer resident or if the clock cannot be read, the DDC shall not restart and systems shall remain in the failure mode indicated until the necessary repairs are made. If the database and application programs are resident, the DDC shall resume operation after an adjustable time delay of from 0 to 600 seconds. The startup sequence for each DDC shall include a unique time delay setting for each control output when system operation is initiated.

2.13.1.2 Operating Mode

Each DDC shall control and monitor functions as specified, independent of communications with other DDC. This software shall perform all DDC functions and DDC resident application programs as specified using data obtained from I/O functions and based upon the DDC real time clock function. When communications circuits between the DDC are operable, the DDC shall obtain real time clock updates and any required global data values transmitted from other network control panels. The DDC software shall execute commands after performing constraints checks in the DDC. Status and analog values, including alarms and other data shall be transmitted from other network control panels when communications circuits are operable. If communications are not available, each DDC shall function in stand-alone mode and operational data, including the latest status and value of each point and results of calculations, normally transmitted from other network control panels shall be stored for later transmission to the network control panel. Storage for the latest 256 values shall be provided at each network control panel. Each DDC shall accept software downloaded from the network control panel. Constraints shall reside at the DDC.

2.13.1.3 Failure Mode

Upon failure for any reason, each DDC shall perform an orderly shutdown and force all DDC outputs to a predetermined (failure mode) state, consistent with the failure modes shown and the associated control device.

2.13.2 Functions

The Contractor shall provide software necessary to accomplish the following functions, as appropriate, fully implemented and operational, within each network control panel, RIU, unitary controller and universal programmable controller.

a. Scanning of inputs.
b. Control of outputs.
c. Reporting of analog changes outside a selectable differential.
d. Reporting of unauthorized digital status.
e. Reporting of alarms automatically to network control panel.
f. Reporting of I/O status to network control panel upon request.
g. Maintenance of real time, updated by the network control panel at least once a day.
h. Communication with the network control panel.
i. Execution of DDC resident application programs.
j. Averaging or filtering of AIs.
k. Constraints checks (prior to command issuance).
l. Diagnostics.
m. Portable workstation/tester operation as specified.
n. Reset of PA by operator based on time and value.

2.13.2.1 Analog Monitoring

The system shall measure and transmit analog values including calculated analog points. An analog change in value is defined as a change exceeding a preset differential value as specified. The record transmitted for each analog value shall include a readily identifiable flag which indicates the abnormal status of the value when it deviates from operator selectable upper and lower analog limits. Analog values shall be expressed in proper engineering units with sign. Engineering units conversions shall be provided for each measurement. Each engineering units conversion set shall include range, span, and conversion equation. A vocabulary of engineering unit descriptors shall be provided, using at least three alphanumeric characters to identify information in the system. The system shall support 255 different engineering units.

2.13.2.2 Logic (Virtual) Points

Logic (virtual) points shall be software points entered in the point database which are not directly associated with a physical I/O function. Logic (virtual) points shall be analog or digital points created by calculation from any combination of digital and analog points, or other data having the properties of real points, including alarms, without the associated hardware. Logic (virtual) points shall be defined or calculated and entered into the database by the Contractor. The calculated analog point shall have point identification in the same format as any other analog point. The calculated point shall be used in any program where the real value is not obtainable directly. Constants used in calculations shall be changeable on-line by the operator. Calculated point values shall be current for use by the system within 10 seconds of the time of any input

changes.

2.13.2.3 State Variables

If an analog point represents more than two (up to eight) specific states, each state shall be nameable. For example, a level sensor shall be displayed at its measured engineering units plus a state variable with named states usable in programs or for display such as low alarm/low/normal/high/high alarm.

2.13.2.4 Analog Totalization

Any analog point shall be operator assignable to the totalization program. Up to eight analog values shall be totalized within a selectable time period. At the end of the period, the totals shall be stored. Totalization shall then restart from zero for the next time period. The program shall keep track of the peak and total value measured during the current period and for the previous period. The operator shall be able to set or reset each totalized value individually. The time period shall be able to be operator defined, modified or deleted on-line.

2.13.2.5 Energy Totalization

The system shall calculate the heat energy in Btus, for each energy source consumed by the mechanical systems specified, totalize the calculated Btus, the instantaneous rate in Btus per hour, and store totals in thousands of Btus (MBtu). The Btus calculated shall be totalized for an adjustable time period. The time period shall be defined uniquely for each Btu totalization.

2.13.2.6 Trending

Any analog or calculated point shall be operator assignable to the trend program. Up to eight points shall be sampled at individually assigned intervals, selectable between one minute and two hours. A minimum of the most recent 128 samples of each trended point shall be stored. The sample intervals shall be able to be defined, modified, or deleted on-line.

2.13.3 I/O Point Database/Parameter Definition

Each I/O point shall be defined in a database residing in the DDC. The definition shall include all physical parameters associated with each point. Each point shall be defined and entered into the database by the Contractor, including as applicable:

a. Name.
b. Device or sensor type (i.e., sensor, control relay, motors).
c. Point identification number.
d. Unit.
e. Building number.
f. Area.
g. Island.
h. DDC number and channel address.
i. KW (running).
j. KW (starting).
k. Sensor range.
l. Controller range.
m. Sensor span.
n. Controller span.

o. Engineering units conversion (scale factor).
p. Setpoint (analog).
q. High reasonableness value (analog).
r. Low reasonableness value (analog).
s. High alarm limit differential (return to normal).
t. Low alarm limit differential (return to normal).
u. High alarm limit (analog).
v. Low alarm limit (analog).
w. Alarm disable time period upon startup or change of setpoint.
x. Analog change differential (for reporting).
y. Alarm class and associated primary message text.
z. High accumulator limit (pulse).
aa. Status description.
bb. Run time target.
cc. Failure mode as specified and shown.
dd. Constraints as specified.

2.13.4 Alarm Processing

Each DDC shall have alarm processing software for AI, DI, and PA alarms for all real and virtual points connected to that DDC.

2.13.4.1 Digital Alarms Definition

Digital alarms are those abnormal conditions indicated by DIs as specified and shown.

2.13.4.2 Analog Alarms Definition

Analog alarms are those conditions higher or lower than a defined value, as measured by an AI. Analog readings shall be compared to predefined high and low limits, and alarmed each time a value enters or returns from a limit condition. Unique high and low limits shall be assigned to each analog point in the system. Analog alarm limits shall be stored in the DDC database. Each analog alarm limit shall have an associated unique limit differential specifying the amount by which a variable must return into the proper operating range before being annunciated as a return-to-normal-state. All limits and differentials shall be entered on-line by the operator in limits of the measured variable, without interruption or loss of monitoring of the point concerned. The program shall automatically change the high or low limits or both, of any analog point, based on time scheduled operations as specified, allowing for a time interval before the alarm limit becomes effective. In CPA applications, key the limit to a finite deviation traveling with the setpoint. The system shall automatically suppress analog alarm reporting associated with a digital point when that digital point is turned off.

2.13.4.3 Pulse Accumulator Alarms Definition

Pulse accumulator alarms are those conditions calculated from totalized values of accumulator inputs or PA input rates that are outside defined limits as specified and shown. PA totalized values shall be compared to predefined limits and alarmed each time a value enters a limit condition. Unique limits shall be assigned to each PA point in the system. Limits shall be stored in the DDC database.

2.13.5 Constraints

2.13.5.1 Equipment Constraints Definitions

Each control point in the database shall have DDC resident constraints defined and entered by the Contractor, including as applicable:

a. Maximum starts (cycles) per hour.
b. Minimum off time.
c. Minimum on time.
d. High limit (value in engineering units).
e. Low limit (value in engineering units).

2.13.5.2 Constraints Checks

Control devices connected to the system shall have the DDC memory resident constraints checked before each command is issued to insure that no equipment damage will result from improper operation. Each command shall be executed by the DDC only after all constraints checks have been passed. Each command point shall have unique constraints assigned. High and low "reasonableness" values or one differential "rate-of-change" value shall be assigned to each AI. Values outside the reasonableness limits shall be rejected and an alarm message sent to the network control panel or portable workstation/tester. Status changes and analog point values shall be reported to the workstation upon operator request, such as for reports, alphanumeric displays, graphic displays, and application programs. Each individual point shall be capable of being selectively disabled by the operator from a workstation/tester. Disabling a point shall prohibit monitoring and automatic control of that point.

2.13.6 Diagnostics

Each DDC shall have self-test diagnostic routines implemented in firmware. The tests shall include routines that exercise memory. Diagnostic software shall be usable in conjunction with the central workstation/tester and portable workstation/tester. The software shall display messages in English to inform the tester's operator of diagnosed problems.

2.13.7 Summer-Winter Operation Monitoring

The system shall provide software to automatically change the operating parameters, monitoring of alarm limits, and start-stop schedules for each mechanical system from summer to winter and vice-versa. The software shall provide automatic commands to applications programs to coordinate proper summer or winter operation. Change over setpoints shall be operator selectable and settable.

2.13.8 Control Sequences and Control Loops

Sufficient memory shall be provided to implement the requirements specified and shown for each DDC. Specific functions to be implemented are defined in individual system control sequences and database tables shown in the drawings, and shall include, as applicable, the following:

a. PI Control: This function shall provide proportional control and proportional plus integral control.

b. Two Position Control: This function shall provide control for a two state device by comparing a set point against a process

variable and an established deadband.

c. Floating Point Control: This function shall exercise control when an error signal exceeds a selected deadband, and shall maintain control until the error is within the deadband limits.

d. Signal Selection: This function shall allow the selection of the highest or lowest analog value from a group of analog values as the basis of control. The function shall include the ability to cascade analog values so that large numbers of inputs can be reduced to one or two outputs.

e. Signal Averaging: This function shall allow the mathematical calculation of the average analog value from a group of analog values as the basis of control. The function shall include the ability to "weight" the individual analog values so that the function output can be biased as necessary to achieve proper control.

f. Reset Function: This function shall develop an AO based on up to two AIs and one operator specified reset schedule.

g. Cooling/Heating Operation Program: Software shall be provided to change, either automatically or on operator command, the operating parameters, monitoring of alarm limits, and start-stop schedules for each mechanical system where such a change from cooling to heating and vice versa is meaningful. The software shall provide commands to application programs to coordinate cooling or heating mode operation. Software shall automatically switch facilities from cooling to heating, and vice versa, based on schedules or temperatures. All HVAC equipment and systems shall be assigned to the program.

2.13.9 Command Priorities

A scheme of priority levels shall be provided to prevent interaction of a command of low priority with a command of higher priority. The system shall require the latest highest priority command addressed to a single point to be stored for a period of time longer than the longest time constraint in the on and off states, insuring that the correct command shall be issued when the time constraint is no longer in effect or report the rejected command. Override commands entered by the operator shall have higher priority than those emanating from applications programs.

2.13.10 Resident Application Software

The Contractor shall provide resident applications programs to achieve the sequences of operation, parameters, constraints, and interlocks necessary to provide control of the systems connected to the DDC system. Application programs shall be resident and shall execute in the DDC, and shall coordinate with each other, to insure that no conflicts or contentions remain unresolved. The Contractor shall coordinate the application programs specified with the equipment and controls operation, and other specified requirements. A scheme of priority levels shall be provided to prevent interaction of a command of low priority with a command of higher priority. The system shall require the latest highest priority command addressed to a single point to be stored for a period of time longer than the longest time constraint in the ON and OFF states, insuring that the correct command shall be issued when the time constraint is no longer in

effect or the rejected command shall be reported. Override commands entered by the operator shall have higher priority than those emanating from application programs.

2.13.10.1 Program Inputs and Outputs

The Contractor shall select the appropriate program inputs listed for each application program to calculate the required program outputs. Where the specific program inputs are not available, a "default" value or virtual point appropriate for the equipment being controlled and the proposed sequence of operation shall be provided to replace the missing input, thus allowing the application program to operate. AIs to application programs shall have an operator adjustable deadband to preclude short cycling or hunting. Program outputs shall be real analog or digital outputs or logic (virtual) points as required to provide the specified functions. The Contractor shall select the appropriate input and output signals to satisfy the requirements for control of systems as shown.

2.13.10.2 DDC General Conditions

The Contractor shall provide software required to achieve the sequences of operation, parameters, constraints, and interlocks shown. Application software shall be resident in the DDC in addition to any other required software. In the event of a DDC failure, the controlled equipment shall continue to function in the failure mode shown.

2.13.10.3 Scheduled Start/Stop Program

This program shall start and stop equipment based on a time of day schedule for each day of the week, and on a holiday schedule. To eliminate power surges, an operator adjustable time delay shall be provided between consecutive start commands.

a. Program Inputs:

(1) Day of week/holiday.
(2) Time of day.
(3) Cooling and heating high-low alarm limits.
(4) Cooling and heating start-stop schedules.
(5) Cooling or heating mode of operation.
(6) Equipment status.
(7) Equipment constraints.
(8) Consecutive start time delay.

b. Program Outputs: Start/stop signal.

2.13.10.4 Optimum Start/Stop Program

This program shall start and stop equipment as specified for the scheduled start/stop program, but shall include a sliding schedule based on indoor and outdoor air conditions. The program shall take into account the thermal characteristics of the structure, and indoor and outdoor air conditions, using prediction software to determine the minimum time of HVAC system operation needed to satisfy space environmental requirements at the start of the occupied cycle, and determine the earliest time for stopping equipment at the day's end without exceeding space environmental requirements. An adaptive control algorithm shall be utilized to automatically adjust the constants used in the program.

a. Program Inputs:

(1) Day of week/holiday.
(2) Time of day.
(3) Cooling or heating mode of operation.
(4) Equipment status.
(5) Cooling and heating building occupancy schedules.
(6) Space temperature.
(7) Building heating constant (operator adjustable and automatically optimized).
(8) Building cooling constant (operator adjustable and automatically optimized).
(9) OA temperature.
(10) Required space temperature at occupancy (heating).
(11) Required space temperature at occupancy (cooling).
(12) Equipment constraints.
(13) Cooling and heating high-low alarm limits.

b. Program Outputs: Start/stop signal.

2.13.10.5 Day-Night Setback Program

The software shall limit the rise or drop of space temperature (or specified fluid temperature) during unoccupied hours. Whenever the space temperature (or specified fluid temperature) is above (or below for heating) the operator assigned temperature limit, the system shall be turned on until the temperature is within the assigned temperature limit.

a. Program Inputs:

(1) Day of week.
(2) Time of day.
(3) Cooling or heating mode of operation.
(4) Cooling and heating occupancy schedules.
(5) Equipment status.
(6) Space temperature (or specified fluid temperature).
(7) Minimum space temperature (or specified fluid temperature) during unoccupied periods.
(8) Maximum space temperature (or specified fluid temperature) during unoccupied periods.
(9) Equipment constraints.

b. Program Outputs: Start/stop signal.

2.13.10.6 Economizer Program I

The software shall reduce the HVAC system cooling requirements when the OA dry bulb temperature is less than the return air temperature. When the OA dry bulb temperature is above the return air temperature or changeover setpoint, the OA dampers, return air dampers, and relief air dampers shall be positioned to provide minimum required OA. When the OA dry bulb temperature is below a changeover setpoint temperature, the OA dampers, return air dampers, and exhaust air dampers shall be positioned to maintain the required mixed air temperature.

a. Program Input:

(1) Changeover conditions.
(2) OA dry bulb temperature.

(3) RA dry bulb temperature.
(4) Mixed air dry bulb temperature.
(5) Equipment constraints.

b. Program Output: Damper actuator/cooling control signal.

2.13.10.7 Ventilation/Recirculation and Flush Programs

The software shall reduce the HVAC system thermal load for two modes of operation and provide for flushing of the building as follows:

a. Ventilation mode: In this mode, the system shall precool the space prior to building occupancy. When the outside air temperature is lower than the space temperature, the outside air damper and exhaust air damper shall open to their maximum positions and the return air damper shall close to its minimum position.

b. Recirculation mode: In this mode, the system shall preheat the space prior to building occupancy. When the outside air temperature is lower than the space temperature, the outside air damper and the exhaust air damper shall close to their minimum positions and the return air damper shall open to its maximum position.

c. Flush mode: The software shall use the HVAC supply system to provide 100% outside air for ventilation purpose and flush building spaces. The network control panel shall modulate the control valves to maintain the air supply temperature setpoints while the flush program is in effect. The flush mode shall be manually initiated and have the highest priority (it shall override all other programs). The outside air damper and the exhaust air damper shall be closed at other times during unoccupied periods, except for economizer operation during day/night setback periods. For systems without mechanical cooling, this program shall, in addition to the above requirements, act as an economizer. The outside, return, and exhaust air dampers shall be modulated to maintain the required mixed air temperature setpoint. When this program is released, the outside and exhaust air dampers shall return to their minimum positions, and the return air damper shall return to its maximum position.

d. Program Inputs:

(1) Day of week.
(2) Time of day.
(3) Cooling or heating mode of operation.
(4) Equipment status.
(5) Cooling and heating occupancy schedules.
(6) OA dry bulb temperature.
(7) Space temperature.
(8) Equipment constraints.

e. Program Output: Damper actuator control signal.

2.13.10.8 Reheat Coil Reset Program

The software shall select the zone with the least amount of heat required.

The program shall reset the discharge temperature upward until it satisfies the zone with the lowest demand.

a. Program Inputs:

(2) Zone temperature (where shown).

(4) Discharge temperature.
(5) Reheat coil valve positions or proportional signals from primary elements.
(6) Minimum space temperature during occupied periods.
(7) Maximum space temperature during occupied periods.
(8) Equipment constraints.

b. Program Output: Cooling coil valve actuator control signal.

2.13.10.9 Heating and Ventilating Unit Program

The software shall control hot water valve position to maintain space/supply air temperatures for heating and ventilating units. This program shall be coordinated with the ventilation-recirculation program for damper control and the scheduled or optimum start-stop program for fan control.

a. Program Inputs:

(1) Space temperature.
(2) Space temperature setpoint.
(3) Supply air temperature.
(4) Supply air temperature setpoint.

b. Program Outputs:

(1) Heating or steam coil valve actuator control signal.
(2) Damper actuator control signal.

2.13.10.10 Air Volume Control Program

The software shall monitor supply and return/exhaust air flow volumes and modulate fan controls to maintain required air flow volumes and/or ratio or fixed differential of supply to return air flows. This program shall be coordinated with the ventilation-recirculation program and the economizer program for damper control and with static pressure control requirements for fan control.

a. Program Inputs:

(1) Supply air flow.
(2) Return/exhaust air flow.
(3) Required supply air flow - high and low limits.
(4) Required return/exhaust air flow - high and low limits.
(5) Volume offset or ratio, as appropriate.

b. Program Outputs:

(1) Supply fan volume control.
(2) Return/exhaust fan volume control.

2.13.10.11 Air Distribution Unitary Controller Software

Software shall be provided for the management and control of the air distribution terminal units. Software shall allow for operator definition of multiple air distribution terminal units as functional groups which may be treated as a single entity; monitoring, alarming and reporting of terminal unit parameters on an individual or group basis; and remote setpoint adjustment on an individual or group basis.

a. Functions:

(1) Volume control in response to temperature.
(2) Volume flow limits, minimum and maximum.
(3) Occupied and unoccupied operation with associated temperature and volume limits.
(4) Temperature setpoint override.

b. Program Inputs:

(1) Space temperature.
(2) Space temperature setpoint.
(3) Space temperature setpoint limits.
(4) Supply airflow volume.
(5) Supply airflow volume high and low limits.

c. Program Outputs:

(1) Supply volume control signal.
(2) Auxiliary fan start/stop signal.
(3) Supplemental heat control signal.

2.13.10.12 Hot Water OA Reset Program

The software shall reset the hot water temperature supplied by the converter in accordance with the OA temperature or other specified independent variable. The hot water supply temperature shall be reset downward or upward from a fixed temperature proportionally, as a function of OA temperature or other specified independent variable.

a. Program Inputs:

(1) Reset schedule.
(2) OA dry bulb temperature or other specified independent variable.
(3) Hot water supply temperature.
(4) Maximum hot water supply temperature.
(5) Minimum hot water supply temperature.
(6) Equipment constraints.

b. Program Output: Valve actuator control signal.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION CRITERIA

3.1.1 HVAC Control System

The HVAC control system shall be completely installed and ready for operation. Dielectric isolation shall be provided where dissimilar metals

are used for connection and support. Penetrations through and mounting holes in the building exterior shall be made watertight. The HVAC control system installation shall provide clearance for control system maintenance by maintaining access space between coils, access space to mixed-air plenums, and other access space required to calibrate, remove, repair, or replace control system devices. The control system installation shall not interfere with the clearance requirements for mechanical and electrical system maintenance.

3.1.2 Software Installation

Software shall be loaded for an operational system, including databases for all points, operational parameters, and system, command, and application software. The Contractor shall provide original and backup copies of source, excluding the general purpose operating systems and utility programs furnished by computer manufacturers and the non-job-specific proprietary code furnished by the system manufacturer, and object modules for software on each type of media utilized, within 30 days of formal Government acceptance. In addition, a copy of individual floppy disks of software for each DDC panel shall be provided.

3.1.3 Device Mounting Criteria

Devices mounted in or on piping or ductwork, on building surfaces, in mechanical/electrical spaces, or in occupied space ceilings shall be installed in accordance with manufacturer's recommendations and as shown. Control devices to be installed in piping and ductwork shall be provided with required gaskets, flanges, thermal compounds, insulation, piping, fittings, and manual valves for shutoff, equalization, purging, and calibration. Strap-on temperature sensing elements shall not be used except as specified.

3.1.4 Wiring Criteria

Wiring external to control panels, including low-voltage wiring, shall be installed in metallic raceways. Wiring shall be installed without splices between control devices and DDC panels. Instrumentation grounding shall be installed as necessary to prevent ground loops, noise, and surges from adversely affecting operation of the system. Ground rods installed by the contractor shall be tested as specified in IEEE Std 142. Cables and conductor wires shall be tagged at both ends, with the identifier shown on the shop drawings. Electrical work shall be as specified in Section 16415A ELECTRICAL WORK, INTERIOR and as shown.

3.2 CONTROL SYSTEM INSTALLATION

3.2.1 Damper Actuators

Actuators shall not be mounted in the air stream. Multiple actuators operating a common damper shall be connected to a common drive shaft. Actuators shall be installed so that their action shall seal the damper to the extent required to maintain leakage at or below the specified rate and shall move the blades smoothly.

3.2.2 Room Instrument Mounting

Room instruments , such as wall mounted thermostats, shall be mounted 60 inches above the floor unless otherwise shown. Temperature setpoint devices shall be recess mounted.

3.2.3 Freezestats

For each 20 square feet of coil face area, or fraction thereof, a freezestat shall be provided to sense the temperature at the location shown. Manual reset freezestats shall be installed in approved, accessible locations where they can be reset easily. The freezestat sensing element shall be installed in a serpentine pattern.

3.2.4 Averaging Temperature Sensing Elements

Sensing elements shall have a total element minimum length equal to 1 linear foot per square foot of duct cross-sectional area.

3.2.5 Duct Static Pressure Sensing Elements and Transmitters

The duct static pressure sensing element and transmitter sensing point shall be located at 75% to 100% of the distance between the first and last air terminal units.

3.2.6 Indication Devices Installed in Piping and Liquid Systems

Gauges in piping systems subject to pulsation shall have snubbers. Thermometers and temperature sensing elements installed in liquid systems shall be installed in thermowells.

3.2.7 Tubing

3.2.7.1 Control System Installation

All tubes and tube bundles exposed to view shall be installed neatly in lines parallel to the lines of the building. Tubing between panels and actuators in mechanical/electrical spaces shall be routed so that the lines are easily traceable.

3.2.7.2 Connection to Liquid and Steam Lines

Tubing for connection of sensing elements and transmitters to liquid and steam lines shall be copper or Series 300 stainless steel with brass compression or stainless-steel compression fittings.

3.2.7.3 Connection to Ductwork

Tubing for connection of sensing elements and transmitters to ductwork shall be plastic tubing.

3.2.7.4 Tubing in Concrete

Tubing in concrete shall be installed in rigid conduit. Tubing in walls containing insulation, fill, or other packing materials shall be installed in raceways dedicated to tubing.

3.3 CONTROL SEQUENCES OF OPERATION

3.3.1 General Requirements - HVAC Systems

These requirements shall apply to all primary HVAC systems unless modified herein. The sequences describe the actions of the control system for one direction of change in the HVAC process analog variable, such as

temperature, humidity or pressure. The reverse sequence shall occur when the direction of change is reversed.

3.3.1.1 Supply Fan Operating

HVAC system outside air, return air, and relief air dampers shall function as described for specific modes of operation. Interlocked exhaust fans shall be stopped in the unoccupied and ventilation delay modes and their dampers shall be closed. Interlocked exhaust fans shall run in the occupied mode, and their dampers shall open. Cooling coil control valves and condensing units shall function as described for the specific modes of operation. Heating coil valves shall be under control.

3.3.1.2 Supply Fan Not Operating

When an HVAC system is stopped, all interlocked fans shall stop, the outside air and relief air dampers shall close, the return air damper shall open, all stages of direct-expansion cooling shall stop, and cooling coil valves for coils located indoors shall close to the coil. Heating coil valves shall remain under control.

3.3.1.3 Hydronic Heating - Distribution Pump Operating

Hydronic heat-exchanger valves shall be under control.

3.3.1.4 Hydronic Heating - Distribution Pump Not Operating

Hydronic heat-exchanger valves shall close.

3.3.2 Perimeter Radiation Control Sequence

All Modes - A room thermostat, located as shown, shall operate a control valve to maintain the setpoint as shown. Sequence with VAV box controls. See controls drawings.

3.3.3 Unit Heater and Cabinet Unit Heater

All Modes - A wall-mounted thermostat with an "AUTO-OFF" switch located as shown, shall cycle the fan to maintain its setpoint as shown when the switch is in the "AUTO" position. When the switch is in the "OFF" position, the fan shall be stopped.

3.3.4 Central Plant High-Temperature Hot-Water Hydronic Heating

3.3.4.1 All Modes

The DDC system shall accept a signal from a sunshielded outside air temperature sensing element and transmitter located as shown. The DDC system shall start and stop lead pump at the outside air temperatures shown. The DDC system shall reset the hydronic heating supply temperature setpoint in a linear schedule based on the outside air temperature as shown. The DDC system shall accept a signal from a temperature sensing element and transmitter located in the hydronic heating supply line and the DDC system output shall modulate the converter high temperature hot water control valve to maintain the reset schedule setpoint in the hydronic heating supply line. Provide lead/lag porgramming for HWP-1 and HWP-2 and VFD speed controls. See controls drawings.

3.3.4.2 Occupied Mode

When the system time schedule places the system in the occupied mode, a space temperature sensing element and transmitter located as shown shall signal the DDC system, which shall maintain the space temperature setpoint as shown by modulating the secondary hydronic system zone valve.

3.3.4.3 Unoccupied Mode

When the system is in the unoccupied mode, the space temperature setpoint shall be as shown.

3.3.5 Heating and Ventilating Unit

3.3.5.1 Occupied, Unoccupied, and Ventilation Delay Operating Modes

Ventilation delay mode timing shall start prior to the occupied mode timing. The DDC system shall prevent the outside air damper from opening. At the time shown, the DDC system shall place the system in the occupied mode. At the expiration of the ventilation delay mode timing period, the DDC system shall allow the outside air damper to open. At the time shown, the DDC system shall place the control system in the unoccupied mode of operation.

3.3.5.2 Outside Air, Return Air, and Relief Air Dampers

a. Occupied Mode - The outside air, return air, and relief air dampers shall be under space temperature and economizer control, and CO_2 level conrol.

b. Unoccupied and Ventilation Delay Modes - The dampers shall return to their normal positions.

3.3.5.3 Fan Control

a. Occupied and Ventilation Delay Modes - Supply and return fans shall start, and shall operate continuously.

b. Unoccupied Mode - The supply and return fans shall cycle according to the night setback schedule. The fans shall start and stop at the setpoints as shown.

3.3.5.4 Filter

The DDC panel shall monitor the differential pressure switch across the filter and shall provide an alarm when the pressure drop exceeds the setpoint.

3.3.5.5 Freeze Protection

All Modes - A freezestat, located as shown, shall stop the supply fan, cause the outside air, return air, and relief air dampers to return to their normal position, and shall initiate a low temperature alarm if the temperature drops below the freezestat's setpoint. Return to the normal mode of operation shall require manual reset at the freezestat. The DDC system shall monitor the freezestat through auxiliary contacts and shall indicate an alarm condition when the freezestat trips.

3.3.5.6 Space Temperature Control

A space temperature sensing element and transmitter operating through the DDC system shall first gradually shut off the heating coil valve. After the heating coil valve is fully closed, the DDC system shall then gradually operate the outside air damper to admit outside air beyond the minimum quantity to maintain the setpoint as shown.

3.3.5.7 Emergency Fan Shutdown

All Modes - Smoke Detectors in the supply air and return air ductwork shall stop the supply and return fan and initiate a smoke alarm if smoke is detected at either location. Restarting the fans shall require manual reset at the smoke detector.

3.3.6 Variable Air Volume Control Sequence with Return Fan

3.3.6.1 Occupied, Unoccupied, and Ventilation Delay Modes of Operation

Ventilation delay mode timing shall start prior to the occupied mode timing. During ventilation delay mode, the dampers shall remain in their normal positions as shown, except when under economizer control. At the time shown, the DDC system shall place the system in the occupied mode. At the expiration of the ventilation delay mode timing period, the DDC system shall place the minimum outside air damper under minimum outside air flow control and shall place the economizer outside air, return air, and relief air dampers under economizer and mixed air temperature control. At the time shown, the DDC system shall place the control system in the unoccupied mode of operation and dampers shall return to their normal positions as shown.

3.3.6.2 Fan Control

a. Occupied and Ventilation Delay Modes - Supply fan and return fan shall operate continuously.

b. Unoccupied Mode - The supply fan and the return fan shall cycle according to the night setback schedule. The fans shall start and stop at the setpoints as shown.

3.3.6.3 Supply Duct Pressurization Control

When the supply fan starts, the DDC system shall modulate the variable frequency drive from the signal of a static pressure sensing element and transmitter to maintain the setpoint as shown. A high limit static pressure switch in the fan discharge shall stop the supply fan and the return fan and initiate a high static alarm when the static pressure exceeds the setpoint.

3.3.6.4 Return Fan Volume Control

When the return fan starts, the DDC system shall modulate the return fan variablae frequency drive from the signals of an air flow measurement station and transmitter in the return air ductwork, in combination with an air flow measurement station and transmitter in the supply air ductwork, to maintain a constant difference between supply air and return air flow rates as shown.

3.3.6.5 Filters

A differential pressure switch across each filter shall initiate a filter alarm when the pressure drop across the filter reaches the setpoint as shown.

3.3.6.6 Freeze Protection

A freezestat, located as shown, shall stop the supply and return fans, cause the outside air, return air, and relief air dampers to return to their normal position, and shall initiate a low temperature alarm if the temperature drops below the freezestat's setpoint as shown. The DDC system shall monitor the freezestat through auxiliary contacts and shall indicate an alarm condition when the freezestat trips.

3.3.6.7 Cooling Coil Control

a. Occupied and Ventilation Delay Modes - The condensing unit and DX coil shall be cycles by the DDC system from the signal of a temperature sensing element and transmitter located in the coil discharge air to maintain the setpoint as shown.

b. Unoccupied Mode - The condensing unit shall remain off.

3.3.6.8 Minimum Outside Air Flow Control

a. Occupied Mode - The minimum outside air damper shall be modulated to maintain the minimum outside air flow at setpoint, as sensed by an air flow measurement station located in the minimum outside air duct.

b. Unoccupied and Ventilation Delay Modes - The minimum outside air damper shall remain closed.

3.3.6.9 Economizer and Mixed Air Temperature Control

The DDC system shall accept the signal of an outside air temperature sensing element and transmitter and the signal of a return air temperature sensing element and transmitter. When the return air temperature is above the economizer setpoint, and the outside air temperature is sufficiently below the return air temperature to be effective for cooling, the DDC system shall place the AHU in the economizer mode by modulating the economizer outside air, relief air, and the return air dampers to maintain the mixed air temperature at setpoint. As the economizer outside air and relief air dampers open, the return air damper closes. When the system is not in economizer mode, the economizer outside air and relief air dampers shall remain closed or at minimum position and the return air damper shall remain open.

3.3.6.10 Pressure Independent Terminal VAV Box with Velocity Controller

All Modes - The control damper of the VAV box shall modulate in response to the signal from a flow sensing element at the discharge or inlet of the VAV box to a microprocessor based VAV box velocity controller. The velocity controller shall control the box damper from the minimum flow position to the full flow position from the signal of a space temperature sensing element located as shown. When the space temperature decreases, the damper shall gradually close to the minimum flow position to maintain the cooling setpoint as shown. When the space temperature calls for heating after the

minimum flow position is reached, control shall then pass through a temperature dead band as shown. When the space temperature has dropped through the dead band, the duct heater coil shall be gradually controlled to maintain the heating setpoint as shown.

3.3.6.11 Emergency Fan Shutdown

All Modes - Smoke detectors in the supply air and return air ductwork shall stop the supply fan and the return fan and initiate a smoke alarm if smoke is detected at either location. Restarting the supply fan and the return fan shall require manual reset at the smoke detector.

3.3.7 Single Zone Pool Air Handling Unit; with Exhaust Fan

3.3.7.1 Occupied and Unoccupied Modes of Operation

At the time shown, the DDC system shall place the system in the occupied mode. The DDC system shall allow the outside air damper to open. At the time shown, the DDC system shall place the control system in the unoccupied mode of operation.

3.3.7.2 Outside Air Damper

a. Occupied Mode - The outside air damper shall open.

b. Unoccupied Modes - The damper shall close.

3.3.7.3 Supply and Exhaust Fan Control

a. Occupied Modes - Supply and exhaust fan shall start, and shall operate continuously.

b. Unoccupied Mode - The supply and exhaust fan shall cycle according to the night setback schedule. The fan shall start and stop at the setpoints.

a. Exhaust fan speed shall modulate to maintain space pressure. See controls drawings for further description.

3.3.7.4 Filter

Differential pressure switch across the filter shall initiate a filter alarm when the pressure drop across the filter reaches the setpoint.

3.3.7.5 Damper and Humidity Control

See drawings.

3.3.7.6 Freeze Protection

All Modes - A freezestat, located as shown, shall stop the supply fan, cause the outside air, return air, and relief air dampers to return to their normal position, and shall initiate a low temperature alarm if the temperature drops below the freezestat's setpoint. Return to the normal mode of operation shall require manual reset at the freezestat. The DDC system shall monitor the freezestat through auxiliary contacts and shall indicate an alarm condition when the freezestat trips.

3.3.7.7 Constant Temperature Hydronic Heating Control

All Modes - The DDC system shall accept a signal from a temperature sensing element and transmitter in the heating supply line, and shall modulate the system control valve to maintain the setpoint.

3.3.7.8 Emergency Fan Shutdown

All Modes - Smoke detectors in the supply air and return air ductwork shall stop the supply fan and initiate a smoke alarm if smoke is detected at either location. Restarting the supply fan shall require manual reset at the smoke detector.

3.3.8 Constant Vollume Hydronic Heating and Direct Expansion Cooling Coil with Heat Recovery Wheel

3.3.8.1 Occupied, Unoccupied, and Ventilation Delay Modes

At the time shown, the DDC system shall place the system in the occupied mode. The DDC system shall allow the outside air damper and exhaust air damper to open. At the time shown, the DDC system shall place the control system in the unoccupied mode of operation.

3.3.8.2 Outside Air and Exhaust Air Dampers

a. Occupied Mode - The outside air and exhaust air dampers shall be wide open.

b. Unoccupied Mode - The dampers shall be closed.

3.3.8.3 Supply and Exhaust Fan Control

a. Occupied Mode - Supply and exhaust fans shall start and shall operate continuously.

b. Unoccupied Mode - The fans shall cycle according to the night setback schedule. The fans shall start and stop at the setpoints shown.

3.3.8.4 Filter

A differential pressure switch across the filter shall initiate a filter alarm when the pressure drop across the filter reaches the setpoint.

3.3.8.5 Heat Wheel Control and Frost Protection

See control drawings.

3.3.8.6 Freeze Protection

All Modes - A freezestat, located as shown, shall stop the supply fan, cause the outside air, return air, and relief air dampers to return to their normal position, and shall initiate a low temperature alarm if the temperature drops below the freezestat's setpoint. Return to the normal mode of operation shall require manual reset at the freezestat. The DDC system shall monitor the freezestat through auxiliary contacts and shall indicate an alarm condition when the freezestat trips.

3.3.8.7 Direct Expansion Cooling Coil

a. Occupied Mode - The stages of cooling shall be controlled according to the discharge air temperature.

b. Unoccupied Mode - Cooling shall be off.

3.3.8.8 Space Temperature Sequenced Heating and Cooling Control

Discharge air temperature setpoint shall be based upon zone requiring the most cooling. Reset discharge air temperature upwards before all zone reheat coils activate. Continuously sample all four temperature sensors. Zone temperature setpoints shall be 72 degrees F in the winter and 75 degrees F in the summer.

3.3.8.9 Emergency Fan Shutdown

All Modes - Smoke detectors in the supply air and exhaust air ductwork shall stop the supply and exhaust fans and initiate a smoke alarm if smoke is detected at either location. Restarting the fans shall require manual reset at the smoke detector.

3.3.8.10 Further Control Sequences

See controls drawings.

3.4 COMMISSIONING PROCEDURES

3.4.1 Evaluations

The Contractor shall make the observations, adjustments, calibrations, measurements, and tests of the control systems, set the time schedule, and make any necessary control system corrections to ensure that the systems function as described in the sequence of operation.

3.4.1.1 Item Check

Signal levels shall be recorded for the extreme positions of each controlled device. An item-by-item check of the sequence of operation requirements shall be performed using Steps 1 through 4 in the specified control system commissioning procedures. Steps 1, 2, and 3 shall be performed with the HVAC system shut down; Step 4 shall be performed after the HVAC systems have been started. External input signals to the DDC system (such as starter auxiliary contacts, and external systems) may be simulated in steps 1, 2, and 3. With each operational mode signal change, DDC system output relay contacts shall be observed to ensure that they function.

3.4.1.2 Weather Dependent Test Procedures

Weather dependent test procedures that cannot be performed by simulation shall be performed in the appropriate climatic season. When simulation is used, the actual results shall be verified in the appropriate season.

3.4.1.3 Two-Point Accuracy Check

A two-point accuracy check of the calibration of each HVAC control system sensing element and transmitter shall be performed by comparing the DDC system readout to the actual value of the variable measured at the sensing

element and transmitter or airflow measurement station location. Digital indicating test instruments shall be used, such as digital thermometers, motor-driven psychrometers, and tachometers. The test instruments shall be at least twice as accurate as the specified sensing element-to-DDC system readout accuracy. The calibration of the test instruments shall be traceable to National Institute Of Standards And Technology standards. The first check point shall be with the HVAC system in the shutdown condition, and the second check point shall be with the HVAC system in an operational condition. Calibration checks shall verify that the sensing element-to-DDC system readout accuracies at two points are within the specified product accuracy tolerances. If not, the device shall be recalibrated or replaced and the calibration check repeated.

3.4.1.4 Insertion and Immersion Temperatures

Insertion temperature and immersion temperature sensing elements and transmitter-to-DDC system readout calibration accuracy shall be checked at one physical location along the axis of the sensing element.

3.4.1.5 Averaging Temperature

Averaging temperature sensing element and transmitter-to-DDC system readout calibration accuracy shall be checked every 2 feet along the axis of the sensing element in the proximity of the sensing element, for a maximum of 10 readings. These readings shall then be averaged.

3.4.2 Space Temperature Controlled Perimeter Radiation

The heating medium shall be turned on, and the thermostat temperature setpoint shall be raised. The valve shall open. The thermostat temperature shall be lowered and the valve shall close. The thermostat shall be set at the setpoint shown.

3.4.3 Unit Heater and Cabinet Unit Heater

The "OFF/AUTO" switch shall be placed in the "OFF" position. Each space thermostat temperature setting shall be turned up so that it makes contact to turn on the unit heater fans. The unit heater fans shall not start. The "OFF/AUTO" switch shall be placed in the "AUTO" position. It shall be ensured that the unit heater fans start. Each space thermostat temperature setting shall be turned down, and the unit heater fans shall stop. The thermostats shall be set at their temperature setpoints. The results of testing of one of each type of unit shall be logged.

