SOLICITATION, OFFER, AND AWARD *(Construction, Alteration, or Repair)*	1. SOLICITATION NO. DACA65-03-R-0013	2. TYPE OF SOLICITATION ☐ SEALED BID (IFB) ☒ NEGOTIATED *(RFP)*	3. DATE ISSUED 07-Feb-2003	PAGE OF PAGES 1 OF 119

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

4. CONTRACT NO.	5. REQUISITION/PURCHASE REQUEST NO. W26GLG-2038-3181	6. PROJECT NO. 5022896

7. ISSUED BY CODE DACA65	8. ADDRESS OFFER TO *(If Other Than Item 7)* CODE
CONTRACTING OFFICE (CA/CW) US ARMY ENGR DIST NORFOLK ATTN: CENAO-SS-C 803 FRONT STREET NORFOLK VA 23510-1096	**See Item 7**
TEL: FAX: (757) 441-7183	TEL: FAX:

9. FOR INFORMATION CALL:	A. NAME DEBORA S GRAY	B. TELEPHONE NO. *(Include area code)* *(NO COLLECT CALLS)* (757) 441-7551

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):*

Hazardous Waste Tanks, Radford Army Ammunition Plant, Radford, VA

DACA65-03-R-0013, HAZARDOUS WASTE TANKS, C-LINE, RADFORD ARMY AMMUNITION PLANT, VA

The contractor will include work on the C-Line Wastewater system at Radford Army Ammunition Plant. Work includes but is not limited to construction of new open tank, secondary containment system, pumps, new piping and interconnection with existing acid waste piping to include control and alarm systems, and demolistion of existing open masonry and stainless steel tank. Rework of surrounding road and parking and incidental electrical work will also be required.

THIS IS AN UNRESTRICTED PROCUREMENT. NAICS CODE 234930

11. The Contractor shall begin performance within 10 calendar days and complete it within 570 calendar days after receiving ☐ award, ☒ notice to proceed. This performance period is ☐ mandatory, ☐ negotiable. *(See _____ .)*

12 A. THE CONTRACTOR MUST FURNISH ANY REQUIRED PERFORMANCE AND PAYMENT BONDS? *(If "YES," indicate within how many calendar days after award in Item 12B.)* ☒ YES ☐ NO	12B. CALENDAR DAYS 10

13. ADDITIONAL SOLICITATION REQUIREMENTS:

A. Sealed offers in original and 1 copies to perform the work required are due at the place specified in Item 8 by _____ *(hour)* local time _____ *(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 120 calendar days for Government acceptance after the date offers are due will not be considered and will be rejected.

SOLICITATION, OFFER, AND AWARD (Continued)

(Construction, Alteration, or Repair)

OFFER ***(Must be fully completed by offeror)***

14. NAME AND ADDRESS OF OFFEROR *(Include ZIP Code)*	15. TELEPHONE NO. *(Include area code)*
	16. REMITTANCE ADDRESS *(Include only if different than Item 14)* **See 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 _____ calendar days after the date offers are due. *(Insert any number equal to or greater than the minimum requirements stated in Item 13D. Failure to insert any number means the offeror accepts the minimum in Item 13D.)*

AMOUNTS	SEE SCHEDULE OF PRICES

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**	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: CODE

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 or 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)* TEL: EMAIL:
30B. SIGNATURE	30C. DATE	31B. UNITED STATES OF AMERICA BY / 31C. AWARD DATE

Section 00010 - Solicitation Contract Form

ITEM NO	SUPPLIES/SERVICES	QUANTITY	UNIT	UNIT PRICE	AMOUNT
0001		1	Lump Sum		

FFP
All work for replacement of the existing Hazardous Waste Tank with new tank that meets RCRA and State standards, complete, in accordance with the drawings and specifications, excluding items 0002 thru 0004.

ITEM NO	SUPPLIES/SERVICES	QUANTITY	UNIT	UNIT PRICE	AMOUNT
0002		1	Lump Sum		

FFP
All work for O&M Manual as specified from preparation to final excluding items 0001, 0003 and 0004.

ITEM NO	SUPPLIES/SERVICES	QUANTITY	UNIT	UNIT PRICE	AMOUNT
0003		1	Lump Sum		
	FFP All work for As-Built drawings as specified from preparation to final excluding items 0001, 0002 and 0004.				

ITEM NO	SUPPLIES/SERVICES	QUANTITY	UNIT	UNIT PRICE	AMOUNT
0004		1	Lump Sum		
	FFP All work for Form 1354 Checklist and Equipment in place list as specified from preparation to final excluding items 0001 thru 0003.				

TOTAL AMOUNT BID

PREAWARD INFORMATION

52.0000-4009 CONTRACTOR PERFORMANCE AND BANKING INFORMATION

1. Prior to awarding a contract, the Government must conduct a PRE-AWARD SURVEY of the firm selected for award. In order for us to minimize delays in conducting the survey and awarding the contract, you are requested to provide the following information with your offer:

a. BANK: Branch/Location
Point-of-Contact
Telephone Number/Fax Number

Please contact the bank in advance so they will release the necessary information regarding average balances in your operating accounts, lines of credit, and credit history.

b. 3 CURRENT PROJECTS OF SIMILAR SCOPE AND SIZE:
Project Title/Contract Number
Customer
Point-of-Contact
Telephone Number/Fax Number
$ Value
% Complete
Scheduled Completion Date

c. 3 COMPLETED PROJECTS OF SIMILAR SCOPE AND SIZE:
Same as CURRENT PROJECTS; however, in lieu of "% Complete" and "Scheduled Completion Date," provide "Completion Date."

d. DO NOT PROVIDE VOLUMINOUS LISTINGS OF YOUR FIRM'S CONTRACTING HISTORY.

e. In addition to the above information, the contractor must meet the following and is also requested and experience should be shown:

Contractor shall provide a minimum of 3 projects (with point of contact and telephone number) where they were the Prime Contractor for similar industrial/acidic wastewater projects to include collection and pumping valued at $2,000,000 - $5,000,000. Contractor shall include a statement of experience with ACI 350R concrete standards.

2. If you wish to shield this information from public view at the bid opening, the information may be placed in an envelope with the following legend:

PRE-AWARD SURVEY INFORMATION
SOLICITATION NO._____
<YOUR FIRM'S NAME>

CLAUSES INCORPORATED BY FULL TEXT

52.204-6 DATA UNIVERSAL NUMBERING SYSTEM (DUNS) NUMBER (JUN 99)

(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.

(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)

52.215-1 INSTRUCTIONS TO OFFERORS--COMPETITIVE ACQUISITION (MAY 2001)

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

"Discussions" are negotiations that occur after establishment of the competitive range that may, at the Contracting Officer's discretion, result in the offeror being allowed to revise its proposal.

"In writing or written" means any worded or numbered expression which can be read, reproduced, and later communicated, and includes electronically transmitted and stored information.

“Proposal modification” is a change made to a proposal before the solicitation's closing date and time, or made in response to an amendment, or made to correct a mistake at any time before award.

“Proposal revision” is a change to a proposal made after the solicitation closing date, at the request of or as allowed by a Contracting Officer as the result of negotiations.

“Time”, if stated as a number of days, is calculated using calendar days, unless otherwise specified, and will include Saturdays, Sundays, and legal holidays. However, if the last day falls on a Saturday, Sunday, or legal holiday, then the period shall include the next working day.

(b) Amendments to solicitations. If this solicitation is amended, all terms and conditions that are not amended remain unchanged. Offerors shall acknowledge receipt of any amendment to this solicitation by the date and time specified in the amendment(s).

(c) Submission, modification, revision, and withdrawal of proposals. (1) Unless other methods (e.g., electronic commerce or facsimile) are permitted in the solicitation, proposals and modifications to proposals shall be submitted in paper media in sealed envelopes or packages (i) addressed to the office specified in the solicitation, and (ii) showing the time and date specified for receipt, the solicitation number, and the name and address of the offeror. Offerors using commercial carriers should ensure that the proposal is marked on the outermost wrapper with the information in paragraphs (c)(1)(i) and (c)(1)(ii) of this provision.

(2) The first page of the proposal must show--

(i) The solicitation number;

(ii) The name, address, and telephone and facsimile numbers of the offeror (and electronic address if available);

(iii) A statement specifying the extent of agreement with all terms, conditions, and provisions included in the solicitation and agreement to furnish any or all items upon which prices are offered at the price set opposite each item;

(iv) Names, titles, and telephone and facsimile numbers (and electronic addresses if available) of persons authorized to negotiate on the offeror's behalf with the Government in connection with this solicitation; and

(v) Name, title, and signature of person authorized to sign the proposal. Proposals signed by an agent shall be accompanied by evidence of that agent's authority, unless that evidence has been previously furnished to the issuing office.

(3) Submission, modification, or revision, of proposals.

(i) Offerors are responsible for submitting proposals, and any modifications, or revisions, so as to reach the Government office designated in the solicitation by the time specified in the solicitation. If no time is specified in the solicitation, the time for receipt is 4:30 p.m., local time, for the designated Government office on the date that proposal or revision is due.

(ii)(A) Any proposal, modification, or revision received at the Government office designated in the solicitation after the exact time specified for receipt of offers is “late” and will not be considered unless it is received before award is made, the Contracting Officer determines that accepting the late offer would not unduly delay the acquisition; and--

(1) If it was transmitted through an electronic commerce method authorized by the solicitation, 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 proposals; or

(2) There is acceptable evidence to establish that it was received at the Government installation designated for receipt of offers and was under the Government's control prior to the time set for receipt of offers; or

(3) It is the only proposal received.

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

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

(iv) If an emergency or unanticipated event interrupts normal Government processes so that proposals cannot be received at the office designated for receipt of proposals by the exact time specified in the solicitation, and urgent Government requirements preclude amendment of the solicitation, the time specified for receipt of proposals 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.

(v) Proposals may be withdrawn by written notice received at any time before award. Oral proposals in response to oral solicitations may be withdrawn orally. If the solicitation authorizes facsimile proposals, proposals may be withdrawn via facsimile received at any time before award, subject to the conditions specified in the provision at 52.215-5, Facsimile Proposals. Proposals may be withdrawn in person by an offeror or an authorized representative, if the identity of the person requesting withdrawal is established and the person signs a receipt for the proposal before award.

(4) Unless otherwise specified in the solicitation, the offeror may propose to provide any item or combination of items.

(5) Offerors shall submit proposals in response to this solicitation in English, unless otherwise permitted by the solicitation, and in U.S. dollars, unless the provision at FAR 52.225-17, Evaluation of Foreign Currency Offers, is included in the solicitation.

(6) Offerors may submit modifications to their proposals at any time before the solicitation closing date and time, and may submit modifications in response to an amendment, or to correct a mistake at any time before award.

(7) Offerors may submit revised proposals only if requested or allowed by the Contracting Officer.

(8) Proposals may be withdrawn at any time before award. Withdrawals are effective upon receipt of notice by the Contracting Officer.

(d) Offer expiration date. Proposals in response to this solicitation will be valid for the number of days specified on the solicitation cover sheet (unless a different period is proposed by the offeror).

(e) Restriction on disclosure and use of data. Offerors that include in their proposals data that they do not want disclosed to the public for any purpose, or used by the Government except for evaluation purposes, shall--

(1) Mark the title page with the following legend: This proposal includes data that shall not be disclosed outside the Government and shall not be duplicated, used, or disclosed--in whole or in part--for any purpose other than to evaluate this proposal. If, however, a contract is awarded to this offeror as a result of--or in connection with-- the submission of this data, the Government shall have the right to duplicate, use, or disclose the data to the extent provided in the resulting contract. This restriction does not limit the Government's right to use information contained in this data if it is obtained from another source without restriction. The data subject to this restriction

are contained in sheets [insert numbers or other identification of sheets]; and

(2) Mark each sheet of data it wishes to restrict with the following legend: Use or disclosure of data contained on this sheet is subject to the restriction on the title page of this proposal.

(f) Contract award. (1) The Government intends to award a contract or contracts resulting from this solicitation to the responsible offeror(s) whose proposal(s) represents the best value after evaluation in accordance with the factors and subfactors in the solicitation.

(2) The Government may reject any or all proposals if such action is in the Government's interest.

(3) The Government may waive informalities and minor irregularities in proposals received.

(4) The Government intends to evaluate proposals and award a contract without discussions with offerors (except clarifications as described in FAR 15.306(a)). Therefore, the offeror's initial proposal should contain the offeror's best terms from a cost or price and technical standpoint. The Government reserves the right to conduct discussions if the Contracting Officer later determines them to be necessary. If the Contracting Officer determines that the number of proposals that would otherwise be in the competitive range exceeds the number at which an efficient competition can be conducted, the Contracting Officer may limit the number of proposals in the competitive range to the greatest number that will permit an efficient competition among the most highly rated proposals.

(5) The Government reserves the right to make an award on any item for a quantity less than the quantity offered, at the unit cost or prices offered, unless the offeror specifies otherwise in the proposal.

(6) The Government reserves the right to make multiple awards if, after considering the additional administrative costs, it is in the Government's best interest to do so.

(7) Exchanges with offerors after receipt of a proposal do not constitute a rejection or counteroffer by the Government.

(8) The Government may determine that a proposal is unacceptable if the prices proposed are materially unbalanced between line items or subline items. Unbalanced pricing exists when, despite an acceptable total evaluated price, the price of one or more contract line items is significantly overstated or understated as indicated by the application of cost or price analysis techniques. A proposal may be rejected if the Contracting Officer determines that the lack of balance poses an unacceptable risk to the Government.

(9) If a cost realism analysis is performed, cost realism may be considered by the source selection authority in evaluating performance or schedule risk.

(10) A written award or acceptance of proposal mailed or otherwise furnished to the successful offeror within the time specified in the proposal shall result in a binding contract without further action by either party.

(11) The Government may disclose the following information in postaward debriefings to other offerors:

(i) The overall evaluated cost or price and technical rating of the successful offeror;

(ii) The overall ranking of all offerors, when any ranking was developed by the agency during source selection;

(iii) A summary of the rationale for award; and

(iv) For acquisitions of commercial items, the make and model of the item to be delivered by the successful offeror.

(End of provision)

52.215-20 REQUIREMENTS FOR COST OR PRICING DATA OR INFORMATION OTHER THAN COST OR PRICING DATA (OCT 1997)

(a) Exceptions from cost or pricing data. (1) In lieu of submitting cost or pricing data, offerors may submit a written request for exception by submitting the information described in the following subparagraphs. The Contracting Officer may require additional supporting information, but only to the extent necessary to determine whether an exception should be granted, and whether the price is fair and reasonable.

(i) Identification of the law or regulation establishing the price offered. If the price is controlled under law by periodic rulings, reviews, or similar actions of a governmental body, attach a copy of the controlling document, unless it was previously submitted to the contracting office.

(ii) Commercial item exception. For a commercial item exception, the offeror shall submit, at a minimum, information on prices at which the same item or similar items have previously been sold in the commercial market that is adequate for evaluating the reasonableness of the price for this acquisition. Such information may include--

(A) For catalog items, a copy of or identification of the catalog and its date, or the appropriate pages for the offered items, or a statement that the catalog is on file in the buying office to which the proposal is being submitted. Provide a copy or describe current discount policies and price lists (published or unpublished), e.g., wholesale, original equipment manufacturer, or reseller. Also explain the basis of each offered price and its relationship to the established catalog price, including how the proposed price relates to the price of recent sales in quantities similar to the proposed quantities;

(B) For market-priced items, the source and date or period of the market quotation or other basis for market price, the base amount, and applicable discounts. In addition, describe the nature of the market;

(C) For items included on an active Federal Supply Service Multiple Award Schedule contract, proof that an exception has been granted for the schedule item.

(2) The offeror grants the Contracting Officer or an authorized representative the right to examine, at any time before award, books, records, documents, or other directly pertinent records to verify any request for an exception under this provision, and the reasonableness of price. For items priced using catalog or market prices, or law or regulation , access does not extend to cost or profit information or other data relevant solely to the offeror's determination of the prices to be offered in the catalog or marketplace.

(b) Requirements for cost or pricing data. If the offeror is not granted an exception from the requirement to submit cost or pricing data, the following applies:

(1) The offeror shall prepare and submit cost or pricing data and supporting attachments in accordance with Table 15-2 of FAR 15.408.

As soon as practicable after agreement on price, but before contract award (except for unpriced actions such as letter contracts), the offeror shall submit a Certificate of Current Cost or Pricing Data, as prescribed by FAR 15.406-2.

(End of provision)

52.216-1 TYPE OF CONTRACT (APR 1984)

The Government contemplates award of a firm fixed price contract resulting from this solicitation.

(End of clause)

52.225-10 NOTICE OF BUY AMERICAN ACT REQUIREMENT--CONSTRUCTION MATERIALS (MAY 2002) ALTERNATE I (MAY 2002)

(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 shall submit the request with its offer, including the information and applicable supporting data required by paragraphs (c) and (d) of the clause at FAR 52.225-9.

(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)

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 acknowledgment of receipt from Chief, Contracting Office, U.S. Army Engineer District, Norfolk, 803 Front Street, Norfolk, VA 23510-1096.

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

(End of provision)

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) Site visits may be arranged during normal duty hours by contacting:

Name: Southwestern VA Area Office
Address: Radford, VA
Telephone: 540-639-7656

(End of provision)

52.252-5 AUTHORIZED DEVIATIONS IN PROVISIONS (APR 1984)

(a) The use in this solicitation of any Federal Acquisition Regulation (48 CFR Chapter 1) provision with an authorized deviation is indicated by the addition of"(DEVIATION)" after the date of the provision.

(b) The use in this solicitation of any _____ (48 CFR Chapter _____) provision with an authorized deviation is indicated by the addition of "(DEVIATION)" after the name of the regulation.

(End of provision)

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.

(End of provision)

E4LC02 AWARD TO RESPONSIBLE OFFEROR

Responsibility will be determined, prior to award, by the Contracting Officer, either by performing a pre-award survey or conclusions based on a previous pre-award survey and/or any performance data available. A pre-award survey will be performed and the offeror will be required to show that he has the necessary capital, experience, and owns or can procure the necessary plant or other resources to commence the work at the time prescribed in the specifications and thereafter to prosecute and complete the work safely and satisfactorily within the time specified.

E4LC04 EVIDENCE OF AUTHORITY TO SIGN OFFERS

Evidence of the authority of individuals signing offers to submit firm offers on behalf of the offeror is required except where the offer is signed, and shows that it is so signed, by: the President, Vice-President, or Secretary of an incorporated offeror; a partner in the case of a partnership; or the owner in the case of a sole proprietorship. Failure to submit with the offer satisfactory evidence of the authority of all other persons may be cause for rejection of the offer as invalid or nonresponsive.

E4LC05 PREAWARD SAFETY CONFERENCE

a. Where an apparent low bidder, in performance of contracts during the previous three-year period, incurred one or more accidents, or where, in the opinion of the Contracting Officer, there is any question regarding this compliance with any safety or accident prevention requirement, such bidder, on request of the Contracting Officer prior to any award under this solicitation, shall attend a conference with representatives of the Contracting Officer to discuss any such accidents or non-compliance, the reason for their occurrence, and measures which will be taken to preclude any recurrence thereof.

b. Information elicited at this conference will be used by the Contracting Officer, in conjunction with other information obtained in a preaward survey, in determining the bidder's responsibility.

c. The items discussed, the preventive measures considered, and any conclusions reached in this conference shall be recorded in minutes of the meeting, which shall be authenticated by the signatures of representatives of the bidder and the Contracting Officer, and any procedures noted therein as agreed upon shall become an obligation of the bidder, along with all other safety and accident prevention requirements of the contract, if award is made to him.

E4LC06 INSPECTION OF THE SITE

Prospective bidders are invited to visit the site of the work in order to acquaint themselves as to site conditions and other problems incident to the prosecution of the work. Arrangements for inspection of the site shall be made through the Office the Area Engineer identified in the clause 52.236-27, entitled "SITE VISIT (CONSTRUCTION)."

E4LC07 SUBCONTRACTING PLAN (CONSTRUCTION)

If the offeror is a large business and the offer amount exceeds $1,000,000.00, he shall submit a subcontracting plan within three (3) working days of being notified (either verbally or in writing) that he is the apparent low bidder or is otherwise in line for award. The subcontracting plan shall be reviewed and approved by the Contracting Officer prior to award.

E4LC08 MAGNITUDE OF CONSTRUCTION PROJECT

The estimated contract price of the work for this project is estimated to between $1,000,000 and $5,000,000.

E4LC09 BASIS OF AWARD

All blanks must be filled in by the bidder. A single award will be made to the lowest responsible, responsive bidder on the basis of the total price bid. Prior to making an award, a pre-award survey will be made and the low bidder will be required to show that he has the necessary capital, experience, and owns or can procure the necessary plant to commence the work at the time prescribed in the specifications and thereafter to prosecute and complete the work safely and satisfactorily within the time specified.

E4LC10 UNBALANCED OFFERS

Any offer which is materially unbalanced as to prices for the Base Items and the Optional Items may be rejected as non-responsive or otherwise not considered for award. An unbalanced offer is one which is based on prices significantly less than cost for some work and prices which are significantly overstated for other work.

E4LC13 PERFORMANCE OF WORK BY CONTRACTOR

Offeror's attention is directed to FAR 52.236-1, "Performance of Work by Contractor." Contractor is required to furnish a description of the work which will be performed by his own organization, (e.g., earthwork, paving, etc.), the percentage of the total work this represents, and the estimated cost thereof. Such description of work to be performed by the contractor's own organization shall be provided to the Contracting Officer within 10 days of contract award.

E4LC23 INCURRING COSTS

The Government is not liable for any costs incurred by the offeror submitting an offer in response to this solicitation.

E4LC27 REQUIREMENT FOR "PAYMENT AND PERFORMANCE BONDS" OR "PAYMENT BONDS ONLY"

If the resulting contract is awarded for an amount in excess of $100,000, the contractor shall be required to provide both payment and performance bonds in accordance with FAR 52.228-15, "Performance and Payment Bonds--Construction." FAR 52.228-15 applies only to those contracts awarded for an amount in excess of $100,000.

If the resulting contract is awarded for an amount in excess of $25,000 but no more than $100,000, the contractor shall not be required to provide a performance bond. The required payment bond shall be provided in accordance with FAR 52.228-13, "Alternative Payment Protections." FAR 52.228-13 applies only to those contracts awarded for an amount in excess of $25,000 by no more than $100,000. Neither payment nor performance bonds are required for contracts awarded for an amount less than $25,000.

E4LC58 BID GUARANTEE (SEP 1996)

(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 the bid.
(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 20 percent of the bid price or $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.

(End of provision)

Section 00600 - Representations & Certifications

CLAUSES INCORPORATED BY FULL TEXT

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

(a) The offeror certifies that --

(c) 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 –

(1) Those prices,

(i) The intention to submit an offer, or

(iii) The methods of 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 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) of this provision; 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) of this provison _____ (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) of this provision.

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

(End of clause)

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.

(d) 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, shall be subject to a civil penalty of not less than $10,000, and not more than $100,000, for each such failure.

(End of provision)

52.204-3 TAXPAYER IDENTIFICATION (OCT 1998)

(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)

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)

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 subdivision (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)

52.219-1 SMALL BUSINESS PROGRAM REPRESENTATIONS (APR 2002)

(a)(1) The North American Industry Classification System (NAICS) code for this acquisition is 234930.