3.4.4 Central Plant High Temperature Hot Water Hydronic Heating

Steps for installation shall be as follows:

a. Step 1 - System Inspection: The HVAC system shall be observed in its shutdown condition. It shall be verified that power and main air are available where required and that the converter valve is closed.

b. Step 2 - Calibration Accuracy Check with HVAC System Shutdown: Readings shall be taken with a digital thermometer at each temperature sensing element location. Each temperature shall be read at the DDC controller, and the thermometer and DDC system readings logged. The calibration accuracy of the sensing element-to-DDC system readout for outside air temperature and system supply temperature shall be checked.

c. Step 3 - Actuator Range Adjustments: A signal shall be applied to the actuator through an operator entered value to the DDC system. The proper operation of the actuators and positioners for all valves shall be verified. The signal shall be varied from live zero to full range, and it shall be verified that the actuators travel from zero stroke to full stroke within the signal range. It shall be verified that all sequenced actuators move from zero stroke to full stroke in the proper direction, and move the connected device in the proper direction from one extreme position to the other.

d. Step 4 - Control System Commissioning:

(1) The two-point calibration sensing element-to-DDC system readout accuracy check for the outside air temperature shall be performed. Any necessary software adjustments shall be made to setpoints or parameters to achieve the outside air temperature schedule.

(2) The outside air temperature shall be simulated through an operator entered value to be above the setpoint. It shall be verified that pump HWP-1 stops and the high-temperature hot-water control valve closes. A value shall be entered to simulate that the outside air temperature is below the setpoint as shown. It shall be verified that pump HWP-1 starts. HWP-1 and HWP-2 shall be set up in a lead-lag scheme. A value shall be entered to simulate that lead pump is at full speed and differential pressure setpoint is not being achieved. It shall be verified that lag pump starts and ramps up to match lead pump speed.

(3) The two-point calibration accuracy check of the sensing element-to-DDC system readout for the hydronic system supply temperature shall be performed. The supply temperature setpoint shall be set for the temperature schedule as shown. Signals of 8 ma and 16 ma shall be sent to the DDC system from the outside air temperature sensor, to verify that the supply temperature setpoint changes to the appropriate values. A high temperature condition shall be initiated in the hydronic system supply line by lowering the thermostat setting. It shall be verified that the high-temperature hot water shutoff valve closes and an alarm is initiated. The thermostat shall be set at the setting shown, the safety circuit shall be manually reset, and it shall be verified that the shutoff valve opens and a return-to-normal signal is sent.

(4) The control system shall be placed in the occupied mode. The calibration accuracy check of sensing element-to-DDC system readout shall be performed for each space temperature sensor and the values logged. Each space temperature setpoint shall be set as shown. The control system shall be placed in the unoccupied mode, and it shall be verified that each space temperature setpoint changes to the unoccupied mode setting.

3.4.5 Heating and Ventilating Unit

Steps for installation are as follows:

a. Step 1 - System Inspection: The HVAC system shall be observed in its shutdown condition. The system shall be checked to see that power is are available where required, the outside air damper and relief air damper are closed, and the return air damper is open.

b. Step 2 - Calibration Accuracy Check with HVAC System Shutdown: Readings shall be taken with a digital thermometer at each temperature sensing element location. Each temperature shall be read at the DDC controller, and the thermometer and DDC system readings logged. The calibration accuracy of the sensing element-to-DDC system readout for space temperature shall be checked.

c. Step 3 - Actuator Range Adjustments: A signal shall be applied to the actuator through an operator entered value to the DDC system. The proper operation of the actuators and positioners for all dampers and valves shall be verified. The signal shall be varied from live zero to full range, and that the actuators travel from zero stroke to full stroke within the signal range shall be verified. It shall be verified that all sequenced and parallel-operated actuators move from zero stroke to full stroke in the proper direction, and move the connected device in the proper direction from one extreme position to the other.

d. Step 4 - Control System Commissioning:

(1) With the fan ready to start, the system shall be placed in the ventilation delay mode and in the occupied mode through operator entered values. It shall be verified that the supply fan and the return fan starts. It shall be verified that the outside air and relief air dampers are closed, the return air damper is open, and the heating coil valve is under control, by artificially changing the space temperature through operator entered values. The system shall be placed out of the ventilation delay mode, and it shall be verified that the outside air, return air, and relief air dampers come under control by simulating a change in space temperature.

(2) The control system shall be placed in the minimum outside air mode. It shall be verified that the outside air damper opens to minimum position.

(3) The calibration accuracy check of sensing element-to-DDC system readout for the space temperature shall be performed. The space temperature setpoint shall be set as shown.

(4) The control system shall be placed in the unoccupied mode, and it shall be verified that the HVAC system shuts down, and the control system assumes the specified shutdown conditions. The space temperature shall be artificially changed to below the night setback setpoint, and it shall be verified that the HVAC system starts; the space temperature shall be artificially changed to above the night setback setpoint, and it shall be verified that the HVAC system stops. The night setback temperature setpoint shall be set as shown.

(5) With the HVAC system running, a filter differential pressure switch input signal shall be simulated, at the device. It shall be verified that the filter alarm is initiated. The differential pressure switch shall be set at the setpoint as shown.

(6) With the HVAC system running, a freezestat trip input signal shall be simulated at the device. HVAC system shutdown shall be verified. It shall be verified that a low temperature alarm is initiated. The freezestat shall be set at the setpoint. The HVAC

system shall be restarted by manual restart and it shall be verified that the alarm returns to normal.

(7) With the HVAC system running, a smoke detector trip input signal shall be simulated at each detector, and verification of control device actions and interlock functions as described in the Sequence of Operation shall be made. Simulation shall be performed without false-alarming any Life Safety systems. It shall be verified that the HVAC system shuts down and that the smoke detector alarm is initiated. The detectors shall be reset. The HVAC system shall be restarted by manual reset, and it shall be verified that the alarm signal is changed to a return-to-normal signal.

3.4.6 Variable Air Volume Control System - With Return Fan

Steps for installation shall be as follows:

a. Step 1 - System Inspection: The HVAC system shall be observed in its shutdown condition. It shall be verified that power and main air are available where required, and that the outside air and relief air dampers are closed, the return air damper is open, and that the supply fan and return/relief fan inlet vanes and cooling coil valve are closed.

b. Step 2 - Calibration Accuracy Check with HVAC System Shutdown: Readings shall be taken with a digital thermometer at each temperature sensing element location. Each temperature shall be read at the DDC controller, and the thermometer and DDC system display readings logged. The calibration accuracy of the sensing element-to-DDC system readout for outside air, return air, mixed air, and cooling coil discharge temperatures shall be checked. The minimum outside air flow, supply air flow, and return air flow shall be read, using a digital indicating velometer, and the velometer and DDC system display readings logged. The flows should read zero.

c. Step 3 - Actuator Range Adjustments: A signal shall be applied to the actuators through an operator entered value at the DDC system. The proper operation of the actuators and positioners for all dampers and valves shall be visually verified. The signal shall be varied from live zero to full range, and actuator travel shall be verified from zero stroke to full stroke within the signal range. It shall be verified that all sequenced and parallel operated actuators move from zero stroke to full stroke in the proper direction, and move the connected device in the proper direction from one extreme position to the other.

d. Step 4 - Control System Commissioning:

(1) With the fans ready to start, the control system shall be placed in the ventilation delay mode and in the occupied mode, and it shall be verified that supply fan and return fan start. It shall be verified that the outside air dampers and relief air damper are closed, the return air damper is open, and the cooling coil valve and inlet vanes are under control, by simulating a change in the fan discharge temperature. The system shall be placed out of the ventilation delay mode, and it shall be verified that the economizer outside air and relief air dampers remain closed, the return air damper remains open, and the minimum outside air damper comes under control.

(2) The two-point calibration accuracy check of sensing element-to-DDC system readout for the minimum outside air flow measurement station shall be performed. Force all VAV box dampers to the full open position, turn all exhaust fans off, manually adjust the supply duct static pressure to achieve the design duct static pressure, manually adjust the output to the return fan to establish the design differential flow difference between the supply and return duct flows, and manually adjust the minimum outside air flow to achieve a flow which is approximately 25% less than the desired air flow. Under these conditions, the minimum outside air flow control loop shall be tuned. Confirm stable operation of the minimum outside air flow control loop in response to a process disturbance.

(3) The starter switch of the return fan shall be turned to the "OFF" position, and the return damper shall be opened. With the supply fan running, a high static pressure input signal shall be simulated at the device by a pressure input to the sensing device. HVAC system shutdown shall be observed, and it shall be verified that the high static alarm is initiated. The HVAC system shall be restarted by manual reset, and it shall be verified that the high static alarm returns to normal.

(4) The two-point accuracy check of sensing element-to-DDC system readout for the static pressure in the supply duct shall be performed.

(5) Each VAV terminal unit controller's minimum flow and maximum flow setpoints shall be set at the same setting. This will prevent the VAV box damper from modulating under space temperature control and will achieve a constant supply duct system pressure drop. The return fan speed shall be placed under control, and the starter switch shall be turned to the "AUTO" position so that the fan starts. The two-point calibration accuracy check of sensing element-to-DDC system readout for the air flow measurement stations shall be performed. The supply fan VFD shall be operated manually to change the supply fan flow, and the control system shall be set to control at 6400 cfm at 4-ma input and 21300 cfm at 20-ma input. The supply fan flow shall be changed to verify that the return flow setpoint tracks the supply fan flow with the proper flow differential.

(6) The economizer mode shall be simulated by a change in the outside air temperature and the return air temperature through operator entered values and it shall be verified that the system goes into the economizer mode. The mixed air temperature shall be artificially changed through operator entered values to slightly open the economizer outside air damper and the second point of the two-point calibration accuracy check of sensing element-to-DDC system readout for outside air, return air, and mixed air temperatures shall be performed. The temperature setpoint shall be set as shown.

(7) The two-point calibration accuracy check of sensing element-to-DDC system readout for the fan discharge temperature shall be performed. The setpoint for the fan discharge temperature shall be set as shown. A change shall be simulated in the discharge air temperature through an operator entered value and it shall be verified that the control valve is modulated.

(8) The control system shall be placed in the unoccupied mode and it shall be verified that the HVAC system shuts down and the control system assumes the specified shutdown conditions. The space temperature shall be artificially changed to below the night setback temperature setpoint, and it shall be verified that the HVAC system starts; the space temperature shall be artificially changed to above the night setback temperature setpoint and it shall be verified that the HVAC system stops. The night setback temperature setpoint shall be set at the setpoint.

(9) With the HVAC system running, a filter differential pressure switch input signal shall be simulated at the device. It shall be verified that the filter alarm is initiated. The differential pressure switch shall be set at the setpoint as shown. This shall be performed for each filter.

(10) With the HVAC system running, a freezestat trip input signal shall be simulated at the device. HVAC system shutdown shall be verified. It shall be verified that a low temperature alarm is initiated. The freezestat shall be set at the setpoint as shown. The HVAC system shall be restarted by manual restart and it shall be verified that the alarm returns to normal.

(11) With the HVAC system running, a smoke detector trip input signal shall be simulated at each device. Control device actions and interlock functions as described in the Sequence of Operation shall be verified. Simulation shall be performed without false-alarming any Life Safety systems. It shall be verified that the HVAC system shuts down and the smoke detector alarm is initiated. The detectors shall be reset. The HVAC system shall be restarted by manual reset, and the alarm return-to-normal shall be verified.

(12) For each VAV terminal unit, velocity setpoints shall be set for minimum and maximum flow, and temperature setpoints for the heating/cooling dead band. The actions of the controller, the operation of the damper, and the operation of heating shall be verified. It shall be verified that space temperature is maintained.

3.4.7 Single Zone with Hydronic Heating Direct Expansion Cooling

Steps for installation shall be as follows:

a. Step 1 - System Inspection: The HVAC system shall be verified in its shutdown condition. The system shall be checked to see that power and main air are available where required, the outside air damper and relief air damper are closed, all stages of cooling are off.

b. Step 2 - Calibration Accuracy Check with HVAC System Shutdown: Readings shall be taken with a digital thermometer at each temperature sensing element location. Each temperature shall be read at the DDC controller, and the thermometer and DDC system display readings logged. The calibration accuracy of the sensing element-to-DDC system readout for outside air, return air, and space temperatures shall be checked.

c. Step 3 - Actuator Range Adjustments: A signal shall be applied to the actuator, through an operator entered value to the DDC system. The

proper operation of the actuators and positioners for all dampers and valves shall be visually verified. The signal shall be varied from live zero of 4 ma to 20 ma, and it shall be verified that the actuators travel from zero stroke to full stroke within the signal range. It shall be verified that all sequenced and parallel operated actuators move from zero stroke to full stroke in the proper direction and move the connected device in the proper direction from one extreme position to the other. Example: NC actuators are closed at 4 ma and are open at 20 ma. The signal levels that move the controlled device to its extreme positions shall be logged. The operating points of the sequence shall be set for each stage of cooling and the proper operation of each stage shall be verified.

d. Step 4 - Control System Commissioning:

(1) With the fan ready to start, the control system shall be placed in the occupied mode, and it shall be verified that the supply and return fans start. It shall be verified that the outside air and relief air dampers are open and the heating coil and stages of cooling are under control, by simulating a change in the space temperature.

(2) The control system shall be placed in the unoccupied mode, and it shall be verified that the HVAC system shuts down, and the control system assumes the specified shutdown conditions. The space temperature shall be artificially changed to below the night setback temperature setpoint, and it shall be verified that the HVAC system starts; the space temperature shall be artificially changed to above the night setback temperature setpoint, and it shall be verified that the HVAC system stops. The night setback temperature setpoint shall be set at the setpoint as shown.

(3) With the HVAC system running, a filter differential pressure switch input signal shall be simulated at the device. It shall be verified that the filter alarm is initiated. The differential pressure switch shall be set at the setpoint as shown.

(4) With the HVAC system running, a freeze condition input signal shall be simulated at the device. Proper heat wheel speed adjustment shall be verified. Upon further low temperature freeze condtiions, HVAC shutdown shall be veritied. It shall be verified that a low-temperature alarm is initiated. The freezestat shall be set at the setpoint. The HVAC system shall be restarted by manual restart and it shall be verified that the alarm returns to normal.

(5) With the HVAC system running, a smoke detector trip input signal shall be simulated at each detector, and control device actions and interlock functions as described in the Sequence of Operation shall be verified. Simulation shall be performed without false-alarming any Life Safety systems. It shall be verified that the HVAC system shuts down and that the smoke detector alarm is initiated. The detectors shall be reset. The HVAC system shall be restarted by manual reset, and it shall be verified that the alarm returns to normal.

3.5 BALANCING, COMMISSIONING, AND TESTING

3.5.1 Coordination with HVAC System Balancing

Commissioning of the control system, except for tuning of controllers, shall be performed prior to or simultaneous with HVAC system balancing. The contractor shall tune the HVAC control system after all air system and hydronic system balancing has been completed, minimum damper positions set and a report has been issued.

3.5.2 Control System Calibration, Adjustments, and Commissioning

Control system commissioning shall be performed for each HVAC system, using test plans and procedures previously approved by the Government. The Contractor shall provide all personnel, equipment, instrumentation, and supplies necessary to perform commissioning and testing of the HVAC control system. All instrumentation and controls shall be calibrated and the specified accuracy shall be verified using test equipment with calibration traceable to NIST standards. Wiring shall be tested for continuity and for ground, open, and short circuits. Tubing systems shall be tested for leaks. Mechanical control devices shall be adjusted to operate as specified. HVAC control panels shall be pretested off-site as a functioning assembly ready for field connections, calibration, adjustment, and commissioning of the operational HVAC control system. Control parameters and logic (virtual) points including control loop setpoints, gain constants, and integral constraints, shall be adjusted before the system is placed on line. Communications requirements shall be as indicated. Written notification of any planned commissioning or testing of the HVAC Control systems shall be given to the Government at least 14 calendar days in advance.

3.5.3 Performance Verification Test

The Contractor shall demonstrate compliance of the HVAC control system with the contract documents. Using test plans and procedures previously approved by the Government, the Contractor shall demonstrate all physical and functional requirements of the project. The performance verification test shall show, step-by-step, the actions and results demonstrating that the control systems perform in accordance with the sequences of operation. The performance verification test shall not be started until after receipt by the Contractor of written permission by the Government, based on Government approval of the Commissioning Report and completion of balancing. The tests shall not be conducted during scheduled seasonal off periods of base heating and cooling systems.

3.5.4 Endurance Test

The endurance test shall be used to demonstrate the specified overall system reliability requirement of the completed system. The endurance test shall not be started until the Government notifies the Contractor in writing that the performance verification test is satisfactorily completed. The Government may terminate the testing at any time when the system fails to perform as specified. Upon termination of testing by the Government or by the Contractor, the Contractor shall commence an assessment period as described for Phase II. Upon successful completion of the endurance test, the Contractor shall deliver test reports and other documentation as specified to the Government prior to acceptance of the system.

a. Phase I (Testing). The test shall be conducted 24 hours per day, 7

days per week, for 15 consecutive calendar days, including holidays, and the system shall operate as specified. The Contractor shall make no repairs during this phase of testing unless authorized by the Government in writing.

b. Phase II (Assessment). After the conclusion of Phase I, the Contractor shall identify failures, determine causes of failures, repair failures, and deliver a written report to the Government. The report shall explain in detail the nature of each failure, corrective action taken, results of tests performed, and shall recommend the point at which testing should be resumed. After delivering the written report, the Contractor shall convene a test review meeting at the jobsite to present the results and recommendations to the Government. As a part of this test review meeting, the Contractor shall demonstrate that all failures have been corrected by performing appropriate portions of the performance verification test. Based on the Contractor's report and test review meeting, the Government may require that the Phase I test be totally or partially rerun. After the conclusion of any retesting which the Government may require, the Phase II assessment shall be repeated as if Phase I had just been completed.

3.5.5 Posted and Panel Instructions

Posted and Panel Instructions, showing the final installed conditions, shall be provided for each system. The posted instructions shall consist of laminated half-size drawings and shall include the control system schematic, equipment schedule, sequence of operation, wiring diagram, communication network diagram, and valve and damper schedules. The posted instructions shall be permanently affixed, by mechanical means, to a wall near the control panel. Panel instructions shall consist of laminated letter-size sheets and shall include a Routine Maintenance Checklist and as-built configuration check sheets. Panel instructions and one copy of the Operation and Maintenance Manuals, previously described herein, shall be placed inside each control panel or permanently affixed, by mechanical means, to a wall near the panel.

3.6 TRAINING

3.6.1 Training Course Requirements

A training course shall be conducted for 4 operating staff members designated by the Contracting Officer in the maintenance and operation of the system, including specified hardware and software. The training period, for a total of 32 hours of normal working time, shall be conducted within 30 days after successful completion of the performance verification test. The training course shall be conducted at the project site. Audiovisual equipment and 6 sets of all other training materials and supplies shall be provided. A training day is defined as 8 hours of classroom instruction, including two 15 minute breaks and excluding lunchtime, Monday through Friday, during the daytime shift in effect at the training facility.

3.6.2 Training Course Content

For guidance in planning the required instruction, the Contractor shall assume that attendees will have a high school education or equivalent, and are familiar with HVAC systems. The training course shall cover all of the material contained in the Operating and Maintenance Instructions, the layout and location of each HVAC control panel, the layout of one of each

type of unitary equipment and the locations of each, the location of each control device external to the panels, the location of the compressed air station, preventive maintenance, troubleshooting, diagnostics, calibration, adjustment, commissioning, tuning, and repair procedures. Typical systems and similar systems may be treated as a group, with instruction on the physical layout of one such system. The results of the performance verification test and the calibration, adjustment and commissioning report shall be presented as benchmarks of HVAC control system performance by which to measure operation and maintenance effectiveness.

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SECTION 15990A

TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS

06/03

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SECTION 15990A

TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS
06/03

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASSOCIATED AIR BALANCE COUNCIL (AABC)

AABC MN-1	(2002) National Standards for Total System Balance

NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)

NEBB TABES	(1998) Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA HVACTAB	(2002) HVAC Systems - Testing, Adjusting and Balancing

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise deignated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

TAB Schematic Drawings and Report Forms; G-AO

Three copies of the TAB Schematic Drawings and Report Forms, no later than 21 days prior to the start of TAB field measurements.

SD-03 Product Data

TAB Related HVAC Submittals; G-AO

A list of the TAB Related HVAC Submittals, no later than 7 days after the approval of the TAB Specialist.

TAB Procedures; G-AO

Proposed procedures for TAB, submitted with the TAB Schematic

Drawings and Report Forms.

Calibration; G-AO

List of each instrument to be used during TAB, stating calibration requirements required or recommended by both the TAB Standard and the instrument manufacturer and the actual calibration history of the instrument, submitted with the TAB Procedures. The calibration history shall include dates calibrated, the qualifications of the calibration laboratory, and the calibration procedures used.

Systems Readiness Check; G-AO

Proposed date and time to begin the Systems Readiness Check, no later than 7 days prior to the start of the Systems Readiness Check.

TAB Execution; G-AO

Proposed date and time to begin field measurements, making adjustments, etc., for the TAB Report, submitted with the Systems Readiness Check Report.

TAB Verification; G-AO

Proposed date and time to begin the TAB Verification, submitted with the TAB Report.

SD-06 Test Reports

Design Review Report; G-AO

A copy of the Design Review Report, no later than 14 days after approval of the TAB Firm and the TAB Specialist.

Systems Readiness Check; G-AO

A copy of completed checklists for each system, each signed by the TAB Specialist, at least 7 days prior to the start of TAB Execution. All items in the Systems Readiness Check Report shall be signed by the TAB Specialist and shall bear the seal of the Professional Society or National Association used as the TAB Standard.

TAB Report; G-AO

Three copies of the completed TAB Reports, no later that 7 days after the execution of TAB. All items in the TAB Report shall be signed by the TAB Specialist and shall bear the seal of the Professional Society or National Association used as the TAB Standard.

TAB Verification Report; G-AO

Three copies of the completed TAB Verification Report, no later that 7 days after the execution of TAB Verification. All items in the TAB Verification Report shall be signed by the TAB Specialist and shall bear the seal of the Professional Society or National

Association used as the TAB Standard.

SD-07 Certificates

Ductwork Leak Testing, G-AO

A written statement signed by the TAB Specialist certifying that the TAB Specialist witnessed the Ductwork Leak Testing, it was successfully completed, and that there are no known deficiencies related to the ductwork installation that will prevent TAB from producing satisfactory results.

TAB Firm; G-AO

Certification of the proposed TAB Firm's qualifications by either AABC, NEBB, or TABB to perform the duties specified herein and in other related Sections, no later than 21 days after the Notice to Proceed. The documentation shall include the date that the Certification was initially granted and the date that the current Certification expires. Any lapses in Certification of the proposed TAB Firm or disciplinary action taken by AABC, NEBB or TABB against the proposed TAB Firm shall be described in detail.

TAB Specialist; G-AO

Certification of the proposed TAB Specialist's qualifications by either AABC, NEBB, or TABB to perform the duties specified herein and in other related Sections, no later than 21 days after the Notice to Proceed. The documentation shall include the date that the Certification was initially granted and the date that the current Certification expires. Any lapses in Certification of the proposed TAB Specialist or disciplinary action taken by AABC, NEBB, or TABB against the proposed TAB Specialist shall be described in detail.

1.3 SIMILAR TERMS

In some instances, terminology differs between the Contract and the TAB Standard primarily because the intent of this Section is to use the industry standards specified, along with additional requirements listed herein to produce optimal results. The following table of similar terms is provided for clarification only. Contract requirements take precedent over the corresponding AABC, NEBB, or TABB requirements where differences exist.

SIMILAR TERMS

Contract Term	AABC Term	NEBB Term	TABB Term
TAB Standard	National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems	Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.	SMACNA's Procedures
TAB Specialist	TAB Engineer	TAB Supervisor	TAB Supervisor
Systems	Construction Phase	Field Readiness	Field

SIMILAR TERMS

Readiness Check	Inspection	Check & Preliminary Field Procedures.	Readiness Check & Prelim. Field Procedures

1.4 TAB STANDARD

TAB shall be performed in accordance with the requirements of the standard under which the TAB Firm's qualifications are approved, i.e., AABC MN-1, NEBB TABES, or SMACNA HVACTAB unless otherwise specified herein. All recommendations and suggested practices contained in the TAB Standard shall be considered mandatory. The provisions of the TAB Standard, including checklists, report forms, etc., shall, as nearly as practical, be used to satisfy the Contract requirements. The TAB Standard shall be used for all aspects of TAB, including qualifications for the TAB Firm and Specialist and calibration of TAB instruments. Where the instrument manufacturer calibration recommendations are more stringent than those listed in the TAB Standard, the manufacturer's recommendations shall be adhered to. All quality assurance provisions of the TAB Standard such as performance guarantees shall be part of this contract. For systems or system components not covered in the TAB Standard, TAB procedures shall be developed by the TAB Specialist. Where new procedures, requirements, etc., applicable to the Contract requirements have been published or adopted by the body responsible for the TAB Standard used (AABC, NEBB, or TABB), the requirements and recommendations contained in these procedures and requirements shall be considered mandatory.

1.5 QUALIFICATIONS

1.5.1 TAB Firm

The TAB Firm shall be either a member of AABC or certified by the NEBB or the TABB and certified in all categories and functions where measurements or performance are specified on the plans and specifications, including TAB of environmental systems and the measuring of sound and vibration in environmental systems. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the firm loses subject certification during this period, the Contractor shall immediately notify the Contracting Officer and submit another TAB Firm for approval. Any firm that has been the subject of disciplinary action by either the AABC, the NEBB, or the TABB within the five years preceding Contract Award shall not be eligible to perform any duties related to the HVAC systems, including TAB. All work specified in this Section and in other related Sections to be performed by the TAB Firm shall be considered invalid if the TAB Firm loses its certification prior to Contract completion and must be performed by an approved successor. These TAB services are to assist the prime Contractor in performing the quality oversight for which it is responsible. The TAB Firm shall be a subcontractor of the prime Contractor and shall be financially and corporately independent of the mechanical subcontractor, and shall report to and be paid by the prime Contractor.

1.5.2 TAB Specialist

The TAB Specialist shall be either a member of AABC,an experienced technician of the Firm certified by the NEBB, or a Supervisor certified by

the TABB. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the Specialist loses subject certification during this period, the Contractor shall immediately notify the Contracting Officer and submit another TAB Specialist for approval. Any individual that has been the subject of disciplinary action by either the AABC, the NEBB, or the TABB within the five years preceding Contract Award shall not be eligible to perform any duties related to the HVAC systems, including TAB. All work specified in this Section and in other related Sections performed by the TAB Specialist shall be considered invalid if the TAB Specialist loses its certification prior to Contract completion and must be performed by the approved successor.

1.6 TAB SPECIALIST RESPONSIBILITIES

All TAB work specified herein and in related sections shall be performed under the direct guidance of the TAB Specialist. The TAB Specialist shall participate in the commissioning process specified in Section 15995A COMMISSIONING OF HVAC SYSTEMS.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 DESIGN REVIEW

The TAB Specialist shall review the Contract Plans and Specifications and advise the Contracting Officer of any deficiencies that would prevent the effective and accurate TAB of the system. The TAB Specialist shall provide a Design Review Report individually listing each deficiency and the corresponding proposed corrective action necessary for proper system operation.

3.2 TAB RELATED HVAC SUBMITTALS

The TAB Specialist shall prepare a list of the submittals from the Contract Submittal Register that relate to the successful accomplishment of all HVAC TAB. The submittals identified on this list shall be accompanied by a letter of approval signed and dated by the TAB Specialist when submitted to the Government. The TAB Specialist shall also ensure that the location and details of ports, terminals, connections, etc., necessary to perform TAB are identified on the submittals.

3.3 TAB SCHEMATIC DRAWINGS AND REPORT FORMS

A schematic drawing showing each system component, including balancing devices, shall be provided for each system. Each drawing shall be accompanied by a copy of all report forms required by the TAB Standard used for that system. Where applicable, the acceptable range of operation or appropriate setting for each component shall be included on the forms or as an attachment to the forms. The schematic drawings shall identify all testing points and cross reference these points to the report forms and procedures.

3.4 DUCTWORK LEAK TESTING

The TAB Specialist shall witness the Ductwork Leak Testing specified in Section 15895 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM and approve the results as specified in Paragraph TAB RELATED HVAC SUBMITTALS.

3.5 TESTING, ADJUSTING, AND BALANCING

3.5.1 TAB Procedures

Step by step procedures for each measurement required during TAB Execution shall be provided. The procedures shall be oriented such that there is a separate section for each system. The procedures shall include measures to ensure that each system performs as specified in all operating modes, interactions with other components (such as exhaust fans, kitchen hoods, fume hoods, relief vents, etc.) and systems, and with all seasonal operating differences, diversity, simulated loads, and pressure relationships required.

3.5.2 Systems Readiness Check

The TAB Specialist shall inspect each system to ensure that it is complete, including installation and operation of controls, and that all aspects of the facility that have any bearing on the HVAC systems, including installation of ceilings, walls, windows, doors, and partitions, are complete to the extent that TAB results will not be affected by any detail or touch-up work remaining. The TAB Specialist shall also verify that all items such as ductwork and piping ports, terminals, connections, etc., necessary to perform TAB shall be complete during the Systems Readiness Check.

3.5.3 Preparation of TAB Report

Preparation of the TAB Report shall begin only when the Systems Readiness Report has been approved. The Report shall be oriented so that there is a separate section for each system. The Report shall include a copy of the appropriate approved Schematic Drawings and TAB Related Submittals, such as pump curves, fan curves, etc., along with the completed report forms for each system. The operating points measured during successful TAB Execution and the theoretical operating points listed in the approved submittals shall be marked on the performance curves and tables. Where possible, adjustments shall be made using an "industry standard" technique which would result in the greatest energy savings, such as adjusting the speed of a fan instead of throttling the flow. Any deficiencies outside of the realm of normal adjustments and balancing during TAB Execution shall be noted along with a description of corrective action performed to bring the measurement into the specified range. If, for any reason, the TAB Specialist determines during TAB Execution that any Contract requirement cannot be met, the TAB Specialist shall immediately provide a written description of the deficiency and the corresponding proposed corrective action necessary for proper system operation to the Contracting Officer.

3.5.4 TAB Verification

The TAB Specialist shall recheck ten percent of the measurements listed in the Tab Report and prepare a TAB Verification Report. The measurements selected for verification and the individuals that witness the verification will be selected by the Contracting Officer's Representative (COR). The measurements will be recorded in the same manner as required for the TAB Report. All measurements that fall outside the acceptable operating range specified shall be accompanied by an explanation as to why the measurement does not correlate with that listed in the TAB Report and a description of corrective action performed to bring the measurement into the specified range. The TAB Specialist shall update the original TAB report to reflect any changes or differences noted in the TAB verification report and submit

the updated TAB report. If over 20 percent of the measurements selected by the COR for verification fall outside of the acceptable operating range specified, the COR will select an additional ten percent for verification. If over 20 percent of the total tested (including both test groups) fall outside of the acceptable range, the TAB Report shall be considered invalid and all contract TAB work shall be repeated beginning with the Systems Readiness Check.

3.5.5 Marking of Setting

Following approval of TAB Verification Report, the setting of all HVAC adjustment devices including valves, splitters, and dampers shall be permanently marked by the TAB Specialist so that adjustment can be restored if disturbed at any time.

3.5.6 Identification of Test Ports

The TAB Specialist shall permanently and legibly identify the location points of duct test ports. If the ductwork has exterior insulation, the identification shall be made on the exterior side of the insulation. All penetrations through ductwork and ductwork insulation shall be sealed to prevent air leakage or to maintain integrity of vapor barrier.

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SECTION 15995A

COMMISSIONING OF HVAC SYSTEMS
07/03

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Commissioning Team; G-AO

List of team members who will represent the Contractor in the pre-commissioning checks and functional performance testing, at least 2 weeks prior to the start of pre-commissioning checks. Proposed revision to the list, prior to the start of the impacted work.

Tests; G-AO

Detailed procedures for pre-commissioning checks and functional performance tests, at least 4 weeks prior to the start of pre-commissioning checks.

Pre-Commissioning Checks; G-AO

Schedule for pre-commissioning checks and functional performance tests, at least 2 weeks prior to the start of pre-commissioning checks.

SD-06 Test Reports

Test Reports; G-AO

Completed pre-commissioning checklists and functional performance test checklists organized by system and by subsystem and submitted as one package. The results of failed tests shall be included along with a description of the corrective action taken.

1.2 SEQUENCING AND SCHEDULING

The work described in this Section shall begin only after all work required in related Sections, including Section 15951A DIRECT DIGITAL CONTROL FOR HVAC and Section 15990A TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS, has been successfully completed, and all test and inspection reports and operation and maintenance manuals required in these Sections have been submitted and approved. Seismic details shall be in accordance with

Sections 13080 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT and 15070A SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 COMMISSIONING TEAM AND CHECKLISTS

The Contractor shall designate team members to participate in the pre-commissioning checks and the functional performance testing specified herein. In addition, the Government will be represented by a representative of the Contracting Officer, the Design Agent's Representative, and the Using Agency. The team members shall be as follows:

Designation	Function
Q	Contractor's Chief Quality Control Representative
M	Contractor's Mechanical Representative
E	Contractor's Electrical Representative
T	Contractor's Testing, Adjusting, and Balancing Representative
C	Contractor's Controls Representative
D	Design Agent's Representative
O	Contracting Officer's Representative
U	Using Agency's Representative

Appendices A and B are provided as a general checklist and have been prepared to best match the various equipment selected during the design of this project. Each checklist shown in Appendices A and B shall be reviewed and modified as necessary to reflect equipment actually installed during construction of the project. The commissioning team shall review the accuracy and applicability of each item in the checklist and revise as needed. Equipment shown in the checklist but not installed for the project shall be annotated as "NA". Likewise, equipment installed but not listed in the checklist shall be added or revised accordingly. A note as to why it was added or revised shall be inserted with the reviewer's initial. The commissioning team shall also add or modify to any of the equipment checklist items as required and/or specified by the equipment manufacturer. Acceptance by each commissioning team member of each pre-commissioning checklist item shall be indicated by initials and date, unless an "X" is shown indicating that participation by that individual is not required. Acceptance by each commissioning team member of each functional performance test checklist shall be indicated by signature and date.

3.2 TESTS

The pre-commissioning checks and functional performance tests shall be performed in a manner which essentially duplicates the checking, testing, and inspection methods established in the related Sections. Where checking, testing, and inspection methods are not specified in other Sections, methods shall be established which will provide the information required. Testing and verification required by this section shall be performed during the Commissioning phase. Requirements in related Sections are independent from the requirements of this Section and shall not be used to satisfy any of the requirements specified in this Section. The Contractor shall provide all materials, services, and labor required to perform the pre-commissioning checks and functional performance tests. A pre-commissioning check or functional performance test shall be aborted if

any system deficiency prevents the successful completion of the test or if any participating non-Government commissioning team member of which participation is specified is not present for the test. The Contractor shall reimburse the Government for all costs associated with effort lost due to tests that are aborted. These costs shall include salary, travel costs and per diem (where applicable) for Government commissioning team members. The Contractor shall submit Test Reports as specified in the Submittals paragraph.

3.2.1 Pre-Commissioning Checks

Pre-commissioning checks shall be performed for the items indicated on the checklists in Appendix A. Deficiencies discovered during these checks shall be corrected and retested in accordance with the applicable contract requirements.

3.2.2 Functional Performance Tests

Functional performance tests shall be performed for the items indicated on the checklists in Appendix B. Functional performance tests shall begin only after all pre-commissioning checks have been successfully completed. Tests shall prove all modes of the sequences of operation, and shall verify all other relevant contract requirements. Tests shall begin with equipment or components and shall progress through subsystems to complete systems. Upon failure of any functional performance test checklist item, the Contractor shall correct all deficiencies in accordance with the applicable contract requirements. The checklist shall then be repeated until it has been completed with no errors.

APPENDIX A

PRE-COMMISSIONING CHECKLISTS

Pre-commissioning checklist - Piping

For Heating Water Piping System

Checklist Item	Q	M	E	T	C	D	O	U
Installation								
a. Piping complete.	___	___	X	___	X	___	___	___
b. As-built shop drawings submitted.	___	___	X	___	X	___	___	___
c. Piping flushed and cleaned.	___	___	X	___	X	___	___	___
d. Strainers cleaned.	___	___	X	___	X	___	___	___
e. Valves installed as required.	___	___	X	___	X	___	___	___
f. Piping insulated as required.	___	___	X	___	X	___	___	___
g. Thermometers and gauges installed as required.	___	___	X	___	X	___	___	___
h. Verify operation of valves.	___	___	X	___	___	___	___	___
i. Air vents installed as specified.	___	___	X	X	X	___	___	___
j. Flexible connectors installed as specified	__	___	X	X	X	___	___	___
k. Verify that piping has been labeled and valves identified as specified.	___	___	X	___	___	___	___	___
Testing, Adjusting, and Balancing (TAB)								
a. Hydrostatic test complete.	___	___	X	___	X	___	___	___
b. TAB operation complete.	___	___	X	___	___	___	___	___

Pre-commissioning Checklist - Ductwork

For Air Handling Systems: AHU-1 through AHU-5

Checklist Item	Q	M	E	T	C	D	O	U
Installation								
a. Ductwork complete.	___	___	X	___	X	___	___	___
b. As-built shop drawings submitted.	___	___	X	___	X	___	___	___
c. Ductwork leak test complete.	___	___	X	___	X	___	___	___
d. Fire dampers, smoke dampers, and access doors installed as required with installation of each verified by the specified team members initialing each location on a copy of the as-built drawings.	___	___	X	___	X	___	___	___
e. Ductwork insulated as required.	___	___	X	___	X	___	___	___
f. Thermometers and gauges installed as required.	___	___	___	___	___	___	___	___
g. Verify open/closed status of dampers.	___	___	X	___	X	___	___	___
h. Verify smoke and fire damper operation.	___	___	X	___	___	___	___	___
i. Flexible connectors installed as specified	__	___	X	___	X	___	___	___
Testing, Adjusting, and Balancing (TAB)								
a. TAB operation complete.	___	___	X	___	X	___	___	___

Pre-commissioning Checklist - Variable Volume Air Handling Unit

For Air Handling Unit: AHU-3

Checklist Item	Q	M	E	T	C	D	O	U
Installation								
a. Vibration isolation devices installed.	___	___	X	X	X	___	___	___
b. Inspection and access doors are operable and sealed.	___	___	X	___	X	___	___	___
c. Casing undamaged.	___	___	X	X	X	___	___	___
d. Insulation undamaged.	___	___	X	X	X	___	___	___
e. Condensate drainage is unobstructed. (Visually verify drainage by pouring a cup of water into drain pan.)	___	___	X	X	X	___	___	___
f. Fan belt adjusted.	___	___	X	___	X	___	___	___
g. Manufacturer's required maintenance clearance provided.	___	___	X	X	X	___	___	___
Electrical								
a. Power available to unit disconnect.	___	___	___	X	X	___	___	___
b. Power available to unit control panel.	___	___	___	X	___	___	___	___
c. Proper motor rotation verified.	___	___	___	___	X	___	___	___
d. Verify that power disconnect is located within sight of the unit it controls.	___	___	___	X	___	___	___	___
Coils								
a. Refrigerant piping properly connected.	___	___	X	X	X	___	___	___
b. Refrigerant piping pressure tested.	___	___	X	X	X	___	___	___
c. Hot water piping properly connected.	___	___	X	X	X	___	___	___
d. Hot water piping pressure tested.	___	___	X	X	X	___	___	___
e. Air vents installed on water coils with shutoff valves as specified.	___	___	X	X	X	___	___	___
f. Any damage to coil fins has been repaired.	___	___	X	___	X	___	___	___
Controls								

Pre-commissioning Checklist - Variable Volume Air Handling Unit

For Air Handling Unit: AHU-3

Checklist Item	Q	M	E	T	C	D	O	U
a. Control valves/actuators properly installed.	___	___	X	___	___	___	___	___
b. Control valves/actuators operable.	___	___	X	___	___	___	___	___
c. Dampers/actuators properly installed.	___	___	X	___	___	___	___	___
d. Dampers/actuators operable.	___	___	X	___	___	___	___	___
e. Verify proper location, installation and calibration of duct static pressure sensor.	___	___	X	___	___	___	___	___
f. Fan air volume controller operable.	___	___	X	___	___	___	___	___
g. Air handler controls system operational.	___	___	X	___	___	___	___	___
Testing, Adjusting, and Balancing (TAB)								
a. Construction filters removed and replaced.	__	___	X	___	___	___	___	___
b. TAB report submitted.	___	___	X	___	X	___	___	___
c. TAB results within limits specified in Section 15990A								
d. TAB results for outside air intake within limits specified in Section 15990A	___	___	X	___	X	___	___	___

Pre-commissioning Checklist - VAV Terminal

For All VAV Terminals:

Checklist Item	Q	M	E	T	C	D	O	U
Installation								
a. VAV terminal in place.	___	___	X	X	X	___	___	___
b. VAV terminal ducted.	___	___	X	X	X	___	___	___
c. VAV terminal connected to controls.	___	___	X	X	___	___	___	___
d. Reheat coil connected to hot water pipe.	___	___	X	___	X	___	___	___
f. Manufacturer's required maintenance clearance provided.	___	___	X	X	X	___	___	___
Controls								
a. Cooling only VAV terminal controls set.	___	___	X	X	___	___	___	___
b. Cooling only VAV controls verified.	___	___	X	X	___	___	___	___
c. Reheat VAV terminal controls set.	___	___	X	X	___	___	___	___
d. Reheat terminal/coil controls verified.	___	___	X	X	___	___	___	___
Testing, Adjusting, and Balancing (TAB)								
a. Verify terminal maximum air flow set.	___	___	X	___	___	___	___	___
b. Verify terminal minimum air flow set.	___	___	X	___	___	___	___	___
c. TAB operation complete.	___	___	X	___	X	___	___	___

Pre-commissioning Checklist - DX Air Cooled Condensing Unit

For Condensing Unit: CU-1 and CU-2

Checklist Item	Q	M	E	T	C	D	O	U
Installation	___	___	X	X	X	___	___	___
b. Refrigerant pipe leak tested.	___	___	X	X	X	___	___	___
c. Refrigerant pipe evacuated and charged in accordance with manufacturer's instructions.	___	___	X	X	X	___	___	___
d. Check condenser fans for proper rotation.	___	___	X	___	X	___	___	___
e. Any damage to coil fins has been repaired.	__	___	X	___	X	___	___	___
f. Manufacturer's required maintenance/ operational clearance provided.	___	___	X	X	X	___	___	___
Electrical								
a. Power available to unit disconnect.	___	___	___	X	X	___	___	___
b. Power available to unit control panel.	___	___	___	X	___	___	___	___
c. Verify that power disconnect is located within sight of the unit it controls	___	___	___	X	___	___	___	___
Controls								
a. Unit safety/protection devices tested.	___	___	X	X	___	___	___	___
b. Control system and interlocks installed.	___	___	X	X	___	___	___	___
c. Control system and interlocks operational.	__	___	X	X	___	___	___	___

Pre-commissioning Checklist - Pumps

For Pump: HWP-1 and HWP-2

Checklist Item	Q	M	E	T	C	D	O	U
Installation								
a. Pumps grouted in place.	___	___	X	X	X	___	___	___
b. Pump vibration isolation devices functional.	___	___	X	X	X	___	___	___
c. Pump/motor coupling alignment verified.	___	___	X	X	X	___	___	___
d. Piping system installed.	___	___	X	X	X	___	___	___
e. Piping system pressure tested.	___	___	X	X	X	___	___	___
f. Pump not leaking.	___	___	X	X	X	___	___	___
g. Field assembled couplings aligned to meet manufacturer's prescribed tolerances.	___	___	X	X	X	___	___	___
Electrical								
a. Power available to pump disconnect.	___	___	___	X	X	___	___	___
b. Pump rotation verified.	___	___	___	X	X	___	___	___
c. Control system interlocks functional.	___	___	___	X	___	___	___	___
d. Verify that power disconnect is located within sight of the unit it controls.	___	___	___	X	___	___	___	___
Testing, Adjusting, and Balancing (TAB)								
a. Pressure/temperature gauges installed.	___	___	X	___	X	___	___	___
b. Piping system cleaned.	___	___	X	X	X	___	___	___
c. Chemical water treatment complete.	___	___	X	X	X	___	___	___
d. Water balance complete.	___	___	X	___	X	___	___	___
e. Water balance with design maximum flow.	___	___	X	___	X	___	___	___
f. TAB Report submitted.	___	___	X	___	X	___	___	___

Pre-commissioning Checklist - Hot Water Converter

For Converter: WHX-1 and WHX-2

Checklist Item	Q	M	E	T	C	D	O	U
Installation								
a. Converter high temperature hot water piping installed.	___	___	X	___	X	___	___	___
b. Converter high temperature hot water piping tested.	___	___	X	X	X	___	___	___
c. Hot water piping installed.	___	___	X	___	___	___	___	___
d. Hot water piping tested.	___	___	X	X	X	___	___	___
e. Makeup water piping installed.	___	___	X	X	X	___	___	___
f. Vacuum breaker installed on shell of shell and tube unit.	___	___	X	X	X	___	___	___
g. Air vent installed as specified.	___	___	X	X	X	___	___	___
h. Manufacturer's required maintenance clearance provided.	___	___	X	X	X	___	___	___
Startup								
a. Hot water system cleaned and filled.	___	___	X	X	X	___	___	___
b. Converter safety/protection devices tested.	___	___	X	X	X	___	___	___
c. Converter startup and checkout complete.	___	___	X	X	X	___	___	___
Controls								
a. Control valves/actuators properly installed.	___	___	X	___	___	___	___	___
b. Control valves/actuators operable.	___	___	X	___	___	___	___	___

Pre-commissioning Checklist - Unit Heater

For All Unit Heaters:

Checklist Item	Q	M	E	T	C	D	O	U
Installation								
a. Hot water piping properly connected.	___	___	X	___	___	___	___	___
b. Hot water piping pressure tested.	___	___	X	___	___	___	___	___
c. Air vent installed on hot water coil with shutoff valve as specified.	___	___	X	X	X	___	___	___
d. Any damage to coil fins has been repaired.	___	___	X	___	X	___	___	___
e. Manufacturer's required maintenance/ operational clearance provided.	___	___	X	X	X	___	___	___
Electrical								
a. Power available to unit disconnect.	___	___	___	X	___	___	___	___
b. Proper motor rotation verified.	___	___	___	X	X	___	___	___
c. Verify that power disconnect is located within sight of the unit it controls.	___	___	___	X	___	___	___	___
Controls								
a. Control valves properly installed.	___	___	X	___	___	___	___	___
b. Control valves operable.	___	___	X	X	___	___	___	___
c. Verify proper location and installation of thermostat.	___	___	X	___	___	___	___	___
Testing, Adjusting, and Balancing (TAB)								
a. TAB Report submitted.	___	___	X	___	X	___	___	___

Pre-commissioning Checklist - Exhaust Fan

For All Exhaust Fans:

Checklist Item	Q	M	E	T	C	D	O	U
Installation								
a. Fan belt adjusted.	___	___	X	___	X	___	___	___
Electrical								
a. Power available to fan disconnect.	___	___	___	X	___	___	___	___
b. Proper motor rotation verified.	___	___	___	___	X	___	___	___
c. Verify that power disconnect is located within sight of the unit it controls.	___	___	___	X	___	___	___	___
Controls								
a. Control interlocks properly installed.	___	___	___	X	___	___	___	___
b. Control interlocks operable.	___	___	___	X	___	___	___	___
c. Dampers/actuators properly installed.	___	___	X	___	___	___	___	___
d. Dampers/actuators operable.	___	___	X	___	___	___	___	___
e. Verify proper location and installation of thermostat.	___	___	X	___	___	___	___	___
Testing, Adjusting, and Balancing (TAB)								
a. TAB results within limits specified in Section 15990A	___	___	X	___	X	___	___	___
b. TAB Report submitted.	___	___	X	___	X	___	___	___

Pre-commissioning Checklist - HVAC System Controls

For HVAC System: AHU-1 through AHU-5

Checklist Item	Q	M	E	T	C	D	O	U
Installation								
a. As-built shop drawings submitted.	___	___	X	X	___	___	___	___
b. Layout of control panel matches drawings.	___	___	X	X	___	___	___	___
c. Framed instructions mounted in or near control panel.	___	___	X	X	___	___	___	___
d. Components properly labeled (on inside and outside of panel).	___	___	X	X	___	___	___	___
e. Control components piped and/or wired to each labeled terminal strip.	___	___	X	X	___	___	___	___
f. EMCS connection made to each labeled terminal strip as shown.	___	___	X	X	___	___	___	___
g. Control wiring and tubing labeled at all terminations, splices, and junctions.	___	___	X	X	___	___	___	___
h. Shielded wiring used on electronic sensors.	__	__	X	X	___	___	___	___
i. Water drain installed as specified.	___	___	X	X	___	___	___	___
Main Power and Control Air								
a. 110 volt AC power available to panel.	___	___	___	X	___	___	___	___
Testing, Commissioning, and Balancing								
a. Testing, Commissioning, and Balancing Report submitted.	___	___	X	___	___	___	___	___

Pre-commissioning Checklist - Single Zone Air Handling Unit

For Air Handling Units: AHU-1, AHU-2, AHU-4, AHU-5

Checklist Item	Q	M	E	T	C	D	O	U
Installation								
a. Vibration isolation devices installed.	__	___	X	X	X	___	___	___
b. Inspection and access doors are operable and sealed.	__	___	X	___	X	___	___	___
c. Casing undamaged.	__	___	X	X	X	___	___	___
d. Insulation undamaged.	__	___	X	X	X	___	___	___
e. Condensate drainage is unobstructed.	__	___	X	X	X	___	___	___
f. Fan belt adjusted.	__	___	X	___	X	___	___	___
g. Any damage to coil fins has been repaired.	__	__	X	___	X	___	___	___
h. Manufacturer's required maintenance clearance provided.	__	___	X	X	X	___	___	___
Electrical								
a. Power available to unit disconnect.	__	___	___	X	X	___	___	___
b. Power available to unit control panel.	__	___	___	X	___	___	___	___
c. Proper motor rotation verified.	___	___	___	__	X	___	___	___
d. Verify that power disconnect is located within sight of the unit it controls.	___	___	__	X	___	___	___	___
e. Power available to electric heating coil.	__	___	___	X	___	___	___	___
Coils								
a. Refrigerant piping properly connected.	__	___	X	X	X	___	___	___
b. Refrigerant piping pressure tested.	__	___	X	X	X	___	___	___
c. Hot water piping properly connected.	__	___	X	___	___	___	___	___
d. Hot water piping pressure tested.	___	___	X	X	__	___	___	___
e. Air vents installed on water coils with shutoff valves as specified.	___	___	X	X	X	__	___	___
f. Any damage to coil fins has been repaired.	___	___	X	___	X	___	___	___

Pre-commissioning Checklist - Single Zone Air Handling Unit

For Air Handling Units: AHU-1, AHU-2, AHU-4, AHU-5

Checklist Item	Q	M	E	T	C	D	O	U
Controls								
a. Control valves/actuators properly installed.	___	___	X	___	___	___	___	___
b. Control valves/actuators operable.	___	___	X	___	___	___	___	___
c. Dampers/actuators properly installed.	___	___	X	___	___	___	___	___
d. Dampers/actuators operable.	___	___	X	___	___	___	___	___
e. Verify proper location and installation of thermostat.	___	___	X	___	___	___	___	___
Testing, Adjusting, and Balancing (TAB)								
a. Construction filters removed and replaced.	___	___	X	___	X	___	___	___
b. TAB results within limits specified in Section 15990A	___	___	X	___	X	___	___	___
c. TAB Report submitted.	___	___	X	___	X	___	___	___

APPENDIX B

FUNCTIONAL PERFORMANCE TESTS CHECKLISTS

Functional Performance Test Checklist - Pumps

For Pumps: HWP-1 and HWP-2

Prior to performing this checklist, ensure that system is pressurized and the make-up water system is operational.

1. Activate pump start using control system commands (all possible combination, on/auto, etc.). ON_____ AUTO_____ OFF_____

a. Verify pressure drop across strainer:

Strainer inlet pressure _____ psig
Strainer outlet pressure _____ psig

b. Verify pump inlet/outlet pressure reading, compare to Testing, Adjusting, and Balancing (TAB) Report, pump design conditions, and pump manufacturer's performance.

	DESIGN	SYSTEM TEST	ACTUAL
Pump inlet pressure (psig)	_____	_____	_____
Pump outlet pressure (psig)	_____	_____	_____

c. Operate pump at shutoff and at 100 percent of designed flow when all components are in full flow. Plot test readings on pump curve and compare results against readings taken from flow measuring devices.

	SHUTOFF	100 percent
Pump inlet pressure (psig)	_____	_____
Pump outlet pressure	_____	_____
Pump flow rate (gpm)	_____	_____

d. Operate pump at shutoff and at minimum flow or when all components are in full by-pass. Plot test readings on pump curve and compare results against readings taken from flow measuring devices.

	SHUTOFF	100 percent
Pump inlet pressure (psig)	_____	_____
Pump outlet pressure	_____	_____
Pump flow rate (gpm)	_____	_____

2. Verify motor amperage each phase and voltage phase to phase and phase to ground for both the full flow and the minimum flow conditions.

a. Full flow:

	PHASE 1	PHASE 2	PHASE 3
Amperage	_____	_____	_____
Voltage		_____	_____
Voltage		_____	
Voltage to ground	_____	_____	_____

b. Minimum flow:

Functional Performance Test Checklist - Pumps

For Pumps: HWP-1 and HWP-2

	PHASE 1	PHASE 2	PHASE 3
Amperage	_____	_____	_____
Voltage		_____	_____
Voltage		_____	
Voltage to ground	_____	_____	_____

3. Unusual vibration, noise, etc.

_____

_____

4. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Chief Quality Control Representative _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's Testing, Adjusting and Balancing Representative _____

Contractor's Controls Representative _____

Contracting Officer's Representative _____

Using Agency's Representative _____

Functional Performance Test Checklist - VAV Terminals

The Contracting officer will select VAV terminals to be spot-checked during the functional performance test. The number of terminals shall not exceed 10 percent.

1. Functional Performance Test: Contractor shall demonstrate operation of selected VAV boxes as per specifications including the following:

a. Cooling only VAV boxes:

(1) Verify VAV box response to room temperature set point adjustment. Turn thermostat to 5 degrees F above ambient and measure maximum air flow. Turn thermostat to 5 degrees F below ambient and measure minimum air flow.

Maximum flow _____ cfm
Minimum flow _____ cfm

(2) Check damper maximum/minimum flow settings.

Maximum flow setting _____ cfm
Minimum flow setting _____ cfm

b. Cooling with reheat VAV boxes:

(1) Verify VAV box response to room temperature set point adjustment. Turn thermostat to 5 degrees F above ambient and measure maximum air flow. Turn thermostat to 5 degrees F below ambient and measure minimum air flow.

Maximum flow _____ cfm
Minimum flow _____ cfm

(2) Check damper maximum/minimum flow settings.

Maximum flow setting _____ cfm
Minimum flow setting _____ cfm

Reheat coil operation range (full open to full closed) _____

2. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Chief Quality Control Representative _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's Testing, Adjusting and Balancing Representative _____

Functional Performance Test Checklist - VAV Terminals

Contractor's Controls Representative _____

Contracting Officer's Representative _____

Using Agency's Representative _____

Functional Performance Test Checklist - Variable Volume Air Handling Unit

For Air Handling Unit: AHU-3

Ensure that a slight negative pressure exists on inboard side of the outside air dampers throughout the operation of the dampers. Modulate OA, RA, and EA dampers from fully open to fully closed positions.

1. Functional Performance Test: Contractor shall verify operation of air handling unit as per specification including the following:

a. The following shall be verified when the supply and return fans operating mode is initiated:

(1) All dampers in normal position and variable frequency drive modulates to maintain the required static pressure. _____

(2) All valves in normal position. _____

(3) System safeties allow start if safety conditions are met. _____

(4) VAV fan controller shall "soft-start" fan. _____

(5) Modulate all VAV boxes to minimum air flow and verify that the static pressure does not exceed the design static pressure Class shown. _____

b. Occupied mode of operation - economizer de-energized.

(1) Outside air damper at minimum position. _____

(2) Return air damper open. _____

(3) Relief air damper at minimum position. _____

(4) Condensing unit cycling on proper stages to maintain leaving air temperature set point. _____

(5) Fan VAV controller receiving signal from duct static pressure sensor and modulating fan to maintain supply duct static pressure set point. _____

c. Occupied mode of operation - economizer energized.

(1) Outside air damper modulated to maintain mixed air temperature set point. _____

(2) Relief air damper modulates with outside air damper according to sequence of operation. _____

(3) Condensing unit cycling to maintain leaving air temperature set point. _____

(4) Hot water control valve modulating to maintain leaving air temperature set point. _____

Functional Performance Test Checklist - Variable Volume Air Handling Unit

For Air Handling Unit: AHU-3

(5) Fan VAV controller receiving signal from duct static pressure sensor and modulating fan to maintain supply duct static pressure set point. _____

d. Unoccupied mode of operation

(1) All dampers in normal position. _____

(2) Verify low limit space temperature is maintained as specified in sequence of operation. _____

e. The following shall be verified when the supply and return fans off mode is initiated:

(1) All dampers in normal position. _____

(2) All valves in normal position. _____

(3) Fan de-energizes. _____

f. Verify the condensing unit operation by setting all VAV's to maximum and minimum cooling.

	Max cooling	Min cooling
Supply air volume _____ cfm)	_____	_____
Supply air temp. (_____ degrees F)	_____	_____

g. Verify safety shut down initiated by smoke detectors. _____

h. Verify safety shut down initiated by low temperature protection thermostat. _____

2. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Chief Quality Control Representative _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's Testing, Adjusting and Balancing Representative _____

Contractor's Controls Representative _____

Contracting Officer's Representative _____

Using Agency's Representative _____

Functional Performance Test Checklist - Variable Volume Air Handling Unit

For Air Handling Unit: AHU-3

Functional Performance Test Checklist - Single Zone Air Handling Unit

For Air Handling Units: AHU-1, AHU-2, AHU-4, AHU-5

1. Functional Performance Test: Contractor shall verify operation of air handling unit as per specification including the following:

a. The following shall be verified when the supply and return fans operating mode is initiated:

(1) All dampers in normal position. _____

(2) All valves in normal position. _____

(3) System safeties allow start if safety conditions are met. _____

b. Occupied mode of operation - economizer de-energized.

(1) Outside air damper at minimum position. _____

(2) Return air damper open. _____

(3) Relief air damper at minimum position. _____

(4) Condensing unit cycling to maintain space cooling temperature set point. _____

(5) Hot water control valve modulating to maintain space heating temperature set point input from outside air temperature controller. _____

c. Occupied mode of operation - economizer energized.

(1) Outside air damper modulated to maintain mixed air temperature set point. _____

(2) Relief air damper modulates with outside air damper according to sequence of operation. _____

(3) Condensing unit cycling to maintain space cooling temperature set point. _____

d. Unoccupied mode of operation

(1) All dampers in normal position. _____

(2) Verify low limit space temperature is maintained as specified in sequence of operation. _____

e. The following shall be verified when the supply fan off mode is initiated:

(1) All dampers in normal position. _____

(2) All valves in normal position. _____

(3) Fan de-energizes. _____

f. Verify cooling coil and heating coil operation by varying

Functional Performance Test Checklist - Single Zone Air Handling Unit

For Air Handling Units: AHU-1, AHU-2, AHU-4, AHU-5
thermostat set point from cooling set point to heating set point and returning to cooling set point. _____

g. Verify safety shut down initiated by smoke detectors. _____

h. Verify safety shut down initiated by low temperature protection thermostat. _____

2. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Chief Quality Control Representative _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's Testing, Adjusting and Balancing Representative _____

Contractor's Controls Representative _____

Contracting Officer's Representative _____

Using Agency's Representative _____

Functional Performance Test Checklist - Air Cooled Condensing Unit

For Condensing Units: CU-1 and CU-2

1. Functional Performance Test: Contractor shall demonstrate operation of refrigeration system as per specifications including the following: Start building air handler to provide load for condensing unit. Activate controls system start sequence as follows.

a. Start air handling unit. Verify control system energizes condensing unit start sequence. _____

b. Shut off air handling equipment to verify condensing unit de-energizes. _____

c. Restart air handling equipment one minute after condensing unit shut down. Verify condensing unit restart sequence. _____

2. Verify condensing unit amperage each phase and voltage phase to phase and phase to ground.

	PHASE 1	PHASE 2	PHASE 3
Amperage	_____	_____	_____
Voltage	_____	_____	
Voltage	_____		
Voltage to ground	_____	_____	_____

3. Record the following information:

Ambient dry bulb temperature	_____	degrees F
Ambient wet bulb temperature	_____	degrees F
Suction pressure	_____	psig
Discharge pressure	_____	psig

4. Unusual vibration, noise, etc.

_____

_____

5. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Chief Quality Control Representative _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative Representative _____

Contractor's Testing, Adjusting and Balancing _____

Functional Performance Test Checklist - Air Cooled Condensing Unit

For Condensing Units: CU-1 and CU-2

Contractor's Controls Representative _____

Contracting Officer's Representative _____

Using Agency's Representative _____

Functional Performance Test Checklist - Unit Heaters

The Contracting Officer will select unit heaters to be spot-checked during the functional performance test. The number of terminals shall not exceed 10.

1. Functional Performance Test: Contractor shall demonstrate operation of selected unit heaters as per specifications including the following:

a. Verify unit heater response to room temperature set point adjustment. Changes to be heating set point to heating set point minus 10 degrees and return to heating set point. _____

b. Check blower fan speed. _____rpm

c. Check heating mode inlet air temperature. Check heating mode inlet air temperature. _____ degrees F

d. Check heating mode outlet air temperature. Check heating mode outlet air temperature. _____ degrees F

2. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Chief Quality Control Representative _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's Testing, Adjusting and Balancing Representative _____

Contractor's Controls Representative _____

Contracting Officer's Representative _____

Using Agency's Representative _____

Functional Performance Test Checklist - Hot Water Converter

For Converters: WHX-1 AND WHX-2

1. Functional Performance Test: Contractor shall demonstrate operation of heating system as per specifications including the following: Start building heating equipment to provide load for converter.

a. Verify control system energizes. _____

b. Verify converter senses hot water temperature below set point and control system modulates high temperature hot water valve.
_____

c. Shut off building heating equipment to remove load on heating system. Verify converter high temperature hot water valve closes after load is removed. _____

2. Verify converter inlet/outlet pressure reading, compare to converter design conditions and manufacturer's performance data.

	DESIGN	ACTUAL
Converter inlet water temp (degrees F)	_____	_____
Converter outlet water temp (degrees F)	_____	_____
Converter inlet HTHW temp (degrees F)	_____	_____
Converter outlet HTHW tmp (degrees F	_____	_____
Determine water flow rate based on pressure drop through converter	_____	_____
Determine water flow rate with flow measuring device	_____	_____
Verify that temperature of water is in accordance with outdoor air reset schedule	_____	_____

3. Verify proper operation of converter safeties. _____

4. Check and report unusual vibration, noise, etc.
_____

_____

5. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Chief Quality Control Representative
_____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's Testing, Adjusting and Balancing Representative
_____

Contractor's Controls Representative _____

Functional Performance Test Checklist - Hot Water Converter

For Converters: WHX-1 AND WHX-2

Contracting Officer's Representative _____

Using Agency's Representative _____

Functional Performance Test Checklist - HVAC Controls

For All HVAC Systems:

The Contracting Officer will select HVAC control systems to undergo functional performance testing. The number of systems shall not exceed 10 percent.

1. Functional Performance Test: Contractor shall verify operation of HVAC controls by performing the following tests:

a. Verify that controller is maintaining the set point by manually measuring the controlled variable with a thermometer, sling psychrometer, inclined manometer, etc.

b. Verify sensor/controller combination by manually measuring the controlled medium. Take readings from control panel display and compare readings taken manually. Record all readings.

Sensor _____
Manual measurement _____
Panel reading value _____

c. Verify system stability by changing the controller set point as follows:

(1) Air temperature - 10 degrees F

(2) Water temperature - 10 degrees F

(3) Static pressure - 10 percent of set point

(4) Relative humidity - percent (RH)

The control system shall be observed for 10 minutes after the change in set point. Instability or excessive hunting will be unacceptable.

d. Verify interlock with other HVAC controls.

e. Verify interlock with fire alarm control panel.

f. Verify interlock with EMCS.

g. Change controller set point 10 percent with EMCS and verify correct response.

2. Verify that operation of control system conforms to that specified in the sequence of operation.

3. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Chief Quality Control Representative _____

Contractor's Mechanical Representative _____

Functional Performance Test Checklist - HVAC Controls

For All HVAC Systems:

Contractor's Electrical Representative _____

Contractor's Testing, Adjusting and Balancing Representative _____

Contractor's Controls Representative _____

Contractor's Officer's Representative _____

Using Agency's Representative _____

-- End of Section --

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SECTION 16070A

ANTITERRORISM/FORCE PROTECTION (AT/FP) FOR ELECTRICAL EQUIPMENT

04/99

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SECTION 16070A

ANTITERRORISM/FORCE PROTECTION (AT/FP) FOR ELECTRICAL EQUIPMENT
04/99

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

UNDERWRITERS LABORATORIES (UL)

UL 1598 (2000) Luminaires

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Lighting Fixtures in Buildings; G-AO

Detail drawings along with catalog cuts, templates, and erection and installation details, as appropriate, for the items listed. Submittals shall be complete in detail; shall indicate thickness, type, grade, class of metal, and dimensions; and shall show construction details, reinforcement, anchorage, and installation with relation to the building construction.

SD-03 Product Data

Lighting Fixtures in Buildings; G-AO

Copies of the design calculations with the detail drawings. Calculations shall be stamped by a registered engineer and shall verify the capability of structural members to which bracing is attached for carrying the load from the brace.

Contractor Designed Bracing; G-AO

Copies of the Design Calculations with the Drawings. Calculations shall be approved, certified, stamped and signed by a Registered Professional Engineer. Calculations shall verify the capability of structural members to which bracing is attached for carrying the load from the brace.

1.3 SYSTEM DESCRIPTION

1.3.1 General Requirements

The requirements for antiterrorism/force protection measures described in this section shall be applied to the electrical equipment and systems listed below. Structural requirements shall be in accordance with Section 13080 ANTITERRORISM/FORCE PROTECTION (AT/FP) FOR MISCELLANEOUS EQUIPMENT.

1.3.2 Electrical Equipment

Electrical equipment shall include the following items to the extent required on the drawings or in other sections of these specifications:

Light Fixtures

1.3.3 Contractor Designed Bracing

The Contractor shall design the bracing in accordance with UL 1598 and additional data furnished by the Contracting Officer. Resistance to lateral forces shall be accomplished without consideration of friction resulting from gravity loads. The bracing for the following electrical equipment and systems shall be developed by the Contractor: Light Fixtures.

PART 2 PRODUCTS

2.1 LIGHTING FIXTURE SUPPORTS

Lighting fixtures and supports shall conform to UL 1598.

2.2 SWAY BRACING MATERIALS

Sway bracing materials (e.g. rods, plates, rope, angles, etc.) shall be as specified in Section 13080 ANTITERRORISM/FORCE PROTECTION (AT/FP) FOR MISCELLANEOUS EQUIPMENT.

PART 3 EXECUTION

3.1 LIGHTING FIXTURES IN BUILDINGS

Lighting fixtures and supports shall conform to the following:

3.1.1 Pendant Fixtures

Pendant fixtures shall conform to the requirements of UL 1598.

3.1.2 Ceiling Attached Fixtures

3.1.2.1 Recessed Fluorescent Fixtures

Recessed fluorescent individual or continuous-row mounted fixtures shall be supported by the building structure.

3.1.2.2 Surface-Mounted Fluorescent Fixtures

Surface-mounted fluorescent individual or continuous-row fixtures shall be attached to the building structure.

3.1.3 Assembly Mounted on Outlet Box

A supporting assembly, that is intended to be mounted on an outlet box, shall be designed to accommodate mounting features on 4 inch boxes, plaster rings, and fixture studs.

-- End of Section --

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DIVISION 16 - ELECTRICAL

SECTION 16120A

INSULATED WIRE AND CABLE

11/91

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PART 3 EXECUTION (Not Applicable)

-- End of Section Table of Contents --

SECTION 16120A

INSULATED WIRE AND CABLE
11/91

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

AEIC CS5	(1994; CS5a-1995) Insulated Shielded Power Cables Rated 5 Through 46 kV
AEIC CS6	(1996) Ethylene Propylene Rubber Insulated Shielded Power Cables Rated 69 kV

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE Std 383	(1974; R 1992) Class 1E Electric Cables, Field Splices, and Connections for Nuclear Power Generating Stations

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA WC 7	(1988; Rev 3 1996) Cross-Linked-Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
NEMA WC 8	(1988; Rev 3 1996) Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Installation Instructions; G-AO

The Contractor shall submit cable manufacturing data.

SD-06 Test Reports

Tests, Inspections, and Verifications; G-AO

9 certified copies of test reports shall be submitted by the contractor.

1.3 DELIVERY, STORAGE, AND HANDLING

Furnish cables on reels or coils. Each cable and the outside of each reel or coil, shall be plainly marked or tagged to indicate the cable length, voltage rating, conductor size, and manufacturer's lot number and reel number. Each coil or reel of cable shall contain only one continuous cable without splices. Cables for exclusively dc applications, as specified in paragraph HIGH VOLTAGE TEST SOURCE, shall be identified as such. Shielded cables rated 2,001 volts and above and shall be reeled and marked in accordance with Section I of AEIC CS5 or AEIC CS6, as applicable. Reels shall remain the property of the Contractor.

1.4 PROJECT/SITE CONDITIONS

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Wire Table

Wire and cable shall be furnished in accordance with the requirements of the wire table below, and shall conform to the detailed requirements specified herein.

2.1.2 Rated Circuit Voltages

All wire and cable shall have minimum rated circuit voltages in accordance with Table 3-1 of NEMA WC 7 or NEMA WC 8.

2.1.3 Conductors

2.1.3.1 Material

Conductors shall conform to all the applicable requirements of Section 2 of NEMA WC 7 or Part 2 of NEMA WC 8 as applicable and shall be annealed copper.

2.1.3.2 Size

Minimum wire size shall be No. 12 AWG for power and lighting circuits; No. 10 AWG for current transformer secondary circuits; No. 14 AWG for potential transformer, relaying, and control circuits; No. 16 AWG for annunciator circuits; and No. 19 AWG for alarm circuits. Minimum wire sizes for rated circuit voltages of 2,001 volts and above shall not be less than those listed for the applicable voltage in Table 3-1 of Section 3 of NEMA WC 7 or Part 3 of NEMA WC 8, as applicable.

2.1.3.3 Stranding

Conductor stranding classes cited herein shall be as defined in Appendix L of NEMA WC 7 or NEMA WC 8, as applicable. Lighting conductors No. 10 AWG and smaller shall be solid or have Class B stranding. Any conductors used between stationary and moving devices, such as hinged doors or panels, shall have Class H or K stranding. All other conductors shall have Class B or C stranding, except that conductors shown on the drawings, or in the

schedule, as No. 12 AWG may be 19 strands of No. 25 AWG, and conductors shown as No. 10 AWG may be 19 strands of No. 22 AWG.

2.1.3.4 Conductor Shielding

Conductor shielding conforming to paragraph 2.7 of NEMA WC 7 or NEMA WC 8, as applicable, shall be used on power cables having a rated circuit voltage above 2,000 volts. In addition, conductor shielding for shielded cables shall also comply with Section C of AEIC CS5 or AEIC CS6. Strict precautions shall be taken after application of the conductor shielding to prevent the inclusion of voids or contamination between the conductor shielding and the subsequently applied insulation.

2.1.3.5 Separator Tape

Where conductor shielding, strand filling, or other special conductor treatment is not required, a separator tape between conductor and insulation is permitted.

2.1.4 Insulation

2.1.4.1 Insulation Material

Insulation shall be an ethylene-propylene rubber (EPR) type meeting the requirements of Part 3 of NEMA WC 8. For shielded cables of rated circuit voltages above 2,000 volts, the following provisions shall also apply:

a. Insulation shall be chemically bonded to conductor shielding.

b. The insulation material and its manufacturing, handling, extrusion and vulcanizing processes, shall all be subject to strict procedures to prevent the inclusion of voids, contamination, or other irregularities on or in the insulation. Insulation material shall be inspected for voids and contaminants. Inspection methods, and maximum allowable void and contaminant content shall be in accordance with Section B of AEIC CS5 or AEIC CS6, as applicable.

c. Cables with repaired insulation defects discovered during factory testing, or with splices or insulation joints, are not acceptable .

2.1.4.2 Insulation Thickness

The insulation thickness for each conductor shall be based on its rated circuit voltage.

a. Power Cables/Single-Conductor Control Cables, 2,000 Volts and Below - The insulation thickness for single-conductor cables rated 2,000 volts and below shall be as required by Table 3-1, Section 3 of NEMA WC 7 or Table 3-1, Part 3, of NEMA WC 8, as applicable. Column "A" thickness of Table 3-1 of NEMA WC 7will be permitted only for single-conductor cross-linked thermosetting polyethylene insulated cables without a jacket. NEMA WC 8 ethylene-propylene rubber-insulated conductors shall have a jacket. Column "B" thickness shall apply to single-conductor cables that require a jacket and to individual conductors of multiple-conductor cables with an overall jacket.

b. Power Cables, Rated 2,001 Volts and Above - Thickness of insulation for power cables rated 2,001 volts and above shall be in accordance

with the following:

(1) Non-shielded cables, 2,001 to 5,000 volts, shall comply with Note 3 to Table 3-1, of either NEMA WC 7 or NEMA WC 8, as applicable.

(2) Shielded cables rated 2,001 volts and above shall comply with Column B of Table B1, of AEIC CS5 or AEIC CS6, as applicable.

c. Multiple-Conductor Control Cables - The insulation thickness of multiple-conductor cables used for control and related purposes shall be as required by Table 7-32 of NEMA WC 7 or Table 7.5.1 of NEMA WC 8 as applicable.

2.1.4.3 Insulation Shielding

Unless otherwise specified, insulation shielding shall be provided for conductors having rated circuit voltages of 2,001 volts and above. The voltage limits above which insulation shielding is required, and the material requirements, are given in Section 4 of NEMA WC 7 or Part 4 of NEMA WC 8, as applicable. The material, if thermosetting, shall meet the wafer boil test requirements as described in Section D of AEIC CS5 or AEIC CS6, as applicable. The method of shielding shall be in accordance with the current practice of the industry; however, the application process shall include strict precautions to prevent voids or contamination between the insulation and the nonmetallic component. Voids, protrusions, and indentations of the shield shall not exceed the maximum allowances specified in Section C of AEIC CS5 or AEIC CS6, as applicable. The cable shall be capable of operating without damage or excessive temperature when the shield is grounded at both ends of each conductor. All components of the shielding system shall remain tightly applied to the components they enclose after handling and installation in accordance with the manufacturer's recommendations. Shielding systems which require heat to remove will not be permitted unless specifically approved.

2.1.5 Jackets

All cables shall have jackets meeting the requirements of Section 4 of NEMA WC 7, or Part 4 of NEMA WC 8, as applicable, and as specified herein. Individual conductors of multiple-conductor cables shall be required to have jackets only if they are necessary for the conductor to meet other specifications herein. Jackets of single-conductor cables and of individual conductors of multiple-conductor cables, except for shielded cables, shall be in direct contact and adhere or be vulcanized to the conductor insulation. Multiple-conductor cables and shielded single-conductor cables shall be provided with a common overall jacket, which shall be tightly and concentrically formed around the core. Repaired jacket defects found and corrected during manufacturing are permitted if the cable, including jacket, afterward fully meets these specifications and the requirements of the applicable standards.

2.1.5.1 Jacket Material

The jacket shall be one of the materials listed below. Polyvinyl chloride compounds will not be permitted.

a. General Use

(1) Heavy-duty black neoprene (NEMA WC 8, paragraph 4.4.3).

(2) Heavy-duty chlorosulfonated polyethylene (NEMA WC 8, paragraph 4.4.10).

b. Accessible Use Only, 2,000 Volts or Less - Cables installed where they are entirely accessible, such as cable trays and raceways with removable covers, or where they pass through less than 10 feet of exposed conduit only, shall have jackets of one of the materials specified in above paragraph GENERAL USE, or the jackets may be of one of the following:

(1) General-purpose neoprene (NEMA WC 8, paragraph 4.4.4).

(2) Black polyethylene (NEMA WC 8, paragraph 4.4.6).

(3) Thermoplastic chlorinated polyethylene (NEMA WC 8, paragraph 4.4.7).

2.1.5.2 Jacket Thickness

The minimum thickness of the jackets at any point shall be not less than 80 percent of the respective nominal thicknesses specified below.

a. Multiple-Conductor Cables - Thickness of the jackets of the individual conductors of multiple-conductor cables shall be as required by Section 4, Table 4-6 of NEMA WC 7 or Part 4, Table 4-4 of NEMA WC 8, and shall be in addition to the conductor insulation thickness required by Column B of Table 3-1 of the applicable NEMA publication for the insulation used. Thickness of the outer jackets or sheaths of the assembled multiple-conductor cables shall be as required by Section 4, Table 4-7, of NEMA WC 7 or Part 4, Table 4-5, of NEMA WC 8.

b. Single-Conductor Cables - Single-conductor cables, if nonshielded, shall have a jacket thickness as specified in Section 4, Table 4-4 of NEMA WC 7 or Part 4, Table 4-2 of NEMA WC 8. If shielded, the jacket thickness shall be in accordance with the requirements of Section 4, Table 4-5 of NEMA WC 7 or Part 4, Table 4-3 of NEMA WC 8.

2.1.6 Identification

2.1.6.1 Color-coding

Insulation of individual conductors of multiple-conductor cables shall be color-coded in accordance with paragraph 5.3 of NEMA WC 8, except that colored braids will not be permitted. Only one color-code method shall be used for each cable construction type. Control cable color-coding shall be in accordance with Table 5-2 of NEMA WC 8. Power cable color-coding shall be black for Phase A, red for Phase B, blue for Phase C, white for grounded neutral below, 250 volts and brown, orange, yellow, light gray neutral on 480 volts, and green for an insulated grounding conductor, if included.

2.1.6.2 Shielded Cables Rated 2,001 Volts and Above

Marking shall be in accordance with Section H of AEIC CS5 or AEIC CS6, as applicable.

2.1.7 Cabling

Individual conductors of multiple-conductor cables shall be assembled with flame-and moisture-resistant fillers, binders, and a lay conforming to Part 5 of NEMA WC 8, except that flat twin cables will not be permitted. Fillers shall be used in the interstices of multiple-conductor round cables with a common covering where necessary to give the completed cable a substantially circular cross section. Fillers shall be non-hygroscopic material, compatible with the cable insulation, jacket, and other components of the cable. The rubber-filled or other approved type of binding tape shall consist of a material that is compatible with the other components of the cable and shall be lapped at least 10 percent of its width.

2.1.8 Dimensional Tolerance

The outside diameters of single-conductor cables and of multiple-conductor cables shall not vary more than 5 percent and 10 percent, respectively, from the manufacturer's published catalog data.

2.2 INSTALLATION INSTRUCTIONS

The following information shall be provided by the cable manufacturer for each size, conductor quantity, and type of cable furnished:

a. Minimum bending radius, in inches - For multiple-conductor cables, this information shall be provided for both the individual conductors and the multiple-conductor cable.

b. Pulling tension and sidewall pressure limits, in pounds.

c. Instructions for stripping semiconducting insulation shields, if furnished, with minimum effort without damaging the insulation.

d. Upon request, compatibility of cable materials and construction with specific materials and hardware manufactured by others shall be stated. Also, if requested, recommendations shall be provided for various cable operations, including installing, splicing, terminating, etc.

2.3 TESTS, INSPECTIONS, AND VERIFICATIONS

2.3.1 Cable Data

Manufacture of the wire and cable shall not be started until all materials to be used in the fabrication of the finished wire or cable have been approved by the Contracting Officer. Cable data shall be submitted for approval including dimensioned sketches showing cable construction, and sufficient additional data to show that these specifications will be satisfied.

2.3.2 Inspection and Tests

Inspection and tests of wire and cable furnished under these specifications shall be made by and at the plant of the manufacturer, and shall be witnessed by the Contracting Officer or his authorized representative, unless waived in writing. The Government may perform further tests before or after installation. Testing in general shall comply with Section 6 of NEMA WC 7 or Part 6 of NEMA WC 8. Specific tests required for particular

materials, components, and completed cables shall be as specified in the sections of the above standards applicable to those materials, components, and cable types. Tests shall also be performed in accordance with the additional requirements specified below.

2.3.2.1 High-Voltage Test Source

Where the applicable standards allow a choice, high-voltage tests for cables to be used exclusively on dc circuits shall be made with dc test voltages. Cables to be used exclusively on ac circuits shall be tested with ac test voltages. If both ac and dc will be present, on either the same or separate conductors of the cable, ac test voltages shall be used.