(2) The small business size standard is $28.5 million.

(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 a veteran-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.

(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 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; 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)

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 the Offeror has represented itself under the provision at 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	Avg. 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

(End of provision)

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 to 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)

52.222-25 AFFIRMATIVE ACTION COMPLIANCE (APR 1984)

The offeror represents that

(a) [ ] it has developed and has on file, [ ] has not developed and does not have on file, at each establishment, affirmative action programs required by the rules and regulations of the Secretary of Labor (41 CFR 60-1 and 60-2), or

(b) [ ] has not previously had contracts subject to the written affirmative action programs requirement of the rules and regulations of the Secretary of Labor.

(End of provision)

52.223-13 CERTIFICATION OF TOXIC CHEMICAL RELEASE REPORTING (OCT 2000)

(a) Submission of this certification is a prerequisite for making or entering into this contract imposed by Executive Order 12969, August 8, 1995.

(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: (Check each block that is applicable.)

( ) (i) The facility does not manufacture, process or otherwise use any toxic chemicals listed under section 313(c) of EPCRA, 42 U.S.C. 11023(c);

( ) (ii) 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);

( ) (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 Standard Industrial Classification Code (SIC) major groups 20 through 39 or their corresponding North American Industry Classification System (NAICS) sectors 31 through 33; or

( ) (v) The facility is not located within any State of the United States, the District of Columbia, the Commonwealth of Puerto Rico, Guam, American Samoa, the United States Virgin Islands, the Northern Mariana Islands, or any other territory or possession over which the United States has jurisdiction.

(End of clause)

252.209-7001 DISCLOSURE OF OWNERSHIP OR CONTROL BY THE GOVERNMENT OF A TERRORIST COUNTRY (MAR 1998)

(a) "Definitions."

As used in this provision --

(a) "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 such 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 indebtness 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."

If the government of a terrorist country has a significant interest in the Offeror or a subsidiary of the Offeror, the Offeror shall disclosure such interest in an attachment to its offer. 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)

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) Representation. The Offeror represents that it:

____ (1) Does anticipate that supplies will be transported by sea in the performance of any contract or subcontract resulting from this solicitation.

____ (2) 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.

(End of provision)

E4LC01 CORPORATE CERTIFICATE

Note: Contractor, if a corporation, should cause the following certificate to be executed under its corporate seal, provided that the same officer shall not execute both the contract and the certificate.

CERTIFICATE

I, _____, certify that I am

_____ of the corporation named as Contractor herein, that

_____, was then the _____ of said

corporation; that said contract was duly signed for and in behalf of said corporation of authority

of its governing body, and is within the scope of its corporate powers.

_____
(Name of Corporation)

_____

(Signature)

(Corporate Seal)

NOTE: A CORPORATE OFFICER OTHER THAN THE OFFICER SIGNING THE SOLICITATION MUST FILL OUT AND SIGN THIS FORM.

E4LC01B CERTIFICATE OF AUTHORITY

The undersigned:

_____
(Names of Partners)

do hereby certify that they are the individual partners who comprise the partnership of

_____
(Name of Partnership)

which firm has its office at

_____
(Address of Partnership)

that _____, one of the said partners, is hereby
(Name of Partner)

authorized to sign contracts between said partnership and the United States Government

and any modifications of such contracts on behalf of and in the name of the said

partnership.

In witness whereof the undersigned have executed this instrument this

_____ day of _____ 19___.

WITNESSES:

Name Address

(1) _____ _____

_____

(Partner)

(2) _____ _____

(1) _____ _____

_____

(Partner)

(2) _____ _____

(1) _____ _____

_____

(Partner)

(2) _____ _____

NOTE: 2 WITNESSES FOR EACH SIGNATURE

E4LC17 COMMERCIAL AND GOVERNMENT ENTITY (CAGE) CODE REPORTING

(a) The Offeror is requested to enter its CAGE code in the space provided below. The CAGE code entered must be for that name and address.

(b) If the Offeror does not have a CAGE code, it may ask the Contracting Officer to request one in accordance with the provisions of DFARS 52.204-7001 in the section of this solicitation entitled "Instructions to Bidders."

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

CAGE Code: __ __ __ __ __

( ) UNKNOWN

E4LC18 CONTRACTOR IDENTIFICATION NUMBER

The offeror is to supply his/her Contractor Identification Number, also known as the Data Universal Numbering System (DUNS) number, in the space provided below:

DUNS: __ __ __ __ __ __ __ __ __

This number can be obtained by following the instructions in FAR Clause 52.204-0006, which appears in Section L or Section 00100 of this document.

Section 00700 - Contract Clauses

CLAUSES INCORPORATED BY FULL TEXT

52.202-1 DEFINITIONS (MAY 2001) --ALTERNATE I (MAR 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) 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).

(d) 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.

(e) 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.

(f) "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.

(g) Except as otherwise provided in this contract, the term "subcontracts" includes, but is not limited to, purchase orders and changes and modifications to purchase orders under this contract.

(End of clause)

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) of this clause, 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.

(End of clause)

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.

(End of clause)

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 any kickback. The Contracting Officer may order the 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 this subparagraph (c)(5) but excepting subparagraph (c)(1), in all subcontracts under this contract which exceed $100,000.

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 1996 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 subsections 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.

(End of clause)

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 by the amount 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.

(End of clause)

52.203-12 LIMITATION ON PAYMENTS TO INFLUENCE CERTAIN FEDERAL TRANSACTIONS (JUN 1997)

(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, the Commonwealth of Puerto Rico, a territory or possession 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 of 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.

(c) Disclosure.

(1) 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.

(2) 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--

(i) 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

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

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

(3) 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.

(4) 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.

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

(e) Penalties.

(1) 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.

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

(f) 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.

(End of clause)

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)

52.209-6 PROTECTING THE GOVERNMENT'S 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 the $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

principles, is or is not debarred, suspended, or proposed for debarment by the Federal Government.

(c) 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 debarred, suspended, or proposed for debarment (see FAR 9.404 for information on the List of Parties Excluded from Federal Procurement and Nonprocurement 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 Federal Procurement and Nonprocurement Programs.

(3) 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.

(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.

(End of clause)

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.

52.215-2 AUDIT AND RECORDS--NEGOTIATION (JUN 1999)

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

(b) Examination of costs. If this is a cost-reimbursement, incentive, time-and-materials, labor-hour, or price redeterminable contract, or any combination of these, the Contractor shall maintain and the Contracting Officer, or an authorized representative of the Contracting Officer, shall have the right to examine and audit all records and other evidence sufficient to reflect properly all costs claimed to have been incurred or anticipated to be incurred directly or indirectly in performance of this contract. This right of examination shall include inspection at all reasonable times of the Contractor's plants, or parts of them, engaged in performing the contract.

(c) Cost or pricing data. If the Contractor has been required to submit cost or pricing data in connection with any pricing action relating to this contract, the Contracting Officer, or an 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 contract, subcontract, or modification;

(2) The discussions conducted on the proposal(s), including those related to negotiating;

(3) Pricing of the contract, subcontract, or modification; or

(4) Performance of the contract, subcontract or modification.

(d) Comptroller General--(1) The Comptroller General of the United States, or an authorized representative, shall have access to and the right to examine any of the Contractor's directly pertinent records involving transactions related to this contract or a subcontract hereunder.

(2) This paragraph may not be construed to require the Contractor or subcontractor to create or maintain any record that the Contractor or subcontractor does not maintain in the ordinary course of business or pursuant to a provision of law.

(e) Reports. If the Contractor is required to furnish cost, funding, or performance reports, the Contracting Officer or an authorized representative of the Contracting Officer shall have the right to examine and audit the supporting records and materials, for the purpose of evaluating (1) the effectiveness of the Contractor's policies and procedures to produce data compatible with the objectives of these reports and (2) the data reported.

(f) Availability. The Contractor shall make available at its office at all reasonable times the records, materials, and other evidence described in paragraphs (a), (b), (c), (d), and (e) of this clause, for examination, audit, or reproduction, until 3 years after final payment under this contract or for any shorter period specified in Subpart 4.7, Contractor Records Retention, of the Federal Acquisition Regulation (FAR), or for any longer period required by statute or by other clauses of this contract. In addition--

(1) If this contract is completely or partially terminated, the Contractor shall make available the records relating to the work terminated until 3 years after any resulting final termination settlement; and

(2) The Contractor shall make available records relating to appeals under the Disputes clause or to litigation or the settlement of claims arising under or relating to this contract until such appeals, litigation, or claims are finally resolved.

(g) The Contractor shall insert a clause containing all the terms of this clause, including this paragraph (g), in all subcontracts under this contract that exceed the simplified acquisition threshold, and--

(1) That are cost-reimbursement, incentive, time-and-materials, labor-hour, or price-redeterminable type or any combination of these;

(2) For which cost or pricing data are required; or

(3) That require the subcontractor to furnish reports as discussed in paragraph (e) of this clause.

The clause may be altered only as necessary to identify properly the contracting parties and the Contracting Officer under the Government prime contract.

(End of clause)

52.215-10 PRICE REDUCTION FOR DEFECTIVE COST OR PRICING DATA (OCT 1997)

(a) If any price, including profit or fee, negotiated in connection with this contract, or any cost reimbursable under this contract, 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 or cost shall be reduced accordingly and the contract shall be modified to reflect the reduction.

(b) Any reduction in the contract price under paragraph (a) of this clause 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.

(c)(1) If the Contracting Officer determines under paragraph (a) 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 (c)(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 “as of” date specified on its Certificate of Current Cost or Pricing Data, and that the data were not submitted before such date.

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

(A) The understated data were known by the Contractor to be understated before the “as of” date specified on its Certificate of Current Cost or Pricing Data; 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 “as of” date specified on its Certificate of Current Cost or Pricing Data.

(d) 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

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

(End of clause)

52.215-11 PRICE REDUCTION FOR DEFECTIVE COST OR PRICING DATA--MODIFICATIONS (OCT 1997)

(a) This clause shall become operative only for any modification to this contract involving a pricing adjustment expected to exceed the threshold for submission of cost or pricing data at FAR 15.403-4, except that this clause does not apply to any modification if an exception under FAR 15.403-1 applies.

(b) If any price, including profit or fee, negotiated in connection with any modification under this clause, or any cost reimbursable under this contract, 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 or cost 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) of this clause 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 “as of” date specified on its Certificate of Current Cost or Pricing Data, and that the data were not submitted before such date.

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

(A) The understated data were known by the Contractor to be understated before the “as of” date specified on its Certificate of Current Cost or Pricing Data; 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 “as of” date specified on its Certificate of Current Cost or Pricing Data.

(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

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

(End of clause)

52.215-13 SUBCONTRACTOR COST OR PRICING DATA--MODIFICATIONS (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 a pricing adjustment expected to exceed the threshold for submission of cost or pricing data at FAR 15.403-4; 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, on the date of agreement on price or the date of award, whichever is later; or before pricing any subcontract modification involving a pricing adjustment expected to exceed the threshold for submission of cost or pricing data at FAR 15.403-4, 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 applies.

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

The Contractor shall insert the substance of this clause, including this paragraph (d), in each subcontract that exceeds the threshold for submission of cost or pricing data at FAR 15.403-4 on the date of agreement on price or the date of award, whichever is later.

(End of clause)

52.215-19 NOTIFICATION OF OWNERSHIP CHANGES (OCT 1997)

(a) The Contractor shall make the following notifications in writing:

(1) When the Contractor becomes aware that a change in its ownership has occurred, or is certain to occur, that could result in changes in the valuation of its capitalized assets in the accounting records, the Contractor shall notify the Administrative Contracting Officer (ACO) within 30 days.

(2) The Contractor shall also notify the ACO within 30 days whenever changes to asset valuations or any other cost changes have occurred or are certain to occur as a result of a change in ownership.

(b) The Contractor shall--

(1) Maintain current, accurate, and complete inventory records of assets and their costs;

(2) Provide the ACO or designated representative ready access to the records upon request;

(3) Ensure that all individual and grouped assets, their capitalized values, accumulated depreciation or amortization, and remaining useful lives are identified accurately before and after each of the Contractor's ownership changes; and

(4) Retain and continue to maintain depreciation and amortization schedules based on the asset records maintained before each Contractor ownership change.

The Contractor shall include the substance of this clause in all subcontracts under this contract that meet the applicability requirement of FAR 15.408(k).

(End of clause)

52.215-21 REQUIREMENTS FOR COST OR PRICING DATA OR INFORMATION OTHER THAN COST OR PRICING DATA--MODIFICATIONS (OCT 1997)

(a) Exceptions from cost or pricing data. (1) In lieu of submitting cost or pricing data for modifications under this

contract, for price adjustments expected to exceed the threshold set forth at FAR 15.403-4 on the date of the agreement on price or the date of the award, whichever is later, the Contractor may submit a written request for exception by submitting the information described in the following subparagraphs. The Contracting Officer may require additional supporting information, but only to the extent necessary to determine whether an exception should be granted, and whether the price is fair and reasonable--

(i) Identification of the law or regulation establishing the price offered. If the price is controlled under law by periodic rulings, reviews, or similar actions of a governmental body, attach a copy of the controlling document, unless it was previously submitted to the contracting office.

(ii) Information on modifications of contracts or subcontracts for commercial items. (A) If--

(1) The original contract or subcontract was granted an exception from cost or pricing data requirements because the price agreed upon was based on adequate price competition or prices set by law or regulation, or was a contract or subcontract for the acquisition of a commercial item; and

(2) The modification (to the contract or subcontract) is not exempted based on one of these exceptions, then the Contractor may provide information to establish that the modification would not change the contract or subcontract from a contract or subcontract for the acquisition of a commercial item to a contract or subcontract for the acquisition of an item other than a commercial item.

(B) For a commercial item exception, the Contractor shall provide, at a minimum, information on prices at which the same item or similar items have previously been sold that is adequate for evaluating the reasonableness of the price of the modification. Such information may include--

(1) For catalog items, a copy of or identification of the catalog and its date, or the appropriate pages for the offered items, or a statement that the catalog is on file in the buying office to which the proposal is being submitted. Provide a copy or describe current discount policies and price lists (published or unpublished), e.g., wholesale, original equipment manufacturer, or reseller. Also explain the basis of each offered price and its relationship to the established catalog price, including how the proposed price relates to the price of recent sales in quantities similar to the proposed quantities.

(2) For market-priced items, the source and date or period of the market quotation or other basis for market price, the base amount, and applicable discounts. In addition, describe the nature of the market.

(3) For items included on an active Federal Supply Service Multiple Award Schedule contract, proof that an exception has been granted for the schedule item.

(2) The Contractor grants the Contracting Officer or an authorized representative the right to examine, at any time before award, books, records, documents, or other directly pertinent records to verify any request for an exception under this clause, and the reasonableness of price. For items priced using catalog or market prices, or law or regulation , access does not extend to cost or profit information or other data relevant solely to the Contractor's determination of the prices to be offered in the catalog or marketplace.

(b) Requirements for cost or pricing data. If the Contractor is not granted an exception from the requirement to submit cost or pricing data, the following applies:

(1) The Contractor shall submit cost or pricing data and supporting attachments in accordance with Table 15-2 of FAR 15.408.

As soon as practicable after agreement on price, but before award (except for unpriced actions), the Contractor shall submit a Certificate of Current Cost or Pricing Data, as prescribed by FAR 15.406-2.

(End of clause)

52.219-8 UTILIZATION OF SMALL BUSINESS CONCERNS (OCT 2000)

(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.

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 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)

52.219-9 SMALL BUSINESS SUBCONTRACTING PLAN (JAN 2002)--ALTERNATE II (OCT 2001).

(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) Proposals submitted in response to this solicitation shall include a subcontracting plan that separately addresses subcontracting with small business, veteran-owner small business, HUBZone small business, 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-owner 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 a 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, 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 HUBZone small business concerns;

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

(vi) 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) HUBZone small business concerns;

(iv) Small disadvantaged business concerns; and

(v) 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, HUBZone small, small disadvantaged, and women-owned small business source list. Use of PRO-Net 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 in 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) HUBZone small business concerns;

(iv) Small disadvantaged business concerns; and

(v) 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, 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, 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, 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-owner 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, 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 HUBZone small business concerns were solicited and, if not, why not;

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

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

(F) 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-owner 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-owner 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-owner 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-owner 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-owner 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)

52.219-14 LIMITATIONS ON SUBCONTRACTING (DEC 1996)

(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 least 25 percent of the cost of the contract, not including the cost of materials, with its own employees.

52.222-3 CONVICT LABOR (AUG 1996)

The Contractor agrees not to employ in the performance of this contract any person undergoing a sentence of imprisonment which has been imposed by any court of a State, the District of Columbia, the Commonwealth of Puerto Rico, the Virgin Islands, Guam, American Samoa, the Commonwealth of the Northern Mariana Islands, or the Trust Territory of the Pacific Islands. This limitation, however, shall not prohibit the employment by the Contractor in the performance of this contract of persons on parole or probation to work at paid employment during the term of their sentence or persons who have been pardoned or who have served their terms. Nor shall it prohibit the employment by the Contractor in the performance of this contract of persons confined for violation of the laws of any of the States, the District of Columbia, the Commonwealth of Puerto Rico, the Virgin Islands, Guam, American Samoa, the Commonwealth of the Northern Mariana Islands, or the Trust Territory of the Pacific Islands who are authorized to work at paid employment in the community under the laws of such jurisdiction, if--

(a)(1) The worker is paid or is in an approved work training program on a voluntary basis;

(2) Representatives of local union central bodies or similar labor union organizations have been consulted;

(3) 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; and

(4) 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

(b) 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)

52.222-4 CONTRACT WORK HOURS AND SAFETY STANDARDS ACT - OVERTIME COMPENSATION. (SEP 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)

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 the 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.

(e) 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.

(End of clause)

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.

(End of clause)

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 the 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 copy 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 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 or 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.

(End of clause)

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 no 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 in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended, and 29 CFR Part 30.

(End of clause)

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.

(End of clause)

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.

(ii) 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.

(End of clause)

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.

(End of clause)

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 or their representatives.

(End of clause)

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).

(f) The penalty for making false statements is prescribed in the U.S. Criminal Code, 18 U.S.C. 1001.

(End of clause)

52.222-21 PROHIBITION OF SEGREGATED 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)

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
12.0%	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's 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 Radford, VA.

(End of provision)

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 subparagraphs (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)

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 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 action 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 rest rooms and necessary dressing or sleeping areas 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 least 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.

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).

(End of clause)

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 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 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 privilege 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 a 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.

(End of clause)

52.223-3 HAZARDOUS MATERIAL IDENTIFICATION AND MATERIAL SAFETY DATA (JAN 1997)

(a) "Hazardous material", as used in this clause, includes any material defined as hazardous under the latest version of Federal Standard No. 313 (including revisions adopted during the term of the contract).

(b) The offeror must list any hazardous material, as defined in paragraph (a) of this clause, to be delivered under this contract. The hazardous material shall be properly identified and include any applicable identification number, such as National Stock Number or Special Item Number. This information shall also be included on the Material Safety Data Sheet submitted under this contract.

Material (If none, insert "None")	Identification No.
_____	_____
_____	_____
_____	_____

(c) This list must be updated during performance of the contract whenever the Contractor determines that any other material to be delivered under this contract is hazardous.

(d) The apparently successful offeror agrees to submit, for each item as required prior to award, a Material Safety Data Sheet, meeting the requirements of 29 CFR 1910.1200(g) and the latest version of Federal Standard No. 313, for all hazardous material identified in paragraph (b) of this clause. Data shall be submitted in accordance with Federal Standard No. 313, whether or not the apparently successful offeror is the actual manufacturer of these items. Failure to submit the Material Safety Data Sheet prior to award may result in the apparently successful offeror being considered nonresponsible and ineligible for award.

(e) If, after award, there is a change in the composition of the item(s) or a revision to Federal Standard No. 313, which renders incomplete or inaccurate the data submitted under paragraph (d) of this clause, the Contractor shall promptly notify the Contracting Officer and resubmit the data.

(f) Neither the requirements of this clause nor any act or failure to act by the Government shall relieve the Contractor of any responsibility or liability for the safety of Government, Contractor, or subcontractor personnel or property.

(g) Nothing contained in this clause shall relieve the Contractor from complying with applicable Federal, State, and local laws, codes, ordinances, and regulations (including the obtaining of licenses and permits) in connection with hazardous material.

(h) The Government's rights in data furnished under this contract with respect to hazardous material are as follows:

(1) To use, duplicate and disclose any data to which this clause is applicable. The purposes of this right are to--

(i) Apprise personnel of the hazards to which they may be exposed in using, handling, packaging, transporting, or disposing of hazardous materials;

(ii) Obtain medical treatment for those affected by the material; and

(iii) Have others use, duplicate, and disclose the data for the Government for these purposes.

(2) To use, duplicate, and disclose data furnished under this clause, in accordance with subparagraph (h)(1) of this clause, in precedence over any other clause of this contract providing for rights in data.

(3) The Government is not precluded from using similar or identical data acquired from other sources.

(End of clause)

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 deter- mine 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 at which 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) though (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 23.506, render the Contractor subject to suspension of contract payments, termination of the contract for default, and suspension or debarment.

(End of clause)

52.223-14 TOXIC CHEMICAL RELEASE REPORTING (OCT 2000)

(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 under section 313(c) of EPCRA, 42 U.S.C. 11023(c);

(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 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 Standard Industrial Classification Code (SIC) major groups 20 through 39 or their corresponding North American Industry Classification System (NAICS) sectors 31 through 33; or

(5) The facility is not located within any State of the United States, the District of Columbia, the Commonwealth of Puerto Rico, Guam, American Samoa, the United States Virgin Islands, the Northern Mariana Islands, or any other territory or possession over which the United States has jurisdiction.

(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)

52.225-9 BUY AMERICAN ACT—CONSTRUCTION MATERIALS (MAY 2002)

(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, U.S. territories and possessions, Puerto Rico, the Northern Mariana Islands, and any other place subject to U.S. jurisdiction, but does not include leased bases.

(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: 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 Buy American 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) \1\
Item 1			
Foreign construction material....	.....	.....	.....
Domestic construction material...	.....	.....	.....
Item 2			
Foreign construction material....	.....	.....	.....
Domestic construction material...	.....	.....	.....

Include all delivery costs to the construction site and any applicable duty (whether or not a duty-free entry certificate is issued).
List name, address, telephone number, and contact for suppliers surveyed. Attach copy of response; if oral, attach summary.
Include other applicable supporting information.

(End of clause)

52.225-13 RESTRICTIONS ON CERTAIN FOREIGN PURCHASES (JUL 2000)

(a) The Contractor shall not acquire, for use in the performance of this contract, any supplies or services originating from sources within, or that were located in or transported from or through, countries whose products are banned from importation into the United States under regulations of the Office of Foreign Assets Control, Department of the Treasury. Those countries are Cuba, Iran, Iraq, Libya, North Korea, Sudan, the territory of Afghanistan controlled by the Taliban, and Serbia (excluding the territory of Kosovo).

(b) The Contractor shall not acquire for use in the performance of this contract any supplies or services from entities controlled by the government of Iraq.

(c) The Contractor shall insert this clause, including this paragraph (c), in all subcontracts.