2.3.2.2 Shielded Cables Rated 2,001 Volts or Greater

The following tests shall be performed in addition to those specified above. Section or paragraph references are to AEIC CS5 or AEIC CS6 as applicable, unless otherwise stated.

a. High potential test voltages shall be as required by Table B1 of AEIC CS5 or AEIC CS6 as applicable, rather than by Table 3-1 of NEMA WC 7 or NEMA WC 8.

b. If high potential testing is done with an ac test voltage as specified in paragraph HIGH-VOLTAGE TEST SOURCE, an additional test shall be made using a dc test voltage rated at 75 percent of the specified full dc test voltage, for 5 consecutive minutes.

c. Production sampling tests shall be performed in accordance with Section D. Sampling frequency and failure contingencies shall be in accordance with paragraph G.3. Unless otherwise approved, samples shall not be taken from the middle of extruder runs of insulation or shielding made only for one continuous shipping length of cable, if such sampling will result in the need to repair the sampled area.

d. Partial discharge tests shall be performed in accordance with Section E, paragraph E.2, and Section F.

2.3.2.3 Flame Tests

All multiple-conductor and single-conductor cable assemblies shall pass IEEE Std 383 flame tests, paragraph 2.5, using the ribbon gas burner. Single-conductor cables and individual conductors of multiple-conductor cables shall pass the flame test of NEMA WC 7, paragraph 7.7.3.1.3. If such tests, however, have previously been made on identical cables, these tests need not be repeated. Instead, certified reports of the original qualifying tests shall be submitted. In this case the reports furnished under paragraph REPORTS, shall verify that all of each cable's materials, construction, and dimensions are the same as those in the qualifying tests.

2.3.2.4 Independent Tests

The Government may at any time make visual inspections, continuity or resistance checks, insulation resistance readings, power factor tests, or dc high-potential tests at field test values. A cable's failure to pass these tests and inspections, or failure to produce readings consistent with acceptable values for the application, will be grounds for rejection of the cable.

2.3.2.5 Reports

Results of tests made shall be furnished. No wire or cable shall be shipped until authorized. Lot number and reel or coil number of wire and cable tested shall be indicated on the test reports.

PART 3 EXECUTION (Not Applicable)

WIRE TABLE

Item No.	Size, AWG or kcmil	No. of Conds.	Rated Circuit Voltage	Stranding	Comments	Quantity lin. ft.
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____

Class ___ stranding may be substituted for ___ where indicated by "*".

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16261N

VARIABLE FREQUENCY DRIVE SYSTEMS UNDER 600 VOLTS

09/99

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16261N

VARIABLE FREQUENCY DRIVE SYSTEMS UNDER 600 VOLTS
09/99

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

47 CFR 15	Radio Frequency Devices

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE Std 519	(1992) Harmonic Control in Electrical Power Systems
IEEE C62.41	(1991) Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-STD-461	(Rev. D) Control of Electromagnetic Interference Emissions and Susceptibility

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(1997) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ICS 1	(2000) Industrial Control and Systems: General Requirements
NEMA ICS 3.1	(1990) Construction and Guide for Selection, Installation and Operation of Adjustable-Speed Drive Systems
NEMA ICS 6	(1993; R 2001) Industrial Control and Systems: Enclosures
NEMA ICS 7	(1993) Industrial Control and Systems Adjustable-Speed Drives

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2002) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 489	(2002; Rev thru May 2003) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures

UL 508C (1996) Power Conversion Equipment

1.2 RELATED REQUIREMENTS

Section 16415A ELECTRICAL WORK, INTERIOR applies to this section with additions and modifications specified herein.

1.3 SYSTEM DESCRIPTION

1.3.1 Performance Requirements

1.3.1.1 Electromagnetic Interference Suppression

Computing devices, as defined by 47 CFR 15, MIL-STD-461 rules and regulations, shall be certified to comply with the requirements for class A computing devices and labeled as set forth in part 15.

1.3.1.2 Electromechanical and Electrical Components

Electrical and electromechanical components of the Variable Frequency Drive (VFD) shall not cause electromagnetic interference to adjacent electrical or electromechanical equipment while in operation.

1.3.2 Electrical Requirements

1.3.2.1 Power Line Surge Protection

IEEE C62.41, IEEE Std 519 Control panel shall have surge protection, included within the panel to protect the unit from damaging transient voltage surges. Surge arrestor shall be mounted near the incoming power source and properly wired to all three phases and ground. Fuses shall not be used for surge protection.

1.3.2.2 Sensor and Control Wiring Surge Protection

I/O functions as specified shall be protected against surges induced on control and sensor wiring installed outdoors and as shown. The inputs and outputs shall be tested in both normal mode and common mode using the following two waveforms:

a. A 10 microsecond by 1000 microsecond waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.

b. An 8 microsecond by 20 microsecond waveform with a peak voltage of 1000 volts and a peak current of 500 amperes.

1.4 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-02 Shop Drawings

Schematic diagrams; G-AE

Interconnecting diagrams; G-AE

Installation drawings; G-AE

Submit drawings for government approval prior to equipment construction or integration. Modifications to original drawings made during installation shall be immediately recorded for inclusion into the as-built drawings.

SD-03 Product Data

Variable frequency drives; G-AE

Wires and cables

Equipment schedule

Include data indicating compatibility with motors being driven.

SD-06 Test Reports

VFD Test

Performance Verification Tests

Endurance Test

SD-08 Manufacturer's Instructions

Installation instructions

SD-09 Manufacturer's Field Reports

VFD Factory Test Plan; G-AO

Factory test results

SD-10 Operation and Maintenance Data

Variable frequency drives, Data Package 4

Submit operation and maintenance manuals in accordance with Section 01781, "Operation and Maintenance Data." Provide service and maintenance information including preventive maintenance, assembly, and disassembly procedures. Include electrical drawings from electrical general sections. Submit additional information necessary to provide complete operation, repair, and maintenance information, detailed to the smallest replaceable unit. Include copies of as-built submittals. Provide routine preventative maintenance instructions, and equipment required. Provide instructions on how to modify program settings, and modify the control program. Provide instructions on drive adjustment, trouble-shooting, and configuration. Provide instructions on process tuning and system calibration.

1.5 QUALITY ASSURANCE

1.5.1 Schematic Diagrams

Show circuits and device elements for each replaceable module. Schematic diagrams of printed circuit boards are permitted to group functional assemblies as devices, provided that sufficient information is provided for government maintenance personnel to verify proper operation of the

functional assemblies.

1.5.2 Interconnecting Diagrams

Show interconnections between equipment assemblies, and external interfaces, including power and signal conductors. Include for enclosures and external devices.

1.5.3 Installation Drawings

Show floor plan of each site, with V.F.D.'s and motors indicated. Indicate ventilation requirements, adequate clearances, and cable routes.

1.5.4 Equipment Schedule

Provide schedule of equipment supplied. Schedule shall provide a cross reference between manufacturer data and identifiers indicated in shop drawings. Schedule shall include the total quantity of each item of equipment supplied. For complete assemblies, such as VFD's, provide the serial numbers of each assembly, and a sub-schedule of components within the assembly. Provide recommended spare parts listing for each assembly or component.

1.5.5 Installation instructions

Provide installation instructions issued by the manufacturer of the equipment, including notes and recommendations, prior to shipment to the site. Provide operation instructions prior to acceptance testing.

1.5.6 Factory Test Results

Document test results and submit to government within 7 working days after completion of test.

1.6 DELIVERY AND STORAGE

Equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, or other contaminants.

1.7 WARRANTY

The complete system shall be warranted by the manufacturer for a period of one year, or the contracted period of any extended warrantee agreed upon by the contractor and the Government, after successful completion of the acceptance test. Any component failing to perform its function as specified and documented shall be repaired or replaced by the contractor at no additional cost to the Government. Items repaired or replaced shall be warranted for an additional period of at least one year from the date that it becomes functional again, as specified in the FAR CLAUSE 52.246-21.

1.8 MAINTENANCE

1.8.1 Spare Parts

Manufacturers provide spare parts in accordance with recommended spare parts list.

1.8.2 Maintenance Support

During the warranty period, the Contractor shall provide on-site, on-call maintenance services by Contractor's personnel on the following basis: The service shall be on a per-call basis with 36 hour response. Contractor shall support the maintenanc e of all hardware and software of the system. Various personnel of different expertise shall be sent on-site depending on the nature of the maintenance service required. Costs shall include travel, local transportation, living expenses, and labor rates of the service personnel while responding to the service request. The provisions of this Section are not in lieu of, nor relieve the Contractor of, warranty responsibilities covered in this specification. Should the result of the service request be the uncovering of a system defect covered under the warranty provisions, all costs for the call, including the labor necessary to identify the defect, shall be borne by the Contractor.

PART 2 PRODUCTS

2.1 VARIABLE FREQUENCY DRIVES (VFD)

Provide frequency drive to control the speed of induction motor(s). The VFD shall include the following minimum functions, features and ratings.

a. Input circuit breaker per UL 489 with a minimum of 10,000 amps symmetrical interrupting capacity and door interlocked external operator.

b. A converter stage per UL 508C shall change fixed voltage, fixed frequency, ac line power to a fixed dc voltage. The converter shall utilize a full wave bridge design incorporating diode rectifiers. Silicon Controlled Rectifiers (SCR) are not acceptable. The converter shall be insensitive to three phase rotation of the ac line and shall not cause displacement power factor of less than .95 lagging under any speed and load condition.

c. An inverter stage shall change fixed dc voltage to variable frequency, variable voltage, ac for application to a standard NEMA design B squirrel cage motor. The inverter shall be switched in a manner to produce a sine coded pulse width modulated (PWM) output waveform.

d. The VFD shall be capable of supplying 150 percent of rated full load current for one minute at maximum ambient temperature.

e. The VFD shall be designed to operate from a 450 volt, + or - 10 percent, three phase, 60 Hz supply, and control motors with a corresponding voltage rating.

f. Acceleration and deceleration time shall be independently adjustable from one second to 60 seconds.

g. Adjustable full-time current limiting shall limit the current to a preset value which shall not exceed 120 percent of the controller rated current. The current limiting action shall maintain the V/Hz ratio constant so that variable torque can be maintained. Short time starting override shall allow starting current to reach 175 percent of controller rated current to maximum starting torque.

h. The controllers shall be capable of producing an output frequency

over the range of 3 Hz to 60 Hz (20 to one speed range), without low speed cogging. Over frequency protection shall be included such that a failure in the controller electronic circuitry shall not cause frequency to exceed 110 percent of the maximum controller output frequency selected.

i. Minimum and maximum output frequency shall be adjustable over the following ranges: 1) Minimum frequency 3 Hz to 50 percent of maximum selected frequency; 2) Maximum frequency 40 Hz to 60 Hz.

j. The controller efficiency at any speed shall not be less than 96 percent.

k. The controllers shall be capable of being restarted into a motor coasting in the forward direction without tripping.

l. Protection of power semiconductor components shall be accomplished without the use of fast acting semiconductor output fuses. Subjecting the controllers to any of the following conditions shall not result in component failure or the need for fuse replacment:

1. Short circuit at controller output

2. Ground fault at controller output

3. Open circuit at controller output

4. Input undervoltage

5. Input overvoltage

6. Loss of input phase

7. AC line switching transients

8. Instantaneous overload

9. Sustained overload exceeding 115 percent of controller rated current

10. Over temperature

11. Phase reversal

m. Solid state motor overload protection shall be included such that current exceeding an adjustable threshold shall activate a 60 second timing circuit. Should current remain above the threshold continuously for the timing period, the controller will automatically shut down.

n. A slip compensation circuit shall be included which will sense changing motor load conditions and adjust output frequency to provide speed regulation of NEMA B motors to within + / - 0.5 percent of maximum speed without the necessity of a tachometer generator.

o. The VFD shall be factory set for manual restart after the first protective circuit trip for malfunction (overcurrent,undervoltage, overvoltage or overtemperature) or an interruption of power. The

VFD shall be capable of being set for automatic restart after a selected time delay. If the drive faults again within a specified time period (adjustable 0-60 seconds), a manual restart will be required.

p. The VFD shall include external fault reset capability. All the necessary logic to accept an external fault reset contact shall be included.

q. Provide critical speed lockout circuitry to prevent operating at frequencies with critical harmonics that cause resonant vibrations. The VFD shall have a minimum of three user selectable bandwidths.

r. Provide the following operator control and monitoring devices mounted on the front panel of the VFD:

1. Manual speed potentiometer.

2. Hand-Off-Auto (HOA) switch.

3. Power on light.

4. Drive run power light.

5. Local display.

s. Provide properly sized NEMA rated by-pass and isolation contactors to enable operation of motor in the event of VFD failure. Mechanical and electrical interlocks shall be installed between the by-pass and isolation contactors. Provide a selector switch and transfer delay timer.

2.2 ENCLOSURES

Provide equipment enclosures conforming to NEMA 250, NEMA ICS 7, NEMA ICS 6.

2.3 WIRES AND CABLES

All wires and cables shall conform to NEMA 250, NEMA ICS 7, NFPA 70.

2.4 NAMEPLATES

Nameplates external to NEMA enclosures shall conform with the requirements of Section 16415A ELECTRICAL WORK, INTERIOR. Nameplates internal to enclosures shall be manufacturer's standard, with the exception that they must be permanent.

2.5 SOURCE QUALITY CONTROL

2.5.1 VFD Factory Test Plan

To ensure quality, each VFD shall be subject to a series of in-plant quality control inspections before approval for shipment from the manufacturer's facilities. Provide test plans and test reports.

PART 3 EXECUTION

3.1 INSTALLATION

Per NEMA ICS 3.1, install equipment in accordance with the approved manufacturer's printed installation drawings, instructions, wiring diagrams, and as indicated on project drawings and the approved shop drawings. A field representative of the drive manufacturer shall supervise the installation of all equipment, and wiring.

3.2 FIELD QUALITY CONTROL

Specified products shall be tested as a system for conformance to specification requirements prior to scheduling the acceptance tests. Contractor shall conduct performance verification tests in the presence of Government representative, observing and documenting complete compliance of the system to the specifications. Contractor shall submit a signed copy of the test results, certifying proper system operation before scheduling tests.

3.2.1 VFD Test

A proposed test plan shall be submitted to the contracting officer at least 28 calendar days prior to proposed testing for approval. The tests shall conform to NEMA ICS 1, NEMA ICS 7, and all manufacturer's safety regulations. The Government reserves the right to witness all tests and review any documentation. The contractor shall inform the Government at least 14 working days prior to the dates of testing. Contractor shall provide video tapes, if available, of all training provided to the Government for subsequent use in training new personnel. All training aids, texts, and expendable support material for a self-sufficient presentation shall be provided, the amount of which to be determined by the contracting officer.

3.2.2 Performance Verification Tests

"Performance Verification Test" plan shall provide the step by step procedure required to establish formal verification of the performance of the VFD. Compliance with the specification requirements shall be verified by inspections, review of critical data, demonstrations, and tests. The Government reserves the right to witness all tests, review data, and request other such additional inspections and repeat tests as necessary to ensure that the system and provided services conform to the stated requirements. The contractor shall inform the Government 14 calendar days prior to the date the test is to be conducted.

3.2.3 Endurance Test

Immediately upon completion of the performance verification test, the endurance test shall commence. The system shall be operated at varying rates for not less than 192 consecutive hours, at an average effectiveness level of .9998, to demonstrate proper functioning of the complete PCS. Continue the test on a day-to-day basis until performance standard is met. During the endurance test, the contractor shall not be allowed in the building. The system shall respond as designed.

3.3 DEMONSTRATION

3.3.1 Training

Coordinate training requirements with the Contracting Officer.

3.3.1.1 Instructions to Government Personnel

Provide the services of competent instructors who will give full instruction to designated personnel in operation, maintenance, calibration, configuration, and programming of the complete control system. Orient the training specifically to the system installed. Instructors shall be thoroughly familiar with the subject matter they are to teach. The Government personnel designated to attend the training will have a high school education or equivalent. The number of training days of instruction furnished shall be as specified. A training day is defined as eight hours of instruction, including two 15-minute breaks and excluding lunch time; Monday through Friday. Provide a training manual for each student at each training phase which describes in detail the material included in each training program. Provide one additional copy for archiving. Provide equipment and materials required for classroom training. Provide a list of additional related courses, and offers, noting any courses recommended. List each training course individually by name, including duration, approximate cost per person, and location of course. Unused copies of training manuals shall be turned over to the Government at the end of last training session.

3.3.1.2 Operating Personnel Training Program

Provide one 2 hour training session at the site at a time and place mutually agreeable between the Contractor and the Government. Provide session to train 4 operation personnel in the functional operations of the system and the procedures that personnel will follow in system operation. This training shall include:

a. System overview

b. General theory of operation

c. System operation

d. Alarm formats

e. Failure recovery procedures

f. Troubleshooting

3.3.1.3 Engineering/Maintenance Personnel Training

Accomplish the training program as specified. Training shall be conducted on site at a location designated by the Government. Provide a one day training session to train 4 engineering personnel in the functional operations of the system. This training shall include:

a. System overview

b. General theory of operation

c. System operation

d. System configuration

e. Alarm formats

f. Failure recovery procedures

g. Troubleshooting and repair

h. Maintenance and calibration

i. System programming and configuration

-- End of Section --

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SECTION 16375A

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SECTION 16375A

ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND
02/02

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C119.1	(1986; R 1997) Sealed Insulated Underground Connector Systems Rated 600 Volts
ANSI C29.1	(1988; R 1996) Electrical Power Insulators - Test Methods
ANSI C57.12.21	(1995) Requirements for Pad-Mounted, Compartmental-Type, Self-Cooled, Single-Phase Distribution Transformers with High-Voltage Bushings; (High-Voltage, 34 500 Grd Y/19 920 Volts and Below; Low-Voltage, 240/120; 167 kVA and Smaller)
ANSI C57.12.26	(1993) Pad-Mounted Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers for Use with Separable Insulated High-Voltage Connectors, High-Voltage, 34 500 Grd Y/19 920 Volts and Below; 2500 kVA and Smaller
ANSI C62.2	(1987; R 1994) Guide for the Application of Gapped Silicon-Carbide Surge Arresters for Alternating Current Systems
ANSI C80.1	(1995) Rigid Steel Conduit - Zinc Coated
ANSI O5.1	(1992) Specifications and Dimensions for Wood Poles

ASTM INTERNATIONAL (ASTM)

ASTM A 123/A 123M	(2002) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(2001a) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 48	(1994ae1) Gray Iron Castings
ASTM B 117	(1997) Operating Salt Spray (Fog) Apparatus

ASTM B 231/B 231M	(1999) Concentric-Lay-Stranded Aluminum 1350 Conductors
ASTM B 400	(1994) Compact Round Concentric-Lay-Stranded Aluminum 1350 Conductor
ASTM B 609/B 609M	(1999) Aluminum 1350 Round Wire, Annealed and Intermediate Tempers, for Electrical purposes
ASTM B 8	(1999) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM C 478	(2002a) Precast Reinforced Concrete Manhole Sections
ASTM C 478M	(1997) Precast Reinforced Concrete Manhole Sections (Metric)
ASTM D 1654	(1992; R 2000) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D 4059	(1996) Analysis of Polychlorinated Biphenyls in Insulating Liquids by Gas Chromatography
ASTM D 923	(1997) Sampling Electrical Insulating Liquids

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

AEIC CS5	(1994; CS5a-1995) Insulated Shielded Power Cables Rated 5 Through 46 kV
AEIC CS6	(1996) Ethylene Propylene Rubber Insulated Shielded Power Cables Rated 69 kV

FM GLOBAL (FM)

FM P7825a	(2003) Approval Guide Fire Protection

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(1997) National Electrical Safety Code
IEEE C37.20.1	(1993) Metal-Enclosed Low-Voltage Power Circuit-Breaker Switchgear
IEEE C37.20.2	(1993; C37.20.2b) Metal-Clad and Station-Type Cubicle Switchgear
IEEE C37.20.3	(1997) Metal-Enclosed Interrupter Switchgear
IEEE C37.34	(1994) Test Code for High-Voltage Air Switches

IEEE C37.41	(1994; C37.41c) Design Tests for High-Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches, and Accessories
IEEE C37.63	(1997) Requirements for Overhead, Pad-Mounted, Dry-Vault, and Submersible Automatic Line Sectionalizer for AC Systems
IEEE C37.90.1	(1989; R 1994) IEEE Standard Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems
IEEE C37.98	(1987; R 1991) Seismic Testing of Relays
IEEE C57.12.00	(1993) Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
IEEE C57.13	(1993) Instrument Transformers
IEEE C57.98	(1993) Guide for Transformer Impulse Tests \$avail only as part of Distribution, Power, and Regulating Transformers Stds Collection
IEEE C62.1	(1989; R 1994) Surge Arresters for AC Power Circuits
IEEE C62.11	(1999) IEEE Standard Metal-Oxide Surge Arresters for AC Power Circuits
IEEE Std 100	(1997) IEEE Standard Dictionary of Electrical and Electronics Terms
IEEE Std 242	(1986; R 1991) Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
IEEE Std 386	(1995) Separable Insulated Connector Systems for Power Distribution Systems Above 600V
IEEE Std 399	(1997) Recommended Practice for Industrial and Commercial Power Systems Analysis
IEEE Std 404	(1993) Cable Joints for Use with Extruded Dielectric Cable Rated 5000 V Through 138 000 V and Cable Joints for Use with Laminated Dielectric Cable Rated 2500 V Through 500 000 V
IEEE Std 48	(1998) Standard Test Procedures and Requirements for Alternating-Current Cable Terminations 2.5 kV through 765 kV
IEEE Std 592	(1990; R 1996) Exposed Semiconducting Shields on Premolded High Voltage Cable

	Joints and Separable Insulated Connectors
IEEE Std 81	(1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Part 1) \$31.00$\F

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA FB 1	(1993) Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies
NEMA LA 1	(1992) Surge Arresters
NEMA TC 6	(1990) PVC and ABS Plastic Utilities Duct for Underground Installation
NEMA WC 7	(1988; Rev 3 1996) Cross-Linked-Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
NEMA WC 8	(1988; Rev 3 1996) Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2002) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 1242	(1996; Rev Mar 1998) Intermediate Metal Conduit
UL 467	(1993; Rev thru Apr 1999) Grounding and Bonding Equipment
UL 486A	(1997; Rev thru Dec 1998) Wire Connectors and Soldering Lugs for Use with Copper Conductors
UL 486B	(1997; Rev Jun 1997) Wire Connectors for Use with Aluminum Conductors
UL 510	(1994; Rev thru Apr 1998) Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape
UL 514A	(1996; Rev Dec 1999) Metallic Outlet Boxes
UL 6	(1997) Rigid Metal Conduit
UL 651	(1995; Rev thru Oct 1998) Schedule 40 and 80 Rigid PVC Conduit

1.2 GENERAL REQUIREMENTS

1.2.1 Terminology

Terminology used in this specification is as defined in IEEE Std 100.

1.2.2 Service Conditions

Items provided under this section shall be specifically suitable for the following service conditions. Seismic details shall conform to Division 13 and as indicated.

b. Altitude 1667 feet

c. Ambient Temperature 89 degrees F

d. Frequency 60 HZ

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Electrical Distribution System; G-AE

Detail drawings consisting of equipment drawings, illustrations, schedules, instructions, diagrams manufacturers standard installation drawings and other information necessary to define the installation and enable the Government to check conformity with the requirements of the contract drawings.

If departures from the contract drawings are deemed necessary by the Contractor, complete details of such departures shall be included with the detail drawings. Approved departures shall be made at no additional cost to the Government.

Detail drawings shall show how components are assembled, function together and how they will be installed on the project. Data and drawings for component parts of an item or system shall be coordinated and submitted as a unit. Data and drawings shall be coordinated and included in a single submission. Multiple submissions for the same equipment or system are not acceptable except where prior approval has been obtained from the Contracting Officer. In such cases, a list of data to be submitted later shall be included with the first submission. Detail drawings shall consist of the following:

a. Detail drawings showing physical arrangement, construction details, connections, finishes, materials used in fabrication, provisions for conduit or busway entrance, access requirements for installation and maintenance, physical size, electrical characteristics, foundation and support details, and equipment

weight. Drawings shall be drawn to scale and/or dimensioned. All optional items shall be clearly identified as included or excluded.

b. Internal wiring diagrams of equipment showing wiring as actually provided for this project. External wiring connections shall be clearly identified.

Detail drawings shall as a minimum depict the installation of the following items:

a. Medium-voltage cables and accessories including cable installation plan.

b. Transformers.

d. Switchgear.

e. Pad-mounted loadbreak sectionalizers.

f. Manholes and overhead distribution drops.

g. Surge arresters.

As-Built Drawings; G-AO

The as-built drawings shall be a record of the construction as installed. The drawings shall include the information shown on the contract drawings as well as deviations, modifications, and changes from the contract drawings, however minor. The as-built drawings shall be a full sized set of prints marked to reflect deviations, modifications, and changes. The as-built drawings shall be complete and show the location, size, dimensions, part identification, and other information. Additional sheets may be added. The as-built drawings shall be jointly inspected for accuracy and completeness by the Contractor's quality control representative and by the Contracting Officer prior to the submission of each monthly pay estimate. Upon completion of the work, the Contractor shall provide three full sized sets of the marked prints to the Contracting Officer for approval. If upon review, the as-built drawings are found to contain errors and/or omissions, they will be returned to the Contractor for correction. The Contractor shall correct and return the as-built drawings to the Contracting Officer for approval within 10 calendar days from the time the drawings are returned to the Contractor.

SD-03 Product Data

Fault Current Analysis; G-AE
Protective Device; G-AE
Coordination Study; G-AE

The study shall be submitted with protective device equipment submittals. No time extension or similar contract modifications will be granted for work arising out of the requirements for this study. Approval of protective devices proposed shall be based on recommendations of this study. The Government shall not be held responsible for any changes to equipment, device ratings, settings, or additional labor for installation of equipment or

devices ordered and/or procured prior to approval of the study.

Nameplates; G-AO

Catalog cuts, brochures, circulars, specifications, product data, and printed information in sufficient detail and scope to verify compliance with the requirements of the contract documents.

Material and Equipment; G-AO

A complete itemized listing of equipment and materials proposed for incorporation into the work. Each entry shall include an item number, the quantity of items proposed, and the name of the manufacturer of each such item.

General Installation Requirements; G-AO

As a minimum, installation procedures for transformers, substations, switchgear, and medium-voltage cable terminations and splices.

Procedures shall include cable pulling plans, diagrams, instructions, and precautions required to install, adjust, calibrate, and test the devices and equipment.

SD-06 Test Reports

Factory Tests; G-AO

Certified factory test reports shall be submitted when the manufacturer performs routine factory tests, including tests required by standards listed in paragraph REFERENCES. Results of factory tests performed shall be certified by the manufacturer, or an approved testing laboratory, and submitted within 7 days following successful completion of the tests. The manufacturer's pass-fail criteria for tests specified in paragraph FIELD TESTING shall be included.

Field Testing; G-AE

A proposed field test plan, 20 days prior to testing the installed system. No field test shall be performed until the test plan is approved. The test plan shall consist of complete field test procedures including tests to be performed, test equipment required, and tolerance limits.

Operating Tests; G-RE

Six copies of the information described below in 8-1/2 by 11 inch binders having a minimum of three rings, including a separate section for each test. Sections shall be separated by heavy plastic dividers with tabs.

a. A list of equipment used, with calibration certifications.

b. A copy of measurements taken.

c. The dates of testing.

d. The equipment and values to be verified.

e. The condition specified for the test.

f. The test results, signed and dated.

g. A description of adjustments made.

Cable Installation; G-AO

Six copies of the information described below in 8-1/2 by 11 inch binders having a minimum of three rings from which material may readily be removed and replaced, including a separate section for each cable pull. Sections shall be separated by heavy plastic dividers with tabs, with all data sheets signed and dated by the person supervising the pull.

a. Site layout drawing with cable pulls numerically identified.

b. A list of equipment used, with calibration certifications. The manufacturer and quantity of lubricant used on pull.

c. The cable manufacturer and type of cable.

d. The dates of cable pulls, time of day, and ambient temperature.

e. The length of cable pull and calculated cable pulling tensions.

f. The actual cable pulling tensions encountered during pull.

SD-07 Certificates

Material and Equipment; G-AO

Where materials or equipment are specified to conform to the standards of the Underwriters Laboratories (UL) or to be constructed or tested, or both, in accordance with the standards of the American National Standards Institute (ANSI), the Institute of Electrical and Electronics Engineers (IEEE), or the National Electrical Manufacturers Association (NEMA), the Contractor shall submit proof that the items provided conform to such requirements. The label of, or listing by, UL will be acceptable as evidence that the items conform. Either a certification or a published catalog specification data statement, to the effect that the item is in accordance with the referenced ANSI or IEEE standard, will be acceptable as evidence that the item conforms. A similar certification or published catalog specification data statement to the effect that the item is in accordance with the referenced NEMA standard, by a company listed as a member company of NEMA, will be acceptable as evidence that the item conforms. In lieu of such certification or published data, the Contractor may submit a certificate from a recognized testing agency equipped and competent to perform such services, stating that the items have been tested and that they conform to the requirements listed, including methods of testing of the specified agencies. Compliance with above-named requirements does not relieve the Contractor from compliance with any other requirements of the

specifications.

Cable Joints; G-AO

A certification that contains the names and the qualifications of people recommended to perform the splicing and termination of medium-voltage cables approved for installation under this contract. The certification shall indicate that any person recommended to perform actual splicing and terminations has been adequately trained in the proper techniques and have had at least three recent years of experience in splicing and terminating the same or similar types of cables approved for installation. In addition, any person recommended by the Contractor may be required to perform a practice splice and termination, in the presence of the Contracting Officer, before being approved as a qualified installer of medium-voltage cables. If that additional requirement is imposed, the Contractor shall provide short sections of the approved types of cables along with the approved type of splice and termination kits, and detailed manufacturer's instruction for the proper splicing and termination of the approved cable types.

Cable Installer Qualifications; G-AO

The Contractor shall provide at least one onsite person in a supervisory position with a documentable level of competency and experience to supervise all cable pulling operations. A resume shall be provided showing the cable installers' experience in the last three years, including a list of references complete with points of contact, addresses and telephone numbers.

SD-10 Operation and Maintenance Data

Electrical Distribution System; G-AO

Six copies of operation and maintenance manuals, within 7 calendar days following the completion of tests and including assembly, installation, operation and maintenance instructions, spare parts data which provides supplier name, current cost, catalog order number, and a recommended list of spare parts to be stocked. Manuals shall also include data outlining detailed procedures for system startup and operation, and a troubleshooting guide which lists possible operational problems and corrective action to be taken. A brief description of all equipment, basic operating features, and routine maintenance requirements shall also be included. Documents shall be bound in a binder marked or identified on the spine and front cover. A table of contents page shall be included and marked with pertinent contract information and contents of the manual. Tabs shall be provided to separate different types of documents, such as catalog ordering information, drawings, instructions, and spare parts data. Index sheets shall be provided for each section of the manual when warranted by the quantity of documents included under separate tabs or dividers.

Three additional copies of the instructions manual shall be provided within 30 calendar days following the manuals.

1.4 DELIVERY, STORAGE, AND HANDLING

Devices and equipment shall be visually inspected by the Contractor when received and prior to acceptance from conveyance. Stored items shall be protected from the environment in accordance with the manufacturer's published instructions. Damaged items shall be replaced. Oil filled transformers and switches shall be stored in accordance with the manufacturer's requirements. Wood poles held in storage for more than 2 weeks shall be stored in accordance with ANSI O5.1. Handling of wood poles shall be in accordance with ANSI O5.1, except that pointed tools capable of producing indentations more than 1 inch in depth shall not be used. Metal poles shall be handled and stored in accordance with the manufacturer's instructions.

1.5 EXTRA MATERIALS

One additional spare fuse or fuse element for each furnished fuse or fuse element shall be delivered to the contracting officer when the electrical system is accepted. Two complete sets of all special tools required for maintenance shall be provided, complete with a suitable tool box. Special tools are those that only the manufacturer provides, for special purposes (to access compartments, or operate, adjust, or maintain special parts).

PART 2 PRODUCTS

2.1 STANDARD PRODUCT

Material and equipment shall be the standard product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Items of the same classification shall be identical including equipment, assemblies, parts, and components.

2.2 NAMEPLATES

2.2.1 General

Each major component of this specification shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a nameplate securely attached to the equipment. Nameplates shall be made of noncorrosive metal. Equipment containing liquid dielectrics shall have the type of dielectric on the nameplate. Sectionalizer switch nameplates shall have a schematic with all switch positions shown and labeled. As a minimum, nameplates shall be provided for transformers, circuit breakers, meters, switches, and switchgear.

2.2.2 Liquid-Filled Transformer Nameplates

Power transformers shall be provided with nameplate information in accordance with IEEE C57.12.00. Nameplates shall indicate the number of gallons and composition of liquid-dielectric, and shall be permanently marked with a statement that the transformer dielectric to be supplied is non-polychlorinated biphenyl. If transformer nameplate is not so marked, the Contractor shall furnish manufacturer's certification for each transformer that the dielectric is non-PCB classified, with less than 50 ppm PCB content in accordance with paragraph LIQUID DIELECTRICS. Certifications shall be related to serial numbers on transformer nameplates. Transformer dielectric exceeding the 50 ppm PCB content or transformers without certification will be considered as PCB insulated and

will not be accepted.

2.3 CORROSION PROTECTION

2.3.1 Ferrous Metal Materials

2.3.1.1 Hardware

Ferrous metal hardware shall be hot-dip galvanized in accordance with ASTM A 153/A 153M and ASTM A 123/A 123M.

2.3.1.2 Equipment

Equipment and component items, including but not limited to transformer stations and ferrous metal luminaries not hot-dip galvanized or porcelain enamel finished, shall be provided with corrosion-resistant finishes which shall withstand 120 hours of exposure to the salt spray test specified in ASTM B 117 without loss of paint or release of adhesion of the paint primer coat to the metal surface in excess of 1/16 inch from the test mark. The scribed test mark and test evaluation shall be in accordance with ASTM D 1654 with a rating of not less than 7 in accordance with TABLE 1, (procedure A). Cut edges or otherwise damaged surfaces of hot-dip galvanized sheet steel or mill galvanized sheet steel shall be coated with a zinc rich paint conforming to the manufacturer's standard.

2.3.2 Finishing

Painting required for surfaces not otherwise specified and finish painting of items only primed at the factory shall be as specified in Section 09900 PAINTS AND COATINGS.

2.4 CABLES

Cables shall be single conductor type unless otherwise indicated.

2.4.1 Medium-Voltage Cables

2.4.1.1 General

Cable construction shall be Okonite-Okogaurd' Uro-Type MV, concentric neutral underground distribution cable conforming to AEIC CS5 and NEMA WC 7. Cables shall be manufactured for use in duct or direct burial applications as indicated.

2.4.1.2 Ratings

Cables shall be rated for a circuit voltage of 15 kV.

2.4.1.3 Conductor Material

Underground cables shall be aluminum alloy 1350, 3/4 hard minimum complying with ASTM B 609/B 609M and ASTM B 231/B 231M for regular concentric and compressed stranding or ASTM B 400 for compacted stranding.

2.4.1.4 Insulation

Cable insulation shall be ethylene-propylene-rubber (EPR) insulation conforming to the requirements of NEMA WC 8 and AEIC CS6. A 133 percent insulation level shall be used on 5 kV, 15 kV and 25 kV rated cables. The

Contractor shall comply with EPA requirements in accordance with Section 01670 RECYCLED / RECOVERED MATERIALS.

2.4.1.5 Shielding

Cables rated for 2 kV and above shall have a semiconducting conductor shield, a semiconducting insulation shield, and an overall copper wire shield for each phase. The shield wire shall be sized to meet IEEE C2 requirements for a ground fault availability of 50,000amperes.

2.4.1.6 Neutrals

Concentric neutrals conductors shall be tinned copper, having a combined ampacity equal to 1/3 of the phase conductor ampacity rating.

2.4.1.7 Jackets

Cables shall be provided with a PVC jacket. Direct buried cables shall be rated for direct burial.

2.4.2 Low-Voltage Cables

Cables shall be rated 600 volts and shall conform to the requirements of NFPA 70, and must be UL listed for the application or meet the applicable section of either ICEA or NEMA standards.

2.4.2.1 Insulation

Insulation must be in accordance with NFPA 70, and must be UL listed for the application or meet the applicable sections of either ICEA, or NEMA standards.

2.4.2.2 Jackets

Multiconductor cables shall have an overall PVC outer jacket.

2.4.2.3 In Duct

Cables shall be single-conductor cable, in accordance with NFPA 70.

2.5 CABLE JOINTS, TERMINATIONS, AND CONNECTORS

2.5.1 Medium-Voltage Cable Joints

Medium-voltage cable joints shall comply with IEEE Std 404 and IEEE Std 592. Medium-voltage cable terminations shall comply with IEEE Std 48. Joints shall be the standard products of a manufacturer and shall be either of the factory preformed type or of the kit type containing tapes and other required parts. Joints shall have ratings not less than the ratings of the cables on which they are installed. Splice kits may be of the heat-shrinkable type for voltages up to 15 kV, of the premolded splice and connector type, the conventional taped type, or the resin pressure-filled overcast taped type for voltages up to 35 kV; except that for voltages of 7.5 kV or less a resin pressure-filled type utilizing a plastic-tape mold is acceptable. Joints used in manholes, handholes, vaults and pull boxes shall be certified by the manufacturer for waterproof, submersible applications.

2.5.2 Medium-Voltage Separable Insulated Connectors

Separable insulated connectors shall comply with IEEE Std 386 and IEEE Std 592 and shall be of suitable construction or standard splice kits shall be used. Separable insulated connectors are acceptable for voltages up to 35 kV. Connectors shall be of the loadbreak type as indicated, of suitable construction for the application and the type of cable connected, and shall include cable shield adaptors. Separable insulated connectors shall not be used as substitutes for conventional permanent splices. External clamping points and test points shall be provided.

2.5.3 Low-Voltage Cable Splices

Low-voltage cable splices and terminations shall be rated at not less than 600 Volts. Splices in conductors No. 10 AWG and smaller shall be made with an insulated, solderless, pressure type connector, conforming to the applicable requirements of UL 486A. Splices in conductors No. 8 AWG and larger shall be made with noninsulated, solderless, pressure type connector, conforming to the applicable requirements of UL 486A and UL 486B. Splices shall then be covered with an insulation and jacket material equivalent to the conductor insulation and jacket. Splices below grade or in wet locations shall be sealed type conforming to ANSI C119.1 or shall be waterproofed by a sealant-filled, thick wall, heat shrinkable, thermosetting tubing or by pouring a thermosetting resin into a mold that surrounds the joined conductors.

2.5.4 Terminations

Terminations shall be in accordance with IEEE Std 48, Class 1 or Class 2; of the molded elastomer, wet-process porcelain, prestretched elastomer, heat-shrinkable elastomer, or taped type. Acceptable elastomers are track-resistant silicone rubber or track-resistant ethylene propylene compounds, such as ethylene propylene rubber or ethylene propylene diene monomer. Separable insulated connectors may be used for apparatus terminations, when such apparatus is provided with suitable bushings. Terminations shall be of the outdoor type, except that where installed inside outdoor equipment housings which are sealed against normal infiltration of moisture and outside air, indoor, Class 2 terminations are acceptable. Class 3 terminations are not acceptable. Terminations, where required, shall be provided with mounting brackets suitable for the intended installation and with grounding provisions for the cable shielding, metallic sheath, and armor.

2.5.4.1 Factory Preformed Type

Molded elastomer, wet-process porcelain, prestretched, and heat-shrinkable terminations shall utilize factory preformed components to the maximum extent practicable rather than tape build-up. Terminations shall have basic impulse levels as required for the system voltage level. Leakage distances shall comply with wet withstand voltage test requirements of IEEE Std 48 for the next higher Basic Insulation Level (BIL) level. Anti-tracking tape shall be applied over exposed insulation of preformed molded elastomer terminations.

2.5.4.2 Taped Terminations

Taped terminations shall use standard termination kits providing terminal connectors, field-fabricated stress cones, and rain hoods. Terminations shall be at least 46 inches long from the end of the tapered cable jacket

to the start of the terminal connector, or not less than the kit manufacturer's recommendations, whichever is greater.

2.6 CONDUIT AND DUCTS

Duct lines shall be concrete-encased, thin-wall type.

2.6.1 Metallic Conduit

Intermediate metal conduit shall comply with UL 1242. Rigid galvanized steel conduit shall comply with UL 6 and ANSI C80.1. Metallic conduit fittings and outlets shall comply with UL 514A and NEMA FB 1.

2.6.2 Nonmetallic Ducts

2.6.2.1 Concrete Encased Ducts

UL 651 Schedule 40 or NEMA TC 6 Type EB.

2.6.2.2 Direct Burial

UL 651 Schedule 40 and Schedule 80 , or NEMA TC 6 Type DB.

2.6.3 Conduit Sealing Compound

Compounds for sealing ducts and conduit shall have a putty-like consistency workable with the hands at temperatures as low as 35 degrees F, shall neither slump at a temperature of 300 degrees F, nor harden materially when exposed to the air. Compounds shall adhere to clean surfaces of fiber or plastic ducts; metallic conduits or conduit coatings; concrete, masonry, or lead; any cable sheaths, jackets, covers, or insulation materials; and the common metals. Compounds shall form a seal without dissolving, noticeably changing characteristics, or removing any of the ingredients. Compounds shall have no injurious effect upon the hands of workmen or upon materials.

2.7 MANHOLES, HANDHOLES, AND PULLBOXES

Manholes, handholes, and pullboxes shall be as indicated. Strength of manholes, handholes, and pullboxes and their frames and covers shall conform to the requirements of IEEE C2. Precast-concrete manholes shall have the required strength established by ASTM C 478, ASTM C 478M. Frames and covers shall be made of gray cast iron and a machine-finished seat shall be provided to ensure a matching joint between frame and cover. Cast iron shall comply with ASTM A 48, Class 30B, minimum. Handholes for low voltage cables installed in parking lots, sidewalks, and turfed areas shall be fabricated from an aggregate consisting of sand and with continuous woven glass strands having an overall compressive strength of at least 10,000 psi and a flexural strength of at least5,000 psi. Pullbox and handhole covers in sidewalks, and turfed areas shall be of the same material as the box. Concrete pullboxes shall consist of precast reinforced concrete boxes, extensions, bases, and covers.

2.8 TRANSFORMERS, SUBSTATIONS, AND SWITCHGEAR

Transformers, substations, and switchgear shall be of the outdoor type having the ratings and arrangements indicated. Medium-voltage ratings of cable terminations shall be 15 kV between phases for 133 percent insulation level.

2.8.1 Pad-Mounted Transformers

Pad-mounted transformers shall comply with ANSI C57.12.26 and shall be of the loop feed type. Pad-mounted transformer stations shall be assembled and coordinated by one manufacturer and each transformer station shall be shipped as a complete unit so that field installation requirements are limited to mounting each unit on a concrete pad and connecting it to primary and secondary lines. Stainless steel pins and hinges shall be provided. Barriers shall be provided between high- and low-voltage compartments. High-voltage compartment doors shall be interlocked with low-voltage compartment doors to prevent access to any high-voltage section unless its associated low-voltage section door has first been opened. Compartments shall be sized to meet the specific dimensional requirements of ANSI C57.12.26. Pentahead locking bolts shall be provided with provisions for a padlock. Pad-mounted transformer color shall match Base standard.

2.8.1.1 High-Voltage Compartments

The high-voltage compartment shall be dead-front construction. Primary switching and protective devices shall include loadbreak switching, drawout, dry-well-mounted, current-limiting fuses or oil-immersed, current-limiting, bayonet-type fuses, medium-voltage separable loadbreak connectors, universal bushing wells and inserts or integral one piece bushings and surge arresters. Fuses shall comply with the requirements of paragraph METERING AND PROTECTIVE DEVICES. The switch shall be mounted inside transformer tank with switch operating handle located in high-voltage compartment and equipped with metal loop for hook stick operation. Fuses shall be interlocked with switches so that fuses can be removed only when the associated switch is in the "OPEN" position. Adjacent to medium-voltage cable connections, a nameplate or equivalent stencilled inscription shall be provided inscribed "DO NOT OPEN CABLE CONNECTORS UNLESS SWITCH IS OPEN." Surge arresters shall be fully insulated and configured to terminate on Bushings of the pad mount sectionalizer as shown on the drawings..

2.8.1.2 Load-Break Switch

Loop feed sectionalizer switches: Provide three, two-position, oil-immersed type switches to permit closed transition loop feed and sectionalizing. Each switch shall be rated at 15 kV, 95 kV BIL, with a continuous current rating and load-break rating of 200 amperes, and a make-and-latch rating of 10,000 rms amperes symmetrical. Locate the switch handle in the high-voltage compartment. Operation of switches shall be as follows:

ARRANGEMENT #	DESCRIPTION OF SWITCH ARRANGEMENT	SWITCH POSITION LINE A SW OPEN	LINE A SW CLOSE	LINE B SW OPEN	LINE B SW CLOSE	XFMR SW OPEN	XFMR SW CLOSE
1	Line A connected to Line B and both lines connected to transformer		X		X		X
2	Transformer connected to Line A only		X	X			X

ARRANGEMENT #	DESCRIPTION OF SWITCH ARRANGEMENT	SWITCH POSITION LINE A SW OPEN	LINE A SW CLOSE	LINE B SW OPEN	LINE B SW CLOSE	XFMR SW OPEN	XFMR SW CLOSE
3	Transformer connected to Line B only	X			X		X
4	Transformer open and loop closed		X		X	X	
5	Transformer open and loop open	X		X		X	

2.8.1.3 Transformer Tank Sections

Transformers shall comply with IEEE C57.12.00, ANSI C57.12.21, and ANSI C57.12.26 and shall be of the mineral oil-insulated typeor dimethyl silicone liquid. Transformers shall be suitable for outdoor use and shall have 2 separate windings per phase. Standard NEMA primary taps shall be provided. Where primary taps are not specified, 4, 2-1/2 percent rated kVA high-voltage taps shall be provided 2 above and 2 below rated, primary voltage. Operating handles for primary tap changers for de-energized operation shall be located within high-voltage compartments, externally to transformer tanks. Adjacent to the tap changer operating handle, a nameplate or equivalent stenciled inscription shall be provided and inscribed "DO NOT OPERATE UNDER LOAD." Transformer ratings at 60 Hz shall be as follows:

Three-phase capacity..... kVA, as indicated on drawings.

Impedance.....5.75%.

Temperature Rise.....65 degrees C.

High-voltage winding.....15,000 volts.

High-voltage winding connections.....12,470 volts.

Low-voltage winding.....480 volts.

Low-voltage winding connections..... ..... 480/277

2.8.1.4 Low-Voltage Cable Compartments

Neutrals shall be provided with fully-insulated bushings. Clamp type cable terminations, suitable for copper conductors entering from below, shall be provided as necessary.

2.8.1.5 Accessories

High-voltage warning signs shall be permanently attached to each side of transformer stations. Voltage warning signs shall comply with IEEE C2. Copper-faced steel or stainless steel ground connection pads shall be

provided in both the high- and low-voltage compartments. Dial-type thermometer, liquid-level gauge, and drain valve with built-in sampling device shall be provided for each transformer station. Insulated-bushing-type parking stands shall be provided adjacent to each separable load-break elbow to provide for cable isolation during sectionalizing operations.

2.8.2 Pad-Mounted Sectionalizers

Pad-mounted, sectionalizing enclosures shall conform to the requirements of IEEE C37.63. The enclosures shall be configured with 4 sets of 200 amp load break bushings and parking stands. Enclosure shall be weatherproof and have a hinged cover. Provide concrete base as shown. Enclosure color shall math Base standard. 2.8.3 Cable Terminating Cabinets

Cable terminating cabinets shall be hook-stick operable, deadfront construction conforming to the requirements of IEEE C37.20.3, Category A. Cabinets shall be provided with with 200 A. loadbreak junctions and elbow-type separable loadbreak connectors, cable parking stands, and grounding lugs. The cable terminating equipments shall conform to IEEE Std 386.

Ratings at 60 Hz shall be:

Nominal voltage (kV).....15.

Rated maximum voltage (kV).....12.5.

Rated continuous current (A).....200.

Three-second short-time current-carrying capacity (kA).....50.

BIL (kV).....95.

2.9 METERING AND PROTECTIVE DEVICES

2.9.1 Circuit Breakers, Low-Voltage

2.10 SURGE ARRESTERS

Surge arresters shall comply with NEMA LA 1, IEEE C62.1, ANSI C62.2, and IEEE C62.11 and shall be provided where indicated. Arresters shall be intermediate class, rated as shown. Arresters for use at elevations in excess of 6000 feet above mean sea level shall be specifically rated for that purpose. Arresters shall be equipped with mounting brackets suitable for the indicated installations. Arresters shall be of the valve or metal-oxide varistor or combination valve-metal-oxide varistor type.

2.11 GROUNDING AND BONDING

2.11.1 Driven Ground Rods

Ground rods shall be copper-clad steel conforming to UL 467 not less than 3/4 inch in diameter by 8 feet in length. Sectional type rods may be used.

2.11.2 Grounding Conductors

Grounding conductors shall be bare, except where installed in conduit with

associated phase conductors. Insulated conductors shall be of the same material as phase conductors and green color-coded, except that conductors shall be rated no more than 600 volts. Bare conductors shall be ASTM B 8 soft-drawn unless otherwise indicated. Aluminum is not acceptable.

2.12 CONCRETE AND REINFORCEMENT

Concrete work shall have minimum 3000 psi compressive strength and conform to the requirements of Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. Concrete reinforcing shall be as specified in Section 03200A CONCRETE REINFORCEMENT.

2.13 PADLOCKS

Padlocks shall comply with Section 08710 DOOR HARDWARE.

2.14 CABLE FIREPROOFING SYSTEMS

Cable fireproofing systems shall be listed in FM P7825a as a fire-protective coating or tape approved for grouped electrical conductors and shall be suitable for application on the type of medium-voltage cables provided. After being fully cured, materials shall be suitable for use where exposed to oil, water, gases, salt water, sewage, and fungus and shall not damage cable jackets or insulation. Asbestos materials are not acceptable.

2.14.1 Fireproof Coating

Cable fireproofing coatings shall be compounded of water-based thermoplastic resins, flame-retardant chemicals, and inorganic noncombustible fibers and shall be suitable for the application methods used. Coatings applied on bundled cables shall have a derating factor of less than 5 percent, and a dielectric strength of 95 volts per mil minimum after curing.

2.14.2 Fireproofing Tape

Fireproofing tape shall be at least 2 inches wide and shall be a flexible, conformable, polymeric, elastomer tape designed specifically for fireproofing cables.

2.14.3 Plastic Tape

Preapplication plastic tape shall be pressure sensitive, 10 mil thick, conforming to UL 510.

2.15 LIQUID DIELECTRICS

Liquid dielectrics for transformers, capacitors, reclosers, and other liquid-filled electrical equipment shall be non-polychlorinated biphenyl (PCB) mineral-oil or less-flammable liquid as specified. Nonflammable fluids shall not be used. Tetrachloroethylene (perchloroethylene) and 1, 2, 4 trichlorobenzene fluids shall not be used. Liquid dielectrics in retrofitted equipment shall be certified by the manufacturer as having less than 50 parts per million (ppm) PCB content. In lieu of the manufacturer's certification, the Contractor may submit a test sample of the dielectric in accordance with ASTM D 923 and have tests performed per ASTM D 4059 at a testing facility approved by the Contracting Officer. Equipment with test results indicating PCB level exceeding 50 ppm shall be replaced.

2.16 FACTORY TESTS

Factory tests shall be performed, as follows, in accordance with the applicable publications and with other requirements of these specifications. The Contracting Officer shall be notified at least 10 days before the equipment is ready for testing. The Contracting Officer reserves the right to witness the tests.

a. Transformers: Manufacturer's standard design and other tests in accordance with IEEE C57.12.00.

b. Transformers rated 200 kVA and above: Reduced full-wave, chopped-wave, and full-wave impulse test on each line and neutral terminal, in accordance with IEEE C57.98.

c. High-Voltage Air Switches: Manufacturer's standard tests in accordance with IEEE C37.34 and IEEE C37.41.

d. Protective Relays: Seismic tests in accordance with IEEE C37.98. Surge withstand tests in accordance with IEEE C37.90.1.

e. Relaying Current Transformers: Manufacturer's standard tests in accordance with IEEE C57.13.

f. Instrument Current Transformers: Manufacturer's standard tests in accordance with IEEE C57.13.

g. Factory Preformed Terminations: Wet withstand voltage tests in accordance with IEEE Std 48 for the next higher BIL level.

h. Outdoor Switchgear: Manufacturer's standard tests in accordance with IEEE C37.20.1, IEEE C37.20.2, and IEEE C37.20.3.

i. Electrical Power Insulators: Manufacturer's standard tests in accordance with ANSI C29.1.

2.17 COORDINATED POWER SYSTEM PROTECTION

Analyses shall be prepared to demonstrate that the equipment selected and system constructed meet the contract requirements for equipment ratings, coordination, and protection. They shall include a load flow analysis, a fault current analysis, and a protective device coordination study. The studies shall be performed by a registered professional engineer with demonstrated experience in power system coordination in the last three years. The Contractor shall provide a list of references complete with points of contact, addresses and telephone numbers. The selection of the engineer is subject to the approval of the Contracting Officer.

2.17.1 Scope of Analyses

The fault current analysis, and protective device coordination study shall begin at: the source bus and extend down to system bused where fault availability is 10,000 amperes (symmetrical) for building/facility 600 volt level distribution buses.

2.17.2 Determination of Facts

The time-current characteristics, features, and nameplate data for each existing protective device shall be determined and documented. The Contractor shall coordinate with the Base for fault current availability at the site.

2.17.3 Single Line Diagram

A single line diagram shall be prepared to show the electrical system buses, devices, transformation points, and all sources of fault current (including generator and motor contributions). A fault-impedance diagram or a computer analysis diagram may be provided. Each bus, device or transformation point shall have a unique identifier. If a fault-impedance diagram is provided, impedance data shall be shown. Locations of switches, breakers, and circuit interrupting devices shall be shown on the diagram together with available fault data, and the device interrupting rating.

2.17.4 Fault Current Analysis

2.17.4.1 Method

The fault current analysis shall be performed in accordance with methods described in IEEE Std 242, and IEEE Std 399.

2.17.4.2 Data

Actual data shall be utilized in fault calculations. Bus characteristics and transformer impedances shall be those proposed. Data shall be documented in the report.

2.17.5 Coordination Study

The study shall demonstrate that the maximum possible degree of selectively has been obtained between devices specified, consistent with protection of equipment and conductors from damage from overloads and fault conditions. The study shall include a description of the coordination of the protective devices in this project. Provide a written narrative that describes: which devices may operate in the event of a fault at each bus; the logic used to arrive at device ratings and settings; situations where system coordination is not achievable due to device limitations (an analysis of any device curves which overlap); coordination between upstream and downstream devices; and any relay settings. Recommendations to improve or enhance system reliability, and detail where such changes would involve additions or modifications to the contract and cost changes (addition or reduction) shall be provided. Composite coordination plots shall be provided on log-log graph paper.

2.17.6 Study Report

a. The report shall include a narrative describing: the analyses performed; the bases and methods used; and the desired method of coordinated protection of the power system.

b. The study shall include descriptive and technical data for existing devices and new protective devices proposed. The data shall include manufacturers published data, nameplate data, and definition of the fixed or adjustable features of the existing or new protective devices.

c. The report shall document utility data including system voltages, fault MVA, system X/R ratio, time-current characteristics curves, current transformer ratios, and relay device numbers and settings; and existing power system data including time-current characteristic curves and protective device ratings and settings.

d. The report shall contain fully coordinated composite time-current characteristic curves for each bus in the system, as required to ensure coordinated power system protection between protective devices or equipment. The report shall include recommended ratings and settings of all protective devices in tabulated form.

e. The report shall provide the calculation performed for the analyses, including computer analysis programs utilized. The name of the software package, developer, and version number shall be provided.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Equipment and devices shall be installed and energized in accordance with the manufacturer's published instructions. Steel conduits installed underground shall be installed and protected from corrosion in conformance with the requirements of Section 16415A ELECTRICAL WORK, INTERIOR. Except as covered herein, excavation, trenching, and backfilling shall conform to the requirements of Section 02300 EARTHWORK. Concrete work shall have minimum 3000 psi compressive strength and conform to the requirements of Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE.

3.1.1 Conformance to Codes

The installation shall comply with the requirements and recommendations of NFPA 70 and IEEE C2 as applicable.

3.1.2 Verification of Dimensions

The Contractor shall become familiar with details of the work, shall verify dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing any work.

3.1.3 Disposal of Liquid Dielectrics

PCB-contaminated dielectrics must be marked as PCB and transported to and incinerated by an approved EPA waste disposal facility. The Contractor shall furnish certification of proper disposal. Contaminated dielectrics shall not be diluted to lower the contamination level.

3.2 CABLE INSTALLATION

The Contractor shall obtain from the manufacturer an installation manual or set of instructions which addresses such aspects as cable construction, insulation type, cable diameter, bending radius, cable temperature, lubricants, coefficient of friction, conduit cleaning, storage procedures, moisture seals, testing for and purging moisture, etc. The Contractor shall then prepare a checklist of significant requirements and perform pulling calculations and prepare a pulling plan which shall be submitted along with the manufacturers instructions in accordance with SUBMITTALS.

3.2.1 Cable Installation Plan and Procedure

Cable shall be installed strictly in accordance with the cable manufacturer's recommendations. Each circuit shall be identified by means of a fiber, laminated plastic, or non-ferrous metal tags, or approved equal, in each manhole, handhole, junction box, and each terminal. Each tag shall contain the following information; cable type, conductor size, circuit number, circuit voltage, cable destination and phase identification. As-Built Drawings shall be provided for the installation.

3.2.1.1 Cable Inspection

The cable reel shall be inspected for correct storage positions, signs of physical damage, and broken end seals. If end seal is broken, moisture shall be removed from cable in accordance with the cable manufacturer's recommendations.

3.2.1.2 Duct Cleaning

Duct shall be cleaned with an assembly that consists of a flexible mandrel (manufacturers standard product in lengths recommended for the specific size and type of duct) that is 1/4 inch less than inside diameter of duct, 2 wire brushes, and a rag. The cleaning assembly shall be pulled through conduit a minimum of 2 times or until less than a volume of 8 cubic inches of debris is expelled from the duct.

3.2.1.3 Duct Lubrication

The cable lubricant shall be compatible with the cable jacket for cable that is being installed. Application of lubricant shall be in accordance with lubricant manufacturer's recommendations.

3.2.1.4 Cable Installation

The Contractor shall provide a cable feeding truck and a cable pulling winch as required. The Contractor shall provide a pulling grip or pulling eye in accordance with cable manufacturer's recommendations. The pulling grip or pulling eye apparatus shall be attached to polypropylene or manilla rope followed by lubricant front end packs and then by power cables. A dynamometer shall be used to monitor pulling tension. Pulling tension shall not exceed cable manufacturer's recommendations. The Contractor shall not allow cables to cross over while cables are being fed into duct. For cable installation in cold weather, cables shall be kept at 50 degrees F temperature for at least 24 hours before installation.

3.2.1.5 Cable Installation Plan

The Contractor shall submit cable installer qualifications and a cable installation plan for all cable pulls in accordance with the detail drawings portion of paragraph SUBMITTALS. Cable installation plan shall include:

a. Site layout drawing with cable pulls identified in numeric order of expected pulling sequence and direction of cable pull.

b. List of cable installation equipment.

c. Lubricant manufacturer's application instructions.

d. Procedure for resealing cable ends to prevent moisture from entering cable.

e. Cable pulling tension calculations of all cable pulls.

f. Cable percentage conduit fill.

g. Cable sidewall thrust pressure.

h. Cable minimum bend radius and minimum diameter of pulling wheels used.

i. Cable jam ratio.

j. Maximum allowable pulling tension on each different type and size of conductor.

k. Maximum allowable pulling tension on pulling device.

3.2.2 Duct Line

Medium-voltage cables shall be installed in duct lines where indicated. Cable splices in low-voltage cables shall be made in manholes and handholes only, except as otherwise noted. Neutral and grounding conductors shall be installed in the same duct with their associated phase conductors.

3.2.3 Electric Manholes

Cables shall be routed around the interior walls and securely supported from walls on cables racks. Cable routing shall minimize cable crossover, provide access space for maintenance and installation of additional cables, and maintain cable separation in accordance with IEEE C2.

3.3 CABLE JOINTS

Medium-voltage cable joints shall be made by qualified cable splicers only. Qualifications of cable splicers shall be submitted in accordance with paragraph SUBMITTALS. Shields shall be applied as required to continue the shielding system through each entire cable joint. Shields may be integrally molded parts of preformed joints. Shields shall be grounded at each joint or in accordance with manufacturer's recommended practice. Cable joints shall provide insulation and jacket equivalent to that of the associated cable. Armored cable joints shall be enclosed in compound-filled, cast-iron or alloy, splice boxes equipped with stuffing boxes and armor clamps of a suitable type and size for the cable being installed.

3.4 FIREPROOFING

Each medium-voltage cable and conductor in manholes shall be fire-proofed for their entire length within the manhole. Where cables and conductors have been lubricated to enhance pulling into ducts, the lubricant shall be removed from cables and conductors exposed in the manhole before fireproofing.

3.4.1 Tape Method

Before application of fireproofing tape, plastic tape wrapping shall be

applied over exposed metallic items such as the cable ground wire, metallic outer covering, or armor to minimize the possibility of corrosion from the fireproofing materials and moisture. Before applying fireproofing tape, irregularities of cables, such as at cable joints, shall be evened out with insulation putty. A flexible conformable polymeric elastomer fireproof tape shall be wrapped tightly around each cable spirally in 1/2 lapped wrapping or in 2 butt-jointed wrappings with the second wrapping covering the joints of the first.

3.4.2 Sprayable Method

Manholes shall be power ventilated until coatings are dry and dewatered and the coatings are cured. Ventilation requirements shall be in accordance with the manufacturer's instruction, but not less than 10 air changes per hour shall be provided. Cable coatings shall be applied by spray, brush, or glove to a wet film thickness that reduces to the dry film thickness approved for fireproofing by FM P7825a. Application methods and necessary safety precautions shall be in accordance with the manufacturers instructions. After application, cable coatings shall be dry to the touch in 1 to 2 hours and fully cured in 48 hours, except where the manufacturer has stated that because of unusual humidity or temperature, longer periods may be necessary.

3.5 DUCT LINES

3.5.1 Requirements

Numbers and sizes of ducts shall be as indicated. Duct lines shall be laid with a minimum slope of 4 inches per 100 feet. Depending on the contour of the finished grade, the high-point may be at a terminal, a manhole, a handhole, or between manholes or handholes. Short-radius manufactured 90-degree duct bends may be used only for pole or equipment risers, unless specifically indicated as acceptable. The minimum manufactured bend radius shall be 18 inches for ducts of less than 3 inch diameter, and 36 inches for ducts 3 inches or greater in diameter. Otherwise, long sweep bends having a minimum radius of 25 feet shall be used for a change of direction of more than 5 degrees, either horizontally or vertically. Both curved and straight sections may be used to form long sweep bends, but the maximum curve used shall be 30 degrees and manufactured bends shall be used. Ducts shall be provided with end bells whenever duct lines terminate in manholes or handholes.

3.5.2 Treatment

Ducts shall be kept clean of concrete, dirt, or foreign substances during construction. Field cuts requiring tapers shall be made with proper tools and match factory tapers. A coupling recommended by the duct manufacturer shall be used whenever an existing duct is connected to a duct of different material or shape. Ducts shall be stored to avoid warping and deterioration with ends sufficiently plugged to prevent entry of any water or solid substances. Ducts shall be thoroughly cleaned before being laid. Plastic ducts shall be stored on a flat surface and protected from the direct rays of the sun.

3.5.3 Concrete Encasement

Ducts requiring concrete encasements shall comply with NFPA 70, except that electrical duct bank configurations for ducts 6 inches in diameter shall be determined by calculation and as shown on the drawings. The separation

between adjacent electric power and communication ducts shall conform to IEEE C2. Duct line encasements shall be monolithic construction. Where a connection is made to a previously poured encasement, the new encasement shall be well bonded or doweled to the existing encasement. The Contractor shall submit proposed bonding method for approval in accordance with the detail drawing portion of paragraph SUBMITTALS. At any point, except railroad and airfield crossings, tops of concrete encasements shall be not less than the cover requirements listed in NFPA 70. At railroad and airfield crossings, duct lines shall be encased with concrete and reinforced as indicated to withstand specified surface loadings. Tops of concrete encasements shall be not less than 5 feet below tops of rails or airfield paving unless otherwise indicated. Where ducts are jacked under existing pavement, rigid steel conduit will be installed because of its strength. To protect the corrosion-resistant conduit coating, predrilling or installing conduit inside a larger iron pipe sleeve (jack-and-sleeve) is required. For crossings of existing railroads and airfield pavements greater than 50 feet in length, the predrilling method or the jack-and-sleeve method will be used. Separators or spacing blocks shall be made of steel, concrete, plastic, or a combination of these materials placed not farther apart than 4 feet on centers. Ducts shall be securely anchored to prevent movement during the placement of concrete and joints shall be staggered at least 6 inches vertically.

3.5.4 Installation of Couplings

Joints in each type of duct shall be made up in accordance with the manufacturer's recommendations for the particular type of duct and coupling selected and as approved.

3.5.5 Duct Line Markers

Duct line markers shall be provided as indicated. In addition to markers, a 5 mil brightly colored plastic tape, not less than 3 inches in width and suitably inscribed at not more than 10 feet on centers with a continuous metallic backing and a corrosion-resistant 1 mil metallic foil core to permit easy location of the duct line, shall be placed approximately 12 inches below finished grade levels of such lines.

3.6 MANHOLES, HANDHOLES, AND PULLBOXES

3.6.1 General

Manholes shall be constructed approximately where shown. The exact location of each manhole shall be determined after careful consideration has been given to the location of other utilities, grading, and paving. The location of each manhole shall be approved by the Contracting Officer before construction of the manhole is started. Manholes shall be the type noted on the drawings and shall be constructed in accordance with the applicable details as indicated. Top, walls, and bottom shall consist of reinforced concrete. Walls and bottom shall be of monolithic concrete construction. The Contractor may at his option utilize monolithically constructed precast-concrete manholes having the required strength and inside dimensions as required by the drawings or specifications. In paved areas, frames and covers for manhole and handhole entrances in vehicular traffic areas shall be flush with the finished surface of the paving. In unpaved areas, the top of manhole covers shall be approximately 1/2 inch above the finished grade. Where existing grades that are higher than finished grades are encountered, concrete assemblies designed for the purpose shall be installed to elevate temporarily the manhole cover to

existing grade level. All duct lines entering manholes must be installed on compact soil or otherwise supported when entering a manhole to prevent shear stress on the duct at the point of entrance to the manhole. Duct lines entering cast-in-place concrete manholes shall be cast in-place with the manhole. Duct lines entering precast concrete manholes through a precast knockout penetration shall be grouted tight with a portland cement mortar. PVC duct lines entering precast manholes through a PVC endbell shall be solvent welded to the endbell. A cast metal grille-type sump frame and cover shall be installed over the manhole sump. A cable-pulling iron shall be installed in the wall opposite each duct line entrance.

3.6.2 Electric Manholes

Cables shall be securely supported from walls by hot-dip galvanized cable racks with a plastic coating over the galvanizing and equipped with adjustable hooks and insulators. The number of cable racks indicated shall be installed in each manhole and not less than 2 spare hooks shall be installed on each cable rack. Insulators shall be made of high-glazed porcelain. Insulators will not be required on spare hooks.

3.6.3 Communications Manholes

The number of hot-dip galvanized cable racks with a plastic coating over the galvanizing indicated shall be installed in each telephone manhole. Each cable rack shall be provided with 2 cable hooks. Cables for the telephone and communication systems will be installed by others.

3.6.4 Handholes

Handholes shall be located approximately as shown. Handholes shall be of the type noted on the drawings and shall be constructed in accordance with the details shown.

3.6.5 Pullboxes

Pullbox tops shall be flush with sidewalks or curbs or placed 1/2 inchabove surrounding grades when remote from curbed roadways or sidewalks. Covers shall be marked "Low-Voltage" and provided with 2 lifting eyes and 2 hold-down bolts. Each box shall have a suitable opening for a ground rod. Conduit, cable, ground rod entrances, and unused openings shall be sealed with mortar.

3.6.6 Ground Rods

A ground rod shall be installed at the manholes, handholes and pullboxes. Ground rods shall be driven into the earth before the manhole floor is poured so that approximately 4 inches of the ground rod will extend above the manhole floor. When precast concrete manholes are used, the top of the ground rod may be below the manhole floor and a No. 1/0 AWG ground conductor brought into the manhole through a watertight sleeve in the manhole wall.

3.7 PAD-MOUNTED EQUIPMENT INSTALLATION

Pad-mounted equipment, shall be installed on concrete pads in accordance with the manufacturer's published, standard installation drawings and procedures, except that they shall be modified to meet the requirements of this document. Units shall be installed so that they do not damage equipment or scratch painted or coated surfaces. After installation,

surfaces shall be inspected and scratches touched up with a paint or coating provided by the manufacturer especially for this purpose.

3.7.1 Concrete Pads

3.7.1.1 Construction

Concrete pads for pad-mounted electrical equipment shall be poured-in-place. Pads shall be constructed as indicated, except that exact pad dimensions and mounting details are equipment specific and are the responsibility of the Contractor. Tops of concrete pads shall be level and shall project 4 inches above finished paving or grade and sloped to drain. Edges of concrete pads shall have 3/4 inch chamfer. Conduits for primary, secondary, and grounding conductors shall be set in place prior to placement of concrete pads. Where grounding electrode conductors are installed through concrete pads, PVC conduit sleeves shall be installed through the concrete to provide physical protection. To facilitate cable installation and termination, the concrete pad shall be provided with a rectangular hole below the primary and secondary compartments, sized in accordance with the manufacturer's recommended dimensions. Upon completion of equipment installation the rectangular hole shall be filled with masonry grout.

3.7.1.2 Concrete and Reinforcement

Concrete work shall have minimum 3000 psi compressive strength and comform to the requirements of Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. Concrete pad reinforcement shall be in accordance with Section 03200A CONCRETE REINFORCEMENT.

3.7.1.3 Sealing

When the installation is complete, the Contractor shall seal all conduit and other entries into the equipment enclosure with an approved sealing compound. Seals shall be of sufficient strength and durability to protect all energized live parts of the equipment from rodents, insects, or other foreign matter.

3.7.2 Padlocks

Padlocks shall be provided for pad-mounted equipment and for each fence gate. Padlocks shall be keyed as directed by the Contracting Officer.

3.8 CONNECTIONS BETWEEN AERIAL AND UNDERGROUND SYSTEMS

Connections between aerial and underground systems shall be made as shown. Underground cables shall be extended up poles in conduit to cable terminations. Conduits shall be secured to the poles by 2-hole galvanized steel pipe straps spaced not more than 10 feet apart and with 1 strap not more than 12 inches from any bend or termination. Cable guards shall be secured to poles in accordance with the manufacturer's published procedures. Conduits shall be equipped with bushings to protect cables and minimize water entry. Capnut potheads shall be used to terminate medium-voltage multiple-conductor cable. Cables shall be supported by devices separate from the conduit or guard, near their point of exit from the conduit or guard.

3.9 CONNECTIONS TO BUILDINGS

Cables shall be extended into the various buildings as indicated, and shall be connected to the first applicable termination point in each building. Interfacing with building interior conduit systems shall be at conduit stubouts terminating 5 feet outside of a building and 3 feet below finished grade as specified and provided under Section 16415A ELECTRICAL WORK, INTERIOR. After installation of cables, conduits shall be sealed with caulking compound to prevent entrance of moisture or gases into buildings.

3.10 GROUNDING

A ground ring consisting of the indicated configuration of bare copper conductors and driven ground rods shall be installed around pad-mounted equipment as shown. Equipment frames of metal-enclosed equipment, and other noncurrent-carrying metal parts, such as cable shields, cable sheaths and armor, and metallic conduit shall be grounded. At least 2 connections shall be provided from a transformer, to the ground ring. Metallic frames and covers of handholes and pull boxes shall be grounded by use of a braided, copper ground strap with equivalent ampacity of No. 6 AWG.

3.10.1 Grounding Electrodes

Grounding electrodes shall be installed as shown on the drawings and as follows:

a. Driven rod electrodes - Unless otherwise indicated, ground rods shall be driven into the earth until the tops of the rods are approximately 1 foot below finished grade.

b. Ground ring - A ground ring shall be installed as shown consisting of bare copper conductors installed 24 inches, plus or minus 3 inches, below finished top of soil grade. Ground ring conductors shall be No. 2 AWG, minimum.

c. Additional electrodes - When the required ground resistance is not met, additional electrodes shall be provided interconnected with grounding conductors as indicated to achieve the specified ground resistance. The additional electrodes will be up to three,8 feet rods spaced a minimum of 12 feet apart. In high ground resistance, UL listed chemically charged ground rods may be used. If the resultant resistance exceeds 25 ohms measured not less than 48 hours after rainfall, the Contracting Officer shall be notified immediately.

3.10.2 Grounding and Bonding Connections

Connections above grade shall be made by the fusion-welding process or with bolted solderless connectors, in compliance with UL 467, and those below grade shall be made by a fusion-welding process. Where grounding conductors are connected to aluminum-composition conductors, specially treated or lined copper-to-aluminum connectors suitable for this purpose shall be used.

3.10.3 Grounding and Bonding Conductors

Grounding and bonding conductors include conductors used to bond transformer enclosures and equipment frames to the grounding electrode

system. Grounding and bonding conductors shall be sized as shown, and located to provide maximum physical protection. Bends greater than 45 degrees in ground conductors are not permitted. Routing of ground conductors through concrete shall be avoided. When concrete penetration is necessary, nonmetallic conduit shall be cast flush with the points of concrete entrance and exit so as to provide an opening for the ground conductor, and the opening shall be sealed with a suitable compound after installation.

3.10.4 Surge Arrester Grounding

Surge arresters and neutrals shall be bonded directly to the transformer enclosure and then to the grounding electrode system with a bare copper conductor, sized as shown. Lead lengths shall be kept as short as practicable with no kinks or sharp bends.

3.10.5 Manhole, Handhole, or Concrete Pullbox Grounding

Ground rods installed in manholes, handholes, or concrete pullboxes shall be connected to cable racks, cable-pulling irons, the cable shielding, metallic sheath, and armor at each cable joint or splice by means of a No. 4 AWG braided tinned copper wire. Connections to metallic cable sheaths shall be by means of tinned terminals soldered to ground wires and to cable sheaths. Care shall be taken in soldering not to damage metallic cable sheaths or shields. Ground rods shall be protected with a double wrapping of pressure-sensitive plastic tape for a distance of 2 inches above and 6 inches below concrete penetrations. Grounding electrode conductors shall be neatly and firmly attached to manhole or handhole walls and the amount of exposed bare wire shall be held to a minimum.

3.10.6 Metal Splice Case Grounding

Metal splice cases for medium-voltage direct-burial cable shall be grounded by connection to a driven ground rod located within 2 feet of each splice box using a grounding electrode conductor having a current-carrying capacity of at least 20 percent of the individual phase conductors in the associated splice box, but not less than No. 6 AWG.

3.11 FIELD TESTING

3.11.1 General

Field testing shall be performed in the presence of the Contracting Officer. The Contractor shall notify the Contracting Officer 10 days prior to conducting tests. The Contractor shall furnish all materials, labor, and equipment necessary to conduct field tests. The Contractor shall perform all tests and inspections recommended by the manufacturer unless specifically waived by the Contracting Officer. The Contractor shall maintain a written record of all tests which includes date, test performed, personnel involved, devices tested, serial number and name of test equipment, and test results. Field test reports shall be signed and dated by the Contractor.

3.11.2 Safety

The Contractor shall provide and use safety devices such as rubber gloves, protective barriers, and danger signs to protect and warn personnel in the test vicinity. The Contractor shall replace any devices or equipment which are damaged due to improper test procedures or handling.

3.11.3 Ground-Resistance Tests

The resistance of each grounding electrode shall be measured using the fall-of-potential method defined in IEEE Std 81. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

a. Single rod electrode - 25 ohms.

b. Multiple rod electrodes - 5 ohms.

3.11.4 Medium-Voltage Cable Test

After installation and before the operating test or connection to an existing system, the medium-voltage cable system shall be given a high potential test. Direct-current voltage shall be applied on each phase conductor of the system by connecting conductors as one terminal and connecting grounds or metallic shieldings or sheaths of the cable as the other terminal for each test. Prior to making the test, the cables shall be isolated by opening applicable protective devices and disconnecting equipment. The test shall be conducted with all splices, connectors, and terminations in place. The method, voltage, length of time, and other characteristics of the test for initial installation shall be in accordance with NEMA WC 7 or NEMA WC 8 for the particular type of cable installed, except that 28 kV and 35 kV insulation test voltages shall be in accordance with either AEIC CS5 or AEIC CS6 as applicable, and shall not exceed the recommendations of IEEE Std 404 for cable joints and IEEE Std 48 for cable terminations unless the cable and accessory manufacturers indicate higher voltages are acceptable for testing. Should any cable fail due to a weakness of conductor insulation or due to defects or injuries incidental to the installation or because of improper installation of cable, cable joints, terminations, or other connections, the Contractor shall make necessary repairs or replace cables as directed. Repaired or replaced cables shall be retested.

3.11.5 Low-Voltage Cable Test

Low-voltage cable, complete with splices, shall be tested for insulation resistance after the cables are installed, in their final configuration, ready for connection to the equipment, and prior to energization. The test voltage shall be 500 volts dc, applied for one minute between each conductor and ground and between all possible combinations conductors in the same trench, duct, or cable, with all other conductors in the same trench, duct, or conduit. The minimum value of insulation shall be:

R in megohms = (rated voltage in kV + 1) x 1000/(length of cable in feet

Each cable failing this test shall be repaired or replaced. The repaired cable shall be retested until failures have been eliminated.

3.11.6 Liquid-Filled Transformer Tests

The following field tests shall be performed on all liquid-filled transformers. Pass-fail criteria shall be in accordance with transformer manufacturer's specifications.

a. Insulation resistance test phase-to-ground.

b. Turns ratio test.

c. Correct phase sequence.

d. Correct operation of tap changer.

3.11.7 Pre-Energization Services

Calibration, testing, adjustment, and placing into service of the installation shall be accomplished by a manufacturer's product field service engineer or independent testing company with a minimum of 2 years of current product experience. The following services shall be performed on the equipment listed below. These services shall be performed subsequent to testing but prior to the initial energization. The equipment shall be inspected to ensure that installation is in compliance with the recommendations of the manufacturer and as shown on the detail drawings. Terminations of conductors at major equipment shall be inspected to ensure the adequacy of connections. Bare and insulated conductors between such terminations shall be inspected to detect possible damage during installation. If factory tests were not performed on completed assemblies, tests shall be performed after the installation of completed assemblies. Components shall be inspected for damage caused during installation or shipment to ensure packaging materials have been removed. Components capable of being both manually and electrically operated shall be operated manually prior to the first electrical operation. Components capable of being calibrated, adjusted, and tested shall be calibrated, adjusted, and tested in accordance with the instructions of the equipment manufacturer. Items for which such services shall be provided, but are not limited to, are the following:

a. Pad-mounted transformers

b. Panelboards

c. Switchboards

d. Medium voltage distribution equipment

e. Busways

f. Switches

3.11.8 Operating Tests

After the installation is completed, and at such times as the Contracting Officer may direct, the Contractor shall conduct operating tests for approval. The equipment shall be demonstrated to operate in accordance with the requirements herein. An operating test report shall be submitted in accordance with paragraph SUBMITTALS.

3.12 MANUFACTURER'S FIELD SERVICE

3.12.1 Onsite Training

The Contractor shall conduct a training course for the operating staff as designated by the Contracting Officer. The training period shall consist of a total of 8 hours of normal working time and shall start after the system is functionally completed but prior to final acceptance tests. The course instruction shall cover pertinent points involved in operating, starting, stopping, and servicing the equipment, as well as all major elements of the operation and maintenance manuals. Additionally, the course instructions shall demonstrate all routine maintenance operations. A DVD format video disk of the entire training session shall be submitted.

3.12.2 Installation Engineer

After delivery of the equipment, the Contractor shall furnish one or more field engineers, regularly employed by the equipment manufacturer to supervise the installation of the equipment, assist in the performance of the onsite tests, initial operation, and instruct personnel as to the operational and maintenance features of the equipment.

3.13 ACCEPTANCE

Final acceptance of the facility will not be given until the Contractor has successfully completed all tests and after all defects in installation, material or operation have been corrected.