(End of clause)

52.226-1 UTILIZATION OF INDIAN ORGANIZATIONS AND INDIAN-OWNED ECONOMIC ENTERPRISES (JUN 2000)

(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 constitutea 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. 1542(c).

"Interested party" means a prime 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.

(b) The Contractor shall use its best efforts to give Indian organizations and Indian-owned economic enterprises (25 U.S.C. 1544) the maximum practicable opportunity to participate in the subcontracts it awards to the fullest extent consistent with efficient performance of its contract.

(1) The Contracting Officer and the Contractor, acting in good faith, may rely on the representation of an Indian organization or Indian-owned economic enterprise as to its eligibility, unless an interested party challenges its status or the Contracting Officer has independent reason to question that status. In the event of a challenge to the representation of a subcontractor, the Contracting Officer will refer the matter to the U.S. Department of the Interior, Bureau of Indian Affairs (BIA), 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 notify the Contracting Officer. No incentive payment will be made within 50 working days of subcontract award or while a challenge is pending. If a subcontractor is determined to be an ineligible participant, no incentive payment will be made under the Indian Incentive Program.

(2) The Contractor may request an adjustment under the Indian Incentive Program to the following:

(i) The estimated cost of a cost-type contract.

(ii) The target cost of a cost-plus-incentive-fee prime contract.

(iii) The target cost and ceiling price of a fixed-price incentive prime contract.

(iv) The price of a firm-fixed-price prime contract.

(3) The amount of the adjustment to the prime contract is 5 percent of the estimated cost, target cost, or firm-fixed-price included in the subcontract initially awarded to the Indian organization or Indian-owned economic enterprise.

(4) The Contractor has the burden of proving the amount claimed and must assert its request for an adjustment prior to completion of contract performance.

(c) 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 amount paid to the subcontractor. The Contracting Officer will seek funding in accordance with agency procedures.

(End of clause)

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.)

(End of clause)

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.

(End of clause)

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.

(End of clause)

52.228-5 INSURANCE--WORK ON A GOVERNMENT INSTALLATION (JAN 1997)

(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.

(End of clause)

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.

(End of clause)

52.228-12 PROSPECTIVE SUBCONTRACTOR REQUESTS FOR BONDS. (OCT 1995)

In accordance with Section 806(a)(3) of Pub. L. 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 requester.

(End of clause)

52.228-13 ALTERNATIVE PAYMENT PROTECTIONS (JULY 2000)

(a) The Contractor shall submit one of the following payment protections:

(i) payment bonds; (ii) irrevocable letter of credit.

(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 such 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.

(End of clause)

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 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 date 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 at 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 institutions 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 less than $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 less than $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 the transferee's sight draft(s) drawn on the 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: _____

(End of clause)

52.228-15 PERFORMANCE AND PAYMENT BONDS--CONSTRUCTION (JUL 2000)-

(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)

52.229-3 FEDERAL, STATE, AND LOCAL TAXES (JAN 1991)

(a) "Contract date," as used in this clause, 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.

"All applicable Federal, State, and local taxes and duties," as used in this clause, 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," as used in this clause, 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.

(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.

(End of clause)

52.232-17 INTEREST (JUNE 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. reproduce, prepare derivative works, distribute copies to the public, and (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.

(End of clause)

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.

(End of clause)

52.232-33 PAYMENT BY ELECTRONIC FUNDS TRANSFER—CENTRAL CONTRACTOR REGISTRATION (MAY 1999)

(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 prompt payment. A payment shall be deemed to have been made in a timely manner in accordance with the prompt payment terms of this contract if, in the EFT payment transaction instruction released to the Federal Reserve System, the date specified for settlement of the payment is on or before the prompt payment due date, provided the specified payment date is a valid date under the rules of the Federal Reserve System.

(h) 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 in the CCR database and shall be paid by EFT in accordance with the terms of this clause. 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.

(i) 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.

(j) 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)

52.236-1 PERFORMANCE OF WORK BY THE CONTRACTOR (APR 1984)

The Contractor shall perform on the site, and with its own organization, work equivalent to at least fifteen (15%) 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.

(End of clause)

52.236-2 DIFFERING SITE CONDITIONS (APR 1984)

As prescribed in 36.502, insert the following clause in solicitations and contracts when a fixed-price construction contract or a fixed-price dismantling, demolition, or removal of improvements contract is contemplated and the contract amount is expected to exceed the small purchase limitation. The Contracting Officer may insert the clause in solicitations and contracts when a fixed-price construction or a fixed-price contract for dismantling, demolition, or removal of improvements is contemplated and the contract amount is expected to be within the small purchase limitation.

(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.

(End of clause)

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.

(End of clause)

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.

(End of clause)

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 worksite a competent superintendent who is satisfactory to the Contracting Officer and has authority to act for the Contractor.

(End of clause)

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.

(End of clause)

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.

(End of clause)

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 refuses to repair the damage promptly, the Contracting Officer may have the necessary work performed and charge the cost to the Contractor.

(End of clause)

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.

(End of clause)

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.

(End of clause)

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.

(End of clause)

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.

(End of clause)

52.236-16 QUANTITY SURVEYS (APR 1984)

(a) Quantity surveys shall be conducted, and the data derived from these surveys shall be used in computing the quantities of work performed and the actual construction completed and in place.

(b) The Government shall conduct the original and final surveys and make the computations based on them. The Contractor shall conduct the surveys for any periods for which progress payments are requested and shall make the computations based on these surveys. All surveys conducted by the Contractor shall be conducted under the direction of a representative of the Contracting Officer, unless the Contracting Officer waives this requirement in a specific instance.

(c) Promptly upon completing a survey, the Contractor shall furnish the originals of all field notes and all other records relating to the survey or to the layout of the work to the Contracting Officer, who shall use them as necessary to determine the amount of progress payments. The Contractor shall retain copies of all such material furnished to the Contracting Officer.

(End of clause)

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.

(End of clause)

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.

(End of clause)

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.

(End of clause)

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.

(End of clause)

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.

(End of clause)

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.

(End of clause)

52.243-5 CHANGES AND CHANGED CONDITIONS (APR 1984)

(a) The Contracting Officer may, in writing, order changes in the drawings and specifications within the general scope of the contract.

(b) The Contractor shall promptly notify the Contracting Officer, in writing, of subsurface or latent physical conditions differing materially from those indicated in this contract or unknown unusual physical conditions at the site before proceeding with the work.

(c) If changes under paragraph (a) or conditions under paragraph (b) increase or decrease the cost of, or time required for performing the work, the Contracting Officer shall make an equitable adjustment (see paragraph (d)) upon submittal of a "proposal for adjustment" (hereafter referred to as proposal) by the Contractor before final payment under the contract.

(d) The Contracting Officer shall not make an equitable adjustment under paragraph (b) unless--

(1) The Contractor has submitted and the Contracting Officer has received the required written notice; or

(2) The Contracting Officer waives the requirement for the written notice.

(e) Failure to agree to any adjustment shall be a dispute under the Disputes clause.

(End of clause)

52.245-2 GOVERNMENT PROPERTY (FIXED-PRICE CONTRACTS) (DEC 1989)

(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) of this clause; 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) Final accounting and disposition of Government property. Upon completing this contract, or at such earlier dates as may be fixed by the Contracting Officer, the Contractor shall submit, in a form acceptable to the Contracting Officer, inventory schedules covering all items of Government property (including any resulting scrap) not consumed in performing this contract or 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 the Contracting Officer directs.

(j) Abandonment and restoration of Contractor's premises. Unless otherwise provided herein, the Government--

(1) May abandon any Government property in place, at which time all obligations of the Government regarding such abandoned property shall cease; and

(2) Has no obligation to restore or rehabilitate the Contractor's premises under any circumstances (e.g., abandonment, disposition upon completion of need, or upon contract completion). However, if the Government-

furnished property (listed in the Schedule or specifications) 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, its territories, or possessions, 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.

(End of clause)

52.246-1 CONTRACTOR INSPECTION REQUIREMENTS (APR 1984)

The Contractor is responsible for performing or having performed all inspections and tests necessary to substantiate that the supplies or services furnished under this contract conform to contract requirements, including any applicable technical requirements for specified manufacturers' parts. This clause takes precedence over any Government inspection and testing required in the contract's specifications, except for specialized inspections or tests specified to be performed solely by the Government.

(End of clause)

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) of this section.

(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.

(End of clause)

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.

(End of clause)

52.249-2 TERMINATION FOR CONVENIENCE OF THE GOVERNMENT (FIXED-PRICE) (SEP 1996) - ALTERNATE I (SEP 1996)

(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 45.6 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 or remaining 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 (g) 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 modified, and the Contractor paid the agreed amount. Paragraph (g) 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 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 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 or request for equitable adjustment 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.

(End of clause)

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 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 obligations of the parties will be the same as if the termination had been issued for the convenience of the Government.

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.

(End of clause)

52.253-1 COMPUTER GENERATED FORMS (JAN 1991)

(a) Any data required to be submitted on a Standard or Optional Form prescribed by the Federal Acquisition Regulation (FAR) may be submitted on a computer generated version of the form, provided there is no change to the name, content, or sequence of the data elements on the form, and provided the form carries the Standard or Optional Form number and edition date.

(b) Unless prohibited by agency regulations, any data required to be submitted on an agency unique form prescribed by an agency supplement to the FAR may be submitted on a computer generated version of the form provided there is no change to the name, content, or sequence of the data elements on the form and provided the form carries the agency form number and edition date.

(g) If the Contractor submits a computer generated version of a form that is different than the required form, then the rights and obligations of the parties will be determined based on the content of the required form.

(End of clause)

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)

252.203-7001 PROHIBITION ON PERSONS CONVICTED OF FRAUD OR OTHER DEFENSE-CONTRACT-RELATED FELONIES (MAR 1999)

(a) Definitions. As used in this clause—

(1) “Arising out of a contract with the DoD” means any act in connection with—

(i) Attempting to obtain;

(ii) Obtaining, or

(iii) Performing a contract or first-tier subcontract of any agency, 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 judgment 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 the board of directors of any DoD contractor or first-tier subcontractor;

(3) As a consultant, agent, or representative for 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 5 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 specified in paragraph (b) of this clause; or

(2) Allowing such a person to serve on the board of directors of the 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 person has been convicted of fraud or any other felony arising out of a contract with the DoD by contacting The Office of Justice Programs, The Denial of Federal Benefits Office, U.S. Department of Justice, telephone (202) 616-3507.

(End of clause)

252.203-7002 DISPLAY OF DOD HOTLINE POSTER (DEC 1991)

(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 the 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.

(h) The Contractor 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.

(End of clause)

252.205-7000 PROVISION OF INFORMATION TO COOPERATIVE AGREEMENT HOLDERS (DEC 1991)

(a) Definition.

"Cooperative agreement holder" means a State or local government; a private, nonprofit organization; a tribal organization (as defined in section 4(c) of the Indian Self-Determination and Education Assistance Act (Pub. L. 93-268; 25 U.S.C. 450 (c))); or an economic enterprise (as defined in section 3(e) of the Indian Financing Act of 1974 (Pub. L. 93-362; 25 U.S.C. 1452(e))) whether such economic enterprise is organized for profit or nonprofit purposes; which has an agreement with the Defense Logistics Agency to furnish procurement technical assistance to business entities.

(b) The Contractor shall provide cooperative agreement holders, upon their request, with a list of those appropriate employees or offices responsible for entering into subcontracts under defense contracts. The list shall include the business address, telephone number, and area of responsibility of each employee or office.

(c) The Contractor need not provide the listing to a particular cooperative agreement holder more frequently than once a year.

(End of clause)

252.215-7000 PRICING ADJUSTMENTS (DEC 1991)

The term "pricing adjustment," as used in paragraph (a) of the clauses entitled "Price Reduction for Defective Cost or Pricing Data - Modifications," "Subcontractor Cost or Pricing Data," and "Subcontractor Cost or Pricing Data - Modifications," means the aggregate increases and/or decreases in cost plus applicable profits.

(End of clause)

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 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 items 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--

(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 small 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.

(End of clause)

252.219-7011 NOTIFICATION TO DELAY PERFORMANCE (JUN 1998)

The Contractor shall not begin performance under this purchase order until 2 working days have passed from the date of its receipt. Unless the Contractor receives notification from the Small Business Administration that it is ineligible for this 8(a) award, or otherwise receives instructions from the Contracting Officer, performance under this purchase order may begin on the third working day following receipt of the purchase order. If a determination of ineligibility is issued within the 2-day period, the purchase order shall be considered canceled.

(End of clause)

252.223-7001 HAZARD WARNING LABELS (DEC 1991)

(a) "Hazardous material," as used in this clause, is defined in the Hazardous Material Identification and Material Safety Data clause of this contract.

(b) The Contractor shall label the item package (unit container) of any hazardous material to be delivered under this contract in accordance with the Hazard Communication Standard (29 CFR 1910.1200 et seq). The Standard requires that the hazard warning label conform to the requirements of the standard unless the material is otherwise subject to the labeling requirements of one of the following statutes:

(1) Federal Insecticide, Fungicide and Rodenticide Act;

(2) Federal Food, Drug and Cosmetics Act;

(3) Consumer Product Safety Act;

(4) Federal Hazardous Substances Act; or

(5) Federal Alcohol Administration Act.

(c) The Offeror shall list which hazardous material listed in the Hazardous Material Identification and Material Safety Data clause of this contract will be labeled in accordance with one of the Acts in paragraphs (b)(1) through (5) of this clause instead of the Hazard Communication Standard. Any hazardous material not listed will be interpreted to mean that a label is required in accordance with the Hazard Communication Standard.

MATERIAL (If None, Insert "None.")	ACT
_____	_____
_____	_____

(d) The apparently successful Offeror agrees to submit, before award, a copy of the hazard warning label for all hazardous materials not listed in paragraph (c) of this clause. The Offeror shall submit the label with the Material Safety Data Sheet being furnished under the Hazardous Material Identification and Material Safety Data clause of this contract.

(e) The Contractor shall also comply with MIL-STD-129, Marking for Shipment and Storage (including revisions adopted during the term of this contract).

(End of clause)

252.223-7004 DRUG-FREE WORK FORCE (SEP 1988)

(a) Definitions.

(1) "Employee in a sensitive position," as used in this clause, means an employee who has been granted access to classified information; or employees in other positions that the Contractor determines involve national security; health or safety, or functions other than the foregoing requiring a high degree of trust and confidence.

(2) "Illegal drugs," as used in this clause, means controlled substances included in Schedules I and II, as defined by section 802(6) of title 21 of the United States Code, the possession of which is unlawful under chapter 13 of that Title. The term "illegal drugs" does not mean the use of a controlled substance pursuant to a valid prescription or other uses authorized by law.

(b) The Contractor agrees to institute and maintain a program for achieving the objective of a drug-free work force. While this clause defines criteria for such a program, contractors are encouraged to implement alternative approaches comparable to the criteria in paragraph (c) that are designed to achieve the objectives of this clause.

(c) Contractor programs shall include the following, or appropriate alternatives:

(1) Employee assistance programs emphasizing high level direction, education, counseling, rehabilitation, and coordination with available community resources;

(2) Supervisory training to assist in identifying and addressing illegal drug use by Contractor employees;

(3) Provision for self-referrals as well as supervisory referrals to treatment with maximum respect for individual confidentiality consistent with safety and security issues;

(4) Provision for identifying illegal drug users, including testing on a controlled and carefully monitored basis. Employee drug testing programs shall be established taking account of the following:

(i) The Contractor shall establish a program that provides for testing for the use of illegal drugs by employees in sensitive positions. The extent of and criteria for such testing shall be determined by the Contractor based on

considerations that include the nature of the work being performed under the contract, the employee's duties, and efficient use of Contractor resources, and the risks to health, safety, or national security that could result from the failure of an employee adequately to discharge his or her position.

(ii) In addition, the Contractor may establish a program for employee drug testing--

(A) When there is a reasonable suspicion that an employee uses illegal drugs; or

(B) When an employees has been involved in an accident or unsafe practice;

(C) As part of or as a follow-up to counseling or rehabilitation for illegal drug use;

(D) As part of a voluntary employee drug testing program.

(iii) The Contractor may establish a program to test applicants for employment for illegal drug use.

(iv) For the purpose of administering this clause, testing for illegal drugs may be limited to those substances for which testing is prescribed by section 2..1 of subpart B of the "Mandatory Guidelines for Federal Workplace Drug Testing Programs" (53 FR 11980 (April 11, 1988), issued by the Department of Health and Human Services.

(d) Contractors shall adopt appropriate personnel procedures to deal with employees who are found to be using drugs illegally. Contractors shall not allow any employee to remain on duty or perform in a sensitive position who is found to use illegal drugs until such times as the Contractor, in accordance with procedures established by the Contractor, determines that the employee may perform in such a position.

(e) The provisions of this clause pertaining to drug testing program shall not apply to the extent that are inconsistent with state or local law, or with an existing collective bargaining agreement; provided that with respect to the latter, the Contractor agrees those issues that are in conflict will be a subject of negotiation at the next collective bargaining session.

(End of clause)

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.

(End of clause)

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.

252.236-7000 MODIFICATION 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

(v) Overhead; and

(2) Must 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.

252.236-7006 COST LIMITATION (JAN 1997)

(a)Certain items in this solicitation are subject to statutory cost limitations. The limitations are stated in the Schedule.

(b)An offer which does not state separate prices for the items identified in the Schedule as subject to a cost limitation may be considered nonresponsive.

(c)Prices stated in offers for items subject to cost limitations shall include an appropriate apportionment of all costs, direct and indirect, overhead, and profit.

(d) Offers may be rejected which--

(1)Are materially unbalanced for the purpose of bringing items within cost limitations; or

(2)Exceed the cost limitations, unless the limitations have been waived by the Government prior to award.

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.

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.

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 my 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 (FAR); 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.

(i) TRANSPORTATION OF SUPPLIES BY SEA (MAY 2002) ALTERNATE III (MAY 2002)

(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 land, 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 vessels 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 contracts 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 than 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 Maritime Administration, Office of Cargo Preference, U.S. Department of Transportation, 400 Seventh Street SW., 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 shall insert the substance of this clause, including this paragraph (f), in subcontracts that are for a type of supplies described in paragraph (b)(2) of this clause.

(End of clause)

CLAUSES INCORPORATED BY FULL TEXT

52.211-10 COMMENCEMENT, PROSECUTION, AND COMPLETION OF WORK (APR 1984)

The Contractor shall be required to (a) commence work under this contract within 10 calendar days after the date the Contractor receives the notice to proceed, (b) prosecute the work diligently, and (c) complete the entire work ready for use not later than 570 calendar days from receipt of Notice to Proceed. The time stated for completion shall include final cleanup of the premises.

(End of clause)

52.211-12 LIQUIDATED DAMAGES--CONSTRUCTION (SEP 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 $475.00 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.

(End of clause)

E4LC11 DEPARTMENT OF LABOR WAGE DECISION (CONSTRUCTION)

Any contract awarded as a result of this solicitation will be subject to the U.S. Department of Labor Wage Decision(s):

General Decision Number VA020064

General Decision Number **VA020064**
Superseded General Decision No. VA010064

State: Virginia

Construction Type:
HEAVY
SEWER AND WATER LINE

County(ies):

BLAND GILES RUSSELL
BUCHANAN GRAYSON SMYTH
CARROLL LEE TAZEWELL
CRAIG MONTGOMERY WISE
DICKENSON NORTON* WYTHE
FLOYD PULASKI
GALAX* RADFORD*

*INDEPENDENT CITIES

*INCLUDING THE RADFORD ARMY AMMUNITION PLANT

HEAVY CONSTRUCTION PROJECTS (Including Sewer and Water Lines)

Modification Number	Publication Date
0	03/01/2002
1	06/07/2002
2	01/03/2003

COUNTY(ies):
BLAND GILES RUSSELL
BUCHANAN GRAYSON SMYTH
CARROLL LEE TAZEWELL
CRAIG MONTGOMERY WISE
DICKENSON NORTON* WYTHE
FLOYD PULASKI
GALAX* RADFORD*

* BOIL0045B 10/01/2002

	Rates	Fringes
BOILERMAKERS	23.87	14.24

PLUM0491B 06/01/2002

	Rates	Fringes
STEAMFITTERS	20.44	7.65

SUVA2021A 04/01/1989

	Rates	Fringes
CARPENTERS (Excluding Concrete Form Work)	7.69	
CEMENT MASONS	9.78	3.05
IRONWORKERS, REINFORCING	7.30	
LABORERS:		
Unskilled	5.37	
Pipelayers	6.17	.93
POWER EQUIPMENT OPERATORS:		
Backhoes	7.71	
Bulldozers	7.84	
Loaders	7.45	
TRUCK DRIVERS	6.29	

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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 (29 CFR 5.5(a)(1)(ii)).

In the listing above, the "SU" designation means that rates listed under that 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, D. C. 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, D. C. 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, D. C. 20210

4.) All decisions by the Administrative Review Board are final.
END OF GENERAL DECISION

E4LC12 REQUIRED INSURANCE

The contractor shall procure and maintain during the entire period of performance under this contract, the following minimum insurance:

TYPE	AMOUNT
Workers Compensation	As required by State law
Employer's Liability	$100,000 per person
General Liability	$500,000 per occurrence
Motor Vehicle Liability (for each motor vehicle):	
Bodily injury or death	$200,000 per person
	$500,000 per occurrence
Property damage	$20,000 per occurrence

Prior to commencement of work hereunder, the contractor shall furnish to the Contracting Officer a certificate or written statement of the above required insurance. The policies evidencing required insurance shall contain an endorsement to the effect that cancellation or any material change in the policies adversely affecting the interests of the Government in such insurance shall not be effective for such period as may be prescribed by the laws of the State in which this contract is to be performed and in no event less than 30 days after written notice thereof to the Contracting Officer.

E4LC 14 PERFORMANCE EVALUATION OF CONTRACTOR

As a minimum, the Contractor's performance will be evaluated upon final acceptance of the work. However, interim evaluations may be prepared at any time during contract performance when determined to be in the best interest of the Government. The format for the evaluation will be DD Form 2626, and the Contractor will be rated

either "Outstanding," "Satisfactory," or "Unsatisfactory" in the areas of Contractor Quality Control, Timely Performance, Effectiveness of Management, Compliance with Labor Standards, and Compliance with Safety Standards. The Contractor will be advised on any unsatisfactory rating, either in an individual element or in the overall rating, prior to completing the evaluation; all contractor comments will be made a part of the official record. In compliance with DOD FAR Supplement 236.201, Performance Evaluation Reports will be available to all DOD Contracting Offices for their future use in determining contractor responsibility.

E4LC15 LOCATION OF SITE ON A GOVERNMENT RESERVATION

The site of the work is on a government reservation and all rules and regulations issued by the Commanding Officer covering general safety, security, and sanitary requirements, etc., shall be observed by the contractor.

E4LC16 ACCIDENT PREVENTION PLAN

In accordance with the clause entitled "Accident Prevention," the contractor will not be allowed to commence work on the job site until an acceptable accident prevention plan has been submitted. The contractor will receive official notification of the acceptance of his accident prevention plan.

E4LC19 YEAR 2000 COMPLIANCE (CONSTRUCTION)

In accordance with FAR 39.106, the contractor shall ensure that with respect to any design, construction, goods, or services under this contract, as well as any subsequent task/delivery orders issued under this contract (if applicable), all information technology contained therein shall be Year 2000 (Y2K) compliant. Specifically, the contractor shall:

a. Perform, maintain, and provide an inventory of all major components to include structures, equipment, items, parts, and furnishings under this contract and each task/delivery order which may be affected by the Y2K acompliance requirement.

b. Indicate whether each component is currently Y2K compliant or requires an upgrade for compliance prior to government acceptance.

(End of clause)

E4LC22 PARTNERING

In order to most effectively accomplish this contract, the Government is willing to form a cohesive partnership with the Contractor and its subcontractors. This partnership would strive to draw on the strengths of each organization in an effort to achieve a quality project done right the first time, within budget, and on schedule. This partnership would be bilateral in make-up and participation will be totally voluntary. Any cost associated with affecting this partnership will be agreed to by both parties and will be shared equally with no change in contract price.

E4LC28 IDENTIFICATION OF CORRESPONDENCE

All correspondence and data submitted by the contractor under this contract shall reference the contract number.

E4LC29 AGENTS

Offers signed by an Agent must be made in the name of the Principal and must be accompanied by evidence of said Agent's authority to act on behalf of its Principal.

E4LC46 UNAUTHORIZED INSTRUCTIONS FROM GOVERNMENT OR OTHER PERSONNEL

The contractor shall not accept instructions issued by any person, employed by the U.S. Government or otherwise, other than the Contracting Officer or the Authorized Representative of the Contracting Officer acting within the limits of his/her authority as defined in the Designation of Authority letter. A copy of the Designation of Authority letter will be furnished to the contractor at time of contract award.

E4LC49 DESIGNATION OF AUTHORIZED REPRESENTATIVE OF THE CONTRACTOR

The Contractor shall assign a number or employee who will act as Project Manager during the course of this contract or during the course of a delivery order. This official shall be responsible for affording liaison between the contract forces and the contracting office(s). This designation shall be in writing with a copy furnished to the Contracting Officer.

E4LC57 OVERSIGHT BY DISTRICT COMMANDER

Although the U.S. Army Corps of Engineers has decided that effective 1 Oct 93 District and operation Major Subordinate Commanders will no longer be contracting officers, the Commanders will be expected to exercise oversight on [approve] critical decisions on this contract, including contract award (see FAR clause 52.204-1, Approval of Contract), settlement actions, and alternate dispute resolution (ADR).

E4LC59 PHYSICAL DATA (APR 1984)

Data and information furnished or referred to below is for the Contractor's 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 the methods identified in Division 1 of the specification.

(b) Weather conditions: See Division 1 of the specification.

(c) Transportation facilities: See Division 1 of the specification.

(d) Other Physical Data: See Division 1 of the specification.

(End of clause)

US ARMY CORPS
OF ENGINEERS
NORFOLK DISTRICT

READY TO ADVERTISE
DESIGN ANALYSIS

Specifications

HAZARDOUS WASTE TANKS
C-LINE - TANKS

CONTRACT NO. DACA65-03-R-0013
OLD PROJECT NO. 59X2896
NEW PROJECT NO. 5022896

FEBRUARY 2003

PREPARED FOR

RADFORD ARMY AMMUNITION PLANT
RADFORD, VIRGINIA

Stone & Webster Inc., A Shaw Group Company
Stoughton, Massachusetts

SPECIFICATIONS VOLUME 1

DIVISION 01 – GENERAL REQUIREMENTS

01006	Special Work Restrictions and Requirements for RFAAP
01111	Safety And Health Requirements
01312A	Quality Control System (QCS)
01320A	Project Schedule
01330	Submittal Procedures
01355	Environmental Protection
01420	Sources For Reference Publications
01451A	Contractor Quality Control
01500A	Temporary Construction Facilities
01780A	Closeout Submittals
01850	Contract Drawings

DIVISION 02 – SITE WORK

02210	Grading
02220A	Demolition
02221	Excavation, Filling, and Backfilling for Buildings
02222	Excavation, Filling, and Backfilling for Utilities Systems
02225	Earthwork for Roadways
02239	Portland Cement-Stabilized Base Or Subbase Course
02243	Drainage Layer
02300A	Earthwork
02511	Concrete Sidewalks And Curbs And Gutters
02531	Acid Sewers
02558	Bituminous Tack Coat
02559	Bituminous Prime Coat
02580	Pavement Markings
02630A	Storm-Drainage System
02660	Water Lines and Other Misc. Piping
02722A	Aggregate And/Or Graded-Crushed Aggregate Base Course
02741	Bituminous Paving For Roads, Streets And Open Storage Areas
02831	Chain Link Fence
02921	Seeding
02935	Turf

DIVISION 03 – CONCRETE

03100A	Structural Concrete Formwork
03200A	Concrete Reinforcement
03250	Expansion Joints, Contraction Joints, and Waterstops
03300	Concrete
03410	Plant-Precast Structural Concrete

DIVISION 05 – METALS

05090	Welding, Structural And Acid Piping
05093	Welding, Pressure Piping And Acid Gravity Piping
05120A	Structural Steel
05300A	Steel Decking
05500A	Miscellaneous Metal

DIVISION 06 – WOODS AND PLASTICS

06100	Rough Carpentry

DIVISION 07 – THERMAL AND MOISTURE PROTECTION

07132	Bituminous Waterproofing
07920	Joint Sealing

DIVISION 08 – DOORS AND WINDOWS

See Section 13121 Precast Preengineered Concrete Buildings

DIVISION 09 – FINISHES

09900	Painting, General
09915	Color Schedule

DIVISION 10 – SPECIALTIES

10430	Exterior Signage
10440	Interior Signage

DIVISION 11 – EQUIPMENT

11211A	Pumps: Industrial, Centrifugal

DIVISION 13 – SPECIAL CONSTRUCTION

13202	Fuel Storage Systems
13206	Stainless Steel Process Tanks
13121	Precast Preengineered Concrete Buildings

DIVISION 15 – MECHANICAL

15200A	Pipelines, Process Piping
15250	Thermal Insulation for Mechanical Systems
15400	Plumbing, General Purpose
15895	Air Supply and Distribution, Ventilation and Exhaust System

DIVISION 16 – ELECTRICAL

16262	Automatic Transfer Switch And By-Pass/Isolation Switch
16263	Diesel-Generator Set Stationary 100-2500 KW, with Auxiliaries
16370	Electrical Distribution System, Aerial

16375	Electrical Distribution System, Underground
16415	Electrical Work, Interior
16670	Lightning Protection System
16721	Fire Detection and Alarm System
16900	Instrument Installation
16902	Control Panels

ADDENDUM
ADDITIONAL QC QUESTIONS AND ANSWERS
PUMP SCHEDULE FOR 3058

DACA65
CONTRACTING OFFICE (CA/CW)
US ARMY ENGR DIST NORFOLK ATTN:
CENAO-CT 803 FRONT STREET
NORFOLK VA 23510-1096

ADDENDUM OF SOLICITATION/MODIFICATION OF CONTRACT

In addition to the referenced plans and specs, the following is also included in this amendment.

Item No. 1

All welding for NC service including all stainless steel pipe and stainless steel tanks shall meet the Alliant and Hercules standards for NC containing materials.

It is recommended that all welding be accomplished by the TIG process.

All welds will be full penetration and fillet welds are unacceptable and slip-on flanges are also unacceptable.

Delete all references to 304L stainless steel in this contract and include 316L stainless steel.

All piping shall be standard weight 316L stainless steel.

Item No. 2

All underground conduit between tank 3020, 3058 and control building shall be in rigid conduit.

Item No. 4

Soil Borings have been added as Attachment 1 to Section 02221.

Item No. 5

All references to stainless steel liner for manholes in Section 02531 shall be deleted.

DACA65
CONTRACTING OFFICE (CA/CW)
US ARMY ENGR DIST NORFOLK ATTN:
CENAO-CT 803 FRONT STREET
NORFOLK VA 23510-1096

ADDENDUM OF SOLICITATION/MODIFICATION OF CONTRACT

SPECIFICATIONS

1. Section 09900: PAINTING, GENERAL, Page 6, Paragraph 3.2.1, in the third sentence after the wording "8 to 10 mils DFT layer of Fluorolast SB" add the following Fluorolast Product number and color "LCGY-8130AK (gray)".
2. Section 05090: WELDING, STRUCTURAL AND ACID PIPING change title to WELDING, STRUCTURAL.
3. Section 05093a: New Section, WELDING PRESSURE PIPING AND ACID GRAVITY PIPING with ATTACHMENT I.
4. Section 02221 EXCAVATION, FILLING, AND BACKFILLING FOR BUILDINGS: Add Attachment 1, "BORINGS FROM SWMU 6 SOIL SAMPLING INVESTIGATION". This is for information only and are borings taken during the May 2001 SWMU (Solid Waste Management Unit) #6 Sampling Investigation for hazardous soils. Included is the EXECUTIVE SUMMARY from this investigation that indicated that no hazardous materials were found.
5. Section 01006 PROJECT WORK REQUIREMENTS AND RESTRICTIONS for RAAP, Paragraph 1.5.2 Rail Service add the following:

   "Contractor is made aware of safety work stoppages due to tanker unloading in the area of the project. The best ATK prediction of frequency and duration of solvent rail car unloading at bldg 3525, based on the last 1-2 years' production.
   - 2 ether cars per month.
   - 1 acetone car per year.
   - 7 or 8 alcohol cars per year.

   Each car takes approximately 2-3 hours to unload, and unloading is done during weekdays when the foreman is present. Ether, alcohol, and acetone, and rail cars are unloaded at approximately 33 cars per year, 2-3 hours each; and sometimes up to 6 cars per month depending on increased production."

   Therefore, Contractor personnel will be required to vacate site for solvent unloading 2-4 hours/week.

6. Section 01006 PROJECT WORK REQUIREMENTS AND RESTRICTIONS for RAAP, Paragraph 1.5.1 Use of Roads Within the Facility add the following:
   Contractor has been given approval by ATK to request road closure associated with excavation for construction of Haz Waste Tanks, subject to the following:

- Access to transformer substation north of location of road closing is maintained.
- Road closure does not extend beyond the following points:
  1. At the east solvent unloading gate (NW of Pump Tank 3054).
  2. Approximately 100 feet west of the west end of the new 3058 structure.

- Contractor shall provide a level turnaround area loop with an all-weather surface for a standard 18 wheel road tractor and tank semi-trailer to enter, unload, and exit the station 3525 area from the west road access without backing up.

  The closure approval is effective only for excavation safety. After concrete structure can be backfilled, road must be re-opened. Contractor must backfill when structure progress permits and not leave the north side excavation opened an excuse to continue to block the road for his convenience."

7. Section 02080, Paragraph 1.4.1, Description of Work, change the first sentence as indicated in the amended spec.
8. Section 01451A, CONTRACTOR QUALITY CONTROL, Paragraph 3.4.3 CQC Personnel, Item b, delete the term "fiberglass".
9. Section 16262, AUTOMATIC TRANSFER SWITCH AND BY-PASS/ISOLATION SWITCH. Add new section.
10. Section 15400, SECTION TABLE OF CONTENTS for PLUMBING, GENERAL PURPOSE was inadvertently inserted before Section 15250 Table of Contents. Reinsert the two pages of TOC to Section 15400.
11. Section 15200A, PIPELINES, PROCESS PIPING. Change all references from 304L stainless steel to 316L stainless steel, "Standard Weight".
12. Section 15200A, PIPELINES, PROCESS PIPING, Paragraph 2.6.2, Valve Schedule. Replace Valve/operator schedule paragraph with the following:

    "All valves for acidic waste and NC process water (35P and 156L):
    Gate, butterfly and check valve.
    The following standard:
    ANSI Std. B16.34
    Pressure Class 150#
    Body material ASTM 351-CF3M"

Extension stem floor stand and hand wheel should be provided as indicated on the drwgs.

Hazardous Waste Tanks, RAAP
DACA65-03-R-0013

ADDITIONAL QC Questions with Answers in bold

1. Is it required that we maintain traffic on the asphalt drive through the project? **Road closing is acceptable, see amendment.**

2. It appears to us that due to the excavation depth, sheeting will need soil anchors. May we drill and pump cement as necessary, and when necessary to provide necessary anchorages, excluding known areas where the anchors would conflict with known buried pipes, etc? **Grouting in anchors is acceptable.**

3. Can power be shut down in the areas where piles need to be driven? **Yes, outages can be scheduled**

4. Would we be permitted to cast the drainage channel in place rather than precast? Would we need to conform to ACI-350R for this work if permitted or could a less restrictive spec. be used? **Cast in place trenches are acceptable and are not considered secondary containment.**

5. Will a storage area be provided for each excavated that will be used to back fill? Will off-road trucks be permitted to haul this surplus to the stockpile area? **Yes, an onsite storage area will be available.**

6. Does ACI-350R apply to construction of manholes for storm drains? **No, storm drains and manholes for storm drains are not designed to ACI 350R.**

7. Is the 12" pipe that is to be relocated for new MH #1 a storm drain? Is the elevation of the pipe known? **No, it is an acid sewer, the elevation is 1788.0'.**

8. Could the dbl 36" pipe, MH #1 thru MH #3 be replaced with one larger pipe of equal or greater capacity? **Yes, one larger pipe is acceptable.**

9. RFQ Package did not have specific valve specifications for each service. Please provide the necessary specs. **See valve schedule in the amendment.**

10. Drawing M2200 shows a 6" FW from a 14" main going into a 2" valve box. Shouldn't this be a 6" valve box? **6" Valve. See Amended drwg.**

11. Drawing M2200 shows a 1-1/2" D water line. The Line Designations given on Drawing G0008 do not have this service listed. Please identify what service designation "D" is and provide a spec for it. **D and PW are the same.**

12. Drawing G0008 shows Spec #156L as "150# 316L Thin Wall Stainless Steel" but the only stainless steel spec given in Division 15200A is for 304L Schedule 40S per paragraph 2.3.1.1. Which is correct? **Standard wt., all piping to be 316L.**

13. Ref Drawing M2100, Location Point 1-C; what size is the gravity drain line from Line No. PS-118-6"-156L-N to PWW-105-16"-156L? Also where is the tie-in point location on Line No. PWW-105-16"-1561? **See C-2201.**

14. Should Control Valve Data Sheet A-34 of 54 be for Control Valve LV222 and not Control Valve LV220? **Yes**

15. Piping spec 35P shown on Drawing G0008 is identified as "PVC Bell End Pressure Pipe" but Division 15, Section 15200A, page 23, paragraph 2.3.3 appears to be a Polyethylene spec. Please provide a specific spec for Spec 35 HP and 35P. **35P specification is for P.E. pipe, see specification for P.E. Pipe.**

16. Drawing G0008 identifies spec 47P as "Galvanized Steel Pipe" and spec 121 as "125# Carbon Steel Pipe". Please review Division 15, Section 15200A, page 20, paragraph 2.2 and provide a specific spec for carbon steel and galvanized pipe. **ASTM A53/A106**

17. Detail A at the bottom left corner of Drawing C2201 shows a 2" x 6" eccentric reducer and a 2" SS ball valve which ties into a 4" drain with a 16" x 16" x 4" tee". Which is the correct, the 2" size or the 4" size? The P&ID does not give a size. **Four inch (4") is correct. See amended drwg.**

18. Ref. Fuel Oil Piping: the RFQ does not have any information on the size, location or if the pipe is underground or above ground. Please provide. **The size should be recommended by the vendor of the equipment and shall be installed above grade.**

19. Reference point C-1 on the right hand center of P&I Drawing M2100: What does "PIT COTTON" refer to? **Material collected from effluent (NC).**

20. Ref Detail 2 shown at the right hand bottom corner of Drawing M2301: Shouldn't the 6" x 6" SS TEE" be a 90 degree ell? **Yes** If not where does the 6" pipe continue too?

21. If the answer to question #4 above is 316L thin wall, are we to Schedule 10 or Schedule 5? If the answer to question #4 above is 304L schedule 40, are we to use "true" schedule 40 or Std Wt for 12" and above sizes? Should either selection be seamless? Please note that it will be impossible to furnish "Domestic SS Pipe" in some sizes, particular the large bore sizes. **Standard wt. S/S 316L ASTM-A312/A312M**

22. Regarding Spec. Section 01006, Paragraph 1.7.4.2.1, pg. 4. With the defined construction operation hours of 7:30 AM to 4:00 PM and the Facility Operating Contractor's Staff working hours of 8:00 AM to 4:30 PM, will Hot Work permits be issued on a weekly basis or daily basis (and if daily, can they be issued on the preceding day)? **Weekly Basis**

23. Regarding Spec. Section 01006, Paragraph 1.7.4.2.2, pg. 4. Will any portion of the work for this project be in any areas where acid-resistant Gore-Tex or Nomex Gore-Tex protective clothing will be required to be worn? If so, what is the cost for procuring this safety equipment from the Operating Contractor and for the servicing of same by the Operating Contractor? **Areas around buildings 3019 and 3002 (50' radius) require acid protective clothing $450/pr.**

24. Regarding Spec. Section 01006, Paragraph 1.7.4.2.3, pg.4. Will the new pumps be required to be "on hand" prior to starting the work? **NO.**

25. Regarding Spec. Section 01006, Paragraph 1.7.4.2.6 & Paragraph 1.7.4.2.7, pg. 5. Are we correct in anticipating the Area Entry Permit will be issued by the Operating Contractor simultaneous with the Notice to Proceed? If not, what additional lead time are we to anticipate? **The Area Entry Permit will be issued at the contractor's request prior to mobilizing the site.**

26. Regarding Spec. Section 01006, Paragraph 1.8.4, pg. 7. Are there any services with the area of this project that will require any non project standard work hours? If so, please define. **Tie-ins for filter water ,domestic water, storm sewer, etc.**

27. Regarding Spec. Section 01006, Paragraph 1.7.3, pg. 3 and Section 01111, Paragraph 1.3.2.6, pg. 18. How is the contractor expected to quantify and adequately anticipate the cost and risk associated with the Operating Contractor and/or the US Government not accepting the responsibility for the adequate removal of the explosive manufacturing residue? **This paragraph provides information that propellants and explosives could be encountered and it is the contractor's responsibility to alert his employees to this situation.**

28. Please address testing and disposal of contaminated soils from excavation. **The site has been sampled and is considered a clean site.**

29. Are soil borings available electronically? **Will be made available.**

30. Will the contaminated debris (from demolition of old tanks) be disposed of on RAAP site? **Yes, see amended sheet D2200 for removal requirements.**

31. Will the COE direct the (present) on site contractor to vacate the construction area or will COE delay NTP until he finishes. **The construction contractor will be complete prior to the NTP.**

32. The stainless steel WT beams designated on the structural drawings are not manufactured. We have been in contact with one of our representatives and he informed us that stainless steel beams are not available in the sizes required for this project. The WT's would have to be manufactured out of 2 plates welded together and with the amount of material needed, the cost will be outrageously high. We need to know how to proceed with pricing for this job, so we feel the engineers need to be contacted concerning this matter. **Yes, you are correct, the WT beams will require fabrication.**

33. Also, we have been informed that nuclear welding might be necessary for this job, however, there is no mention of this in the steel specifications. Can you shed any light on this subject? **The welding information is in the specifications.**

34. There is no information in the steel specs as to what type of grating is to be used at the catwalk area. We need to know this in order to get prices from our distributor. There is also no information on the plans or in the specs as to what surface the 5/8" stainless steel plate has. Is this plate smooth or is it checkered or diamond plate? **See specification section 5500A, para. 2.8 and 2.9. Stainless steel plate for tanks is smooth.**

35. Regarding Spec. Section 15200A, Paragraph 2.6.2, pg. 27. This paragraph states "Requirements relative … on the Valve Schedule and Operator Schedule located on the contract drawings." We cannot find the Valve Schedule or the Operator Schedule in the contract drawings. Please provide ASAP. **See general note in amendment.**

36. Regarding Spec. Section 15200A, Paragraph 2.6.3.1, pg. 27. This paragraph has two subparagraphs (b. and c.) which deal with swing check valves of the same size and have different requirements. Which of these subparagraphs is applicable? **See general note in amendment.**

37. Regarding Spec. Section 15200A, Paragraph 2.6.8.1, pg. 31, Paragraph 2.9.6.1.a, pg. 36 and Paragraph 2.9.6.1.b, pg. 36. These paragraphs again make reference to the Valve Schedule. Without this schedule we are unable to adequately obtain pricing for the valves for this project. Please provide ASAP. **See general note in amendment.**

38. Regarding Spec. Section 15200A, Paragraph 3.1.2.3, pg. 39. Reference is made to Section 05093, Welding Pressure Piping. This section is not included in the project specifications. Please provide ASAP. **Specification is provided.**

39. Regarding Spec. Section 15200A, Paragraph 3.2.3, pg. 40. This paragraph states "Additional pipe anchors and flexible couplings beyond those shown on the contract drawings, shall be provided to facilitate piping installation, in accordance with reviewed shop drawings." We were not aware that this was to be a "design/build" project. How are we to anticipate any requirements beyond those shown on the contract drawings? **See paragraph 3.11 and 3.11.1, pipe supports shall meet the requirements of MSS SP-58.**

40. Regarding Spec. Section 15200A, Paragraph 2.3.1.1, pg. 22. This paragraph requires seamless pipe for the A 312 material and does not indicate seamless or ERW for A 814 material. Is seamless definitely required? Delivery of a large quantity of seamless stainless steel pipe will be extremely difficult to obtain in a timely manner. Please respond ASAP. **The piping shall meet A312, allows for seamless & welded pipe.**

41. Drawing M2301 shows a bellows expansion joint on PWW-105-16"-156L-N with the note "Location of Bellows Expansion Joint every 150'". Does this

note also apply to PS-118-6”-156L-N that follows (above) PWW-105-16”-156L-N? **No.**

42. Drawing M2600, Section “C”/M2600/M2600 and Detail 1/M2300/M2300 shows line PS-118-6”-156L-C (insulated for cold) while showing the preceding line (PS-117-6”-156L-N) to be uninsulated and the continuation on Drawing M2300 and M2301 shows line PS-117-6”-156L-N to be uninsulated. Which is correct? **PS-118-6”-156L is not insulated.**

43. Drawing M2100 shows a gravity drain connection to PWW-105-16”-156L-N from line PS-118-6”-156L-N while the orthographic drawing (M2301) does not show this connection. Which is correct? **See drawing C-2201.**

44. Will the new construction need to be completed ,in operation and accepted by the owner before demolition of the existing structures? **See Note #5 on D2300.**

45. To expound further on the previous question, is there any phasing required for this project? **Phasing will be required for tie-in to existing utilities.**

46. Can demo material be dumped at disposal area on plant site? **No**

47. Will acid brick shown on demo drawings be removed by separate contract or by Alliant personnel? **By Contractor, see amended demo sheet.**

48. Do we have to fence in area along PWW concrete trench? **No.**

49. Drwg #S2100 sec A shows settling pit concrete slab thickness as 2’ 6”. Drwg. # S2103 sec A shows it to be 3’ 0”-Which one is correct? **2’-6” is correct.**

50. Drwg #S2200 sec A shows pump pit slab thickness to be 6’ 0”. Drwg. #S2201 sec A shows it to be 3’ 0”. Which one is correct? **2’-6”**

51. Is there any new fence construction? **Yes, on substation**

52. There is no asbestos abatement shown on the drawings, nor is there any asbestos abatement survey, what is the extent of the abatement? Will you be furnishing a survey? **See D2102 roofing material and siding, shingles are asbestos.**

53. Section 2080 para. 1.4.1 Description of Work, states that the contractor will perform a survey and provide unit rates for asbestos removal. Will the survey be paid for as a modification to the contract? Is the cost for the survey to be included with our lump sum bid? Will the unit rates for asbestos removal be paid for by a contract modification? **Sentence has been changed to read as follows: "During initial demolition, the Contractor determine the extent of friable ACM and shall provide a lump sum cost for disposal as a change condition. Preliminary field unsubstantiated analysis indicates mainly non-friable ACM.**

54. There is no specification for lead abatement or lead survey, yet Drawing D2100 states lead removal will be required. Will the contracting office provide a survey or other means to quantify the amount and type of abatement? Will lead abatement be handled as a contract modification? No lead abatement anticipated. **See answer above.**

55. Section 0145A-Contactor Quality Control – Please answer the following questions on this spec section.

    A. Is a Safety and Health Manager required, one is mentioned in para 3.4.1? **See specification 01111.**
    B. If so, what are the qualifications? **See specification 01111.**
    C. Is he required full time and to have no other duties? **See specification 01111.**
    D. There is very little civil work on this project, can civil QC, structural QC and concrete technician be combined into one individual with a civil or structural engineering degree to be full time during all site, concrete and structural work? **Any qualified engineer.**
    E. During what phase of work would an Environmental Engineer be required? **See specification 01355.**
    F. I cannot find the fiberglass lining, is it the coating system required in the concrete tanks? **No** If not, are we required to have the fiberglass lining technician? **The concrete coating system technician.**

57. Dwg. #EX2400 lists Conduit and Cable Schedule E2400, where is this schedule? Dwg #EX2401 lists Conduit and Cable Schedule E2407, where is this schedule? Will these schedules be issued by amendments? **These are the schedules**

58. Are there any soil borings available? Will they be issued by amendment? **Yes**

59.Is the 6" sub-base shown in a detail on Dwg #G0005 to be Portland Cement-Stabilized Sub-base? **No, 21a stone**.