-- End of Section --

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SECTION 16415A

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SECTION 16415A

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PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C39.1	(1981; R 1992) Requirements for Electrical Analog Indicating Instruments
ANSI C78.1	(1991; C78.1a; R 1996) Fluorescent Lamps - Rapid-Start Types - Dimensional and Electrical Characteristics
ANSI C78.1350	(1990) Electric Lamps - 400-Watt, 100-Volt, S51 Single-Ended High-Pressure Sodium Lamps
ANSI C78.1351	(1989) Electric Lamps - 250-Watt, 100-Volt S50 Single-Ended High-Pressure Sodium Lamps
ANSI C78.1352	(1990) Electric Lamps - 1000-Watt, 250-Volt, S52 Single-Ended High-Pressure Sodium Lamps
ANSI C78.1355	(1989) Electric Lamps - 150-Watt, 55-Volt S55 High-Pressure Sodium Lamps
ANSI C78.1375	(1996) 400-Watt, M59 Single-Ended Metal-Halide Lamps
ANSI C78.1376	(1996) 1000-Watt, M47 Metal-Halide Lamps
ANSI C78.20	(1995) Electric Lamps - Characteristics of Incandescent Lamps A, G, PS, and Similar Shapes with E26 Medium Screw Bases
ANSI C78.21	(1995) Physical and Electrical Characteristics - Incandescent Lamps - PAR and R Shapes
ANSI C78.2A	(1991) 18 & 26- Watt, Compact Fluorescent Quad Tube Lamps **
ANSI C78.2B	(1992) 9 & 13-Watt, Compact Fluorescent Quad Tube Lamps **
ANSI C80.5	(1995) Rigid Aluminum Conduit

ANSI C82.1	(1997) Specifications for Fluorescent Lamp Ballasts \$18.00$\F\X Addenda D & E
ANSI C82.4	(1992) Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type)

ASTM INTERNATIONAL (ASTM)

ASTM B 1	(1995) Hard-Drawn Copper Wire
ASTM B 8	(1999) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM D 709	(2000) Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C37.20.1	(1993) Metal-Enclosed Low-Voltage Power Circuit-Breaker Switchgear
IEEE C57.12.00	(1993) Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
IEEE C57.13	(1993) Instrument Transformers
IEEE C62.41	(1991) Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits
IEEE Std 242	(1986; R 1991) Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
IEEE Std 399	(1997) Recommended Practice for Industrial and Commercial Power Systems Analysis
IEEE Std 81	(1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Part 1) \$31.00$\F

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA AB 1	(1993) Molded Case Circuit Breakers and Molded Case Switches
NEMA FU 1	(1986) Low Voltage Cartridge Fuses
NEMA ICS 1	(2000) Industrial Control and Systems: General Requirements
NEMA ICS 2	(2000) Industrial Controls and Systems: Controllers, Contactors, and Overload Relays Rated 600 Volts
NEMA ICS 3	(1993) Industrial Control and Systems Factory Built Assemblies

NEMA ICS 6	(1993; R 2001) Industrial Control and Systems: Enclosures
NEMA LE 4	(1987) Recessed Luminaires, Ceiling Compatibility
NEMA LL 1	(1997; R 2002) Procedures for Linear Fluorescent Lamp Sample Preparation and the TCLP
NEMA MG 1	(1998) Motors and Generators
NEMA MG 10	(1994) Energy Management Guide for Selection and Use of Polyphase Motors
NEMA OS 1	(1996) Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports
NEMA PB 1	(1995) Panelboards
NEMA PB 2	(1995) Deadfront Distribution Switchboards
NEMA RN 1	(1998) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA TC 2	(1998) Electrical Polyvinyl Chloride (PVC) Tubing (EPT) and Conduit (EPC-40 and EPC-80)
NEMA VE 1	(1996) Metal Cable Tray Systems
NEMA WD 1	(1999) General Requirements for Wiring Devices
NEMA WD 6	(1997) Wiring Devices - Dimensional Requirements

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101	(2003) Code for Safety to Life from Fire in Buildings and Structures
NFPA 70	(2002) National Electrical Code

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

47 CFR 18	Industrial, Scientific, and Medical Equipment

UNDERWRITERS LABORATORIES (UL)

UL 1	(2000) Flexible Metal Conduit
UL 1004	(1994; Rev thru Nov 1999) Electric Motors
UL 1029	(1994; Rev thru Dec 1997) High-Intensity-Discharge Lamp Ballasts

UL 1236	(1994; Rev thru Mar 1999) Battery Chargers for Charging Engine-Starter Batteries
UL 1242	(1996; Rev Mar 1998) Intermediate Metal Conduit
UL 1449	(1996; Rev thru Dec 1999) Transient Voltage Surge Suppressors
UL 1570	(1995; Rev thru Nov 1999) Fluorescent Lighting Fixtures
UL 1571	(1995; Rev thru Nov 1999) Incandescent Lighting Fixtures
UL 1572	(1995; Rev thru Nov 1999) High Intensity Discharge Lighting Fixtures
UL 1660	(2000) Liquid-Tight Flexible Nonmetallic Conduit
UL 198C	(1986; Rev thru Feb 1998) High-Interrupting-Capacity Fuses, Current-Limiting Types
UL 198D	(1995) Class K Fuses
UL 198E	(1988; Rev Jul 1988) Class R Fuses
UL 198G	(1988; Rev May 1988) Fuses for Supplementary Overcurrent Protection
UL 20	(1995; Rev thru Oct 1998) General-Use Snap Switches
UL 360	(1996; Rev thru Oct 1997) Liquid-Tight Flexible Steel Conduit
UL 467	(1993; Rev thru Apr 1999) Grounding and Bonding Equipment
UL 486A	(1997; Rev thru Dec 1998) Wire Connectors and Soldering Lugs for Use with Copper Conductors
UL 486B	(1997; Rev Jun 1997) Wire Connectors for Use with Aluminum Conductors
UL 486E	(1994; Rev thru Feb 1997) Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors
UL 489	(2002; Rev thru May 2003) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 5	(1996) Surface Metal Raceways and Fittings

UL 50	(1995; Rev thru Nov 1999) Enclosures for Electrical Equipment
UL 508	(1999; Rev thru Dec 2002) Industrial Control Equipment
UL 510	(1994; Rev thru Apr 1998) Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape
UL 512	(1993; Rev thru Mar 1999) Fuseholders
UL 514A	(1996; Rev Dec 1999) Metallic Outlet Boxes
UL 514B	(1997; Rev Oct 1998) Fittings for Cable and Conduit
UL 542	(1999) Lampholders, Starters, and Starter Holders for Fluorescent Lamps
UL 6	(1997) Rigid Metal Conduit
UL 651	(1995; Rev thru Oct 1998) Schedule 40 and 80 Rigid PVC Conduit
UL 651A	(1995; Rev thru Apr 1998) Type EB and A Rigid PVC Conduit and HDPE Conduit
UL 67	(1993; Rev thru Oct 1999) Panelboards
UL 674	(1994; Rev thru Oct 1998) Electric Motors and Generators for Use in Division 1 Hazardous (Classified) Locations
UL 797	(1993; Rev thru Mar 1997) Electrical Metallic Tubing
UL 83	(1998; Rev thru Sep 1999) Thermoplastic-Insulated Wires and Cables
UL 844	(1995; Rev thru Mar 1999) Electric Lighting Fixtures for Use in Hazardous (Classified) Locations
UL 845	(1995; Rev thru Nov 1999) Motor Control Centers
UL 877	(1993; Rev thru Nov 1999) Circuit Breakers and Circuit-Breaker Enclosures for Use in Hazardous (Classified) Locations
UL 886	(1994; Rev thru Apr 1999) Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations
UL 891	(1994; Rev thru Jan 1995) Dead-Front Switchboards
UL 916	(1998) Energy Management Equipment

UL 924	(1995; Rev thru Oct 97) Emergency Lighting and Power Equipment
UL 943	(1993; Rev thru May 1998) Ground-Fault Circuit-Interrupters
UL 98	(1994; Rev thru Jun 1998) Enclosed and Dead-Front Switches
UL Elec Const Dir	(2003) Electrical Construction Equipment Directory

U.S. DEPARTMENT OF COMMERCE (DOC)

UFC 4-021-01	Design and O&M: Mass Notification Systems

1.2 GENERAL

1.2.1 Rules

The installation shall conform to the requirements of NFPA 70 and NFPA 101, unless more stringent requirements are indicated or shown.

1.2.2 Coordination

The drawings indicate the extent and the general location and arrangement of equipment, conduit, and wiring. The Contractor shall become familiar with all details of the work and verify all dimensions in the field so that the outlets and equipment shall be properly located and readily accessible. Lighting fixtures, outlets, and other equipment and materials shall be carefully coordinated with mechanical or structural features prior to installation and positioned according to architectural reflected ceiling plans; otherwise, lighting fixtures shall be symmetrically located according to the room arrangement when uniform illumination is required, or asymmetrically located to suit conditions fixed by design and shown. Raceways, junction and outlet boxes, and lighting fixtures shall not be supported from sheet metal roof decks. If any conflicts occur necessitating departures from the drawings, details of and reasons for departures shall be submitted and approved prior to implementing any change. The Contractor shall coordinate the electrical requirements of the mechanical work and provide all power related circuits, wiring, hardware and structural support, even if not shown on the drawings.

1.2.3 Special Environments

1.2.3.1 Weatherproof Locations

Wiring, Fixtures, and equipment in designated locations shall conform to NFPA 70 requirements for installation in damp or wet locations.

1.2.3.2 Ducts, Plenums and Other Air-Handling Spaces

Wiring and equipment in ducts, plenums and other air-handling spaces shall be installed using materials and methods in conformance with NFPA 70unless more stringent requirements are indicated in this specification or on the contract drawings.

1.2.4 Standard Products

Material and equipment shall be a standard product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

1.2.5 Nameplates

1.2.5.1 Identification Nameplates

Major items of electrical equipment and major components shall be permanently marked with an identification name to identify the equipment by type or function and specific unit number as indicated. Designation of motors shall coincide with their designation in the motor control center or panel. Unless otherwise specified, identification nameplates shall be made of laminated plastic in accordance with ASTM D 709 with black outer layers and a white core. Edges shall be chamfered. Plates shall be fastened with black-finished round-head drive screws, except motors, or approved nonadhesive metal fasteners. When the nameplate is to be installed on an irregular-shaped object, the Contractor shall devise an approved support suitable for the application and ensure the proper installation of the supports and nameplates. In all instances, the nameplate shall be installed in a conspicuous location. At the option of the Contractor, the equipment manufacturer's standard embossed nameplate material with black paint-filled letters may be furnished in lieu of laminated plastic. The front of each panelboard, motor control center, switchgear, and switchboard shall have a nameplate to indicate the phase letter, corresponding color and arrangement of the phase conductors. The following equipment, as a minimum, shall be provided with identification nameplates:

Minimum 1/4 inch High Letters	Minimum 1/8 inch High Letters
Panelboards	Control Power Transformers
Starters	Control Devices
Safety Switches	Instrument Transformers
Motor Control Centers	
Transformers	
Equipment Enclosures	
Switchgear	
Switchboards	
Motors	

Each panel, section, or unit in motor control centers, switchgear or similar assemblies shall be provided with a nameplate in addition to nameplates listed above, which shall be provided for individual compartments in the respective assembly, including nameplates which identify "future," "spare," and "dedicated" or "equipped spaces."

1.2.5.2 Liquid-Filled Transformer Nameplates

Power transformers shall be provided with Nameplate C information in accordance with IEEE C57.12.00. Nameplates shall indicate percent impedance, voltage, kVA, frequency, number of phases, cooling class, insulation class, temperature rise, the number of gallons and composition of liquid-dielectric, and shall be permanently marked with a statement that the transformer dielectric to be supplied is non-polychlorinated biphenyl. The Contractor shall furnish manufacturer's certification for each

transformer that the dielectric is non-PCB classified, with less than 50 ppm PCB content in accordance with paragraph LIQUID DIELECTRICS. Certifications shall be related to serial numbers on transformer nameplates. Transformer dielectric exceeding the 50 ppm PCB content or transformers without certification will be considered as PCB insulated and will not be accepted.

1.2.6 As-Built Drawings

Following the project completion or turnover, within 30 days the Contractor shall furnish 2 sets of as-built drawings to the Contracting Officer.

1.2.7 Recessed Light Fixtures (RLF) Option

The Contractor has the option to substitute inch-pound (I-P) RLF to metric RLF. This option shall be coordinated with Section 09510 ACOUSTICAL CEILINGS.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Interior Electrical Equipment; G-AE.

Detail drawings consisting of equipment drawings, illustrations, schedules, instructions, diagrams, and other information necessary to define the installation. Detail drawings shall show the rating of items and systems and how the components of an item and system are assembled, function together, and how they will be installed on the project. Data and drawings for component parts of an item or system shall be coordinated and submitted as a unit. Data and drawings shall be coordinated and included in a single submission. Multiple submissions for the same equipment or system are not acceptable except where prior approval has been obtained from the Contracting Officer. In such cases, a list of data to be submitted later shall be included with the first submission. Detail drawings shall show physical arrangement, construction details, connections, finishes, materials used in fabrication, provisions for conduit or busway entrance, access requirements for installation and maintenance, physical size, electrical characteristics, foundation and support details, and equipment weight. Drawings shall be drawn to scale and/or dimensioned. Optional items shall be clearly identified as included or excluded. Detail drawings shall as a minimum include:

a. Transformers.

b. Switchgear.

c. Battery system including calculations for the battery and charger.

d. Motors and rotating machinery.

e. Single line electrical diagrams including primary, metering, sensing and relaying, control wiring, and control logic.

f. Sway bracing for suspended luminaires.

g. Mass notification system.

Structural drawings showing the structural or physical features of major equipment items, components, assemblies, and structures, including foundations or other types of supports for equipment and conductors. These drawings shall include accurately scaled or dimensioned outline and arrangement or layout drawings to show the physical size of equipment and components and the relative arrangement and physical connection of related components. Weights of equipment, components and assemblies shall be provided when required to verify the adequacy of design and proposed construction of foundations or other types of supports. Dynamic forces shall be stated for switching devices when such forces must be considered in the design of support structures. The appropriate detail drawings shall show the provisions for leveling, anchoring, and connecting all items during installation, and shall include any recommendations made by the manufacturer.

Electrical drawings including single-line and three-line diagrams, and schematics or elementary diagrams of each electrical system; internal wiring and field connection diagrams of each electrical device when published by the manufacturer; wiring diagrams of cabinets, panels, units, or separate mountings; interconnection diagrams that show the wiring between separate components of assemblies; field connection diagrams that show the termination of wiring routed between separate items of equipment; internal wiring diagrams of equipment showing wiring as actually provided for this project. Field wiring connections shall be clearly identified.

If departures from the contract drawings are deemed necessary by the Contractor, complete details of such departures, including changes in related portions of the project and the reasons why, shall be submitted with the detail drawings. Approved departures shall be made at no additional cost to the Government.

SD-03 Product Data

Fault Current and Protective Device Coordination Study; G-AE.

The study shall be submitted along with protective device equipment submittals. No time extensions or similar contract modifications will be granted for work arising out of the requirements for this study. Approval of protective devices proposed shall be based on recommendations of this study, The Government shall not be held responsible for any changes to equipment, device ratings, settings, or additional labor for installation of equipment or devices ordered and/or procured prior to approval of the study.

Manufacturer's Catalog; G-AE.

Data composed of catalog cuts, brochures, circulars, specifications, product data, and printed information in sufficient detail and scope to verify compliance with the requirements of the contract documents.

Material, Equipment, and Fixture Lists; G-AE.

A complete itemized listing of equipment and materials proposed for incorporation into the work. Each entry shall include an item number, the quantity of items proposed, and the name of the manufacturer of each item.

Installation Procedures; G-AO.

Installation procedures for rotating equipment, transformers, switchgear, battery systems, voltage regulators, and grounding resistors. Procedures shall include diagrams, instructions, and precautions required to install, adjust, calibrate, and test devices and equipment.

As-Built Drawings; G-AO.

The as-built drawings shall be a record of the construction as installed. The drawings shall include all the information shown on the contract drawings, deviations, modifications, and changes from the contract drawings, however minor. The as-built drawings shall be kept at the job site and updated daily. The as-built drawings shall be a full-sized set of prints marked to reflect all deviations, changes, and modifications. The as-built drawings shall be complete and show the location, size, dimensions, part identification, and other information. Additional sheets may be added. The as-built drawings shall be jointly inspected for accuracy and completeness by the Contractor's quality control representative and by the Contracting Officer prior to the submission of each monthly pay estimate. Upon completion of the work, the Contractor shall submit three full sized sets of the marked prints to the Contracting Officer for approval. If upon review, the as-built drawings are found to contain errors and/or omissions, they will be returned to the Contractor for correction. The Contractor shall correct and return the as-built drawings to the Contracting Officer for approval within ten calendar days from the time the drawings are returned to the Contractor.

Onsite Tests; G-AO.

A detailed description of the Contractor's proposed procedures for on-site tests.

SD-06 Test Reports

Factory Test Reports; G-AO.

Six copies of the information described below in 8 1/2 x 11 inch binders having a minimum of 5 rings from which material may readily be removed and replaced, including a separate section for each test. Sections shall be separated by heavy plastic dividers with tabs.

a. A list of equipment used, with calibration certifications.

b. A copy of measurements taken.

c. The dates of testing.

d. The equipment and values to be verified.

e. The conditions specified for the test.

f. The test results, signed and dated.

g. A description of adjustments made.

Field Test Plan; G-AO.

A detailed description of the Contractor's proposed procedures for onsite test submitted 30 days prior to testing the installed system. No field test will be performed until the test plan is approved. The test plan shall consist of complete field test procedures including tests to be performed, test equipment required, and tolerance limits.

Field Test Reports; G-AO.

Six copies of the information described below in 8 1/2 x 11 inch binders having a minimum of 5 rings from which material may readily be removed and replaced, including a separate section for each test. Sections shall be separated by heavy plastic dividers with tabs.

a. A list of equipment used, with calibration certifications.

b. A copy of measurements taken.

c. The dates of testing.

d. The equipment and values to be verified.

e. The conditions specified for the test.

f. The test results, signed and dated.

g. A description of adjustments made.

h. Final position of controls and device settings.

SD-07 Certificates

Materials and Equipment; G-AO.

The label or listing of the Underwriters Laboratories, Inc., will be accepted as evidence that the materials or equipment conform to the applicable standards of that agency. In lieu of this label or listing, a statement from a nationally recognized, adequately equipped testing agency indicating that the items have been tested in accordance with required procedures and that the materials and equipment comply with all contract requirements will be accepted. However, materials and equipment installed in

hazardous locations must bear the UL label unless the data submitted from other testing agency is specifically approved in writing by the Contracting Officer. Items which are required to be listed and labeled in accordance with Underwriters Laboratories must be affixed with a UL label that states that it is UL listed. No exceptions or waivers will be granted to this requirement. Materials and equipment will be approved based on the manufacturer's published data.

For other than equipment and materials specified to conform to UL publications, a manufacturer's statement indicating complete compliance with the applicable standard of the American Society for Testing and Materials, National Electrical Manufacturers Association, or other commercial standard, is acceptable.

1.4 WORKMANSHIP

Materials and equipment shall be installed in accordance with NFPA 70, recommendations of the manufacturer, and as shown.

1.5 SEISMIC REQUIREMENTS

Seismic details shall be as indicated.

PART 2 PRODUCTS

Products shall conform to the respective publications and other requirements specified below. Materials and equipment not listed below shall be as specified elsewhere in this section. Items of the same classification shall be identical including equipment, assemblies, parts, and components.

2.1 CABLES AND WIRES

Conductors No. 8 AWG and larger diameter shall be stranded. Conductors No. 10 AWG and smaller diameter shall be solid, except that conductors for remote control, alarm, and signal circuits, classes 1, 2, and 3, shall be stranded unless specifically indicated otherwise. Conductor sizes and ampacities shown are based on copper, unless indicated otherwise. All conductors shall be copper.

2.1.1 Equipment Manufacturer Requirements

When manufacturer's equipment requires copper conductors at the terminations or requires copper conductors to be provided between components of equipment, provide copper conductors or splices, splice boxes, and other work required to meet manufacturer's requirements.

2.1.2 Insulation

Unless indicated otherwise, or required by NFPA 70, power and lighting wires shall be 600-volt, Type THWN, THHN, or THW conforming to UL 83 except that grounding wire may be type TW conforming to UL 83; remote-control and signal circuits shall be Type TW, THW or TF, conforming to UL 83. Where lighting fixtures require 90-degree Centigrade (C) conductors, provide only conductors with 90-degree C insulation or better.

2.1.3 Bonding Conductors

ASTM B 1, solid bare copper wire for sizes No. 8 AWG and smaller diameter; ASTM B 8, Class B, stranded bare copper wire for sizes No. 6 AWG and larger diameter.

2.2 CABLE TRAYS

Cable tray shall conform to NEMA VE 1, shall form a wireway system, and shall be of nominal 3 inch depth. Cable trays shall be constructed of aluminum. Trays shall include splice and end plates, dropouts, and miscellaneous hardware. Edges, fittings, and hardware shall be finished free from burrs and sharp edges. Fittings shall have not less than the load-carrying ability of straight tray sections and shall have manufacturer's minimum standard radius. Radius of bends shall be 24 inches.

2.2.1 Trough

Trough-type cable trays shall be of a nominal 9 inch width.

2.2.2 Ladder

Ladder-type cable trays shall be of nominal 9 inch width. Rung spacing shall be on 6 inch maximum centers.

2.2.3 Cantilever

Cantilever-type, center-hung cable trays may be provided at the Contractor's option in lieu of other cable tray types specified.

2.3 TRANSIENT VOLTAGE SURGE PROTECTION

Transient voltage surge suppressors shall be provided as indicated. Surge suppressors shall meet the requirements of IEEE C62.41 and be UL listed and labeled as having been tested in accordance with UL 1449. Surge suppressor ratings shall be 480 volts rms, operating voltage; 60 Hz; 3-phase; 4 wire with ground; transient suppression voltage (peak let-through voltage) of 800 volts. Fuses shall not be used as surge suppression.

2.4 CHARGERS, BATTERY

UL 1236. Battery chargers shall be general purpose, continuous current output, with solid state rectifiers. Means shall be provided to regulate and to adjust the dc output voltage. Chargers shall have continuous current ratings of 10 to 15 percent higher than battery current outputs based upon an 8-hour discharge.

2.5 CIRCUIT BREAKERS

2.5.1 MOLDED-CASE CIRCUIT BREAKERS

Molded-case circuit breakers shall conform to NEMA AB 1 and UL 489and UL 877 for circuit breakers and circuit breaker enclosures located in hazardous (classified) locations. Circuit breakers may be installed in panelboards, switchboards, enclosures, motor control centers, or combination motor controllers.

2.5.1.1 Construction

Circuit breakers shall be suitable for mounting and operating in any position. Lug shall be listed for copper conductors only in accordance with UL 486E. Single-pole circuit breakers shall be full module size with not more than one pole per module. Multi-pole circuit breakers shall be of the common-trip type having a single operating handle such that an overload or short circuit on any one pole will result in all poles opening simultaneously. Sizes of 100 amperes or less may consist of single-pole breakers permanently factory assembled into a multi-pole unit having an internal, mechanical, nontamperable common-trip mechanism and external handle ties. All circuit breakers shall have a quick-make, quick-break overcenter toggle-type mechanism, and the handle mechanism shall be trip-free to prevent holding the contacts closed against a short-circuit or sustained overload. All circuit breaker handles shall assume a position between "ON" and "OFF" when tripped automatically. All ratings shall be clearly visible.

2.5.1.2 Ratings

Voltage ratings shall be not less than the applicable circuit voltage. The interrupting rating of the circuit breakers shall be at least equal to the available short-circuit current at the line terminals of the circuit breaker and correspond to the UL listed integrated short-circuit current rating specified for the panelboards and switchboards. Molded-case circuit breakers shall have nominal voltage ratings, maximum continuous-current ratings, and maximum short-circuit interrupting ratings in accordance with NEMA AB 1. Ratings shall be coordinated with system X/R ratio.

2.5.1.3 Cascade System Ratings

Circuit breakers used in series combinations shall be in accordance with UL 489. Equipment, such as switchboards and panelboards, which house series-connected circuit breakers shall be clearly marked accordingly. Series combinations shall be listed in the UL Recognized Component Directory under "Circuit Breakers-Series Connected."

2.5.1.4 Thermal-Magnetic Trip Elements

Thermal magnetic circuit breakers shall be provided as shown. Automatic operation shall be obtained by means of thermal-magnetic tripping devices located in each pole providing inverse time delay and instantaneous circuit protection. The instantaneous magnetic trip shall be adjustable and accessible from the front of all circuit breakers on frame sizes above 150 amperes.

2.5.2 Solid-State Trip Elements

Solid-state circuit breakers shall be provided as shown. All electronics shall be self-contained and require no external relaying, power supply, or accessories. Printed circuit cards shall be treated to resist moisture absorption, fungus growth, and signal leakage. All electronics shall be housed in an enclosure which provides protection against arcs, magnetic interference, dust, and other contaminants. Solid-state sensing shall measure true RMS current with error less than one percent on systems with distortions through the 13th harmonic. Peak or average actuating devices are not acceptable. Current sensors shall be torodial construction, encased in a plastic housing filled with epoxy to protect against damage and moisture and shall be integrally mounted on the breaker. Where

indicated on the drawings, circuit breaker frames shall be rated for 100 percent continuous duty. Circuit breakers shall have tripping features as shown on the drawings and as described below:

a. Long-time current pick-up, adjustable from 50 percent to 100 percent of continuous current rating.

b. Adjustable long-time delay.

c. Short-time current pick-up, adjustable from 1.5 to 9 times long-time current setting.

d. Adjustable short-time delay.

e. Short-time I square times t switch.

f. Instantaneous current pick-up, adjustable from 1.5 to 9 times long-time current setting.

g. Ground-fault pick-up, adjustable from 20 percent to 60 percent of sensor rating, but not greater than 1200 amperes. Sensing of ground-fault current at the main bonding jumper or ground strap will not be permitted. Zone-selective interlocking shall be provided as shown.

h. Adjustable ground-fault delay.

i. Ground-fault I square times t switch.

j. Overload and short-time and ground-fault trip indicators shall be provided.

2.5.3 Current-Limiting Circuit Breakers

Current-limiting circuit breakers shall be provided as shown. Current-limiting circuit breakers shall limit the let-through I square times t to a value less than the I square times t of one-half cycle of the symmetrical short-circuit current waveform. On fault currents below the threshold of limitation, breakers shall provide conventional overload and short-circuit protection. Integrally-fused circuit breakers shall not be used.

2.5.4 SWD Circuit Breakers

Circuit breakers rated 15 amperes and intended to switch 277 volts or less fluorescent lighting loads shall be marked "SWD."

2.5.5 HACR Circuit Breakers

Circuit breakers 60 amperes or below, 240 volts, 1-pole or 2-pole, intended to protect multi-motor and combination-load installations involved in heating, air conditioning, and refrigerating equipment shall be marked "Listed HACR Type."

2.5.6 Ground Fault Circuit Interrupters

UL 943. Breakers equipped with ground fault circuit interrupters shall have ground fault class, interrupting capacity, and voltage and current ratings as indicated.

2.6 MOTOR SHORT-CIRCUIT PROTECTOR (MSCP)

Motor short-circuit protectors shall conform to UL 508 and shall be provided as shown. Protectors shall be used only as part of a combination motor controller which provides coordinated motor branch-circuit overload and short-circuit protection, and shall be rated in accordance with the requirements of NFPA 70.

2.6.1 Construction

Motor short-circuit protector bodies shall be constructed of high temperature, dimensionally stable, long life, nonhygroscopic materials. Protectors shall fit special MSCP mounting clips and shall not be interchangeable with any commercially available fuses. Protectors shall have 100 percent one-way interchangeability within the A-Y letter designations. All ratings shall be clearly visible.

2.6.2 Ratings

Voltage ratings shall be not less than the applicable circuit voltage. Letter designations shall be A through Y for motor controller Sizes 0, 1, 2, 3, 4, and 5, with 100,000 amperes interrupting capacity rating. Letter designations shall correspond to controller sizes as follows:

CONTROLLER SIZE	MSCP DESIGNATION
NEMA O	A-N
NEMA 1	A-P
NEMA 2	A-S
NEMA 3	A-U
NEMA 4	A-W
NEMA 5	A-Y

2.7 CONDUIT AND TUBING

2.7.1 Electrical, Zinc-Coated Steel Metallic Tubing (EMT)

UL 797

2.7.2 Electrical Plastic Tubing and Conduit

NEMA TC 2.

2.7.3 Flexible Conduit, Steel and Plastic

General-purpose type, UL 1; liquid tight, UL 360, and UL 1660.

2.7.4 Intermediate Metal Conduit

UL 1242.

2.7.5 PVC Coated Rigid Steel Conduit

NEMA RN 1.

2.7.6 Rigid Aluminum Conduit

ANSI C80.5 and UL 6.

2.7.7 Rigid Metal Conduit

UL 6.

2.7.8 Rigid Plastic Conduit

NEMA TC 2, UL 651 and UL 651A.

2.7.9 Surface Metal Electrical Raceways and Fittings

UL 5.

2.8 CONDUIT AND DEVICE BOXES AND FITTINGS

2.8.1 Boxes, Metallic Outlet

NEMA OS 1 and UL 514A.

2.8.2 Boxes, Switch (Enclosed), Surface-Mounted

UL 98.

2.8.3 Fittings for Conduit and Outlet Boxes

UL 514B.

2.8.4 Fittings For Use in Hazardous (Classified) Locations

UL 886.

2.8.5 Fittings, PVC, for Use with Rigid PVC Conduit and Tubing

UL 514B.

2.9 CONDUIT COATINGS PLASTIC RESIN SYSTEM

NEMA RN 1, Type A-40.

2.10 CONNECTORS, WIRE PRESSURE

2.10.1 For Use With Copper Conductors

UL 486A.

2.10.2 For Use With Aluminum Conductors

UL 486B.

2.11 ELECTRICAL GROUNDING AND BONDING EQUIPMENT

UL 467.

2.11.1 Ground Rods

Ground rods shall be of copper-clad steel conforming to UL 467 not less than 5/8 inch in diameter by 8 feet in length of the sectional type driven full length into the earth.

2.11.2 Ground Bus

The ground bus shall be bare conductor or flat copper in one piece, if practicable.

2.12 ENCLOSURES

NEMA ICS 6 unless otherwise specified.

2.12.1 Cabinets and Boxes

Cabinets and boxes with volume greater than 100 cubic inches shall be in accordance with UL 50, hot-dip, zinc-coated, if sheet steel.

2.12.2 Circuit Breaker Enclosures

UL 489.

2.12.3 Circuit Breaker Enclosures for Use in Hazardous (Classified) Locations

UL 877.

2.13 LIGHTING FIXTURES, LAMPS, BALLASTS, EMERGENCY EQUIPMENT, CONTROLS AND ACCESSORIES

The following specifications are supported and supplemented by information and details on the drawings. Additional fixtures, if shown, shall conform to this specification. Lighting equipment installed in classified hazardous locations shall conform to UL 844. Lamps, lampholders, ballasts, transformers, electronic circuitry and other lighting system components shall be constructed according to industry standards. Equipment shall be tested and listed by a recognized independent testing laboratory for the expected installation conditions. Equipment shall conform to the standards listed below.

2.13.1 Lamps

Lamps shall be constructed to operate in the specified fixture, and shall function without derating life or output as listed in published data. Lamps shall meet the requirements of the Energy Policy Act of 1992.

a. Incandescent and tungsten halogen lamps shall be designed for 125 volt operation (except for low voltage lamps), shall be rated for minimum life of 2,000 hours, and shall have color temperature between 2,800 and 3,200 degrees Kelvin. Tungsten halogen lamps shall incorporate quartz capsule construction. Lamps shall comply with ANSI C78.20 and sections 238 and 270 of ANSI C78.21.

b. Fluorescent lamps shall be green-tipped and shall have color temperature ofdegrees Kelvin. T8 rapid start low mercury lamps shall be rated 32 watt (minimum), 2800 initial lumens minimum, and

average rated life of 20,000 hours. Low mercury lamps shall have passed the EPA "Toxicity Characteristic Leachate Procedure" (TCLP) for mercury by using the lamp sample preparation procedure described in NEMA LL 1.They shall be designed to operate with the ballasts and circuitry of the fixtures in which they will be used. Fluorescent lamps, including spares, shall be manufactured by one manufacturer to provide for color and performance consistency. Fluorescent lamps shall comply with ANSI C78.1. Fluorescent tube lamp efficiencies shall meet or exceed the following requirements.

T8, 32 watts	(4' lamp)	2800 lumens
T8,59 watts	(8' lamp)	5700 lumens
T8/U,31-32 watts	(U-tube)	2600 lumens

(1) Linear fluorescent lamps, unless otherwise indicated, shall be 4 feet long 32 watt T8, 265 mA, with minimum CRI of 75. Lamps of other lengths or types shall be used only where specified or shown. Lamps shall deliver rated life when operated on rapid start ballasts.

(2) Small compact fluorescent lamps shall be twin, double, or triple tube configuration as shown with bi-pin or four-pin snap-in base and shall have minimum CRI of 85. They shall deliver rated life when operated on ballasts as shown. 9 and 13 watt double tube lamps shall comply with ANSI C78.2B. 18 and 26 watt double tube lamps shall comply with ANSI C78.2A. Minimum starting temperature shall be 32 degrees F for twin tube lamps and for double and triple twin tube lamps without internal starter; and 15 degrees F for double and triple twin tube lamps with internal starter.

(3) Long compact fluorescent lamps shall be 18, 27, 39, 40, 50, or 55 watt bi-axial type as shown with four-pin snap-in base; shall have minimum CRI of 85; and shall have a minimum starting temperature of 50 degrees F. They shall deliver rated life when operated on ballasts.

c. High intensity discharge lamps, including spares, shall be manufactured by one manufacturer in order to provide color and performance consistency. High intensity discharge lamps shall be designed to operate with the ballasts and circuitry of the fixtures in which they will be used and shall have wattage, shape and base as shown. High intensity discharge lamps, unless otherwise shown, shall have medium or mogul screw base and minimum starting temperature of -20 degrees F. Metal halide lamps, unless otherwise shown, shall have minimum CRI of 65; color temperature of 4,300 degrees Kelvin; shall be -BU configuration if used in base-up position; and shall be -H or high output configuration if used in horizontal position. Lamps shall comply with all applicable ANSI C78.1350, ANSI C78.1351, ANSI C78.1352, ANSI C78.1355,ANSI C78.1375, and ANSI C78.1376.

2.13.2 Ballasts and Transformers

Ballasts or transformers shall be designed to operate the designated lamps

within their optimum specifications, without derating the lamps. Lamp and ballast combinations shall be certified as acceptable by the lamp manufacturer.

a. Low voltage incandescent transformers shall be Class II UL listed 120/12 volt or 120/24 volt step-down transformers as required for the lamps shown. Transformers shall be high power factor type and shall be rated for continuous operation under the specified load. Transformers shall be encased or encased and potted, and mounted integrally within the lighting fixture unless otherwise shown.

b. Fluorescent ballasts shall comply with ANSI C82.1 and shall be mounted integrally within fluorescent fixture housing unless otherwise shown. Ballasts shall have maximum current crest factor of 1.7; high power factor; Class A sound rating; maximum operating case temperature of 77 degrees F above ambient; and shall be rated Class P. Unless otherwise indicated, the minimum number of ballasts shall be used to serve each individual fixture. A single ballast may be used to serve multiple fixtures if they are continuously mounted, identically controlled and factory manufactured for that installation with an integral wireway.

(1) Compact fluorescent ballasts shall comply with IEEE C62.41 Category A transient voltage variation requirements and shall be mounted integrally within compact fluorescent fixture housing unless otherwise shown. Ballasts shall have minimum ballast factor of 0.95; maximum current crest factor of 1.6; high power factor; maximum operating case temperature of 77 degrees F above ambient; shall be rated Class P; and shall have a sound rating of Class A. Ballasts shall meet FCC Class A specifications for EMI/RFI emissions. Ballasts shall operate from nominal line voltage of 120 or 277 volts at 60 Hz and maintain constant light output over a line voltage variation of $\pm$ 10%. Ballasts shall have an end-of-lamp-life detection and shut-down circuit. Ballasts shall be UL listed and shall contain no PCBs. Ballasts shall contain potting to secure PC board, provide lead strain relief, and provide a moisture barrier.

(2) Electronic fluorescent ballasts shall comply with 47 CFR 18 for electromagnetic interference. Ballasts shall withstand line transients per IEEE C62.41, Category A. Ballasts shall have total harmonic distortion between 10 and 20%; minimum frequency of 20,000Hz; filament voltage between 2.5 and 4.5 volts; maximum starting inrush current of 20 amperes; and shall comply with the minimum Ballast Efficacy Factors shown in the table below. Minimum starting temperature shall be 50 degrees F. Ballasts shall carry a manufacturer's full warranty of three years, including a minimum $10 labor allowance per ballast.

ELECTRONIC FLUORESCENT BALLAST EFFICACY FACTORS

LAMP TYPE	TYPE OF STARTER & LAMP	NOMINAL OPERATIONAL VOLTAGE	NUMBER OF LAMPS	MINIMUM BALLAST EFFICACY FACTOR
32W T8	rapid start	120 or 277 V	1	2.54
			2	1.44

ELECTRONIC FLUORESCENT BALLAST EFFICACY FACTORS

	linear & U-tubes		3	0.93
			4	0.73
34W T12	rapid start linear & U-tubes	120 or 277 V	1	2.64
			2	1.41
			3	0.93
59W T8	rapid start linear	120 or 277 V	2	0.80

(4) Dimming fluorescent ballasts shall be electronic and shall comply with the applicable electronic ballast specifications shown above. Dimming ballasts shall be compatible with the specified dimming control equipment and shall operate the lamps shown in the range from full rated light output to 1 percent of full rated light output. Dimming ballasts shall provide smooth square law dimming such that perceived dimming action is proportionate to the motion of the dimming control. Single or two-lamp dimming ballasts shall be used. Multi-lamp dimming ballasts shall be designed to operate lamps of the same length and current rating.

(5) Dimming compact fluorescent ballasts shall be electronic and shall comply with the applicable compact fluorescent and dimming ballast specifications shown above. Ballasts shall operate the lamps shown in the range from full rated light output to 5 percent of full rated light output. Ballast power factor shall be <90% throughout dimming range. THD shall be <10% at maximum light output and <20% at minimum light output. Ballast shall ignite the lamps at any light output setting selected.

c. High intensity discharge ballasts shall comply with UL 1029 and, if multiple supply types, with ANSI C82.4. Ballasts shall have minimum ballast factor of 0.9; high power factor; Class A sound rating; and maximum operating case temperature of 77 degrees F above ambient.

(1) Electronic high intensity discharge ballasts shall be constant wattage autotransformer type; shall have less than 10% ballast loss; shall have total harmonic distortion between 10 and 20%; and shall have a minimum starting temperature of 0 degrees F.

(2) Magnetic high intensity discharge ballasts shall have a minimum starting temperature of -20 degrees F.

2.13.3 Fixtures

Fixtures shall be in accordance with the size, shape, appearance, finish, and performance shown. Unless otherwise indicated, lighting fixtures shall be provided with housings, junction boxes, wiring, lampholders, mounting supports, trim, hardware and accessories for a complete and operable

installation. Recessed housings shall be minimum 20 gauge cold rolled or galvanized steel as shown. Extruded aluminum fixtures shall have minimum wall thickness of 0.125 inches. Plastic lenses shall be 100% virgin acrylic or as shown. Glass lenses shall be tempered. Heat resistant glass shall be borosilicate type. Conoid recessed reflector cones shall be Alzak with clear specular low iridescent finish.

a. Incandescent fixtures shall comply with UL 1571. Incandescent fixture specular reflector cone trims shall be integral to the cone and shall be finished to match. Painted trim finishes shall be white with minimum reflectance of 88%. Low voltage incandescent fixtures shall have integral step-down transformers.

b. Fluorescent fixtures shall comply with UL 1570. Recessed ceiling fixtures shall comply with NEMA LE 4. Fixtures shall be plainly marked for proper lamp and ballast type to identify lamp diameter, wattage, color and start type. Marking shall be readily visible to service personnel, but not visible from normal viewing angles. Fluorescent fixture lens frames on recessed and surface mounted troffers shall be one assembly with mitered corners. Parabolic louvers shall have a low iridescent finish and 45 degree cut-off. Louver intersection joints shall be hairline type and shall conceal mounting tabs or other assembly methods. Louvers shall be free from blemishes, lines or defects which distort the visual surface. Integral ballast and wireway compartments shall be easily accessible without the use of special tools. Housings shall be constructed to include grounding necessary to start the lamps. Open fixtures shall be equipped with a sleeve, wire guard, or other positive means to prevent lamps from falling. Medium bi-pin lampholders shall be twist-in type with positive locking position. Long compact fluorescent fixtures and fixtures utilizing U-bend lamps shall have clamps or secondary lampholders to support the free ends of the lamps.

c. High intensity discharge fixture shall comply with UL 1572. Recessed ceiling fixtures shall comply with NEMA LE 4. Reflectors shall be anodized aluminum. Fixtures for horizontal lamps shall have position oriented lampholders. Lampholders shall be pulse-rated to 5,000 volts. Fixtures indicated as classified or rated for hazardous locations or special service shall be designed and independently tested for the environment in which they are installed. Recessed lens fixtures shall have extruded aluminum lens frames. Ballasts shall be integral to fixtures and shall be accessible without the use of special tools. Remote ballasts shall be encased and potted. Lamps shall be shielded from direct view with a UV absorbing material such as tempered glass, and shall be circuited through a cut-off switch which will shut off the lamp circuit if the lens is not in place.

d. Emergency lighting fixtures and accessories shall be constructed and independently tested to meet the requirements of applicable codes. Batteries shall be Nicad or equal with no required maintenance, and shall have a minimum life expectancy of five years and warranty period of three years.

e. Exit Signs

Exit signs shall be ENERGY STAR compliant, thereby meeting the following requirements. Input power shall be less than 5 watts per face. Letter

size and spacing shall adhere to NFPA 101. Luminance contrast shall be greater than 0.8. Average luminance shall be greater than 15 cd/m^2 measured at normal (0 degree) and 45 degree viewing angles. Minimum luminance shall be greater than 8.6 cd/m^2 measured at normal and 45 degree viewing angles. Maximum to minimum luminance shall be less than 20:1 measured at normal and 45 degree viewing angles. The manufacturer warranty for defective parts shall be at least 5 years.

2.13.4 Lampholders, Starters, and Starter Holders

UL 542

2.13.5 Ultrasonic, and Passive Infrared Occupancy Sensors

UL 916

2.14 LOW-VOLTAGE FUSES AND FUSEHOLDERS

2.14.1 Fuses, Low Voltage Cartridge Type

NEMA FU 1.

2.14.2 Fuses, High-Interrupting-Capacity, Current-Limiting Type

Fuses, Class G, J, L and CC shall be in accordance with UL 198C.

2.14.3 Fuses, Class K, High-Interrupting-Capacity Type

UL 198D.

2.14.4 Fuses, Class R

UL 198E.

2.14.5 Fuses for Supplementary Overcurrent Protection

UL 198G.

2.14.6 Fuseholders

UL 512.

2.15 INSTRUMENTS, ELECTRICAL INDICATING

ANSI C39.1.

2.16 MOTORS, AC, FRACTIONAL AND INTEGRAL

Motors, ac, fractional and integral horsepower, 500 hp and smaller shall conform to NEMA MG 1 and UL 1004for motors; NEMA MG 10 for energy management selection of polyphase motors; and UL 674 for use of motors in hazardous (classified) locations. In addition to the standards listed above, motors shall be provided with efficiencies as specified in the table "MINIMUM NOMINAL EFFICIENCIES" below.

2.16.1 Rating

The horsepower rating of motors should be limited to no more than 125

percent of the maximum load being served unless a NEMA standard size does not fall within this range. In this case, the next larger NEMA standard motor size should be used.

2.16.2 Motor Efficiencies

All permanently wired polyphase motors of 1 hp or more shall meet the minimum full-load efficiencies as indicated in the following table, and as specified in this specification. Motors of 1 hp or more with open, drip proof or totally enclosed fan cooled enclosures shall be high efficiency type, unless otherwise indicated. Motor efficiencies indicated in the tables apply to general-purpose, single-speed, polyphase induction motors. Applications which require definite purpose, special purpose, special frame, or special mounted polyphase induction motors are excluded from these efficiency requirements. Motors provided as an integral part of motor driven equipment are excluded from this requirement if a minimum seasonal or overall efficiency requirement is indicated for that equipment by the provisions of another section.

MINIMUM NOMINAL MOTOR EFFICIENCIES
OPEN DRIP PROOF MOTORS

kW	1200 RPM	1800 RPM	3600 RPM
0.746	82.5	85.5	80.0
1.12	86.5	86.5	85.5
1.49	87.5	86.5	86.5
2.24	89.5	89.5	86.5
3.73	89.5	89.5	89.5
5.60	91.7	91.0	89.5
7.46	91.7	91.7	90.2
11.2	92.4	93.0	91.0
14.9	92.4	93.0	92.4
18.7	93.0	93.6	93.0
22.4	93.6	93.6	93.0
29.8	94.1	94.1	93.6
37.3	94.1	94.5	93.6
44.8	95.0	95.0	94.1
56.9	95.0	95.0	94.5
74.6	95.0	95.4	94.5
93.3	95.4	95.4	95.0
112.0	95.8	95.8	95.4
149.0	95.4	95.8	95.4
187.0	95.4	96.2	95.8
224.0	95.4	95.0	95.4
261.0	94.5	95.4	95.0
298.0	94.1	95.8	95.0
336.0	94.5	95.4	95.4
373.0	94.5	94.5	94.5

TOTALLY ENCLOSED FAN-COOLED MOTORS

kW	1200 RPM	1800 RPM	3600 RPM
0.746	82.5	85.5	78.5
1.12	87.5	86.5	85.5
1.49	88.5	86.5	86.5
2.24	89.5	89.5	88.5
3.73	89.5	89.5	89.5

TOTALLY ENCLOSED FAN-COOLED MOTORS

5.60	91.7	91.7	91.0
7.46	91.7	91.7	91.7
11.2	92.4	92.4	91.7
14.9	92.4	93.0	92.4
18.7	93.0	93.6	93.0
22.4	93.6	93.6	93.0
29.8	94.1	94.1	93.6
37.3	94.1	94.5	94.1
44.8	94.5	95.0	94.1
56.9	95.0	95.4	94.5
74.6	95.4	95.4	95.0
93.3	95.4	95.4	95.4
112.0	95.8	95.8	95.4
149.0	95.8	96.2	95.8
187.0	95.6	96.2	95.9
224.0	95.4	96.1	95.8
261.0	94.5	96.2	94.8
298.0	94.5	95.8	94.5
336.0	94.5	94.5	94.5
373.0	94.5	94.5	94.5

MINIMUM NOMINAL MOTOR EFFICIENCIES
OPEN DRIP PROOF MOTORS

HP	1200 RPM	1800 RPM	3600 RPM
1	82.5	85.5	80.0
1.5	86.5	86.5	85.5
2	87.5	86.5	86.5
3	89.5	89.5	86.5
5	89.5	89.5	89.5
7.5	91.7	91.0	89.5
10	91.7	91.7	90.2
15	92.4	93.0	91.0
20	92.4	93.0	92.4
25	93.0	93.6	93.0
30	93.6	93.6	93.0
40	94.1	94.1	93.6
50	94.1	94.5	93.6
60	95.0	95.0	94.1
75	95.0	95.0	94.5
100	95.0	95.4	94.5
125	95.4	95.4	95.0
150	95.8	95.8	95.4
200	95.4	95.8	95.4
250	95.4	96.2	95.8
300	95.4	95.0	95.4
350	94.5	95.4	95.0
400	94.1	95.8	95.0
450	94.5	95.4	95.4
500	94.5	94.5	94.5

TOTALLY ENCLOSED FAN-COOLED MOTORS

HP	1200 RPM	1800 RPM	3600 RPM
1	82.5	85.5	78.5
1.5	87.5	86.5	85.5

TOTALLY ENCLOSED FAN-COOLED MOTORS			
2	88.5	86.5	86.5
3	89.5	89.5	88.5
5	89.5	89.5	89.5
7.5	91.7	91.7	91.0
10	91.7	91.7	91.7
15	92.4	92.4	91.7
20	92.4	93.0	92.4
25	93.0	93.6	93.0
30	93.6	93.6	93.0
40	94.1	94.1	93.6
50	94.1	94.5	94.1
60	94.5	95.0	94.1
75	95.0	95.4	94.5
100	95.4	95.4	95.0
125	95.4	95.4	95.4
150	95.8	95.8	95.4
200	95.8	96.2	95.8
250	95.6	96.2	95.9
300	95.4	96.1	95.8
350	94.5	96.2	94.8
400	94.5	95.8	94.5
450	94.5	94.5	94.5
500	94.5	94.5	94.5

2.17 MOTOR CONTROLS AND MOTOR CONTROL CENTERS

2.17.1 General

NEMA ICS 1, NEMA ICS 2, NEMA ICS 3 and NEMA ICS 6, and UL 508 and UL 845. Panelboards supplying non-linear loads shall have neutrals sized for 200 percent of rated current.

2.17.2 Motor Starters

Combination starters shall be provided with switches equipped with high-interrupting-capacity current-limiting fuses.

2.17.2.1 Reduced-Voltage Starters

Reduced-voltage starters shall be provided for polyphase motors 50 hp or larger. Reduced-voltage starters shall be of the single-step autotransformer, reactor, or resistor type having an adjustable time interval between application of reduced and full voltages to the motors. Wye-delta reduced voltage starter or part winding increment starter having an adjustable time delay between application of voltage to first and second winding of motor may be used in lieu of the reduced voltage starters specified above for starting of motor-generator sets, centrifugally operated equipment or reciprocating compressors provided with automatic unloaders.

2.17.3 Thermal-Overload Protection

Each motor of 1/8 hp or larger shall be provided with thermal-overload protection. Polyphase motors shall have overload protection in each ungrounded conductor. The overload-protection device shall be provided either integral with the motor or controller, or shall be mounted in a separate enclosure. Unless otherwise specified, the protective device shall be of the manually reset type. Single or double pole tumbler

switches specifically designed for alternating-current operation only may be used as manual controllers for single-phase motors having a current rating not in excess of 80 percent of the switch rating.

2.17.4 Low-Voltage Motor Overload Relays

2.17.4.1 General

Thermal and magnetic current overload relays shall conform to NEMA ICS 2 and UL 508. Overload protection shall be provided either integral with the motor or motor controller, and shall be rated in accordance with the requirements of NFPA 70. Standard units shall be used for motor starting times up to 7 seconds. Slow units shall be used for motor starting times from 8 to 12 seconds.

2.17.4.2 Construction

Manual reset type thermal relay shall be melting alloy or bimetallic construction. Automatic reset type thermal relays shall be bimetallic construction. Magnetic current relays shall consist of a contact mechanism and a dash pot mounted on a common frame.

2.17.4.3 Ratings

Voltage ratings shall be not less than the applicable circuit voltage. Trip current ratings shall be established by selection of the replaceable overload device and shall not be adjustable. Where the controller is remotely-located or difficult to reach, an automatic reset, non-compensated overload relay shall be provided. Manual reset overload relays shall be provided otherwise, and at all locations where automatic starting is provided. Where the motor is located in a constant ambient temperature, and the thermal device is located in an ambient temperature that regularly varies by more than minus 18 degrees F, an ambient temperature-compensated overload relay shall be provided.

2.17.5 Automatic Control Devices

2.17.5.1 Direct Control

Automatic control devices (such as thermostats, float or pressure switches) which control the starting and stopping of motors directly shall be designed for that purpose and have an adequate horsepower rating.

2.17.5.2 Pilot-Relay Control

Where the automatic-control device does not have such a rating, a magnetic starter shall be used, with the automatic-control device actuating the pilot-control circuit.

2.17.5.3 Manual/Automatic Selection

a. Where combination manual and automatic control is specified and the automatic-control device operates the motor directly, a double-throw, three-position tumbler or rotary switch (marked MANUAL-OFF-AUTOMATIC) shall be provided for the manual control.

b. Where combination manual and automatic control is specified and the automatic-control device actuates the pilot control circuit of a magnetic starter, the magnetic starter shall be provided with a

three-position selector switch marked MANUAL-OFF-AUTOMATIC.

c. Connections to the selector switch shall be such that; only the normal automatic regulatory control devices will be bypassed when the switch is in the Manual position; all safety control devices, such as low-or high-pressure cutouts, high-temperature cutouts, and motor-overload protective devices, shall be connected in the motor-control circuit in both the Manual and the Automatic positions of the selector switch. Control circuit connections to any MANUAL-OFF-AUTOMATIC switch or to more than one automatic regulatory control device shall be made in accordance with wiring diagram approved by the Contracting Officer unless such diagram is included on the drawings. All controls shall be 120 volts or less unless otherwise indicated.

2.18 PANELBOARDS

Dead-front construction, NEMA PB 1 and UL 67.

2.19 SWITCHBOARDS

Assemblies shall be metal-enclosed, freestanding general-purpose type in accordance with NEMA PB 2, UL 891, and IEEE C37.20.1 and shall be installed to provide front access. Busses shall be copper. Assembly shall be approximately 90 inches high; arrangement of circuit breakers and other items specified shall be as indicated. The withstand rating and interrupting capacity of the switchboards and circuit breakers shall be as indicated on the one line diagram. . Provide solid state multi-function metering consisting of ammeter, voltmeter, kva, kw, power factor and harmonics.

2.19.1 Circuit Breakers

Circuit breakers shall be stationarymolded-case circuit breakers insulated-case, systems type circuit breakers.

2.20 SNAP SWITCHES

UL 20.

2.21 TAPES

2.21.1 Plastic Tape

UL 510.

2.21.2 Rubber Tape

UL 510.

2.22 WIRING DEVICES

NEMA WD 1 for wiring devices, and NEMA WD 6 for dimensional requirements of wiring devices.

2.23 COORDINATED POWER SYSTEM PROTECTION

Analyses shall be prepared to demonstrate that the equipment and system constructed meet the specified requirements for equipment ratings, coordination, and protection. They shall include a load flow analysis, a

fault current analysis, and protective device coordination study. The studies shall be performed by a registered professional engineer with demonstrated experience in power system coordination in the last three years. The Contractor shall provide a list of references complete with points of contact, addresses and telephone numbers. The selection of the engineer is subject to the approval of the Contracting Officer.

2.23.1 Scope of Analyses

The fault current analysis, and protective device coordination study shall begin at: the source bus and extend down to system buses where fault availability is 10,000 amperes (symmetrical) for building/facility 600 volt level distribution buses.

2.23.2 Determination of Facts

The time-current characteristics, features, and nameplate data for each existing protective device shall be determined and documented. The Contractor shall coordinate with the Base utilities for fault current availability at the site.

2.23.3 Single Line Diagram

A single line diagram shall be prepared to show the electrical system buses, devices, transformation points, and all sources of fault current (including generator and motor contributions). A fault-impedance diagram or a computer analysis diagram may be provided. Each bus, device or transformation point shall have a unique identifier. If a fault-impedance diagram is provide, impedance data shall be shown. Locations of switches, breakers, and circuit interrupting devices shall be shown on the diagram together with available fault data, and the device interrupting rating.

2.23.4 Fault Current Analysis

2.23.4.1 Method

The fault current analysis shall be performed as part of the fault current and protective device coordination study in accordance with methods described in IEEE Std 242, and IEEE Std 399.

2.23.4.2 Data

Actual data shall be utilized in fault calculations. Bus characteristics and transformer impedances shall be those proposed. Data shall be documented in the report.

2.23.4.3 Fault Current Availability

Balanced three-phase fault, bolted line-to-line fault, and line-to-ground fault current values shall be provided at each voltage transformation point and at each power distribution bus. The maximum and minimum values of fault available at each location shall be shown in tabular form on the diagram or in the report.

2.23.5 Coordination Study

The study shall demonstrate that the maximum possible degree of selectivity has been obtained between devices specified, consistent with protection of equipment and conductors from damage from overloads and fault conditions.

The study shall include a description of the coordination of the protective devices in this project. Provide a written narrative that describes: which devices may operate in the event of a fault at each bus; the logic used to arrive at device ratings and settings; situation where system coordination is not achievable due to device limitations (an analysis of any device curves which order overlap); coordination between upstream and downstream devices; and relay settings. Recommendations to improve or enhance system reliability, and detail where such changes would involve additions or modifications to the contract and cost changes (addition or reduction) shall be provided. Composite coordination plots shall be provided on log-log graph paper.

2.23.6 Study Report

a. The report shall include a narrative: the analyses performed; the bases and methods used; and the desired method of coordinated protection of the power system.

b. The study shall include descriptive and technical data for existing devices and new protective devices proposed. The data shall include manufacturers published data, nameplate data, and definition of the fixed or adjustable features of the existing or new protective devices.

c. The report shall document utility company data including system voltages, fault MVA, system X/R ratio, time-current characteristic curves, current transformer ratios, and relay device curves and protective device ratings and settings.

d. The report shall contain fully coordinated composite time-current characteristic curves for each bus in the system, as required to ensure coordinated power system protection between protective devices or equipment. The report shall include recommended ratings and settings of all protective devices in tabulated form.

e. The report shall provide the calculations performed for the analyses, including computer analysis programs utilized. The name of the software package, developer, and version number shall be provided.

2.24 MASS NOTIFICATION SYSTEM

Provide a mass notification system for the building in accordance with UFC 4-021-01. The system shall include a control panel, a digitized recorded message panel, speaker strobes, notification appliance circuit (NAC) panels and a local microphone. The system receives a radio frequency signal and plays the recorded message while simultaneously flashing the strobes. A signal is sent to the fire detection and alarm system panel to prevent the fire alarm audible signals from sounding if the mass notification system is activated.

2.24.1 Control Panel

Provide a control panel to receive the audio signal from the recorded message panel and distributes it to all speaker strobes. Panel shall include an output signal to all NAC panels to flash the strobes. All strobes shall be synchronized. Panel shall include an output relay contact to signal the fire alarm system panel to inhibit operation of the fire alarm audible devices if mass notification is activated. The panel shall

supervise the all input circuits, all output signal circuits, the panel power supply, the NAC panels and the recorded message panel. Power to the panel shall be 120 volt AC. Provide battery backup for loss of AC power for a minimum of 72 hours of panel operation and 15 minutes of audible/visual alarm after the 72 hour period expires. Local indication of activation, supervisory or trouble conditions. Manufacturer's standard enclosure with lockable door.

2.24.2 Recorded Message Panel

Provide a recorded message panel to store and play the recorded message. Provide a radio frequency receiver with antenna compatible with the base Motorola radio system. This receiver shall activate the message play and send a signal to the control panel to activate the strobes. Provide minimum message storage of 6 minutes. Panel shall include a microphone input for local messages. Activation of the local microphone shall stop the recorded message and sound a tone notifying the building occupants that a local message is about to be sounded. Provide amplifier(s) to power all speakers in the system with 25 or 70 volt output. Power to the panel shall be 120 volt AC. Provide battery backup for loss of AC power for a minimum of 72 hours of panel operation and 15 minutes of audible/visual alarm after the 72 hour period expires. Manufacturer's standard enclosure with lockable door.

2.24.3 Speaker Strobes

Speaker strobe with separate screw terminals for the speaker and the strobe. Multi-wattage speaker with 25 or 70 volt input to match amplifier. Strobe candela as indicated on the Drawings.

2.24.4 Notification Appliance Circuit (NAC) Panel

Provide NAC panels to power strobes. Minimum four output circuits per panel. Synchronize all strobes. Supervision for input circuits, output circuits, loss of AC power and battery trouble. Local indicators for AC power "ON", battery trouble and ground fault. Power to the panel shall be 120 volt AC. Provide battery backup for loss of AC power for a minimum of 72 hours of panel operation and 15 minutes of audible/visual alarm after the 72 hour period expires. Manufacturer's standard enclosure with lockable door.

2.24.5 Microphone

Provide microphone with push to talk switch for local message capability into system. Microphone base for desk location. Provide with cables and jack.

PART 3 EXECUTION

3.1 SUBMITTALS

Provide submittals for interior electrical equipment as specified in Paragraph 1.3 of this section, to include manufacturer's catalog, material, equipment, and fixture lists, installation procedures, factory test reports, and field test plan.

3.2 GROUNDING

Grounding shall be in conformance with NFPA 70, the contract drawings, and

the following specifications.

3.2.1 Ground Rods

The resistance to ground shall be measured using the fall-of-potential method described in IEEE Std 81. The maximum resistance of a driven ground shall not exceed 25 ohms under normally dry conditions. If this resistance cannot be obtained with a single rod, 2 additional rods not less than 6 feet on centers, or if sectional type rods are used, 2 additional sections may be coupled and driven with the first rod. In high-ground-resistance, UL listed chemically charged ground rods may be used. If the resultant resistance exceeds 25 ohms measured not less than 48 hours after rainfall, the Contracting Officer shall be notified immediately. Connections below grade shall be fusion welded. Connections above grade shall be fusion welded or shall use UL 467 approved connectors.

3.2.2 Ground Bus

Ground bus shall be provided in the electrical equipment rooms as indicated. Noncurrent-carrying metal parts of electrical equipment shall be effectively grounded by bonding to the ground bus. The ground bus shall be bonded to both the entrance ground, and to a ground rod or rods as specified above having the upper ends terminating approximately 4 inches above the floor. Connections and splices shall be of the brazed, welded, bolted, or pressure-connector type, except that pressure connectors or bolted connections shall be used for connections to removable equipment. For raised floor equipment rooms in computer and data processing centers, a minimum of 4, one at each corner, multiple grounding systems shall be furnished. Connections shall be bolted type in lieu of thermoweld, so they can be changed as required by additions and/or alterations.

3.2.3 Grounding Conductors

A green equipment grounding conductor, sized in accordance with NFPA 70 shall be provided, regardless of the type of conduit. Equipment grounding bars shall be provided in all panelboards. The equipment grounding conductor shall be carried back to the service entrance grounding connection or separately derived grounding connection. All equipment grounding conductors, including metallic raceway systems used as such, shall be bonded or joined together in each wiring box or equipment enclosure. Metallic raceways and grounding conductors shall be checked to assure that they are wired or bonded into a common junction. Metallic boxes and enclosures, if used, shall also be bonded to these grounding conductors by an approved means per NFPA 70. When switches, or other utilization devices are installed, any designated grounding terminal on these devices shall also be bonded to the equipment grounding conductor junction with a short jumper.

3.3 WIRING METHODS

Wiring shall conform to NFPA 70, the contract drawings, and the following specifications. Unless otherwise indicated, wiring shall consist of insulated conductors installed in rigid zinc-coated steel conduit, rigid plastic conduit, electrical metallic tubing, intermediate metal conduit. Where cables and wires are installed in cable trays, they shall be of the type permitted by NFPA 70 for use in such applications. Wire fill in conduits shall be based on NFPA 70 for the type of conduit and wire insulations specified. Wire fill in conduits located in Class I or II hazardous areas shall be limited to 25 percent of the cross sectional area

of the conduit.

3.3.1 Conduit and Tubing Systems

Conduit and tubing systems shall be installed as indicated. Conduit sizes shown are based on use of copper conductors with insulation types as described in paragraph WIRING METHODS. Minimum size of raceways shall be 1/2 inch. Only metal conduits will be permitted when conduits are required for shielding or other special purposes indicated, or when required by conformance to NFPA 70. Nonmetallic conduit and tubing may be used in damp, wet or corrosive locations when permitted by NFPA 70 and the conduit or tubing system is provided with appropriate boxes, covers, clamps, screws or other appropriate type of fittings. Electrical metallic tubing (EMT) may be installed only within buildings. EMT shall not be installed in damp or wet locations, or the air space of exterior masonry cavity walls. Bushings, manufactured fittings or boxes providing equivalent means of protection shall be installed on the ends of all conduits and shall be of the insulating type, where required by NFPA 70. Only UL listed adapters shall be used to connect EMT to rigid metal conduit, cast boxes, and conduit bodies. Aluminum conduit may be used only where installed exposed in dry locations. Nonaluminum sleeves shall be used where aluminum conduit passes through concrete floors and firewalls. Penetrations of above grade floor slabs, time-rated partitions and fire walls shall be firestopped in accordance with Section 07840 FIRESTOPPING. Except as otherwise specified, IMC may be used as an option for rigid steel conduit in areas as permitted by NFPA 70. Raceways shall not be installed under the firepits of boilers and furnaces and shall be kept 6 inches away from parallel runs of flues, steam pipes and hot-water pipes. Raceways shall be concealed within finished walls, ceilings, and floors unless otherwise shown. Raceways crossing structural expansion joints or seismic joints shall be provided with suitable expansion fittings or other suitable means to compensate for the building expansion and contraction and to provide for continuity of grounding.

3.3.1.1 Pull Wires

A pull wire shall be inserted in each empty raceway in which wiring is to be installed if the raceway is more than 50 feet in length and contains more than the equivalent of two 90-degree bends, or where the raceway is more than 150 feet in length. The pull wire shall be of No. 14 AWG zinc-coated steel, or of plastic having not less than 200 pounds per square inch tensile strength. Not less than 10 inches of slack shall be left at each end of the pull wire.

3.3.1.2 Conduit Stub-Ups

Where conduits are to be stubbed up through concrete floors, a short elbow shall be installed below grade to transition from the horizontal run of conduit to a vertical run. A conduit coupling fitting, threaded on the inside shall be installed, to allow terminating the conduit flush with the finished floor. Wiring shall be extended in rigid threaded conduit to equipment, except that where required, flexible conduit may be used 6 inches above the floor. Empty or spare conduit stub-ups shall be plugged flush with the finished floor with a threaded, recessed plug.

3.3.1.3 Below Slab-on-Grade or in the Ground

Electrical wiring below slab-on-grade shall be protected by a conduit system. Conduit passing vertically through slabs-on-grade shall be rigid

steel or IMC. Rigid steel or IMC conduits installed below slab-on-grade or in the earth shall be field wrapped with 0.010 inch thick pipe-wrapping plastic tape applied with a 50 percent overlay, or shall have a factory-applied polyvinyl chloride, plastic resin, or epoxy coating system.

3.3.1.4 Installing in Slabs Including Slabs on Grade

Conduit installed in slabs-on-grade shall be rigid steel or IMC. Conduits shall be installed as close to the middle of concrete slabs as practicable without disturbing the reinforcement. Outside diameter shall not exceed 1/3 of the slab thickness and conduits shall be spaced not closer than 3 diameters on centers except at cabinet locations where the slab thickness shall be increased as approved by the Contracting Officer. Where conduit is run parallel to reinforcing steel, the conduit shall be spaced a minimum of one conduit diameter away but not less than one inch from the reinforcing steel.

3.3.1.5 Changes in Direction of Runs

Changes in direction of runs shall be made with symmetrical bends or cast-metal fittings. Field-made bends and offsets shall be made with an approved hickey or conduit-bending machine. Crushed or deformed raceways shall not be installed. Trapped raceways in damp and wet locations shall be avoided where possible. Lodgment of plaster, dirt, or trash in raceways, boxes, fittings and equipment shall be prevented during the course of construction. Clogged raceways shall be cleared of obstructions or shall be replaced.

3.3.1.6 Supports

Metallic conduits and tubing,and the support system to which they are attached, shall be securely and rigidly fastened in place to prevent vertical and horizontal movement at intervals of not more than 10 feet and within 3 feet of boxes, cabinets, and fittings, with approved pipe straps, wall brackets, conduit clamps, conduit hangers, threaded C-clamps, beam clamps, or ceiling trapeze. Loads and supports shall be coordinated with supporting structure to prevent damage or deformation to the structure. Loads shall not be applied to joist bridging. Attachment shall be by wood screws or screw-type nails to wood; by toggle bolts on hollow masonry units; by expansion bolts on concrete or brick; by machine screws, welded threaded studs, heat-treated or spring-steel-tension clamps on steel work. Nail-type nylon anchors or threaded studs driven in by a powder charge and provided with lock washers and nuts may be used in lieu of expansion bolts or machine screws. Raceways or pipe straps shall not be welded to steel structures. Cutting the main reinforcing bars in reinforced concrete beams or joists shall be avoided when drilling holes for support anchors. Holes drilled for support anchors, but not used, shall be filled. In partitions of light steel construction, sheet-metal screws may be used. Raceways shall not be supported using wire or nylon ties. Raceways shall be independently supported from the structure. Upper raceways shall not be used as a means of support for lower raceways. Supporting means shall not be shared between electrical raceways and mechanical piping or ducts. Cables and raceways shall not be supported by ceiling grids. Except where permitted by NFPA 70, wiring shall not be supported by ceiling support systems. Conduits shall be fastened to sheet-metal boxes and cabinets with two locknuts where required by NFPA 70, where insulating bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, a single locknut and bushing may be used. Threadless fittings for electrical metallic tubing shall be of a type approved for the

conditions encountered. Additional support for horizontal runs is not required when EMT rests on steel stud cutouts.

3.3.1.7 Exposed Raceways

Exposed raceways shall be installed parallel or perpendicular to walls, structural members, or intersections of vertical planes and ceilings. Raceways under raised floors and above accessible ceilings shall be considered as exposed installations in accordance with NFPA 70 definitions.

3.3.1.8 Exposed Risers

Exposed risers in wire shafts of multistory buildings shall be supported by U-clamp hangers at each floor level, and at intervals not to exceed 10 feet.

3.3.1.9 Exposed Lengths of Conduit, Over 600 Volts

Exposed lengths of conduit containing power conductors operating at more than 600 volts shall have two red bands 2 inches wide spaced 8 inches apart painted near each coupling; the intervening space between the red bands shall be painted white, and on the white space the voltage shall be stenciled in black: 15,000 volts.

3.3.1.10 Communications Raceways

Communications raceways indicated shall be installed in accordance with the previous requirements for conduit and tubing and with the additional requirement that no length of run shall exceed 50 feet for 1/2 inch and 3/4 inch sizes, and 100 feet for 1 inch or larger sizes, and shall not contain more than two 90-degree bends or the equivalent. Additional pull or junction boxes shall be installed to comply with these limitations whether or not indicated. Inside radii of bends in conduits of 1 inch size or larger shall not be less than ten times the nominal diameter.

3.3.2 Cable Trays

Cable trays shall be supported in accordance with the recommendations of the manufacturer but at no more than 6 foot intervals. Contact surfaces of aluminum connections shall be coated with an antioxidant compound prior to assembly. Adjacent cable tray sections shall be bonded together by connector plates of an identical type as the cable tray sections. The Contractor shall submit the manufacturer's certification that the cable tray system meets all requirements of Article 318 of NFPA 70. The cable tray shall be installed and grounded in accordance with the provisions of Article 318 of NFPA 70. Data submitted by the Contractor shall demonstrate that the completed cable tray systems will comply with the specified requirements. Cable trays shall terminate 10 inches from both sides of smoke and fire partitions. Conductors run through smoke and fire partitions shall be installed in 4 inch rigid steel conduits with grounding bushings, extending 12 inches beyond each side of the partitions. The installation shall be sealed to preserve the smoke and fire rating of the partitions. Penetrations shall be firestopped in accordance with Section 07840 FIRESTOPPING.

3.3.3 Cables and Conductors

Installation shall conform to the requirements of NFPA 70. Covered, bare or insulated conductors of circuits rated over 600 volts shall not occupy

the same equipment wiring enclosure, cable, or raceway with conductors of circuits rated 600 volts or less.

3.3.3.1 Sizing

Unless otherwise noted, all sizes are based on copper conductors and the insulation types indicated. Sizes shall be not less than indicated. Branch-circuit conductors shall be not smaller than No. 12 AWG. Conductors for branch circuits of 120 volts more than 100 feet long and of 277 volts more than 230 feet long, from panel to load center, shall be no smaller than No. 10 AWG. Class 1 remote control and signal circuit conductors shall be not less than No. 14 AWG. Class 2 remote control and signal circuit conductors shall be not less than No. 16 AWG. Class 3 low-energy, remote-control and signal circuits shall be not less than No. 22 AWG.

3.3.3.2 Conductor Identification and Tagging

Power, control, and signal circuit conductor identification shall be provided within each enclosure where a tap, splice, or termination is made. Where several feeders pass through a common pull box, the feeders shall be tagged to indicate clearly the electrical characteristics, circuit number, and panel designation. Phase conductors of low voltage power circuits shall be identified by color coding. Phase identification by a particular color shall be maintained continuously for the length of a circuit, including junctions.

a. Color coding shall be provided for service, feeder, branch, and ground conductors. Color shall be green for grounding conductors and white for neutrals; except where neutrals of more than one system are installed in the same raceway or box, other neutral shall be white with colored (not green) stripe. The color coding for 3-phase and single-phase low voltage systems shall be as follows:

   120/208-volt, 3-phase: Black(A), red(B), and blue(C).
   277/480-volt, 3-phase: Brown(A), orange(B), and yellow(C).
   120/240-volt, 1-phase: Black and red.

b. Conductor phase and voltage identification shall be made by color-coded insulation for all conductors smaller than No. 6 AWG. For conductors No. 6 AWG and larger, identification shall be made by color-coded insulation, or conductors with black insulation may be furnished and identified by the use of half-lapped bands of colored electrical tape wrapped around the insulation for a minimum of 3 inches of length near the end, or other method as submitted by the Contractor and approved by the Contracting Officer.

c. Control and signal circuit conductor identification shall be made by color-coded insulated conductors, plastic-coated self-sticking printed markers, permanently attached stamped metal foil markers, or equivalent means as approved. Control circuit terminals of equipment shall be properly identified. Terminal and conductor identification shall match that shown on approved detail drawings. Hand lettering or marking is not acceptable.

3.4 BOXES AND SUPPORTS

Boxes shall be provided in the wiring or raceway systems where required by

NFPA 70 for pulling of wires, making connections, and mounting of devices or fixtures. Pull boxes shall be furnished with screw-fastened covers. Indicated elevations are approximate, except where minimum mounting heights for hazardous areas are required by NFPA 70. Unless otherwise indicated, boxes for wall switches shall be mounted 48 inches above finished floors. Switch and outlet boxes located on opposite sides of fire rated walls shall be separated by a minimum horizontal distance of 24 inches. The total combined area of all box openings in fire rated walls shall not exceed 100 square inches per 100 square feet. Maximum box areas for individual boxes in fire rated walls vary with the manufacturer and shall not exceed the maximum specified for that box in UL Elec Const Dir. Only boxes listed in UL Elec Const Dir shall be used in fire rated walls.

3.4.1 Box Applications

Each box shall have not less than the volume required by NFPA 70 for number of conductors enclosed in box. Boxes for metallic raceways shall be listed for the intended use when located in normally wet locations, when flush or surface mounted on outside of exterior surfaces, or when located in hazardous areas. Boxes installed in wet locations and boxes installed flush with the outside of exterior surfaces shall be gasketed. Boxes for mounting lighting fixtures shall be not less than 4 inches square, or octagonal, except smaller boxes may be installed as required by fixture configuration, as approved. Cast-metal boxes with 3/32 inch wall thickness are acceptable. Large size boxes shall be as shown. Boxes in other locations shall be sheet steel except that aluminum boxes may be used with aluminum conduit, and nonmetallic boxes may be used with nonmetallic conduit and tubing or nonmetallic sheathed cable system, when permitted by NFPA 70. Boxes for use in masonry-block or tile walls shall be square-cornered, tile-type, or standard boxes having square-cornered, tile-type covers.

3.4.2 Brackets and Fasteners

Boxes and supports shall be fastened to wood with wood screws or screw-type nails of equal holding strength, with bolts and metal expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screw or welded studs on steel work. Threaded studs driven in by powder charge and provided with lockwashers and nuts, or nail-type nylon anchors may be used in lieu of expansion shields, or machine screws. Penetration of more than 1-1/2 inches into reinforced-concrete beams or more than 3/4 inch into reinforced-concrete joists shall avoid cutting any main reinforcing steel. The use of brackets which depend on gypsum wallboard or plasterboard for primary support will not be permitted. In partitions of light steel construction, bar hangers with 1 inch long studs, mounted between metal wall studs or metal box mounting brackets shall be used to secure boxes to the building structure. When metal box mounting brackets are used, additional box support shall be provided on the side of the box opposite the brackets. This additional box support shall consist of a minimum 12 inch long section of wall stud, bracketed to the opposite side of the box and secured by two screws through the wallboard on each side of the stud. Metal screws may be used in lieu of the metal box mounting brackets.

3.4.3 Mounting in Walls, Ceilings, or Recessed Locations

In walls or ceilings of concrete, tile, or other non-combustible material, boxes shall be installed so that the edge of the box is not recessed more than 1/4 inch from the finished surface. Boxes mounted in combustible

walls or ceiling material shall be mounted flush with the finished surface. The use of gypsum or plasterboard as a means of supporting boxes will not be permitted. Boxes installed for concealed wiring shall be provided with suitable extension rings or plaster covers, as required. The bottom of boxes installed in masonry-block walls for concealed wiring shall be mounted flush with the top of a block to minimize cutting of the blocks, and boxes shall be located horizontally to avoid cutting webs of block. Separate boxes shall be provided for flush or recessed fixtures when required by the fixture terminal operating temperature, and fixtures shall be readily removable for access to the boxes unless ceiling access panels are provided.

3.4.4 Installation in Overhead Spaces

In open overhead spaces, cast-metal boxes threaded to raceways need not be separately supported except where used for fixture support; cast-metal boxes having threadless connectors and sheet metal boxes shall be supported directly from the building structure or by bar hangers. Hangers shall not be fastened to or supported from joist bridging. Where bar hangers are used, the bar shall be attached to raceways on opposite sides of the box and the raceway shall be supported with an approved type fastener not more than 24 inches from the box.

3.5 DEVICE PLATES

One-piece type device plates shall be provided for all outlets and fittings. Plates on unfinished walls and on fittings shall be of zinc-coated sheet steel, cast-metal, or impact resistant plastic having rounded or beveled edges. Plates on finished walls shall be of gray or satin finish corrosion resistant stainless steel.. Screws shall be of metal with countersunk heads, in a color to match the finish of the plate. Plates shall be installed with all four edges in continuous contact with finished wall surfaces without the use of mats or similar devices. Plaster fillings will not be permitted. Plates shall be installed with an alignment tolerance of 1/16 inch. The use of sectional-type device plates will not be permitted. Plates installed in wet locations shall be gasketed and provided with a hinged, gasketed cover, unless otherwise specified.

3.6 RECEPTACLES

3.6.1 Single and Duplex, 15 or 20-ampere, 125 volt

Single and duplex receptacles shall be rated 20 amperes, 125 volts, two-pole, three-wire, grounding type with polarized parallel slots. Bodies shall be of gray or as indicated to match color of switch handles in the same room or to harmonize with the color of the respective wall, and supported by mounting strap having plaster ears. Contact arrangement shall be such that contact is made on two sides of an inserted blade. Receptacle shall be side- or back-wired with two screws per terminal. The third grounding pole shall be connected to the metal mounting yoke. Switched receptacles shall be the same as other receptacles specified except that the ungrounded pole of each suitable receptacle shall be provided with a separate terminal. Only the top receptacle of a duplex receptacle shall be wired for switching application. Receptacles with ground fault circuit interrupters shall have the current rating as indicated, and shall be UL Class A type unless otherwise shown. Ground fault circuit protection shall be provided as required by NFPA 70 and as indicated on the drawings.

3.6.2 Floor Outlets

Floor outlets shall be adjustable and each outlet shall consist of a cast-metal body with threaded openings for conduits, adjustable ring, and cover plate with 1/2 inch or 3/4 inch threaded flush plug. Each telephone outlet shall consist of a horizontal cast housing with a receptacle as specified. Gaskets shall be used where necessary to ensure a watertight installation. Plugs with installation instructions shall be delivered to the Contracting Officer at the job site for capping outlets upon removal of service fittings.

3.6.3 Weatherproof Applications

Weatherproof receptacles shall be suitable for the environment, damp or wet as applicable, and the housings shall be labeled to identify the allowable use. Receptacles shall be marked in accordance with UL 514A for the type of use indicated; "Damp locations", "Wet Locations", "Wet Location Only When Cover Closed". Assemblies shall be installed in accordance with the manufacturer's recommendations.

3.6.3.1 Damp Locations

Receptacles in damp locations shall be mounted in an outlet box with a gasketed, weatherproof, cast-metal cover plate (device plate, box cover) and a gasketed cap (hood, receptacle cover) over each receptacle opening. The cap shall be either a screw-on type permanently attached to the cover plate by a short length of bead chain or shall be a flap type attached to the cover with a spring loaded hinge.

3.6.3.2 Wet Locations

Receptacles in wet locations shall be installed in an assembly rated for such use whether the plug is inserted or withdrawn, unless otherwise indicated. In a duplex installation, the receptacle cover shall be configured to shield the connections whether one or both receptacles are in use.

3.6.4 Receptacles, 15-Ampere, 250-Volt

Receptacles, 15-ampere, 250-volt, shall be duplex two-pole, three-wire, grounding type with bodies of gray as indicated phenolic compound supported by mounting yoke having plaster ears. The third grounding pole shall be connected to the metal yoke. Each receptacle shall be provided with a mating cord-grip plug.

3.6.5 Receptacles, 20-Ampere, 250-Volt

Receptacles, single, 20-ampere, 250-volt, shall be gray or as indicated molded plastic, two-pole, three-wire or three-pole, four-wire, grounding type complete with appropriate mating cord-grip plug.

3.6.6 Receptacles, 30-Ampere, 125/250-Volt

Receptacles, single, 30-ampere, 125/250-volt, shall be molded-plastic, three-pole, four-wire, grounding type, complete with appropriate mating cord-grip type attachment plug. Each dryer receptacle shall be furnished with a non-detachable power supply cord for connection to the electric clothes dryer. The cord shall be an angle-type 36 inch length of Type SRDT range and dryer cable with three No. 10 AWG conductors.