60. Regarding Specification Section 05090, Paragraph 1.3, pg. 330. Reference is made to Alliant Engineering Standard 1CS-15500 entitled "piping Fabrication, Erection and Testing", these are not included in the IFB Documents. If we are to comply with these requirements, please forward a copy ASAP. **Provided by amendment.**

61. Reference Spec. Section 152, Paragraph 2.1.4, pg. 19. The first sentence of this paragraph reads "Ductile iron piping shall be coated with the manufacturer's standard asphaltic coating, …, applied to the outside of pipe and fittings" and continues with "hot-dipped galvanized in accordance with ASTM A 153/A 153M" I do not understand this additional reference to the hot-dipped galvanized. Is the additional reference correct? **This is below grade to above grade connections**.

62. Regarding Spec. Section 15200A, Paragraph 2.3.1.1, pg 22 Specification calls for TP304L, Schedule 40 seamless stainless steel for pipe and the Pipe Schedule on Drawing G0008 indicates TP316L thin wall stainless steel. **Standard wt. S/S 316L ASTM-A312/A312M?**

63. Regarding Spec. Section 15200A, Paragraph 2.9.1.3, pg 33. End connections for 4 inch and larger air and vacuum valves suitable for corrosive services are not specified completely. Please provide the pressure class rating of the flange connections. **150#**

64. Regarding Spec. Section 15200A, paragraph 3.16, pg. 52. Reference is made to a Valve Schedule and Valve Operator Schedule. We cannot find either of these schedules, please provide ASAP. **See amendment**.

STONE & WEBSTER ENGINEERING CORPORATION
CALCULATION SHEET

CALCULATION IDENTIFICATION NUMBER				PAGE 4
JOB ORDER NUMBER	DIVISION & GROUP	CALCULATION N0.	OPTIONAL TASK CODE	
390803	46	5	N/A	

Objective:

Determine the TDH required at the maximum flow rate for the new C line Pump Tank pumps (3058-P1, 3058-P2 & 3058-P3)

Method:

Determine required total discharge head at the maximum flow rate in the new piping system using Darcy equations

Inputs:

Acid wastewater will be removed from the Pump Tank at the rate of 500 gpm.

Acid wastewater is less than 1% acid and can be treated as water at 60 deg F

Pipe is to be 10" SS Schedule 40

Pumps 3058-P1 & 3058-P2 are two 100% pumps set in parallel and will operate one at a time.

A booster pump (3058-P3) will be used to overcome the head produced by the operation of pump 3056-P3 in the forced main.

PUMP SCHEDULE FOR 3058

CALCULATION IDENTIFICATION NUMBER				PAGE 5
JOB ORDER NUMBER	DIVISION & GROUP	CALCULATION N0.	OPTIONAL TASK CODE	
39390803	46	5	N/A	

Body of Calculation

Determine discharge head due to elevation

Lowest point is at pump location	1790 ft asl
Highest point @ building 3026	1837 ft asl
Discharge point	1814.5 ft asl
Net elev. difference (1814.5-1790)	24.5 ft

Discharge head due to friction (Case 1: pumps 3056-P3 and 3056-P4, idle)

Flow	500 gpm
Flow in cubic ft per second	1.114
Pipe Diameter (10" sch 40) *	0.835 ft
Pipe inside area	0.5473 sq. ft
Velocity (flow/area)	2.0354 fps
density	62.3 lbm/cu ft
viscosity	0.0008 lbm ft sec sq
Reynolds No. (density)Dv/(viscosity)	139317
E/D	1.80E-04
f (from Crane Tech. Paper)	0.018

* length of 8" pipe (< 10') is negligible

length of forced main	2000 ft
additional distance to Pump Tank	350 ft

fittings	quantity	k Value
45 el	8	16 f
90 el	30	30 f
gate	1	8 f
globe	1	340 f
tee (turn)	1	60 f
tee (run thru)	2	20 f

sum k = f(8*16+30*30+1*8+1*340+1*60+2*20) = 26.568

Head loss (friction) = (fLv**2(.1863)/d) + ((sum k)(v**2)/(2*g))
= 4.97 ft

This gives the total discharge losses (head loss friction + head loss elev.) as

29.47 ft

CALCULATION IDENTIFICATION NUMBER				PAGE 6
JOB ORDER NUMBER	DIVISION & GROUP	CALCULATION N0.	OPTIONAL TASK CODE	
9390803	46	5	N/A	

Suction Side Losses

Elevation Loss (inlet is 12' below the pump)	12 ft
Frictional Losses (negligible for 12' pipe)	0 ft
Total for suction side	12 ft

Total Dynamic Head (Discharge side + Suction side)	41.47 ft
NPSHA (Ha+Hs-Hf(s)-Hvp) =	21 ft
Water Pressure at Pumps Total Dynamic Head * Density	17.94 psi

Case 2: (CASE 2 IS TO DETERMINE HEAD THAT 3058-P3 IS REQUIRED TO DEVELOP AS THE BOOSTER PUMP FOR 3058-P OR 3058-P2 WHEN 3056-P4 OR 3056-P3 IS OPERATING AND DISCHARGING INTO THE SAME FORCED MAIN)

Flow**	3000 gpm
Flow in cubic ft per second	6.684
Pipe Diameter (10" sch 40) ***	0.835 ft
Pipe inside area	0.5473 sq. ft
Velocity (flow/area)	12.212 fps
density	62.3 lbm/cu ft
viscosity	0.0008 lbm ft sec sq
Reynolds No. (density)Dv/(viscosity)	835901
E/D	1.80E-04
f (from Crane Tech. Paper)	0.0145

**flow of 3000 gpm will cause pump 3056-P1 to drop to approx. 2500 gpm, which is satisfactory.
*** length of 8" pipe (<10') is negligible

Head loss (friction) = 144.05 ft

This gives the total discharge losses (head loss friction + head loss elev.) as

168.55 ft

Total Dynamic Head (Discharge side + Suction side)	180.55 ft

(THEREFORE, THE BOOSTER PUMP MUST PROVIDE THE DIFFERENCE IN CASE 2 AND CASE 1 (TDH) AT 500 GPM)

NPSHA (Ha+Hs-Hf(s)-Hvp) =	62.5 ft
Water Pressure at Pumps Total Dynamic Head * Density	78.11 psi

CALCULATION IDENTIFICATION NUMBER				
JOB ORDER NUMBER	DIVISION & GROUP	CALCULATION N0.	OPTIONAL TASK CODE	PAGE 4
39390803	46	11	N/A	

Objective:

Determine the TDH required at the maximum flow rate for the new boiling tub settling pits pumps (3056-P1 & 3056-P2)

Method:

Determine required total discharge head at the maximum flow rate in the new piping system using Darcy equations

Inputs:

Slightly slurried wastewater will be removed from the boiling tub settling pit at the rate of 500 gpm.

Pumped fluid is less than 2% pulp and therefore can be treated as water. (ref. 4)

Pipe is to be SS Schedule 40

Pumps 3056-P1 and 3056-P2 are parallel 100% pumps which will be running one at a time.

Pumps will be primed with filtered water prior to start-up.

Assumptions:

Fluid is at 80 degF.

CALCULATION IDENTIFICATION NUMBER				PAGE 5
JOB ORDER NUMBER	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	
9390803	46	11	N/A	

Body of Calculation

Determine discharge head due to elevation

Lowest point is at pump location	1790 ft asl
Highest point	1816 ft asl
Discharge point	1816 ft asl
Net elev. difference (1816-1790)	26 ft

Discharge head due to friction

	6 in. pipe	4 in. pipe
Flow	500 gpm	500 gpm
Flow in cubic ft per second	1.114	1.114
Pipe Diameter (sch 40)	0.5054 ft	0.3355 ft
Pipe inside area	0.2005 sq. ft	0.0884 sq. ft
Velocity (flow/area)	5.5558 fps	12.608 fps
density	62.3 lbm/cu ft	62.3 lbm/cu ft
viscosity	0.0008 lbm ft sec sq	0.0008 lbm ft sec sq
Reynolds No. (density)Dv/(viscosity)	230173	346735
E/D	2.97E-04	4.47E-04
f (from Crane Tech. Paper, ref. 2)	0.0175	0.0177

from ref. 1: length of 6" piping 470 ft
length of 4" piping 240 ft

fittings (6")	quantity	k Value
45 el	4	16 f
90 el	3	30 f
mixer fitting (est.)	1	60 f
gate	1	8 f
globe	1	340 f
tee (branch)	1	20 f

sum k = f((#*k)n) = 10.185

Head loss (friction, 6" pipe & fittings) = (fLv**2(.1863)/d) + ((sum k)(v**2)/(2*g))
= 12.68 ft

Discharge subtotal 38.68 ft

CALCULATION IDENTIFICATION NUMBER				
JOB ORDER NUMBER	DIVISION & GROUP	CALCULATION N0.	OPTIONAL TASK CODE	PAGE 6
39390803	46	11	N/A	

fittings (4")	quantity	k Value
45 el	0	16 f
90 el	2	30 f
exit	1	50 f
tee (run)	14	20 f
globe	0	340 f
tee (branch)	1	60 f

sum k = f((#*k)n) = 7.965

Head loss (friction, 4" pipe & fittings) = (fLv**2(.1863)/d) + ((sum k)(v**2)/(2*g))
= 50.90 ft

This gives the total discharge losses (head loss friction + head loss elev.) as
89.58 ft

Suction Side Losses

Elevation Loss (inlet is 10' below the pump) 10 ft

Frictional Losses (negligible for 10' pipe) 0 ft

Total for suction side 10 ft

Total Dynamic Head (Discharge side + Suction side) 99.58 ft

Water Pressure at Pumps

Total Dynamic Head * Density 43.08 psi

NPSHA (Ha+Hs-Hf(s)-Hvp) = 23 ft

CALCULATION IDENTIFICATION NUMBER				PAGE 4
JOB ORDER NUMBER	DIVISION & GROUP	CALCULATION N0.	OPTIONAL TASK CODE	
39390803	46	13	N/A	

Objective:

Determine the TDH required at the maximum flow rate for the new boiling tub settling pits forced main pumps (3056-P3,3056-P4, and 3056-P5)

Method:

Determine required total discharge head at the maximum flow rate in the new piping system using Darcy equations

Inputs:

Acid wastewater will be removed from the boiling tub settling pit at the rate of 3000 gpm (ref. 5), reference coordination meeting SWEC/Hercules 11-30-94

Acid wastewater is less than 1% acid and can be treated as water at 60 deg F

Pipe is to be 10" SS Schedule 40

Pumps 3056-P3 and 3056-P4 are parallel 100% pumps which will be running one at a time.

Pump 3056-P5 will be a pump for flows less than 1000 gpm.

Both pumps operations will be throttled and sequenced to control water hammer.

CALCULATION IDENTIFICATION NUMBER				
JOB ORDER NUMBER	DIVISION & GROUP	CALCULATION N0.	OPTIONAL TASK CODE	PAGE 5
39390803	46	13	N/A	

Body of Calculation

Determine discharge head due to elevation

Lowest point is at pump location	1790 ft asl
Highest point @ building 3026	1837 ft asl
Discharge point	1814.5 ft asl
Net elev. difference (1814.5-1790)	24.5 ft

Discharge head due to friction (case 1: full flow)

Flow	3000 gpm
Flow in cubic ft per second	6.684
Pipe Diameter (10" sch 40)	0.835 ft
Pipe inside area	0.5473 sq. ft
Velocity (flow/area)	12.212 fps
density	62.3 lbm/cu ft
viscosity	0.0008 lbm ft sec sq
Reynolds No. (density)Dv/(viscosity)	835901
E/D	1.80E-04
f (from Crane Tech. Paper, ref. 2)	0.0145
length of forced main, ref. 3	2000 ft
additional distance to new BTSP area	380 ft

fittings	quantity	k Value
45 el	8	16 f
90 el	30	30 f
gate	1	8 f
globe	1	340 f
tee (run thru)	3	20 f

sum k = f(8*16+30*30+1*8+1*340+3*20) 20.822

Head loss (friction) = (fLv**2(.1863)/d) + ((sum k)(v**2)/(2*g))
= 143.91 ft

This gives the total discharge losses (head loss friction + head loss elev.) as

168.41 ft

CALCULATION IDENTIFICATION NUMBER				
JOB ORDER NUMBER	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	PAGE 6
39390803	46	13	N/A	

Suction Side Losses

Elevation Loss (inlet is 10' below the pump)	10 ft
Frictional Losses (negligible for 10' pipe)	0 ft
Total for suction side	10 ft
Total Dynamic Head (Discharge side + Suction side)	178.41 ft

Water Pressure at Pumps

Total Dynamic Head * Density	77.19 psi

Discharge head due to friction (case 2: flow @ 1000 gpm)

Flow	1000 gpm
Flow in cubic ft per second	2.228
Pipe Diameter (10" sch 40)	0.835 ft
Pipe inside area	0.5473 sq. ft
Velocity (flow/area)	4.0707 fps
density	62.3 lbm/cu ft
viscosity	0.0008 lbm ft sec sq
Reynolds No. (density)Dv/(viscosity)	278634
E/D	1.80E-04
f (from Crane Tech. Paper, ref. 2)	0.0162

Head loss (friction) =	17.24 ft	
Head loss (friction + elev.) =	41.74 ft	
Total Dynamic Head (Discharge side + Suction side)		51.74 ft

Water Pressure at Pumps

Total Dynamic Head * Density	22.38 psi
NPSHA (Ha+Hs-Hf(s)-Hvp) =	~~27 ft~~ 23

SECTION 01006
PROJECT WORK REQUIREMENTS AND RESTRICTIONS for RAAP

03/98

PART 1 GENERAL

1.1 DEFINITIONS

The following definitions apply to the sections within this project:

a. Facility: Radford Army Ammunition Plant, Radford, Virginia.

b. CO: Contracting Officer or his designated representative.

c. Plant Operating Contractor or Operating Contractor: Alliant TechSystems Inc.

1.2 REFERENCES

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(1996) U.S. Army Corps of Engineers Safety and Health Requirements Manual

1.3 COOPERATION WITH USING AGENCY AND OTHER CONTRACTORS

During the period of this contract, other contracts may be in force for the construction of other features of work on or adjacent to the site of work being accomplished under this contract. It shall be the responsibility of the Contractor on this contract to be fully informed of the extent of the limits of work to be performed by other Contractors. Should there be any conflict between these limits, it shall be brought to the attention of the CO and the CO's decision shall be final. Also, prior to completion of work under this contract, members of the Using Agency may be performing work or occupying facilities on or adjacent to the area. The Contractor shall arrange his plant and shall schedule and perform this work so as to effectively cooperate with all other Contractors and Government agencies and minimize disruptions to Operating Contractor's operations.

1.4 PERSONNEL RESTRICTIONS

Personnel are limited to the immediate site areas and shall not enter buildings or facilities not involved in the work. All employees of the Contractor will be subject to all rules and regulations of the Facility which pertain to personnel. The Contractor shall erect fences and signs to restrict personnel to the worksite. The Contractor's plans for restricting personnel access to the project site shall be submitted for approval as a part of the SITE SAFETY AND HEALTH PLAN.

1.5 TRANSPORTATION FACILITIES

The facility is served by an all weather surfaced road network. Road(s) within the military reservation proposed to be used by the Contractor shall be subject to prior approval of the Facility authorities and such roads, if used, shall be maintained throughout construction and shall be restored to as good condition as existed prior to their use. The Contractor shall also construct, subject to approval, such temporary haul roads and bridges as

may be necessary for conducting his work. Any such temporary construction shall be removed and the affected area restored to its original condition. All costs for the use of existing transportation facilities, for the construction of temporary facilities, and for maintenance, repair, removal and restoration shall be borne by the Contractor.

1.5.1 Use of Roads Within the Facility

Hard-surfaced roads from U.S. Highways 11 and 460 serve the plant.The movement of all vehicles within the Facility shall be confined to the roads designated and shall comply with traffic regulations within the Facility. Other roads may be used only with the approval of the CO. The Contractor shall keep all roads clear of all obstructions and free of mud and other foreign materials resulting from operations. The Contractor's vehicles shall at no time follow a vehicle closer than 50 feet, and all vehicles shall pull off the road and come to a complete stop when meeting emergency vehicles, vehicles with flashing lights, vehicles escorting heavy equipment. When approaching jeep tractor-trailers from the rear, vehicles shall not pass. Facility speed limits and traffic controls shall be observed.

1.5.2 Rail Service

Railroad shipments may be made by Norfolk Southern Railway directly into Radford Army Ammunition Plant. Such shipments shall be made to Pepper, Virginia.

1.5.3 New River Bridge Limitations

The New River bridge in the Facility has an H-20 live load limit as designated by the American Association of State Highway Officials, and the posted limit shall not be exceeded. Loads wider than 10-1/2 feet or higher than 16 feet shall not be moved over the bridge without prior approval of the CO.

1.5.4 Loading Limitations

Load limit for all roads within the boundaries of the Facility is 8 tons per axle. The Contractor shall not exceed these limits except by prior written approval of the CO.

1.5.5 Cleated Vehicles

Cleated vehicles shall not be moved over surfaced roads except at the immediate site of the area where they are to be used.

1.5.6 Transportation of Personnel Within the Facility

Contractor owned vehicles shall be used to transport workers from the entrance gates to the work sites, be equipped with approved fire extinguisher and first aid kits, and meet all laws and regulations for transporting person(s) on state of Virginia highways. Private owned vehicles shall not be allowed in the Facility area within the security fence. Buses and other approved vehicles used for transport of workers only may be parked overnight inside the gate in the area to be designated at the time of construction.

1.5.7 Vehicle Passes

Only official Contractors' vehicles which are used in the performance of the work will be permitted within the Facility. A vehicle pass will be issued to approved vehicles upon request to the Plant Security Officer. No vehicles shall be allowed to enter the Facility until such permits have been issued.

1.6 COORDINATION IN WORK AREAS

1.6.1 Occupied Work Area

The area where work is to be accomplished will be occupied during the work. The Contractor shall plan, schedule, and execute the work to minimize, to the greatest extent possible, disruptions to Operating Contractor operations. This may require some work to be scheduled for productions shutdowns over July 4th and Christmas. Activities of the occupants of the scheduled work area shall not be interrupted or hampered in any way without prior written approval of the Contracting Officer.

1.6.2 Maintenance of Utilities and Services In Occupied Areas

Active utilities, including but not limited to electricity, gas, water, sewer, heating, air conditioning, or any like service, that will require interruption or replacement in an occupied area affected as a result of the Contractors scheduled work activities, shall be temporarily provided by the Contractor at his own expense until the affected service is fully and permanently restored. The Contractor shall provide any necessary rerouting or temporary bypass of affected pipelines, sewers, or services, or provision of temporary equipment. Temporary method(s) of service replacement the Contractor proposes for use on this contract shall be approved by the Contracting Officer prior to commencing the work.

1.6.3 Hours of Work

The normal work hours for construction shall be from 7:30 a.m. to 4:00 p.m., Monday through Friday of each week. Any request to change these hours shall be made in writing to the Contracting Officer at least two calendar days prior to the desired day on which the change is to go into effect. The changed hours shall not go into effect until written permission has been received from the Contracting Officer.

1.7 SPECIAL RADFORD AAP REQUIREMENTS

1.7.1 Hot Work Permit

Heat or spark producing devices such as welding machines, power actuated anchoring devices, drills, flares, matches, ammunitions, cameras, and flashlights shall not be used either inside or outside working areas until a hot work permit has been issued by the Operating Contractor. Request for hot work permits shall be made in writing to the Contracting Officer not less than five working days prior to the request of the permit. All heat producing devices shall be attended at all times.

1.7.2 Mobile Radio Equipment

The Contractor shall not use any mobile radio equipment within the fenced area of the Facility.

1.7.3 Contaminated Areas

Notice is hereby given that some of the areas in which the work is to be performed may have been used for the processing of explosive materials. The Government does not in any way warrant that the areas are entirely free of all explosives and no representation of any kind whatsoever is made that all explosives have been removed, nor will the Government be liable for any damage to persons or property should any damage be occasioned as a result of any explosive material that may not have been removed. The Contractor will be held responsible for making these facts known to all personnel during the performance of this work.

1.7.4 Security

1.7.4.1 Property Passes

Property passes for the entry and removal of property will be issued by the CO. All materials and tools, including hand tools, must be itemized on the property pass for entry into the Plant, and property to be removed from the Plant must be itemized on a pass signed by a Government representative. Any property to be removed that is not on the pass will not be allowed to be removed.

1.7.4.2 Area Entry Permit

The Contractor shall sign Form RA-603 before Contractor employees will be allowed to enter the Plant area within the security fence. This form will be completed by the OC and a copy of the signed form furnished to the CO.

Requirements to be imposed on Corps of Engineers Contractor:

1. The Corps of Engineers Construction Contractor must have a Hot Work Permit, Form RA-604, specific to the job location to do any welding, burning, grinding or other heat producing work at the job site. The permit is issued by the Operating Contractor and must be maintained at the site of the hot work, unless otherwise agreed. Entry shall not be made into any confined space until a Confined Space Entry Permit has been issued by the Operating Contractor. Operating Contractor Staff normal daylight shift workday hours are 8:00 a.m. to 4:30 p.m. Issuance of any permits will be accomplished during these working hours.

2. The Construction Contractor building site employees and transients must wear hard hats, safety glasses, and steel-toed safety shoes while work is being performed. Acid-resistant Gore-tex or Nomex Gore-tex coveralls, and acid-resistant Gore-tex neck protector on hard hat shall be worn in areas with active acid facilities or pipelines. Flame-retardant cotton coveralls or Nomex Gore-tex coveralls with flame-retardant cotton or Nomex Gore-tex neck protector shall be worn where there is a risk of encountering residual propellant. Coveralls and neck protectors must be purchased from and laundered by the Operating Contractor.

3. The Construction Contractor shall have all equipment and materials for the job on hand prior to starting the work with the exception of concrete. Designated storage area(s) will be reserved, as required, for this purpose.

4. If required, a Building Transfer, Form RA-602, will be issued by the Operating Contractor to transfer existing buildings associated with construction to the construction contractor, prior to commencing work.

5. Blasting will not be permitted on this project.

6. Prior to performing any work including unescorted site visits or inspections, all Construction Contractor personnel or Corps of Engineers representatives are required to obtain permission from the Alliant Techsystems Engineer, the involved Operating Area Supervisor, and an approved Area Entry Permit, Form RA-603.

7. No work will commence prior to the construction contractor's obtaining an Area Entry Permit from the Operating Contractor.

8. All work near buildings which must remain in operation must be accomplished in such a manner that operating personnel can continue operations without interruption or hazard.

Hazards and Communications

1. Some of the work areas have been used for the manufacture of explosive materials that are sensitive to impact, friction or heat sources.

2. The Operating Contractor will clean and provide for a safety inspection of any facilities, prior to their transfer to the Construction Contractor. However, the Operating Contractor does not, in any way, warrant that any buildings will be entirely free of all explosive materials.

3. Construction work will be monitored by the Operating Contractor, and work will be subject to stoppage for further clean-up, if any flammable or explosive materials, acid, or caustic materials are found to be present.

4. Acid fumes are dangerous, if inhaled. The Construction Contractor's employees must be instructed to leave the job site or access route if they observe any acid fumes of any kind (These can be red, yellow or white). If any Construction Contractor employee inhales fumes of any kind, that individual should immediately report to the Plant Hospital, (Building 205, near Gate 1). These and other chemical site hazards which the A/E or Construction Contractor might encounter at work sites or along access routes are included in Section 01111.

5. The contractor shall comply with the Operating Contractor's plant safety regulations, OSHA and the Corps of Engineers' Manual EM 385-1-1, June 1977.

6. The contractor shall permit inspection of work at any time during progress by representatives of RAAP's Administrative Contracting Officer (ACO).

1.7.4.3 Notification Letter

Within 5 calendar days after receipt of Notice to Proceed the Contractor shall forward a letter through the Area Engineer, Southwestern Virginia Area Office, Norfolk District, Corps of Engineers, Radford, Virginia 24141, to the plant security officer (Commander, Radford Army Ammunition Plant, ATTN: SMARF-RM-SE, Radford, Virginia 24141) providing general data about the project. Required information is shown in the following "INITIAL CONTRACTOR REPORT". Significant changes will be reported as they occur and

documented as a part of the Daily Report.

INITIAL CONTRACTOR REPORT

* ON SITE SUPERINTENDENT

* LOCAL ADDRESS

* LOCAL TELEPHONE NUMBER

* WORK AREA/BUILDING

* BRIEF DESCRIPTION OF WORK

* NUMBER OF PERSONNEL EMPLOYED ON PROJECT (approx.)

* LENGTH OF CONTRACT

* SUBCONTRACTORS

* NORMAL WORKING HOURS

* LOCATION OF OFFICE TRAILER(S) ON PLANT (if any)

* Changes in this information will be reported in the Daily Report of operations as they occur.

1.7.4.4 Daily Report

A daily report shall be provided by the Contractor which shall indicate which employees are working that day and what area/building they will be working in. This report shall be provided to the Security Department, Badge and Decal Section (Building 229), not later than 8:00 a.m. daily. Contractors shall document in the Daily Report and notify the Security Department whenever they have personnel working in an area before or after their regularly established working hours. Any request to work at other than regularly established hours may require using a gate not normally open at that time. The request shall be in writing and will be processed through the plant security office at least 24 hours prior to performance of the work. A copy of the approved request shall be furnished to the Contracting Officer and noted in the Daily Report of operations. The operating Contractor will have its Security Department check work sites periodically to verify the accuracy of the daily reports provided by the Contractor.

1.8 INTERRUPTIONS OF UTILITIES

1.8.1 Approval

Utility services shall not be interrupted by the Contractor to relocate, make connections, or interrupt for any purpose, without written approval of the Contracting Officer.

1.8.2 Request

Request for permission to shut down services shall be submitted in writing to the Contracting Officer not less than 14 calendar days prior to date of proposed interruption. The request shall give the following information:

a. Nature of Utility (Gas, L.P. or H.P., Steam, Water, Elec.)

b. Size of line and location of shutoff.

c. Buildings and services affected.

d. Hours and date of shutoff.

e. Estimated length of time service will be interrupted.

1.8.3 Service Interruptions

Services shall not be shut off until receipt of approval of the proposed h ours and date from the Contracting Officer.

1.8.4 Timely Disconnections

Shutoffs which will cause interruption of Government work operations as determined by the Contracting Officer shall be accomplished during regular non-work hours or non-work days of the Using Agency without any additional cost to the Government.

1.8.5 Utilities Operation

Operation of valves on water mains will be by operating contractor personnel. Where shutoff of water lines interrupts service to fire hydrants or fire sprinkler systems, the Post Fire Department shall be notified by the Contractor in writing 10 days prior to the proposed interruption. The Contractor shall arrange his operations and have sufficient material and personnel available to complete the work without undue delay and shall restore service without delay in event of emergency.

1.8.6 Gas

Flow in gas mains which have been shut off shall not be restored until the Government inspector has determined that all items serviced by the gas line have been shut off.

1.9 PHYSICAL DATA

The physical conditions indicated on the drawings and in the specifications are the result of site visits, surveys and borings.

1.10 TIME EXTENSIONS FOR UNUSUALLY SEVERE WEATHER

This provision 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:

a. 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.

b. 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.

1.10.1 Schedule

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
11	9	9	6	8	8	9	7	6	5	6	10

1.10.2 Records

Upon acknowledgement of the Notice to Proceed 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.

1.10.3 Impacted Days

The number of actual adverse weather 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 in each month, and be recorded as full days. If the number of actual adverse weather delay days exceeds the number of days anticipated in the schedule of monthly anticipated adverse weather delays, 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 Clauses entitled "Default (Fixed Price Construction)".

1.11 SITE CONTAMINATION

This site is designated a Category III site and is defined as a site which is located in an area known or suspected to be contaminated.

1.11.1 Compliance Requirements

The Contractor shall comply with applicable Federal, state and local laws, codes, ordinances and regulations (including the obtaining of licenses and permits) in connection with any hazardous material, substance or waste. In addition, the Contractor shall comply with all applicable requirements of 29 CFR Part 1910, Section 1910.119(h)(3), which pertain to established responsibilities of Contract or Employers in Process Safety Management.

1.11.2 Requirements

The requirements of this clause and any act or failure to act by the Government shall not relieve the Contractor of any responsibility or liability for the safety of Government, Contractor or subcontractor personnel or property.

1.11.3 Contamination

In the event that contamination is encountered, the Contracting Officer shall be advised immediately for further instructions. Unless otherwise notified, the Contractor shall not be responsible for removing the contamination. Alliant Techsystems, the Operating Contractor, shall remove all contamination. The Operating Contractor shall be notified by the Contracting Officer to proceed with the necessary removal procedures.

1.12 WORK IN QUARANTINED AREA

The work called for by this contract involves activities in counties quarantined by the Department of Agriculture to prevent the spread of certain plant pests which may be present in the soil. The Contractor agrees that all construction equipment and tools to be moved from such counties shall be thoroughly cleaned of all soil residues at the construction site with water under pressure and that hand tools shall be thoroughly cleaned by brushing or other means to remove all soil. In addition, if this contract involves the identification, shipping, storage, testing, or disposal of soils from such a quarantined area, the Contractor agrees to comply with the provisions of ER 1110-1-5 and attachments, a copy of which will be made available by the Contracting Officer upon request. The Contractor agrees to assure compliance with this obligation by all subcontractors.

1.13 HISTORICAL AND ARCHAEOLOGICAL FINDS

Federal legislation provides for the protection, preservation, and collection of scientific, prehistorical, historical, and archaeological data, including relics and specimens which might otherwise be lost due to alteration of the terrain or building features as a result of any Federal construction project. Should the Contractor, or any of the Contractor's employees, or parties operating or associated with the Contractor, in the performance of this contract discover evidence of possible scientific, prehistorical, historical, or archaeological data, the Contractor shall immediately cease work at that location and notify the Contracting Officer, giving the location and nature of the findings. The Contractor shall forward written confirmation to the Contracting Officer as directed. The Contractor shall exercise care so as not to disturb or damage artifacts or fossils uncovered during excavation operations, and shall provide such cooperation and assistance as may be necessary to preserve the findings for removal or other disposition. Any person who, without permission, injures, destroys, excavates, appropriates, or removes any historical or prehistorical artifact, object of antiquity, or archaeological resource on the public lands of the United States is subject to arrest and penalty of law. Where appropriate by reason of discovery, the Contracting Officer may order delays in the time of performance or changes in the work, or both. If such delays or changes are ordered, an equitable adjustment will be made in the contract in accordance with the applicable clauses of the contract.

1.14 EQUIPMENT-IN-PLACE LIST:

The Contractor shall maintain a current copy of equipment installed under the terms of the contract. In the event that the contract includes more than one building or facility, a list must be maintained for each and delivered to the Contracting Officer upon acceptance of each building or facility. Forms to be used for this purpose shall be obtained from the Area Engineer's Office. The list shall include the following:

a. Contract number
b. Description of item
c. Model number
d. Serial number
e. Capacity
f. Name of manufacturer
g. Address of manufacturer
h. Condition of item
i. Replacement cost
j. Name of person who checked item

1.15 EQUIPMENT OWNERSHIP AND OPERATING EXPENSE SCHEDULE

1.15.1 Allowable Costs

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 when the Government can determine both ownership and operating costs for each piece of equipment or equipment groups of similar serial and series from the Contractor's accounting records. When both ownership and operating costs cannot be determined from the Contractor's accounting records, equipment costs shall be based upon the applicable provisions of EP 1110-1-8, "Construction Equipment Ownership and Operating Expense Schedule," Region II. 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 used or a rate 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.

1.15.2 Rental Costs

Equipment rental costs are allowable, subject to the applicable provisions of the Federal Acquisition Regulations, and shall be substantiated by certified copies of paid invoices. Rates for equipment rented from an organization under common control, lease-purchase or sale-leaseback arrangements will be determined using the schedule except that rental costs leased form an organization under common control that has an established practice of leasing the same or similar equipment to unaffiliated lessees are allowable. Costs for major repairs and overhaul are unallowable.

1.15.3 Equipment Costs

When actual equipment costs are proposed and the total amount of the pricing action is over $25,000, cost or pricing data shall be submitted on the Standard Form 1411, "Contract Pricing Proposal Cover Sheet". By submitting cost or pricing data, the Contractor grants to the Contracting Officer or an authorizing representative the right to examine those books, records, documents and other supporting data that will permit evaluation of the proposed equipment costs. After price agreement the Contractor shall certify that the equipment costs or pricing data submitted are accurate, complete and current.

1.16 SUBCONTRACTS AND WORK COORDINATION

Contract Clauses "SUBCONTRACTS", "PERMITS AND RESPONSIBILITIES", and

"MATERIAL AND WORKMANSHIP" are supplemented as follows:

a. Divisions or sections of specifications are not intended to control the Contractor in dividing the work among subcontractors, or to limit work performed by any trade.

b. Contractor shall be responsible for coordination of the work of the trades, subcontractors, and materials.

c. The Government or its representative will not undertake to settle any difference between the Contractor and Contractor's subcontractors, or between subcontractors.

d. The Government reserves the right to refuse to permit employment on the work or require dismissal from the work of any subcontractor who, by reason of previous unsatisfactory work on Corps of Engineers projects, or for any other reason is considered by the Contracting Officer to be incompetent or otherwise objectionable.

1.17 CONSTRUCTION MANPOWER AND EQUIPMENT REPORT

The Contractor shall submit executed CENAO Form 987, Construction Manpower and Equipment Report daily. The report shall include manpower and equipment for the general and subcontractors. Forms are available from the Contracting Officer.

1.18 PURCHASE ORDERS

To ensure proper expediting of orders the Contractor and his subcontractors shall furnish to the Contracting Officer, one copy of each purchase order covering supplies or services required for performance of the work. Each purchase order shall clearly indicate the date of placement, the date delivery is required in order to avoid delay in the scheduled progress of the work, and the date delivery is promised by the supplier or producer. Copies of purchase orders shall be forwarded on the date issued.

1.19 PROFIT

1.19.1 Weighted Guidelines

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		
Relative difficulty of work	15		
Size of Job	15		
Period of performance	15		
Contractor's investment	05		
Assistance by Government	05		
Subcontracting	25		
	100		

1.19.2 Value

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 totalled indicates the fair and reasonable profit percentage under the circumstances of the particular procurement.

1.19.2.1 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.

1.19.2.2 Relative Difficulty of Work

It 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.

1.19.2.3 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.

1.19.2.4 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.

1.19.2.5 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.

1.19.2.6 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.

1.19.2.7 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.

PART 2 PRODUCTS (This Part Not Used)

PART 3 EXECUTION(This Part Not Used)

-- End of Section --

SECTION 01111
SAFETY AND HEALTH REQUIREMENTS
03/98

PART 1 GENERAL

The Contractor shall train all on site personnel to the requirements of this section.

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.

ENGINEERING MANUALS (EM)

EM 385-1-1	(1996) Safety and Health Requirements Manual

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910	Occupational Safety and Health Standards, General Industry.
29 CFR 1926	Occupational Safety and Health Standards, Construction Industry.

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL DESCRIPTIONS:

SD-01 SD Data

Safety and Health Plan(Accident Prevention Plan); GA.

1.3 SAFETY REQUIREMENTS AND ACCIDENT PREVENTION

1.3.1 l Standards

The Contractor shall comply with Occupational Safety and Health Act (OSHA) Standards, the Corps of Engineers Manual EM 385-1-1, "Safety and Health Requirements Manual," NFPA 101, and state, local, and facility safety requirements.

1.3.2 Information

1.3.2.1 General Information

a. Ammonia: Located in the Acid Area of the plant are large quantities of anhydrous ammonia. Ammonia is a colorless gas which in large quantities is extremely toxic and can be lethal. In the event of an ammonia spill, a warning of repeated 3 short blasts will be sounded on the Powerhouse whistle. If this alert is sounded, take note of your location in relation

to the Acid Area and the wind direction. (Wind direction can be determined by observing the wind sock atop the AOP Tower in the Acid Area.) Staying upwind of the Acid Area, proceed to your designated assembly location and account for all employees and visitors. Remaining upwind and away from the Acid Area, proceed to the nearest exit from the plant. Before exiting the plant, inform Security and the assigned Alliant Techsystems Engineer of your situation. This is necessary for an accounting of all personnel on plant. The MSDS for ammonia will be discussed at the preconstruction meeting and included in the safety information presented to the Contractor.

b. Nitric Oxides, Nitrogen Oxides (NO, NO2): The Acid Area produces and stores large quantities of nitric acid. In abnormal circumstances these operations can discharge nitric and nitrogen oxides which are hazardous materials. In the event a yellowish or orange discharge of fumes is observed emanating from the Acid Area and traveling in the direction of your work site, take note of the wind direction. (Wind direction can be determined by observing the wind sock atop the AOP tower in the Acid Area.) Staying upwind of the Acid Area arid flume cloud proceed to your designated assembly location or designated alternative assembly location and account for all employees and visitors. Remaining upwind and away from the Acid Area and flume cloud, proceed to the nearest exit from the plant. Some effects of over exposure can be delayed. Therefore, any exposure shall be reported. Before exiting plant property, inform Security and the assigned Contracting Officer of your personnel situation and location. This is necessary for safety and an accounting of all personnel on plant. The MSDS for nitric and nitrogen oxides will be discussed at the preconstruction meeting and included in the safety information presented to the Contractor.

c. Assembly Location: Prior to start of work, an assembly location shall be established. In the event of an incident, all Contractor personnel shall immediately proceed to the assigned assembly location. Contractor's supervision shall account for all personnel. Any problems or questions shall be presented to the Alliant Techsystems Engineer. If the incident doesn't involve the general area of the work site, and there are no problems, work may resume. If the incident does involve the general area of the work site, the Contractor shall report to Security and the Alliant Techsystems Engineer and leave the plant.

1.3.2.2 Reporting Requirements

a. Contractor shall report all injuries incurred on plant within 24 hours of this occurance.

b. Contractor shall provide monthly a copy of the OSHA 200 Log that includes injuries requiring such reporting.

1.3.2.3 Safety Precautions: The Contractor shall adhere strictly to the following safety precautions. In addition, the Contractor shall assure compliance by all lower-tier Contractors and visitors on the job site.

a. Contractor shall, while on plant site, observe all Alliant Techsystems safety regulations as noted in the booklet "Safety Rules for Contractors and Contractors" and all applicable OSHA requirements. Strict compliance with confined space control and entry requirements is mandatory. Note that work will be accomplished in a below-grade basin.

b. Monthly safety meetings shall be conducted for all workers on site. Copies of the minutes and attendance sheets shall be submitted to the CO

Representative the first week of each month.

c. The Contractor will not be permitted to operate any internal combustion engine within or permit his employees to work within, fifty feet (50') of any explosive operating building.

d. The Contractor shall exercise necessary safety precautions to provide safe working conditions for his employees, including providing and requiring the use of protective hard hats, steel-toed safety shoes, safety glasses, breathing protection, and protective clothing in accordance with EM 385-1-1.

e. Under no circumstances shall the Contractor allow his employees to enter a building unless the Alliant Techsystems Engineer has given specific permission to do so.

f. No work shall be performed from or with aerial man lifts or other cranes or lifting devices in the vicinity of energized electrical circuits. The Contractor shall have Alliant Techsystems de-energize all power circuits in the vicinity as necessary, prior to commencing work.

g. The Contractor shall furnish and be responsible for the structural soundness and safe condition of all scaffolding and ladders, which might be necessary and are used during the performance of this Contract.

h. The Contractor will not be allowed to support ladders and scaffolding upon or against any machinery, equipment, or pipes nor upon or against any unsafe or unstable object.

i. Individuals shall use an approved safety harness and lifeline when performing work on elevated surfaces. Lifelines shall be attached to a fixed object. In lieu of lifelines, other approved OSHA Standards such as scaffolding, ladders, or aerial lifts will be acceptable.

1.3.2.4 Safety Precautions

The Construction Contractor shall make each of his personnel aware of the potential hazards of the project and shall emphasize to each the importance of safe practices.

General

1. The Construction Contractor shall submit Material Safety Data Sheets (MSDS) for material to be used in this Contract (except for material listed as previously approved). The material must be approved for use by the Radford Army Ammunition Plant Toxicity Review Board, based on information in the MSDS, prior to bringing the material on plant.

2. Prior to the start of increments of this project and prior to the issuance of specific permits, The Operating Contractor will review the specific operations and may require additional precautions.

3. Under no circumstances shall the Construction Contractor allow his employees to enter any area not involved in the work unless the Operating Contractor has provided the Construction Contractor with an approved, written permit to do so. Some of the facilities involved must remain in operation for the duration of

this Contract, and the Construction Contractor shall not interfere with the normal operations of these facilities.

Specific Process Hazards

Within the project areas and along access routes are ammonia, acid, alcohol and other solvents, caustic, petroleum, compressed air, steam, water and other process pipelines and storage tanks, and electrical lines. The Construction Contractor shall take the necessary precautions to prevent damage to these and any other utility or supply lines while working in the area. Entry into any dikes or pits without an approved confined space entry permit is prohibited and could be fatal. The Construction Contractor shall take the necessary precautions to avoid injury to his personnel in the event of damage to pipelines or vessels, or contact with these chemicals.

Applicable portions of the Operating Contractor's (i.e., Alliant Techsystems) area emergency action plans will be reviewed in the pre-construction safety conference. Information on hazardous chemicals from the Hazard Communication Physical Data and First Aid section of the RFAAP Hazardous Material Emergency Response Plan is furnished as Appendix A of this Section. The hazards at the immediate work sites at the various building accounts are the tank contents as listed in the Radford Tank Database and as reviewed/provided by ATK at pre-work safety meetings, and as confirmed by the designer in field investigations.

Safety Equipment

The Construction Contractor's personnel shall properly wear hard hats, safety glasses with side shields, and hard toed safety shoes at all time on site. Acid-resistant Gore-tex or Nomex Gore-tex coveralls, and acid-resistant Gore-tex neck protector on hard hat shall be worn in areas with active acid facilities or pipelines. Flame-retardant cotton coveralls or Nomex Gore-tex coveralls with flame-retardant cotton or Nomex Gore-tex neck protector shall be worn where there is a risk of encountering residual propellant. Coveralls and neck protectors must be purchased from and laundered by the Operating Contractor.

Safety Reports

1. The Construction Contractor shall advise the Contracting Officer's Representative who will in turn advise Alliant Techsystems of any unique hazards presented by the Contractor's work, or of any hazards found by the Contractor's work.

2. The Construction Contractor shall report all the injuries incurred by the Contractor or its Subcontractors on plant site (RFAAP) within 24 hours of their occurrence to the COR who in turn shall notify Alliant Techsystems contact, and shall provide a monthly OSHA 200 Log which includes all injuries requiring such recording on a monthly basis.

3. The Construction Contractor shall submit a copy of documentation of training of Subcontractor's employees required by 29 CFR 1910.119(h)(3)(iii).

1.3.2.5 Scheduling of Work

An area entry permit (Form RA-603) will be executed authorizing the Construction Contractor to work in the specified areas. The Construction Contractor will be required to accomplish the work in phases, sometimes with the subject acid sewer line remaining in service.

1.3.2.6 Explosive Contents

Notice is hereby given that some of the facilities in and around which some of the work is to be performed have been used for the manufacture of propellants and explosives.

A. The Operating Contractor does not, in any way, warrant that the facilities or acid sewer lines are entirely free of explosives. No representation of any kind is made that all explosives have been removed and the Government will not be liable for any damage or injury to persons or property should any damage or injury occur as a result of any explosive material that may not have been removed.

B. Concealed cavities, such as in pores and cracks of concrete, joints of sewer lines, and in joints between wooden boards of manhole sewer plugs which will be exposed during the course of demolition, alteration, and construction have, in the past, been found to contain explosive material which cannot be removed prior to exposure of the cavity. Therefore, the Construction Contractor shall at all times keep all work areas and adjacent surfaces of structures and facilities saturated with water during demolition, minimize impact blows to existing structures, and minimize the use of spark or heat producing tools during demolition.