3.6.7 Receptacles, 30-Ampere, 250-Volt

Receptacles, single, 30-ampere, 250-volt, shall be molded-plastic, three-pole, three-wire type, complete with appropriate mating cord-grip plug.

3.6.8 Receptacles, 50-Ampere, 125/250-Volt

Receptacles, single 50-ampere, 125/250-volt, shall be flush, molded plastic, three-pole, four-wire, grounding type. Each range receptacle shall be furnished with a nondetachable power supply cord for connection to the electric range. The cord shall be an angle-type 36 inch length of SRDT range and dryer cable with one No. 8 and two No. 6 AWG conductors.

3.6.9 Receptacles, 50-Ampere, 250-Volt

Receptacles, single, 50-ampere, 250-volt, shall be flush molded plastic, three-pole, three-wire type, complete with appropriate mating cord-grip plug.

3.6.10 Special-Purpose or Heavy-Duty Receptacles

Special-purpose or heavy-duty receptacles shall be of the type and of ratings and number of poles indicated or required for the anticipated purpose. Contact surfaces may be either round or rectangular. One appropriate straight or angle-type plug shall be furnished with each receptacle. Locking type receptacles, rated 30 amperes or less, shall be locked by rotating the plug. Locking type receptacles, rated more than 50 amperes, shall utilize a locking ring.

3.7 WALL SWITCHES

Wall switches shall be of the totally enclosed tumbler type. The wall switch handle and switch plate color shall be gray or as indicated. Wiring terminals shall be of the screw type or of the solderless pressure type having suitable conductor-release arrangement. Not more than one switch shall be installed in a single-gang position. Switches shall be rated 20-ampere 277-volt for use on alternating current only. Pilot lights indicated shall consist of yoke-mounted candelabra-base sockets rated at 75 watts, 125 volts, and fitted with glass or plastic jewels. A clear 6-watt lamp shall be furnished and installed in each pilot switch. Jewels for use with switches controlling motors shall be green, and jewels for other purposes shall be red. Dimming switches shall be solid-state flush mounted, sized for the loads.

3.8 PANELBOARDS

Circuit breakers and switches used as a motor disconnecting means shall be capable of being locked in the open position. Door locks shall be keyed alike. Nameplates shall be as approved. Directories shall be typed to indicate loads served by each circuit and mounted in a holder behind a clear protective covering. Busses shall be copper.

3.8.1 Loadcenters

Loadcenters shall be circuit breaker equipped.

3.8.2 Panelboards

Panelboards shall be circuit breaker or fusible switch equipped as indicated on the drawings. Multipole fusible switches shall be of the hinged-door type; single pole fusible switches shall be of the tumbler switch and fuse type. Switches serving as a motor disconnect means shall be of the tumbler switch and fuse type. Switches serving as motor disconnect means shall be horsepower rated in conformance with UL 98.

3.9 FUSES

Equipment provided under this contract shall be provided with a complete set of properly rated fuses when the equipment manufacturer utilize fuses in the manufacture of the equipment, or if current-limiting fuses are required to be installed to limit the ampere-interrupting capacity of circuit breakers or equipment to less than the maximum available fault current at the location of the equipment to be installed. Fuses shall have a voltage rating of not less than the phase-to-phase circuit voltage, and shall have the time-current characteristics required for effective power system coordination. Time-delay and non-time-delay options shall be as shown.

3.9.1 Cartridge Fuses; Noncurrent-Limiting Type

Cartridge fuses of the noncurrent-limiting type shall be Class H, nonrenewable, dual element, time lag type and shall have interrupting capacity of 10,000 amperes. At 500 percent current, cartridge fuses shall not blow in less than 10 seconds.

3.9.2 Cartridge Fuses; Current-Limiting Type

Cartridge fuses, current-limiting type, Class JRK1 RK5 shall have tested interrupting capacity not less than 200,000 amperes. Fuse holders shall be the type that will reject all Class H fuses.

3.9.3 Continuous Current Ratings (600 Amperes and Smaller)

Service entrance and feeder circuit fuses (600 amperes and smaller) shall be Class RK1, RK5 or J, current-limiting, time-delay with 200,000 amperes interrupting capacity.

3.9.4 Continuous Current Ratings (Greater than 600 Amperes)

Service entrance and feeder circuit fuses (greater than 600 amperes) shall be Class L, current-limiting, time-delay with 200,000 amperes interrupting capacity.

3.9.5 Motor and Transformer Circuit Fuses

Motor, motor controller, transformer, and inductive circuit fuses shall be Class RK1 or RK5, current-limiting, time-delay with 200,000 amperes interrupting capacity.

3.10 MOTORS

Each motor shall conform to the hp and voltage ratings indicated, and shall have a service factor and other characteristics that are essential to the proper application and performance of the motors under conditions shown or specified. Three-phase motors for use on 3-phase 208-volt systems shall

have a nameplate rating of 200 volts. Unless otherwise specified, all motors shall have open frames, and continuous-duty classification based on a 40 degree C ambient temperature reference. Polyphase motors shall be squirrel-cage type, having normal-starting-torque and low-starting-current characteristics, unless other characteristics are specified in other sections of these specifications or shown on contract drawings. The Contractor shall be responsible for selecting the actual horsepower ratings and other motor requirements necessary for the applications indicated. When electrically driven equipment furnished under other sections of these specifications materially differs from the design, the Contractor shall make the necessary adjustments to the wiring, disconnect devices and branch-circuit protection to accommodate the equipment actually installed.

3.11 MOTOR CONTROL

Each motor or group of motors requiring a single control and not controlled from a motor-control center shall be provided under other sections of these specifications with a suitable controller and devices that will perform the functions as specified for the respective motors. Each motor of 1/8 hp or larger shall be provided with thermal-overload protection. Polyphase motors shall have overload protection in each ungrounded conductor. The overload-protection device shall be provided either integral with the motor or controller, or shall be mounted in a separate enclosure. Unless otherwise specified, the protective device shall be of the manually reset type. Single or double pole tumbler switches specifically designed for alternating-current operation only may be used as manual controllers for single-phase motors having a current rating not in excess of 80 percent of the switch rating. Automatic control devices such as thermostats, float or pressure switches may control the starting and stopping of motors directly, provided the devices used are designed for that purpose and have an adequate horsepower rating. When the automatic-control device does not have such a rating, a magnetic starter shall be used, with the automatic-control device actuating the pilot-control circuit. When combination manual and automatic control is specified and the automatic-control device operates the motor directly, a double-throw, three-position tumbler or rotary switch shall be provided for the manual control; when the automatic-control device actuates the pilot control circuit of a magnetic starter, the latter shall be provided with a three-position selector switch marked MANUAL-OFF-AUTOMATIC. Connections to the selector switch shall be such that only the normal automatic regulatory control devices will be bypassed when the switch is in the Manual position; all safety control devices, such as low- or high-pressure cutouts, high-temperature cutouts, and motor-overload protective devices, shall be connected in the motor-control circuit in both the Manual and the Automatic positions of the selector switch. Control circuit connections to any MANUAL-OFF-AUTOMATIC switch or to more than one automatic regulatory control device shall be made in accordance with wiring diagram approved by the Contracting Officer unless such diagram is included on the drawings. All controls shall be 120 volts or less unless otherwise indicated.

3.11.1 Contacts

Unless otherwise indicated, contacts in miscellaneous control devices such as float switches, pressure switches, and auxiliary relays shall have current and voltage ratings in accordance with NEMA ICS 2 for rating designation B300.

3.11.2 Safety Controls

Safety controls for boilers shall be connected to a 2-wire, 120 volt grounded circuit supplied from the associated boiler-equipment circuit. Where the boiler circuit is more than 120 volts to ground, safety controls shall be energized through a two-winding transformer having its 120 volt secondary winding grounded. Overcurrent protection shall be provided in the ungrounded secondary conductor and shall be sized for the load encountered.

3.12 MOTOR-DISCONNECT MEANS

Each motor shall be provided with a disconnecting means when required by NFPA 70 even though not indicated. For single-phase motors, a single or double pole toggle switch, rated only for alternating current, will be acceptable for capacities less than 30 amperes, provided the ampere rating of the switch is at least 125 percent of the motor rating. Switches shall disconnect all ungrounded conductors.

3.13 TRANSFORMER INSTALLATION

Three-phase transformers shall be connected only in a delta-wye configuration as indicated. Dry-type transformers shown located within 5 feet of the exterior wall shall be provided in a weatherproof enclosure. Transformers to be located within the building may be provided in the manufacturer's standard, ventilated indoor enclosure designed for use in 40 degrees C ambient temperature, unless otherwise indicated.

3.14 LIGHTING FIXTURES, LAMPS AND BALLASTS

This paragraph shall cover the installation of lamps, lighting fixtures and ballasts in interior or building mounted applications.

3.14.1 Lamps

Lamps of the type, wattage, and voltage rating indicated shall be delivered to the project in the original cartons and installed just prior to project completion. Lamps installed and used for working light during construction shall be replaced prior to turnover to the Government if more than 15% of their rated life has been used. Lamps shall be tested for proper operation prior to turn-over and shall be replaced if necessary with new lamps from the original manufacturer. 10% spare lamps of each type, from the original manufacturer, shall be provided.

3.14.2 Lighting Fixtures

Fixtures shall be as shown and shall conform to the following specifications and shall be as detailed on the drawings. Illustrations shown on the drawings are indicative of the general type desired and are not intended to restrict selection to fixtures of any particular manufacturer. Fixtures of similar designs and equivalent energy efficiency, light distribution and brightness characteristics, and of equal finish and quality will be acceptable if approved. In suspended acoustical ceilings with fluorescent fixtures, the fluorescent emergency light fixtures shall be furnished with self-contained battery packs.

3.14.2.1 Accessories

Accessories such as straps, mounting plates, nipples, or brackets shall be

provided for proper installation.

3.14.2.2 Ceiling Fixtures

Ceiling fixtures shall be coordinated with and suitable for installation in, on or from the ceiling as shown. Installation and support of fixtures shall be in accordance with NFPA 70 and manufacturer's recommendations. Where seismic requirements are specified herein, fixtures shall be supported as shown or specified. Recessed fixtures shall have adjustable fittings to permit alignment with ceiling panels. Recessed fixtures installed in fire-resistive ceiling construction shall have the same fire rating as the ceiling or shall be provided with fireproofing boxes having materials of the same fire rating as the ceiling, in conformance withUL Elec Const Dir. Surface-mounted fixtures shall be suitable for fastening to the ceiling panel structural supports.

3.14.2.3 Fixtures for Installation in Grid Type Ceilings

Fixtures for installation in grid type ceilings which are smaller than a full tile shall be centered in the tile. 1 by 4 foot fixtures shall be mounted along the grid rail as shown. Work above the ceiling shall be coordinated among the trades to provide the lighting layout shown. Fixtures mounted to the grid shall have trim exactly compatible with the grid. Contractor shall coordinate trims with ceiling trades prior to ordering fixtures. Metric fixtures shall be designed to fit the metric grid specified. Fixtures in continuous rows shall be coordinated between trades prior to ordering. Fixtures shall be mounted using independent supports capable of supporting the entire weight of the fixture. No fixture shall rest solely on the ceiling grid. Recessed fixtures installed in seismic areas should be installed utilizing specially designed seismic clips. Junction boxes shall be supported at four points.

3.14.2.4 Suspended Fixtures

Suspended fixtures shall be provided with swivel hangers or hand-straights so that they hang plumb. Pendants, rods, or chains 4 feet or longer excluding fixture shall be braced to prevent swaying using three cables at 120 degrees of separation. Suspended fixtures in continuous rows shall have internal wireway systems for end to end wiring and shall be properly aligned to provide a straight and continuous row without bends, gaps, light leaks or filler pieces. Aligning splines shall be used on extruded aluminum fixtures to assure hairline joints. Steel fixtures shall be supported to prevent "oil-canning" effects. Fixture finishes shall be free of scratches, nicks, dents, and warps, and shall match the color and gloss specified. Pendants shall be finished to match fixtures. Aircraft cable shall be stainless steel. Canopies shall be finished to match the ceiling and shall be low profile unless otherwise shown. Maximum distance between suspension points shall be 10 feet or as recommended by the manufacturer, whichever is less.

Suspended fixtures installed in seismic areas shall have 45% swivel hangers and shall be located with no obstructions within the 45% range in all directions. The stem, canopy and fixture shall be capable of 45% swing.

3.14.3 Ballasts

Remote type ballasts or transformers, where indicated, shall be mounted in a well ventilated, easily accessible location, within the maximum operating distance from the lamp as designated by the manufacturer.

3.14.4 Emergency Light Sets

Emergency light sets shall conform to UL 924 with the number of heads as indicated. Sets shall be permanently connected to the wiring system by conductors installed in short lengths of flexible conduit.

3.15 BATTERY CHARGERS

Battery chargers shall be installed in conformance with NFPA 70.

3.16 EQUIPMENT CONNECTIONS

Wiring not furnished and installed under other sections of the specifications for the connection of electrical equipment as indicated on the drawings shall be furnished and installed under this section of the specifications. Connections shall comply with the applicable requirements of paragraph WIRING METHODS. Flexible conduits 6 feet or less in length shall be provided to all electrical equipment subject to periodic removal, vibration, or movement and for all motors. All motors shall be provided with separate grounding conductors. Liquid-tight conduits shall be used in damp or wet locations.

3.16.1 Motors and Motor Control

Motors, motor controls, and motor control centers shall be installed in accordance with NFPA 70, the manufacturer's recommendations, and as indicated. Wiring shall be extended to motors, motor controls, and motor control centers and terminated.

3.16.2 Installation of Government-Furnished Equipment

Wiring shall be extended to the equipment and terminated.

3.16.3 Food Service Equipment Provided Under Other Sections

Wiring shall be extended to the equipment and terminated.

3.17 CIRCUIT PROTECTIVE DEVICES

The Contractor shall calibrate, adjust, set and test each new adjustable circuit protective device to ensure that they will function properly prior to the initial energization of the new power system under actual operating conditions.

3.18 PAINTING AND FINISHING

Field-applied paint on exposed surfaces shall be provided under Section 09900 PAINTS AND COATINGS.

3.19 REPAIR OF EXISTING WORK

The work shall be carefully laid out in advance, and where cutting, channeling, chasing, or drilling of floors, walls, partitions, ceiling, or other surfaces is necessary for the proper installation, support, or anchorage of the conduit, raceways, or other electrical work, this work shall be carefully done, and any damage to building, piping, or equipment shall be repaired by skilled mechanics of the trades involved at no additional cost to the Government.

3.20 FIELD TESTING

Field testing shall be performed in the presence of the Contracting Officer. The Contractor shall notify the Contracting Officer 10 days prior to conducting tests. The Contractor shall furnish all materials, labor, and equipment necessary to conduct field tests. The Contractor shall perform all tests and inspection recommended by the manufacturer unless specifically waived by the Contracting Officer. The Contractor shall maintain a written record of all tests which includes date, test performed, personnel involved, devices tested, serial number and name of test equipment, and test results. All field test reports will be signed and dated by the Contractor.

3.20.1 Safety

The Contractor shall provide and use safety devices such as rubber gloves, protective barriers, and danger signs to protect and warn personnel in the test vicinity. The Contractor shall replace any devices or equipment which are damaged due to improper test procedures or handling.

3.20.2 Ground-Resistance Tests

The resistance of each grounding electrode shall be measured using the fall-of-potential method defined in IEEE Std 81. Soil resistivity in the area of the grid shall be measured concurrently with the grid measurements. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

a. Single rod electrode - 25 ohms.

b. Grid electrode - 5 ohms.

3.20.3 Ground-Grid Connection Inspection

All below-grade ground-grid connections will be visually inspected by the Contracting Officer before backfilling. The Contractor shall notify the Contracting Officer 24 hours before the site is ready for inspection.

3.20.4 Cable Tests

The Contractor shall be responsible for identifying all equipment and devices that could be damaged by application of the test voltage and ensuring that they have been properly disconnected prior to performing insulation resistance testing. An insulation resistance test shall be performed on all low and medium voltage cables after the cables are installed in their final configuration and prior to energization. The test voltage shall be 500 volts DC applied for one minute between each conductor and ground and between all possible combinations of conductors. The minimum value of resistance shall be:

R in megohms = (rated voltage in kV + 1) x 1000/(length of cable in feet)

Each cable failing this test shall be repaired or replaced. The repaired cable system shall then be retested until failures have been eliminated.

3.20.4.1 Medium Voltage Cable Tests

a. Continuity test.

b. Insulation resistance test.

c. DC high-potential test.

3.20.4.2 Low Voltage Cable Tests

a. Continuity test.

b. Insulation resistance test.

3.20.5 Metal Enclosed Bus Duct Tests

a. Insulation Resistance phase-to-phase, all combinations.

b. Insulation resistance phase-to-ground, each phase.

c. AC or DC high-potential test.

d. Phase rotation test.

3.20.6 Motor Tests

a. Phase rotation test to ensure proper directions.

b. Operation and sequence of reduced voltage starters.

c. High potential test on each winding to ground.

d. Insulation resistance of each winding to ground.

e. Vibration test.

f. Dielectric absorption test on motor and starter.

3.20.7 Liquid-Filled Transformer Tests

The following field tests shall be performed on all liquid-filled transformers 500 kVA and above.

a. Insulation resistance test phase-to-ground, each phase.

b. Turns ratio test.

c. Correct phase sequence.

d. Correct operation of tap changer.

3.20.8 Dry-Type Transformer Tests

The following field tests shall be performed on all dry-type transformers 30

kVA and above.

a. Insulation resistance test phase-to-ground, each phase.

b. Turns ratio test.

3.20.9 Circuit Breaker Tests

The following field tests shall be performed on circuit breakers.

3.20.9.1 Circuit Breaker Tests, Medium Voltage

a. Insulation resistance test phase-to-phase, all combinations.

b. Insulation resistance tests phase-to-ground, each phase.

c. Closed breaker contact resistance test.

d. Power factor test.

e. High-potential test.

f. Manual and electrical operation of the breaker.

3.20.9.2 Circuit Breakers, Low Voltage

a. Insulation resistance test phase-to-phase, all combinations.

b. Insulation resistance test phase-to-ground, each phase.

c. Closed breaker contact resistance test.

d. Manual and electrical operation of the breaker.

3.20.9.3 Circuit Breakers, Molded Case

a. Insulation resistance test phase-to-phase, all combinations.

b. Insulation resistance test phase-to-ground, each phase.

c. Closed breaker contact resistance test.

d. Manual operation of the breaker.

3.20.10 Motor Control Centers

a. Insulation resistance test phase-to-phase, all combinations.

b. Insulation resistance test phase-to-ground, each phase.

c. Manual and electrical operational tests.

3.20.11 Protective Relays

Protective relays shall be visually and mechanically inspected, adjusted, tested, and calibrated in accordance with the manufacturer's published instructions. These tests shall include pick-up, timing, contact action, restraint, and other aspects necessary to insure proper calibration and

operation. Relay settings shall be implemented in accordance with the coordination study. Relay contacts shall be manually or electrically operated to verify that the proper breakers and alarms initiate. Relaying current transformers shall be field tested in accordance with IEEE C57.13.

3.21 OPERATING TESTS

After the installation is completed, and at such time as the Contracting Officer may direct, the Contractor shall conduct operating tests for approval. The equipment shall be demonstrated to operate in accordance with the specified requirements. An operating test report shall be submitted in accordance with paragraph FIELD TEST REPORTS.

3.22 FIELD SERVICE

3.22.1 Onsite Training

The Contractor shall conduct a training course for the operating staff as designated by the Contracting Officer. The training period shall consist of a total of 16 hours of normal working time and shall start after the system is functionally completed but prior to final acceptance tests. The course instruction shall cover pertinent points involved in operating, starting, stopping, servicing the equipment, as well as all major elements of the operation and maintenance manuals. Additionally, the course instructions shall demonstrate all routine maintenance operations. A DVD format video disk of the entire training shall be submitted.

3.22.2 Installation Engineer

After delivery of the equipment, the Contractor shall furnish one or more field engineers, regularly employed by the equipment manufacturer to supervise the installation of equipment, assist in the performance of the onsite tests, oversee initial operations, and instruct personnel as to the operational and maintenance features of the equipment.

3.23 ACCEPTANCE

Final acceptance of the facility will not be given until the Contractor has successfully completed all tests and after all defects in installation, material or operation have been corrected.

-- End of Section --

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SECTION 16710A

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SECTION 16710A

PREMISES DISTRIBUTION SYSTEM
09/02

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ELECTRONIC INDUSTRIES ALLIANCE (EIA)

EIA ANSI/TIA/EIA-568-B	(2001) Commercial Building Telecommunications Cabling Standard
EIA ANSI/TIA/EIA-568-B.2-1	(2002) Transmission Performance Specifications for 4-pair 100 ohm Category 6 Cabling
EIA ANSI/TIA/EIA-569-A	(2001) Commercial Building Standard for Telecommunications Pathways and Spaces
EIA ANSI/TIA/EIA-606A	(1993) Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
EIA ANSI/TIA/EIA-607A	(1994) Commercial Building Grounding/Bonding Requirement Standard
EIA TIA/EIA-TSB-67	(1995) Transmission Performance Specifications for Field Testing of Unshielded Twisted-Pair Cabling Systems

IBM CORPORATION (IBM)

IBM GA27-3773-0	(1987) Cabling System Technical Interface Specifications

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2002) National Electrical Code

1.2 SYSTEM DESCRIPTION

The premises distribution system shall consist of inside-plant horizontal, riser, and backbone cables and connecting hardware to transport telephone and data (including LAN) signals between equipment items in a building.

1.3 ENVIRONMENTAL REQUIREMENTS

Connecting hardware shall be rated for operation under ambient conditions of 32 to 140 degrees F and in the range of 0 to 95 percent relative

humidity, noncondensing.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Premises Distribution System; G-AE

Detail drawings including a complete list of equipment and material. Detail drawings shall contain complete wiring and schematic diagrams and other details required to demonstrate that the system has been coordinated and will function properly as a system. Drawings shall include vertical riser diagrams, equipment rack details, elevation drawings of telecommunications closet walls, outlet face plate details for all outlet configurations, sizes and types of all cables, conduits, and cable trays. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearance for maintenance and operation.

Installation; G-AE

Record drawings for the installed wiring system infrastructure per EIA ANSI/TIA/EIA-606A. The drawings shall show the location of all cable terminations and location and routing of all backbone and horizontal cables. The identifier for each termination and cable shall appear on the drawings.

SD-03 Product Data

Record Keeping and Documentation; G-AE

Documentation on cables and termination hardware in accordance with EIA ANSI/TIA/EIA-606A.

Spare Parts; G-AE

Lists of spare parts, tools, and test equipment for each different item of material and equipment specified, after approval of detail drawings, not later than 2 months prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of spare parts recommended for stocking.

Manufacturer's Recommendations; G-AE

Where installation procedures, or any part thereof, are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations, prior to installation shall be provided. Installation of the item will not be allowed to proceed until the recommendations are received and approved.

Test Plan; G-AE

Test plan defining the tests required to ensure that the system meets technical, operational and performance specifications, 60 days prior to the proposed test date. The test plan must be approved before the start of any testing. The test plan shall identify the capabilities and functions to be tested, and include detailed instructions for the setup and execution of each test and procedures for evaluation and documentation of the results.

Qualifications; G-AE

The qualifications of the Manufacturer, Contractor, and the Installer to perform the work specified herein. This shall include proof of the minimum qualifications specified herein.

SD-06 Test Reports

Test Reports; G-AE

Test reports in booklet form with witness signatures verifying execution of tests. Test results will also be provided on 3-1/2 inch diskettes in MS WORD format. Reports shall show the field tests performed to verify compliance with the specified performance criteria. Test reports shall include record of the physical parameters verified during testing. Test reports shall be submitted within 7 days after completion of testing.

SD-07 Certificates

Premises Distribution System; G-AE

Written certification that the premises distribution system complies with the EIA ANSI/TIA/EIA-568-B.2-1, EIA ANSI/TIA/EIA-569-A, and EIA ANSI/TIA/EIA-606A standards.

Materials and Equipment; G-AE

Where materials or equipment are specified to conform, be constructed or tested to meet specific requirements, certification that the items provided conform to such requirements. Certification by a nationally recognized testing laboratory that a representative sample has been tested to meet the requirements, or a published catalog specification statement to the effect that the item meets the referenced standard, will be acceptable as evidence that the item conforms. Compliance with these requirements does not relieve the Contractor from compliance with other requirements of the specifications.

Installers; G-AE

The Contractor shall submit certification that all the installers are factory certified to install and test the provided products.

1.5 QUALIFICATIONS

1.5.1 Minimum Contractor Qualifications

All work under this section shall be performed by and all equipment shall be furnished and installed by a certified Telecommunications Contractor, hereafter referred to as the Contractor. The Contractor shall have the following qualifications in Telecommunications Systems installation:

a. Contractor shall have a minimum of 3 years experience in the application, installation and testing of the specified systems and equipment.

b. All supervisors and installers assigned to the installation of this system or any of its components shall have factory certification from each equipment manufacturer that they are qualified to install and test the provided products.

c. All installers assigned to the installation of this system or any of its components shall have a minimum of 3 years experience in the installation of the specified copper and fiber optic cable and components.

1.5.2 Minimum Manufacturer Qualifications

The equipment and hardware provided under this contract will be from manufacturers that have a minimum of 3 years experience in producing the types of systems and equipment specified.

1.6 DELIVERY AND STORAGE

Equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variation, dirt and dust or other contaminants.

1.7 OPERATION AND MAINTENANCE MANUALS

Commercial off the shelf manuals shall be furnished for operation, installation, configuration, and maintenance for all products provided as a part of the premises distribution system. Specification sheets for all cable, connectors, and other equipment shall be provided.

1.8 RECORD KEEPING AND DOCUMENTATION

1.8.1 Cables

A record of all installed cable shall be provided in hard copy format and on electronic media using Windows based computer cable management software per EIA ANSI/TIA/EIA-606A. A licensed copy of the cable management software including documentation, shall be provided. The cable records shall include the required data fields for each cable and complete end-to-end circuit report for each complete circuit from the assigned outlet to the entry facility per EIA ANSI/TIA/EIA-606A.

1.8.2 Termination Hardware

A record of all installed patch panels and outlets shall be provided in hard copy format and on electronic media using Windows based computer cable management software per EIA ANSI/TIA/EIA-606A. A licensed copy of the

cable management software including documentation, shall be provided. The hardware records shall include only the required data fields per EIA ANSI/TIA/EIA-606A.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall be the manufacturer's latest standard design that has been in satisfactory use for at least 1 year prior to installation. Materials and equipment shall conform to the respective publications and other requirements specified below and to the applicable requirements of NFPA 70.

2.2 UNSHIELDED TWISTED PAIR CABLE SYSTEM

2.2.1 Backbone Cable

Backbone cable shall meet the requirements of EIA ANSI/TIA/EIA-568-B for Category 3 100-ohm unshielded twisted pair cable. Cable shall be label-verified. Cable jacket shall be factory marked at regular intervals indicating verifying organization and performance level. Conductors shall be solid untinned copper 24 AWG. Cable shall be rated CMP per NFPA 70, outside plant, gel filled, for installation in underground duct.

2.2.2 Horizontal Cable

Horizontal cable shall meet the requirements of EIA ANSI/TIA/EIA-568-B.2-1 for Category 5e. Cable shall be label-verified. Cable jacket shall be factory marked at regular intervals indicating verifying organization and performance level. Cable shall be rated CMP per NFPA 70.

2.2.3 Connecting Hardware

Connecting and cross-connecting hardware shall be the same category as the cable it serves. Hardware shall be in accordance with EIA ANSI/TIA/EIA-568-B.

2.2.3.1 Telecommunications Outlets

Outlet assemblies used in the premises distribution system shall consist of modular jacks assembled into both simplex and duplex outlet assemblies in single or double gang covers as indicated on the drawings. Wall and desk outlet plates shall come equipped with two modular jacks, with the top or left jack labeled "voice" and the bottom or right jack labeled "data". Modular jacks shall be the same category as the cable they terminate and shall meet the requirements of EIA ANSI/TIA/EIA-568-B and shall meet the Link Test parameters as listed in EIA TIA/EIA-TSB-67 and supplemented by EIA ANSI/TIA/EIA-568-B.2-1.. Modular jack pin/pair configuration shall be T568B per EIA ANSI/TIA/EIA-568-B. Modular jacks shall be unkeyed. Faceplates shall be provided and shall be gray in color, impact resistant plastic. Mounting plates shall be provided for system furniture and shall match the system furniture in color.

2.2.3.2 Patch Panels

Patch panels shall consist of eight-position modular jacks, with rear mounted type 110 insulation displacement connectors, arranged in rows or

columns on 19 inch rack mounted panels. Jack pin/pair configuration shall be T568B per EIA ANSI/TIA/EIA-568-B. Jacks shall be unkeyed. Panels shall be provided with labeling space. The modular jacks shall conform to the requirements of EIA ANSI/TIA/EIA-568-B, and shall be rated for use with Category 6 cable in accordance with EIA ANSI/TIA/EIA-568-B.2-1 and shall meet the Link Test parameters as listed in EIA TIA/EIA-TSB-67 and supplemented by EIA ANSI/TIA/EIA-568-B.2-1.

2.2.3.3 Terminal Blocks

Terminal blocks shall be rack mounted wire termination units consisting of insulation displacement connectors mounted in plastic blocks, frames or housings. Blocks shall be type 110 which meet the requirements of EIA ANSI/TIA/EIA-568-B, and shall be rated for use with Category 6 cable in accordance with EIA ANSI/TIA/EIA-568-B.2-1 and shall meet the Link Test parameters as listed in EIA TIA/EIA-TSB-67 and supplemented by EIA ANSI/TIA/EIA-568-B.2-1. Blocks shall be mounted on standoffs and shall include cable management hardware. Insulation displacement connectors shall terminate 22 or 24 gauge solid copper wire as a minimum, and shall be connected in pairs so that horizontal cable and connected jumper wires are on separate connected terminals.

2.3 SHIELDED TWISTED PAIR CABLE SYSTEM

2.3.1 Backbone Cable

Backbone cable shall meet the requirements of IBM GA27-3773-0 for 150 ohm Shielded Twisted Pair Cable and shall meet or exceed IBM performance requirements for Type 1A cable. Cable shall be label-verified. Cable jacket shall be factory marked at regular intervals indicating verifying organization and performance level. Cable shall be rated CMP per NFPA 70.

2.3.2 Horizontal Cable

Horizontal cable shall meet the requirements of IBM GA27-3773-0 for 150 ohm Shielded Twisted Pair Cable and shall meet or exceed IBM performance requirements for Type 1A cable. Cable shall be label-verified. Cable jacket shall be factory marked at regular intervals indicating verifying organization and performance level. Cable shall be rated CMP per NFPA 70.

2.3.3 Connecting Hardware

2.3.3.1 Connectors

Connectors for shielded twisted pair cable shall meet the requirements of EIA ANSI/TIA/EIA-568-B for media interface connectors and IBM GA27-3773-0 for Type 1A data connectors. Connectors shall be of hermaphroditic design and shall be utilized for outlets and patch panel terminations. Outlet faceplates shall be provided and shall be gray in color, impact resistant plastic, single gang.

2.3.3.2 Patch Panels

Patch panels shall be 19 inch rack mounted panels with openings for shielded twisted pair connectors. Panels shall be non-metallic. Patch panels shall provide strain relief for cables. Panels shall be provided with labeling space.

2.4 EQUIPMENT RACKS

2.4.1 Floor Mounted Open Frame

Floor mounted equipment racks shall be welded steel relay racks with uprights to mount equipment 19 inches wide. Uprights shall be 3 inch deep channel, 1-1/4 inches wide, drilled and tapped 12-24 in a 1/2 inch pattern. Racks shall be provided with a standard top crossmember, and predrilled base plate to allow floor fastening. Open frame equipment racks shall be 7 feet in height and paintedblack. AC outlets shall be provided as shown.

2.4.2 Cable Guides

Cable guides shall be specifically manufactured for the purpose of routing cables, wires and patch cords horizontally and vertically on 19 inch equipment racks. Cable guides shall consist of ring or bracket-like devices mounted on rack panels for horizontal use or individually mounted for vertical use. Cable guides shall mount to racks by screws and/or nuts and lockwashers.

2.4.3 Floor Mounted Cabinets

Equipment cabinets shall be floor mounted enclosures with side panels, acrylic plastic front doors, rear louvered metal doors, depth-adjustable front and rear mounting rails, and louvered top. Ventilation fans will be included. Vertical cable management devices shall be integral to the cabinet. Power strips with 12 outlets shall be provided within the cabinet. Equipment racks shall mount equipment 19 inches wide and shall be 72 inches high and 30 inches deep. Cabinet exteriors shall be painted ivory/off-white.

2.5 EQUIPMENT MOUNTING BACKBOARD

Plywood backboards shall be provided, sized as shown, painted with white or light colored fire resistant paint.

2.6 TELECOMMUNICATIONS OUTLET BOXES

Electrical boxes for telecommunication outlets shall be 4-11/16 inch square by 2-1/8 inches deep with minimum 3/8 inch deep single or two gang plaster ring as shown. Provide a minimum 1 inch conduit.

PART 3 EXECUTION

3.1 INSTALLATION

System components and appurtenances shall be installed in accordance with NFPA 70, manufacturer's instructions and as shown. Necessary interconnections, services, and adjustments required for a complete and operable signal distribution system shall be provided. Components shall be labeled in accordance with EIA ANSI/TIA/EIA-606A. Penetrations in fire-rated construction shall be firestopped in accordance with Section 07840 FIRESTOPPING. Conduits, outlets and raceways shall be installed in accordance with Section 16415A ELECTRICAL WORK, INTERIOR. Wiring shall be installed in accordance with EIA ANSI/TIA/EIA-568-B and as specified in Section 16415A ELECTRICAL WORK, INTERIOR. Wiring, and terminal blocks and outlets shall be marked in accordance with EIA ANSI/TIA/EIA-606A. Cables shall not be installed in the same cable tray, utility pole compartment, or floor trench compartment with ac power cables. Cables not installed in

conduit or wireways shall be properly secured and neat in appearance and, if installed in plenums or other spaces used for environmental air, shall comply with NFPA 70 requirements for this type of installation.

3.1.1 Horizontal Distribution Cable

The rated cable pulling tension shall not be exceeded. Cable shall not be stressed such that twisting, stretching or kinking occurs. Cable shall not be spliced. Fiber optic cables shall be installed either in conduit or through type cable trays to prevent microbending losses. Copper cable not in a wireway shall be suspended a minimum of 8 inches above ceilings by cable supports no greater than 60 inches apart. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items. Placement of cable parallel to power conductors shall be avoided, if possible; a minimum separation of 12 inches shall be maintained when such placement cannot be avoided. Cables shall be terminated; no cable shall contain unterminated elements. Minimum bending radius shall not be exceeded during installation or once installed. Cable ties shall not be excessively tightened such that the transmission characteristics of the cable are altered. In raised floor areas, cable shall be installed after the flooring system has been installed. Cable 6 feet long shall be neatly coiled not less than 12 inches in diameter below each feed point in raised floor areas.

3.1.2 Riser and Backbone Cable

Vertical cable support intervals shall be in accordance with manufacturer's recommendations. Cable bend radius shall not be less than ten times the outside diameter of the cable during installation and once installed. Maximum tensile strength rating of the cable shall not be exceeded. Cable shall not be spliced.

3.1.3 Telecommunications Outlets

3.1.3.1 Faceplates

As a minimum each jack shall be labeled as to its function and a unique number to identify cable link.

3.1.3.2 Cables

Unshielded twisted pair and fiber optic cables shall have a minimum of 6 inches of slack cable loosely coiled into the telecommunications outlet boxes. Minimum manufacturers bend radius for each type of cable shall not be exceeded.

3.1.3.3 Pull Cords

Pull cords shall be installed in all conduit serving telecommunications outlets which do not initially have fiber optic cable installed.

3.1.4 Terminal Blocks

Terminal blocks shall be mounted in orderly rows and columns. Adequate vertical and horizontal wire routing areas shall be provided between groups of blocks. Industry standard wire routing guides shall be utilized.

3.1.5 Unshielded Twisted Pair Patch Panels

Patch panels shall be mounted in equipment racks with sufficient modular jacks to accommodate the installed cable plant plus 10 percent spares. Cable guides shall be provided above, below and between each panel.

3.1.6 Fiber Optic Patch Panels

Patch panels shall be mounted in equipment racks with sufficient ports to accommodate the installed cable plant plus 10 percent spares. A slack loop of fiber shall be provided within each panel. Loop shall be 3 feet in length. The outer jacket of each cable entering a patch panel shall be secured to the panel to prevent movement of the fibers within the panel, using clamps or brackets specifically manufactured for that purpose.

3.1.7 Equipment Racks

Open frame equipment racks shall be bolted to the floor. Cable guides shall be bolted or screwed to racks. Racks shall be installed level. Ganged racks shall be bolted together. Ganged rack cabinets shall have adjacent side panels removed. Wall mounted racks shall be secured to the mounting surface to prevent fully loaded racks from separating from the mounting surface.

3.1.8 Rack Mounted Equipment

Equipment to be rack mounted shall be securely fastened to racks by means of the manufacturer's recommended fasteners.

3.1.9 Spare Parts

The Contractor shall provide spare parts data for each different item of material and equipment specified, after approval of the related submittals and not later than the start of the field tests.

3.2 TERMINATION

Cables and conductors shall sweep into termination areas; cables and conductors shall not bend at right angles. Manufacturer's minimum bending radius shall not be exceeded. When there are multiple system type drops to individual workstations, relative position for each system shall be maintained on each system termination block or patch panel.

3.2.1 Unshielded Twisted Pair Cable

Each pair shall be terminated on appropriate outlets, terminal blocks or patch panels. No cable shall be unterminated or contain unterminated elements. Pairs shall remain twisted together to within the proper distance from the termination as specified in EIA ANSI/TIA/EIA-568-B. Conductors shall not be damaged when removing insulation. Wire insulation shall not be damaged when removing outer jacket.

3.3 GROUNDING

Signal distribution system ground shall be installed in the telecommunications entrance facility and in each telecommunications closet in accordance with EIA ANSI/TIA/EIA-607A and Section 16415A ELECTRICAL WORK, INTERIOR. Equipment racks shall be connected to the electrical safety ground.

3.4 ADDITIONAL MATERIALS

The Contractor shall provide the following additional materials required for facility startup.

a. 10 of each type outlet.

b. 10 of each type cover plate.

c. 1 of each type terminal block for each telecommunications closet.

d. 4 Patch cords of 10 feet for each telecommunications closet.

e. 1 Set of any and all special tools required to establish a cross connect and to change and/or maintain a terminal block.

3.5 ADMINISTRATION AND LABELING

3.5.1 Labeling

3.5.1.1 Labels

All labels shall be in accordance with EIA ANSI/TIA/EIA-606A.

3.5.1.2 Cable

All cables will be labeled using color labels on both ends with pencoded identifiers per EIA ANSI/TIA/EIA-606A.

3.5.1.3 Termination Hardware

All workstation outlets and patch panel connections will be labeled using color coded labels with encoded identifiers per EIA ANSI/TIA/EIA-606A.

3.6 TESTING

Materials and documentation to be furnished under this specification are subject to inspections and tests. All components shall be terminated prior to testing. Equipment and systems will not be accepted until the required inspections and tests have been made in accordance with the approved Test Plan submitted by the Contractor, demonstrating that the signal distribution system conforms to the specified requirements, and that the required equipment, systems, and documentation have been provided. The Contractor shall submit Test Reports as they are completed.

3.6.1 Unshielded Twisted Pair Tests

All metallic cable pairs shall be tested for proper identification and continuity. All opens, shorts, crosses, grounds, and reversals shall be corrected. Correct color coding and termination of each pair shall be verified in the communications closet and at the outlet. Horizontal wiring shall be tested from and including the termination device in the communications closet to and including the modular jack in each room. Backbone wiring shall be tested end-to-end, including termination devices, from terminal block to terminal block, in the respective communications closets. These test shall be completed and all errors corrected before any other tests are started.

3.6.2 Category 6 Circuits

All category 6 circuits shall be tested using a test set that meets the Class II accuracy requirements of EIA TIA/EIA-TSB-67 standard, including the additional tests and test set accuracy requirements of EIA ANSI/TIA/EIA-568-B.2-1. Testing shall use the Basic Link Test procedure of EIA TIA/EIA-TSB-67, as supplemented by EIA ANSI/TIA/EIA-568-B.2-1. Cables and connecting hardware which contain failed circuits shall be replaced and retested to verify the standard is met.

-- End of Section --

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