C. If, at any time during the performance of this work, the Construction Contractor finds any explosive material, whether real or perceived, he shall immediately:

1. Cease work of all types and evacuate the area.

2. Notify the COR who in turn will notify the designated Operating Contractor's Area Supervision and Engineer in charge.

D. The Construction Contractor agrees to make these facts and procedures known to all persons working under his supervision and/or jurisdiction and agrees to be liable for failure to make such notice.

1.4 SAFETY AND HEALTH PLAN

1.4.1 Preparation and Implementation

An Accident Prevention Plan (APP) shall be prepared covering onsite work to be performed by the Contractor and all subcontractors. The Safety and Health Manager shall be responsible for the development, implementation and oversight of the APP. The APP shall establish, in detail, the protocols necessary for the anticipation, recognition, evaluation, and control of hazards associated with each task performed. The APP shall address general safety and health requirements and procedures. The level of detail provided in the APP shall be tailored to the type of work, complexity of operations to be performed, and hazards anticipated. Details about some activities may not be available when the initial APP is prepared and

submitted. Therefore, the APP shall address, in as much detail as possible, anticipated tasks, their related hazards and anticipated control measures.

1.4.2 Acceptance and Modifications

Prior to submittal, the APP shall be signed and dated by the Contractor's Safety and Health Manager and the Site Superintendent. The APP shall be submitted for review at least 10 days prior to the Prework Safety Conference. Deficiencies in the APP will be discussed at the Prework Safety Conference, and the APP shall be revised to correct the deficiencies and resubmitted for acceptance. Onsite work shall not begin until the plan has been accepted. A copy of the written APP shall be maintained onsite. As work proceeds, the APP shall be adapted to new situations and new conditions. Changes and modifications to the accepted APP shall be made with the knowledge and concurrence of the Safety and Health Manager, the Site Superintendent, and the Contracting Officer. Should any unforeseen hazard become evident during the performance of the work, shall bring such hazard to the attention of the Safety and Health Manager, the Site Superintendent, and the Contracting Officer, both verbally and in writing, for resolution as soon as possible. In the interim, necessary action shall be taken to re-establish and maintain safe working conditions in order to safeguard onsite personnel, visitors, the public, and the environment. Disregard for the provisions of this specification or the accepted APP shall be cause for stopping of work until the matter has been rectified to the satisfaction of the Contracting Officer.

1.4.3 Availability

The APP shall be made available in accordance with EM 385-1-1

1.4.4 Corps of Engineers Standards

Corps of Engineers (COE) Manual EM 385-1-1, referred to in "ACCIDENT PREVENTION" article of Contract Clauses, is hereby supplemented or revised as follows:

1.4.5 Conflicts

When a conflict exists between the Corps of Engineers Safety and Health Requirements Manual, other safety requirements, or the contract plans and/or Specifications, the most stringent requirement shall prevail. (NAOSA 5 FEB 87).

1.4.6 Front End Loader - Backhoe Machines

1.4.6.1 Non-compliance Safety Check

All front end loader-backhoe machines and other machines, such as tractors that utilize a backhoe attachment, shall be checked for:

a. Exposed backhoe boom swing foot pedals.

b. Backhoe boom swing lever which can be reached by a man standing on the ground or on the outrigger support bracket.

1.4.6.2 Correction and Fabrication of Non-compliance Safety Items

Where these conditions exist, guards shall be fabricated to:

a. Cover over exposed foot pedals to prevent someone from accidentally stepping on them.

b. Inclose the swing lever so as to preclude operation from the ground or from the outrigger support bracket.

1.4.7 Attendance at Safety Meetings

In order to allow for maximum attendance at weekly tool box meetings and monthly supervisor meetings by Corps of Engineers personnel, the Contractor shall advise the CO's Office, a minimum of 48 hours before the start of each meeting, of the date, time and location of Safety Meetings.

1.4.8 Minutes of Safety Meetings

Minutes shall be prepared by the Contractor and forwarded to the Contracting Officer by close of business the next work day.

1.4.9 Protective Footwear

Protective footwear as defined by American National Standards Institute Z41 shall be worn by all working personnel on site.

1.4.10 Ground Fault Circuit Interrupters (GFCI)

GFCI's are required for work on this contract in accordance with EM 385-1-1. GFCI's are also required when using electric power extension cords.

1.4.11 Crawler-, Truck-, and Wheel-Mounted Cranes

Implementation of paragraph (16.D.01.eC1) shall include the following:

a. When a crane is performing duty cycle work (such as clamshell, dragline, grapple, or pile driving) it does not require anti-two block equipment. If the crane is required to make a non-duty cycle lift (for example, to lift a piece of equipment, a tool box, or supplies), it will be exempt from the anti-two block equipment requirements if the following procedures are implemented:

(1) an international orange warning device (warning flag, warning tape, or warning ball) is properly secured to the hoist line at a distance of 8 to 10 feet above the hoist rigging;

(2) the signal person (or an individual designated as the signalperson) acts as a spotter to alert the crane operator with a "STOP" signal when the warning device approaches the boom tip and the crane operator ceases hoisting functions when alerted of this; and

(3) while the non-duty cycle lift is underway, the signal person shall not stand under the load, shall have no duties other than signalperson, and shall comply with the signaling requirements of EM 385-1-1;

b. Anti-two block devices are always required when hoisting personnel by crane or derrick.

1.4.12 Safety Indoctrination Certificates

The Contractor shall obtain from each of his employees, prior to his employment at the Radford Army Ammunition Plant, a signed certificate indicating that the employee has read and understands a statement prepared by the Plant Commander setting forth the hazards and restrictions incident to construction operations in buildings used for powder production. The certificates shall be delivered to the CO on the first day the employee is admitted to the Radford Army Ammunition Plant.

PART 2 PRODUCTS (This Part Not Used)

PART 3 EXECUTION (This Part Not Used)

-- End of Section --

SECTION 01312A

QUALITY CONTROL SYSTEM (QCS)
08/01

PART 1 GENERAL

1.1 Resident Management System for Windows (RMS)

The Government will use the Resident Management System for Windows (RMS) to assist in its monitoring and administration of this contract. The Contractor shall use the Government-furnished Construction Contractor Module of RMS, referred to as QCS, to record, maintain, and submit various information throughout the contract period. This joint Government-Contractor use of RMS and QCS will facilitate electronic exchange of information and overall management of the contract. QCS provides the means for the Contractor to input, track, and electronically share information with the Government in the following areas:

Administration
Finances
Quality Control
Submittal Monitoring
Scheduling
Import/Export of Data

1.1.1 Correspondence and Electronic Communications

For ease and speed of communications, both Government and Contractor will, to the maximum extent feasible, exchange correspondence and other documents in electronic format. Correspondence, pay requests and other documents comprising the official contract record shall also be provided in paper format, with signatures and dates where necessary. Paper documents will govern, in the event of discrepancy with the electronic version.

1.1.2 Other Factors

Particular attention is directed to Contract Clause, "Schedules for Construction Contracts", Contract Clause, "Payments", Section 01320A, PROJECT SCHEDULE, Section 01330, SUBMITTAL PROCEDURES, and Section 01451A, CONTRACTOR QUALITY CONTROL, which have a direct relationship to the reporting to be accomplished through QCS. Also, there is no separate payment for establishing and maintaining the QCS database; all costs associated therewith shall be included in the contract pricing for the work.

1.2 QCS SOFTWARE

QCS is a Windows-based program that can be run on a stand-alone personal computer or on a network. The Government will make available the QCS software to the Contractor after award of the construction contract. Prior to the Pre-Construction Conference, the Contractor shall be responsible to download, install and use the latest version of the QCS software from the Government's RMS Internet Website. Upon specific justification and request by the Contractor, the Government can provide QCS on 3-1/2 inch high-density diskettes or CD-ROM. Any program updates of QCS will be made available to the Contractor via the Government RMS Website as they become

available.

1.3 SYSTEM REQUIREMENTS

The following listed hardware and software is the minimum system configuration that the Contractor shall have to run QCS:

Hardware

IBM-compatible PC with 200 MHz Pentium or higher processor

32+ MB RAM

4 GB hard drive disk space for sole use by the QCS system

3 1/2 inch high-density floppy drive

Compact disk (CD) Reader

Color monitor

Laser printer compatible with HP LaserJet III or better, with minimum 4 MB installed memory.

Connection to the Internet, minimum 28 BPS

Software

MS Windows 95 or newer version operating system (MS Windows NT 4.0 or newer is recommended)

Word Processing software compatible with MS Word 97 or newer

Internet browser

The Contractor's computer system shall be protected by virus protection software that is regularly upgraded with all issued manufacturer's updates throughout the life of the contract.

Electronic mail (E-mail) compatible with MS Outlook

1.4 RELATED INFORMATION

1.4.1 QCS User Guide

After contract award, the Contractor shall download instructions for the installation and use of QCS from the Government RMS Internet Website; the Contractor can obtain the current address from the Government. In case of justifiable difficulties, the Government will provide the Contractor with a CD-ROM containing these instructions.

1.4.2 Contractor Quality Control(CQC) Training

The use of QCS will be discussed with the Contractor's QC System Manager during the mandatory CQC Training class.

1.5 CONTRACT DATABASE

Prior to the pre-construction conference, the Government shall provide the Contractor with basic contract award data to use for QCS. The Government will provide data updates to the Contractor as needed, generally by files attached to E-mail. These updates will generally consist of submittal reviews, correspondence status, QA comments, and other administrative and QA data.

1.6 DATABASE MAINTENANCE

The Contractor shall establish, maintain, and update data for the contract in the QCS database throughout the duration of the contract. The Contractor shall establish and maintain the QCS database at the Contractor's site office. Data updates to the Government shall be submitted by E-mail with file attachments, e.g., daily reports, schedule updates, payment requests. If permitted by the Contracting Officer, a data diskette or CD-ROM may be used instead of E-mail (see Paragraph DATA SUBMISSION VIA COMPUTER DISKETTE OR CD-ROM). The QCS database typically shall include current data on the following items:

1.6.1 Administration

1.6.1.1 Contractor Information

The database shall contain the Contractor's name, address, telephone numbers, management staff, and other required items. Within 14 calendar days of receipt of QCS software from the Government, the Contractor shall deliver Contractor administrative data in electronic format via E-mail.

1.6.1.2 Subcontractor Information

The database shall contain the name, trade, address, phone numbers, and other required information for all subcontractors. A subcontractor must be listed separately for each trade to be performed. Each subcontractor/trade shall be assigned a unique Responsibility Code, provided in QCS. Within 14 calendar days of receipt of QCS software from the Government, the Contractor shall deliver subcontractor administrative data in electronic format via E-mail.

1.6.1.3 Correspondence

All Contractor correspondence to the Government shall be identified with a serial number. Correspondence initiated by the Contractor's site office shall be prefixed with "S". Letters initiated by the Contractor's home (main) office shall be prefixed with "H". Letters shall be numbered starting from 0001. (e.g., H-0001 or S-0001). The Government's letters to the Contractor will be prefixed with "C".

1.6.1.4 Equipment

The Contractor's QCS database shall contain a current list of equipment planned for use or being used on the jobsite, including the most recent and planned equipment inspection dates.

1.6.1.5 Management Reporting

QCS includes a number of reports that Contractor management can use to track the status of the project. The value of these reports is reflective

of the quality of the data input, and is maintained in the various sections of QCS. Among these reports are: Progress Payment Request worksheet, QA/QC comments, Submittal Register Status, Three-Phase Inspection checklists.

1.6.2 Finances

1.6.2.1 Pay Activity Data

The QCS database shall include a list of pay activities that the Contractor shall develop in conjunction with the construction schedule. The sum of all pay activities shall be equal to the total contract amount, including modifications. Pay activities shall be grouped by Contract Line Item Number (CLIN), and the sum of the activities shall equal the amount of each CLIN. The total of all CLINs equals the Contract Amount.

1.6.2.2 Payment Requests

All progress payment requests shall be prepared using QCS. The Contractor shall complete the payment request worksheet and include it with the payment request. The work completed under the contract, measured as percent or as specific quantities, shall be updated at least monthly. After the update, the Contractor shall generate a payment request report using QCS. The Contractor shall submit the payment requests with supporting data by E-mail with file attachment(s). If permitted by the Contracting Officer, a data diskette may be used instead of E-mail. A signed paper copy of the approved payment request is also required, which shall govern in the event of discrepancy with the electronic version.

1.6.3 Quality Control (QC)

QCS provides a means to track implementation of the 3-phase QC Control System, prepare daily reports, identify and track deficiencies, document progress of work, and support other contractor QC requirements. The Contractor shall maintain this data on a daily basis. Entered data will automatically output to the QCS generated daily report. The Contractor shall provide the Government a Contractor Quality Control (CQC) Plan within the time required in Section 01451A, CONTRACTOR QUALITY CONTROL. Within seven calendar days of Government acceptance, the Contractor shall submit a data diskette or CD-ROM reflecting the information contained in the accepted CQC Plan: schedule, pay activities, features of work, submittal register, QC requirements, and equipment list.

1.6.3.1 Daily Contractor Quality Control (CQC) Reports.

QCS includes the means to produce the Daily CQC Report. The Contractor may use other formats to record basic QC data. However, the Daily CQC Report generated by QCS shall be the Contractor's official report. Data from any supplemental reports by the Contractor shall be summarized and consolidated onto the QCS-generated Daily CQC Report. Daily CQC Reports shall be submitted as required by Section 01451A, CONTRACTOR QUALITY CONTROL. Reports shall be submitted electronically to the Government using E-mail or diskette within 24 hours after the date covered by the report. Use of either mode of submittal shall be coordinated with the Government representative. The Contractor shall also provide the Government a signed, printed copy of the daily CQC report.

1.6.3.2 Deficiency Tracking.

The Contractor shall use QCS to track deficiencies. Deficiencies

identified by the Contractor will be numerically tracked using QC punch list items. The Contractor shall maintain a current log of its QC punch list items in the QCS database. The Government will log the deficiencies it has identified using its QA punch list items. The Government's QA punch list items will be included in its export file to the Contractor. The Contractor shall regularly update the correction status of both QC and QA punch list items.

1.6.3.3 Three-Phase Control Meetings

The Contractor shall maintain scheduled and actual dates and times of preparatory and initial control meetings in QCS.

1.6.3.4 Accident/Safety Tracking.

The Government will issue safety comments, directions, or guidance whenever safety deficiencies are observed. The Government's safety comments will be included in its export file to the Contractor. The Contractor shall regularly update the correction status of the safety comments. In addition, the Contractor shall utilize QCS to advise the Government of any accidents occurring on the jobsite. This brief supplemental entry is not to be considered as a substitute for completion of mandatory reports, e.g., ENG Form 3394 and OSHA Form 200.

1.6.3.5 Features of Work

The Contractor shall include a complete list of the features of work in the QCS database. A feature of work may be associated with multiple pay activities. However, each pay activity (see subparagraph "Pay Activity Data" of paragraph "Finances") will only be linked to a single feature of work.

1.6.3.6 QC Requirements

The Contractor shall develop and maintain a complete list of QC testing, transferred and installed property, and user training requirements in QCS. The Contractor shall update all data on these QC requirements as work progresses, and shall promptly provide this information to the Government via QCS.

1.6.4 Submittal Management

The Government will provide the initial submittal register, ENG Form 4288, SUBMITTAL REGISTER, in electronic format. Thereafter, the Contractor shall maintain a complete list of all submittals, including completion of all data columns. Dates on which submittals are received and returned by the Government will be included in its export file to the Contractor. The Contractor shall use QCS to track and transmit all submittals. ENG Form 4025, submittal transmittal form, and the submittal register update, ENG Form 4288, shall be produced using QCS. RMS will be used to update, store and exchange submittal registers and transmittals, but will not be used for storage of actual submittals.

1.6.5 Schedule

The Contractor shall develop a construction schedule consisting of pay activities, in accordance with Contract Clause "Schedules for Construction Contracts", or Section 01320A, PROJECT SCHEDULE, as applicable. This schedule shall be input and maintained in the QCS database either manually

or by using the Standard Data Exchange Format (SDEF) (see Section 01320A PROJECT SCHEDULE). The updated schedule data shall be included with each pay request submitted by the Contractor.

1.6.6 Import/Export of Data

QCS includes the ability to export Contractor data to the Government and to import submittal register and other Government-provided data, and schedule data using SDEF.

1.7 IMPLEMENTATION

Contractor use of QCS as described in the preceding paragraphs is mandatory. The Contractor shall ensure that sufficient resources are available to maintain its QCS database, and to provide the Government with regular database updates. QCS shall be an integral part of the Contractor's management of quality control.

1.8 DATA SUBMISSION VIA COMPUTER DISKETTE OR CD-ROM

The Government-preferred method for Contractor's submission of updates, payment requests, correspondence and other data is by E-mail with file attachment(s). For locations where this is not feasible, the Contracting Officer may permit use of computer diskettes or CD-ROM for data transfer. Data on the disks or CDs shall be exported using the QCS built-in export function. If used, diskettes and CD-ROMs will be submitted in accordance with the following:

1.8.1 File Medium

The Contractor shall submit required data on 3-1/2 inch double-sided high-density diskettes formatted to hold 1.44 MB of data, capable of running under Microsoft Windows 95 or newer. Alternatively, CD-ROMs may be used. They shall conform to industry standards used in the United States. All data shall be provided in English.

1.8.2 Disk or CD-ROM Labels

The Contractor shall affix a permanent exterior label to each diskette and CD-ROM submitted. The label shall indicate in English, the QCS file name, full contract number, contract name, project location, data date, name and telephone number of person responsible for the data.

1.8.3 File Names

The Government will provide the file names to be used by the Contractor with the QCS software.

1.9 MONTHLY COORDINATION MEETING

The Contractor shall update the QCS database each workday. At least monthly, the Contractor shall generate and submit an export file to the Government with schedule update and progress payment request. As required in Contract Clause "Payments", at least one week prior to submittal, the Contractor shall meet with the Government representative to review the planned progress payment data submission for errors and omissions. The Contractor shall make all required corrections prior to Government acceptance of the export file and progress payment request. Payment requests accompanied by incomplete or incorrect data submittals will be

returned. The Government will not process progress payments until an acceptable QCS export file is received.

1.10 NOTIFICATION OF NONCOMPLIANCE

The Contracting Officer will notify the Contractor of any detected noncompliance with the requirements of this specification. 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.

-- End of Section --

SECTION 01320A

PROJECT SCHEDULE
08/01

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.

1.3 SCHEDULING

After award of the construction contract and prior to the start of any construction work, an authorized representative of the Contracting Officer (CO) will schedule and conduct a preconstruction conference. The Contractor's Project Manager, Superintendent and his Quality Control System Manager shall attend this meeting. The Contractor is encouraged to have an officer of his company (Project Manager could be this person) and representation from each of his sub-contractors at the conference. This conference will be held at a location and time as specified by the CO.

1.4 PURPOSE

The purpose of this preconstruction conference is to enable the CO to outline the procedures that will be followed by the Government in its administration of this construction contract and to discuss the performance that will be expected from the Contractor. This conference will allow the Contractor an opportunity to ask questions about the Government's supervision and inspection of contract work, about security requirements, regulations, etc. The CO may invite Using Service Engineering and Security personnel and any other Government personnel to attend this conference.

1.5 DISCUSSION ITEMS

The following is a list of items for discussion during the preconstruction conference. However, the Contracting Officer may include additional items for discussion as conditions and the work require.

a. Authority of the Area/Resident Engineer and organization of the Area/Resident office.

b. Contractor's Environmental Protection Plan.

c. Contractor's Progress Schedule: The Contractor will bring a draft schedule for a significant feature of work showing the methods and level of detail to be used for compliance with Section 01006. A summary schedule of all other work will also be provided by the Contractor.

d. Correspondence Procedures.

e. Contractor Labor Standards Provisions.

f. Contractor Plan of Operations.

g. Contract Modifications and Administrative Procedures.

h. Contractor's Job Layout and Storage Area.

i. Procedures for Processing Shop Drawings.

j. Payment Estimate Data and Procedures

k. Contractor Utilities.

l. Security Requirements and Other Regulations, if applicable.

m. Government Furnished Equipment, if applicable.

n. Disposition of Salvage Property.

o. Contractor Insurance Requirements.

p. Value Engineering Program.

q. Contractor Performance Evaluation.

r. As-Built Drawings.

s. Single Point of Contact for Warranty of Construction.

t. Turnover of Completed Facilities.

1.6 PLAN SUBMISSION

The Contractor shall submit his Accident Prevention (Safety) Plan, Quality Control Plan, and Environmental Protection Plan for review one week prior to the conference. Construction work shall not proceed until; after this meeting has been held; the Safety Program, Quality Control Plan, and the Environmental Protection Plan have been approved; and the Notice to Proceed has been received and acknowledged by the Contractor.

1.7 MINUTES OF THE MEETING

The Government will prepare legibly written or typed minutes of the meeting and will provide the Contractor with a signed original for review and concurrence. The minutes shall include all items discussed at the meeting and the Government will make all corrections provided by the Contractor and resubmit the corrected minutes to the Contractor within seven days.

1.8 PROGRESS MEETINGS

Other meetings are or may be scheduled during the course of the Contractor's work progress, and such meetings may include the following:

1.8.1 Accident Prevention Safety Plan

1.8.2 Quality Control Plan

1.8.3 Environmental Protection Plan

1.9 FACILITY MEETINGS

The Facility may also schedule meetings with the Contractor through the CO during the progress of construction work.

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.

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 Periodic Schedule Updates

Based on the result of progress meetings, specified in "Periodic Progress Meetings," the Contractor shall submit periodic 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 periodic 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, under the MS-DOS Version 5. or 6.x, 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, and the MS-DOS version used to format the disk.

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.

-- End of Section --

SECTION 01355

ENVIRONMENTAL PROTECTION
10/00

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 in the text by basic designation only.

U.S. AIR FORCE (USAF)

AFI 32-1053	Pest Management Program

U.S. ARMY (DA)

AR 200-5	Pest Management

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

33 CFR 328	Definitions
40 CFR 68	Chemical Accident Prevention Provisions
40 CFR 152 - 186	Pesticide Programs
40 CFR 260	Hazardous Waste Management System: General
40 CFR 261	Identification and Listing of Hazardous Waste
40 CFR 262	Standards Applicable to Generators of Hazardous Waste
40 CFR 279	Standards for the Management of Used Oil
40 CFR 302	Designation, Reportable Quantities, and Notification
40 CFR 355	Emergency Planning and Notification
49 CFR 171 - 178	Hazardous Materials Regulations

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(1996) U.S. Army Corps on Engineers Safety and Health Requirements Manual
WETLAND MANUAL	Corps of Engineers Wetlands Delineation Manual Technical Report Y-87-1

1.2 DEFINITIONS

1.2.1 Environmental Pollution and Damage

Environmental pollution and damage is the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances of importance to human life; affect other species of importance to humankind; or degrade the environment aesthetically, culturally and/or historically.

1.2.2 Environmental Protection

Environmental protection is the prevention/control of pollution and habitat disruption that may occur to the environment during construction. The control of environmental pollution and damage requires consideration of land, water, and air; biological and cultural resources; and includes management of visual aesthetics; noise; solid, chemical, gaseous, and liquid waste; radiant energy and radioactive material as well as other pollutants.

1.2.3 Contractor Generated Hazardous Waste

Contractor generated hazardous waste means materials that, if abandoned or disposed of, may meet the definition of a hazardous waste. These waste streams would typically consist of material brought on site by the Contractor to execute work, but are not fully consumed during the course of construction. Examples include, but are not limited to, excess paint thinners (i.e. methyl ethyl ketone, toluene etc.), waste thinners,excess paints, excess solvents, waste solvents, and excess pesticides, and contaminated pesticide equipment rinse water.

1.2.4 Installation Pest Management Coordinator

Installation Pest Management Coordinator (IPMC) is the individual officially designated by the Installation Commander to oversee the Installation Pest Management Program and the Installation Pest Management Plan.

1.2.4 Project Pesticide Coordinator

The Project Pesticide Coordinator (PPC) is an individual that resides at a Civil Works Project office and that is responsible for oversight of pesticide application on Project grounds.

1.2.5 Land Application for Discharge Water

The term "Land Application" for discharge water implies that the Contractor shall discharge water at a rate which allows the water to percolate into the soil. No sheeting action, soil erosion, discharge into storm sewers, discharge into defined drainage areas, or discharge into the "waters of the United States" shall occur. Land Application shall be in compliance with all applicable Federal, State, and local laws and regulations.

1.2.6 Pesticide

Pesticide is defined as any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest, or intended for

use as a plant regulator, defoliant or desiccant.

1.2.7 Pests

The term "pests" means arthropods, birds, rodents, nematodes, fungi, bacteria, viruses, algae, snails, marine borers, snakes, weeds and other organisms (except for human or animal disease-causing organisms) that adversely affect readiness, military operations, or the well-being of personnel and animals; attack or damage real property, supplies, equipment, or vegetation; or are otherwise undesirable.

1.2.8 Surface Discharge

The term "Surface Discharge" implies that the water is discharged with possible sheeting action and subsequent soil erosion may occur. Waters that are surface discharged may terminate in drainage ditches, storm sewers,creeks, and/or "waters of the United States" and would require a permit to discharge water from the governing agency.

1.2.9 Waters of the United States

All waters which are under the jurisdiction of the Clean Water Act, as defined in 33 CFR 328.

1.2.10 Wetlands

Wetlands means those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, and bogs. Official determination of whether or not an area is classified as a wetland must be done in accordance with WETLAND MANUAL.

1.3 GENERAL REQUIREMENTS

The Contractor shall minimize environmental pollution and damage that may occur as the result of construction operations. The environmental resources within the project boundaries and those affected outside the limits of permanent work shall be protected during the entire duration of this contract. The Contractor shall comply with all applicable environmental Federal, State, and local laws and regulations. The Contractor shall be responsible for any delays resulting from failure to comply with environmental laws and regulations.

1.4 SUBCONTRACTORS

The Contractor shall ensure compliance with this section by subcontractors.

1.5 PAYMENT

No separate payment will be made for work covered under this section. The Contractor shall be responsible for payment of fees associated with environmental permits, application, and/or notices obtained by the Contractor. All costs associated with this section shall be included in the contract price. The Contractor shall be responsible for payment of all fines/fees for violation or non-compliance with Federal, State, Regional and local laws and regulations.

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. "TSCS" is the code for the Radford Area Office. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Environmental Protection Plan; G, TSCS

The environmental protection plan.

1.7 ENVIRONMENTAL PROTECTION PLAN

Prior to commencing construction activities or delivery of materials to the site, the Contractor shall submit an Environmental Protection Plan for review and approval by the Contracting Officer and TSCS. The purpose of the Environmental Protection Plan is to present a comprehensive overview of known or potential environmental issues which the Contractor must address during construction. Issues of concern shall be defined within the Environmental Protection Plan as outlined in this section. The Contractor shall address each topic at a level of detail commensurate with the environmental issue and required construction task(s). Topics or issues which are not identified in this section, but which the Contractor considers necessary, shall be identified and discussed after those items formally identified in this section. Prior to submittal of the Environmental Protection Plan, the Contractor shall meet with the Contracting Officer for the purpose of discussing the implementation of the initial Environmental Protection Plan; possible subsequent additions and revisions to the plan including any reporting requirements; and methods for administration of the Contractor's Environmental Plans. The Environmental Protection Plan shall be current and maintained onsite by the Contractor.

1.7.1 Compliance

No requirement in this Section shall be construed as relieving the Contractor of any applicable Federal, State, and local environmental protection laws and regulations. During Construction, the Contractor shall be responsible for identifying, implementing, and submitting for approval any additional requirements to be included in the Environmental Protection Plan.

1.7.2 Contents

The environmental protection plan shall include, but shall not be limited to, the following:

a. Name(s) of person(s) within the Contractor's organization who is(are) responsible for ensuring adherence to the Environmental Protection Plan.

b. Name(s) and qualifications of person(s) responsible for manifesting hazardous waste to be removed from the site, if applicable.

c. Name(s) and qualifications of person(s) responsible for training the Contractor's environmental protection personnel.

d. Description of the Contractor's environmental protection personnel training program.

e. An erosion and sediment control plan which identifies the type and location of the erosion and sediment controls to be provided. The plan shall include monitoring and reporting requirements to assure that the control measures are in compliance with the erosion and sediment control plan, Federal, State, and local laws and regulations. A Storm Water Pollution Prevention Plan (SWPPP) may be substituted for this plan.

f. Drawings showing locations of proposed temporary excavations or embankments for haul roads, stream crossings, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials including methods to control runoff and to contain materials on the site.

g. Traffic control plans including measures to reduce erosion of temporary roadbeds by construction traffic, especially during wet weather. Plan shall include measures to minimize the amount of mud transported onto paved public roads by vehicles or runoff.

h. Work area plan showing the proposed activity in each portion of the area and identifying the areas of limited use or nonuse. Plan should include measures for marking the limits of use areas including methods for protection of features to be preserved within authorized work areas.

i. Drawing showing the location of borrow areas.

j. The Spill Control plan shall include the procedures, instructions, and reports to be used in the event of an unforeseen spill of a substance regulated by 40 CFR 68, 40 CFR 302, 40 CFR 355, and/or regulated under State or Local laws and regulations. The Spill Control Plan supplements the requirements of EM 385-1-1 and the Radford Army Ammunition Plant. This plan shall include as a minimum:

1. The name of the individual who will report any spills or hazardous substance releases and who will follow up with complete documentation. This individual shall immediately notify the Contracting Officer and Facility Response Personnel in addition to the legally required Federal, State, and local reporting channels (including the National Response Center 1-800-424-8802) if a reportable quantity is released to the environment. The plan shall contain a list of the required reporting channels and telephone numbers.

2. The name and qualifications of the individual who will be responsible for implementing and supervising the containment and cleanup.

3. Training requirements for Contractor's personnel and methods of accomplishing the training.

4. A list of materials and equipment to be immediately available at the job site, tailored to cleanup work of the potential hazard(s) identified.

5. The names and locations of suppliers of containment materials

and locations of additional fuel oil recovery, cleanup, restoration, and material-placement equipment available in case of an unforeseen spill emergency.

6. The methods and procedures to be used for expeditious contaminant cleanup.

k. A non-hazardous solid waste disposal plan identifying methods and locations for solid waste disposal including clearing debris. The plan shall include schedules for disposal. The Contractor shall identify any subcontractors responsible for the transportation and disposal of solid waste. Licenses or permits shall be submitted for solid waste disposal sites that are not a commercial operating facility. Evidence of the disposal facility's acceptance of the solid waste shall be attached to this plan during the construction. The Contractor shall attach a copy of each of the Non-hazardous Solid Waste Diversion Reports to the disposal plan. The report shall be submitted on the first working day after the first quarter that non-hazardous solid waste has been disposed and/or diverted and shall be for the previous quarter (e.g. the first working day of January, April, July, and October). The report shall indicate the total amount of waste generated and total amount of waste diverted in cubic yards or tons along with the percent that was diverted.

l. A recycling and solid waste minimization plan with a list of measures to reduce consumption of energy and natural resources. The plan shall detail the Contractor's actions to comply with and to participate in Federal, State, Regional, and local government sponsored recycling programs to reduce the volume of solid waste at the source.

m. An air pollution control plan detailing provisions to assure that dust, debris, materials, trash, etc., do not become air borne and travel off the project site.

n. A contaminant prevention plan that: identifies potentially hazardous substances to be used on the job site; identifies the intended actions to prevent introduction of such materials into the air, water, or ground; and details provisions for compliance with Federal, State, and local laws and regulations for storage and handling of these materials. In accordance with EM 385-1-1, a copy of the Material Safety Data Sheets (MSDS) and the maximum quantity of each hazardous material to be on site at any given time shall be included in the contaminant prevention plan. As new hazardous materials are brought on site or removed from the site, the plan shall be updated.

o. A waste water management plan that identifies the methods and procedures for management and/or discharge of waste waters which are directly derived from construction activities, such as concrete curing water, clean-up water, dewatering of ground water, disinfection water, hydrostatic test water, and water used in flushing of lines. If a settling/retention pond is required, the plan shall include the design of the pond including drawings, removal plan, and testing requirements for possible pollutants. If land application will be the method of disposal for the waste water, the plan shall include a sketch showing the location for land application along with a description of the pretreatment methods to be implemented. If surface discharge will be the method of disposal, a copy of the permit and associated documents shall be included as an attachment prior to discharging the waste water. If disposal is to a sanitary sewer, the plan shall include

documentation that the Waste Water Treatment Plant Operator has approved the flow rate, volume, and type of discharge.

p. A historical, archaeological, cultural resources biological resources and wetlands plan that defines procedures for identifying and protecting historical, archaeological, cultural resources, biological resources and wetlands known to be on the project site: and/or identifies procedures to be followed if historical archaeological, cultural resources, biological resources and wetlands not previously known to be onsite or in the area are discovered during construction. The plan shall include methods to assure the protection of known or discovered resources and shall identify lines of communication between Contractor personnel and the Contracting Officer.

q. A pesticide treatment plan shall be included and updated, as information becomes available. The plan shall include: sequence of treatment, dates, times, locations, pesticide trade name, EPA registration numbers, authorized uses, chemical composition, formulation, original and applied concentration, application rates of active ingredient (i.e. pounds of active ingredient applied), equipment used for application and calibration of equipment. The Contractor is responsible for Federal, State, Regional and Local pest management record keeping and reporting requirements as well as any additional Installation Project Office specific requirements. The Contractor shall follow AFI 32-1053 Sections 3.4.13 and 3.4.14 for data required to be reported to the Installation.

1.7.3 Appendix

Copies of all environmental permits, permit application packages, approvals to construct, notifications, certifications, reports, and termination documents shall be attached,as an appendix, to the Environmental Protection Plan.

1.8 PROTECTION FEATURES

This paragraph supplements the Contract Clause PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES, AND IMPROVEMENTS. Prior to start of any onsite construction activities, the Contractor and the Contracting Officer shall make a joint condition survey. Immediately following the survey, the Contractor shall prepare a brief report including a plan describing the features requiring protection under the provisions of the Contract Clauses, which are not specifically identified on the drawings as environmental features requiring protection along with the condition of trees, shrubs and grassed areas immediately adjacent to the site of work and adjacent to the Contractor's assigned storage area and access route(s), as applicable. This survey report shall be signed by both the the Contractor and the Contracting Officer upon mutual agreement as to its accuracy and completeness. The Contractor shall protect those environmental features included in the survey report and any indicated on the drawings, regardless of interference which their preservation may cause to the Contractor's work under the contract.

1.9 SPECIAL ENVIRONMENTAL REQUIREMENTS

Not used.

1.10 ENVIRONMENTAL ASSESSMENT OF CONTRACT DEVIATIONS

Any deviations, requested by the Contractor, from the drawings,plans and specifications which may have an environmental impact will be subject to approval by the Contracting Officer and may require an extended review, processing, and approval time. The Contracting Officer reserves the right to disapprove alternate methods, even if they are more cost effective, if the Contracting Officer determines that the proposed alternate method will have an adverse environmental impact.

1.11 NOTIFICATION

The Contracting Officer will notify the Contractor in writing of any observed noncompliance with Federal, State or local environmental laws or regulations, permits, and other elements of the Contractor's Environmental Protection plan. The Contractor shall, after receipt of such notice, inform the Contracting Officer of the proposed corrective action and take such action when approved by the Contracting Officer. The Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No time extensions shall be granted or equitable adjustments allowed to the Contractor for any such suspensions. This is in addition to any other actions the Contracting Officer may take under the contract, or in accordance with the Federal Acquisition Regulation or Federal Law.

1.12 HTRW PERIMETER AIR MONITORING

Not used.

1.12.1 Perimeter Air Contaminant of Concern

Not used.

1.12.2 Time Averaged Perimeter Action Levels

Not used.

1.12.3 Perimeter Sampling/Monitoring Locations

Not used.

1.12.4 Monitoring Instruments/Sampling and Analysis Methods

Not used.

1.12.5 Staffing

Not used.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 ENVIRONMENTAL PERMITS AND COMMITMENTS

The Contractor shall be responsible for obtaining and complying with all environmental permits and commitments required by Federal, State, Regional, and local environmental laws and regulations.

3.2 LAND RESOURCES

The Contractor shall confine all activities to areas defined by the drawings and specifications. Prior to the beginning of any construction, the Contractor shall identify any land resources to be preserved within the work area. Except in areas indicated on the drawings or specified to be cleared, the Contractor shall not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, topsoil, and land forms without approval. No ropes, cables, or guys shall be fastened to or attached to any trees for anchorage unless specifically authorized. The Contractor shall provide effective protection for land and vegetation resources at all times as defined in the following subparagraphs. Stone, soil, or other materials displaced into uncleared areas shall be removed by the Contractor.

3.2.1 Work Area Limits

Prior to commencing construction activities, the Contractor shall mark the areas that need not be disturbed under this contract. Isolated areas within the general work area which are not to be disturbed shall be marked or fenced. Monuments and markers shall be protected before construction operations commence. Where construction operations are to be conducted during darkness, any markers shall be visible in the dark. The Contractor's personnel shall be knowledgeable of the purpose for marking and/or protecting particular objects.

3.2.2 Landscape

Trees, shrubs, vines, grasses, land forms and other landscape features indicated and defined on the drawings to be preserved shall be clearly identified by marking, fencing, or wrapping with boards, or any other approved techniques. The Contractor shall restore landscape features damaged or destroyed during construction operations outside the limits of the approved work area.

3.2.3 Erosion and Sediment Controls

The Contractor shall be responsible for providing erosion and sediment control measures in accordance with Federal, State, and local laws and regulations. The erosion and sediment controls selected and maintained by the Contractor shall be such that water quality standards are not violated as a result of the Contractor's construction activities. The area of bare soil exposed at any one time by construction operations should be kept to a minimum. The Contractor shall construct or install temporary and permanent erosion and sediment control best management practices (BMPs) as indicated on the drawings. BMPs may include, but not be limited to, vegetation cover, stream bank stabilization, slope stabilization, silt fences, construction of terraces, interceptor channels, sediment traps, inlet and outfall protection, diversion channels, and sedimentation basins. The Contractor's best management practices shall also be in accordance with the Virginia Pollutant Discharge Elimination System (VPDES) Storm Water Pollution Prevention Plan (SWPPP) which may be reviewed at the Alliant Tech Environmental Office. Any temporary measures shall be removed after the area has been stabilized.

3.2.4 Contractor Facilities and Work Areas

The Contractor's field offices, staging areas, stockpile storage, and temporary buildings shall be placed in areas designated on the drawings or

as directed by the Contracting Officer. Temporary movement or relocation of Contractor facilities shall be made only when approved. Erosion and sediment controls shall be provided for on-site borrow and spoil areas to prevent sediment from entering nearby waters. Temporary excavation and embankments for plant and/or work areas shall be controlled to protect adjacent areas.

3.3 WATER RESOURCES

The Contractor shall monitor construction activities to prevent pollution of surface and ground waters. Toxic or hazardous chemicals shall not be applied to soil or vegetation unless otherwise indicated. All water areas affected by construction activities shall be monitored by the Contractor. For construction activities immediately adjacent to impaired surface waters, the Contractor shall be capable of quantifying sediment or pollutant loading to that surface water when required by State or Federally issued Clean Water Act permits.

3.3.1 Cofferdams, Diversions, and Dewatering Operations

Construction operations for dewatering, removal of cofferdams, tailrace excavation, and tunnel closure shall be controlled at all times to maintain compliance with existing State water quality standards and designated uses of the surface water body. The Contractor shall comply with the State of Virginia water quality standards and anti-degradation provisions.

3.3.2 Stream Crossings

Stream crossings shall allow movement of materials or equipment without violating water pollution control standards of the Federal, State, and local governments.

3.3.3 Wetlands

The Contractor shall not enter, disturb, destroy, or allow discharge of contaminants into any wetlands.

3.4 AIR RESOURCES

Equipment operation, activities, or processes performed by the Contractor shall be in accordance with all Federal and State air emission and performance laws and standards.

3.4.1 Particulates

Dust particles; aerosols and gaseous by-products from construction activities; and processing and preparation of materials, such as from asphaltic batch plants; shall be controlled at all times, including weekends, holidays and hours when work is not in progress. The Contractor shall maintain excavations, stockpiles, haul roads, permanent and temporary access roads, plant sites, spoil areas, borrow areas, and other work areas within or outside the project boundaries free from particulates which would cause the Federal, State, and local air pollution standards to be exceeded or which would cause a hazard or a nuisance. Sprinkling, chemical treatment of an approved type, baghouse, scrubbers, electrostatic precipitators or other methods will be permitted to control particulates in the work area. Sprinkling, to be efficient, must be repeated to keep the disturbed area damp at all times. The Contractor must have sufficient, competent equipment available to accomplish these tasks. Particulate

control shall be performed as the work proceeds and whenever a particulate nuisance or hazard occurs. The Contractor shall comply with all State and local visibility regulations.

3.4.2 Odors

Odors from construction activities shall be controlled at all times. The odors shall not cause a health hazard and shall be in compliance with State regulations and/or local ordinances.

3.4.3 Sound Intrusions

The Contractor shall keep construction activities under surveillance and control to minimize environment damage by noise. The Contractor shall comply with the provisions of the State of Virginia rules.

3.4.4 Burning

Burning shall be prohibited on the Government premises.

3.5 HTRW AIR EMISSION CONTROL

The Contractor shall implement the following control(s) to meet or exceed performance levels identified in HTRW PERIMETER AIR MONITORING.

3.5.1 Air Emission Control to Meet Action Levels

Not used.

3.5.2 Excavation/Production/Processing Rate Reduction

Not used.

3.5.3 Exposed Surface Area Reduction

Not used.

3.6 CHEMICAL MATERIALS MANAGEMENT AND WASTE DISPOSAL

Disposal of wastes shall be as directed below, unless otherwise specified in other sections and/or shown on the drawings.

3.6.1 Solid Wastes

Solid wastes (excluding clearing debris) shall be placed in containers which are emptied on a regular schedule. Handling, storage, and disposal shall be conducted to prevent contamination. Segregation measures shall be employed so that no hazardous or toxic waste will become co-mingled with solid waste. The Contractor shall transport solid waste off Government property and dispose of it in compliance with Federal, State, and local requirements for solid waste disposal. A Subtitle D RCRA permitted landfill shall be the minimum acceptable off-site solid waste disposal option. The Contractor shall verify that the selected transporters and disposal facilities have the necessary permits and licenses to operate.

3.6.2 Chemicals and Chemical Wastes

Chemicals shall be dispensed ensuring no spillage to the ground or water. Periodic inspections of dispensing areas to identify leakage and initiate

corrective action shall be performed and documented. This documentation will be periodically reviewed by the Government. Chemical waste shall be collected in corrosion resistant, compatible containers. Collection drums shall be monitored and removed to a staging or storage area when contents are within 6 inches of the top. Wastes shall be classified, managed, stored, and disposed of in accordance with Federal, State, and local laws and regulations.

3.6.3 Contractor Generated Hazardous Wastes/Excess Hazardous Materials

Hazardous wastes are defined in 40 CFR 261, or are as defined by applicable State and local regulations. Hazardous materials are defined in 49 CFR 171 - 178. The Contractor shall, at a minimum, manage and store hazardous waste in compliance with 40 CFR 262 and shall manage and store hazardous waste in accordance with the Installation hazardous waste management plan. The Contractor shall take sufficient measures to prevent spillage of hazardous and toxic materials during dispensing. The Contractor shall segregate hazardous waste from other materials and wastes, shall protect it from the weather by placing it in a safe covered location, and shall take precautionary measures such as berming or other appropriate measures against accidental spillage. The Contractor shall be responsible for storage, describing, packaging, labeling, marking, and placarding of hazardous waste and hazardous material in accordance with 49 CFR 171 - 178, State, and local laws and regulations. The Contractor shall transport Contractor generated hazardous waste off Government property within 60 days in accordance with the Environmental Protection Agency and the Department of Transportation laws and regulations. The Contractor shall dispose of hazardous waste in compliance with Federal, State and local laws and regulations. Spills of hazardous or toxic materials shall be immediately reported to the Contracting Officer and the Facility Environmental Office. Cleanup and cleanup costs due to spills shall be the Contractor's responsibility. The disposition of Contractor generated hazardous waste and excess hazardous materials are the Contractor's responsibility.

3.6.4 Fuel and Lubricants

Storage, fueling and lubrication of equipment and motor vehicles shall be conducted in a manner that affords the maximum protection against spill and evaporation. Fuel, lubricants and oil shall be managed and stored in accordance with all Federal, State, Regional, and local laws and regulations. Used lubricants and used oil to be discarded shall be stored in marked corrosion-resistant containers and recycled or disposed in accordance with 40 CFR 279, State, and local laws and regulations. There shall be no storage of fuel on the project site. Fuel must be brought to the project site each day that work is performed.

3.6.5 Waste Water

Disposal of waste water shall be as specified below.

a. Waste water from construction activities, such as onsite material processing, concrete curing, foundation and concrete clean-up, water used in concrete trucks, forms, etc. shall not be allowed to enter water ways or to be discharged prior to being treated to remove pollutants. The Contractor shall dispose of the construction related waste water off-Government property in accordance with all Federal, State, Regional and Local laws and regulations.

b. For discharge of ground water, the Contractor shall surface discharge in accordance with the requirements of the NPDES or State STORM WATER DISCHARGES FROM CONSTRUCTION SITES permit.

c. Water generated from the flushing of lines after hydrostatic testing shall be land applied in accordance with all Federal, State, and local laws and regulations for land application.

3.7 RECYCLING AND WASTE MINIMIZATION

The Contractor shall participate in State and local government sponsored recycling programs. The Contractor is further encouraged to minimize solid waste generation throughout the duration of the project. .

3.8 NON-HAZARDOUS SOLID WASTE DIVERSION REPORT

The Contractor shall maintain an inventory of non-hazardous solid waste diversion and disposal of construction and demolition debris. The Contractor shall submit a report to the Area Office through the Contracting Officer on the first working day after each fiscal year quarter, starting the first quarter that non-hazardous solid waste has been generated. The following shall be included in the report:

a. Construction and Demolition (C&D) Debris Disposed = _____ in cubic yards or tons, as appropriate.

b. Construction and Demolition (C&D) Debris Recycled = _____ in cubic yards or tons, as appropriate.

c. Total C&D Debris Generated = _____ in cubic yards or tons, as appropriate.

d. Waste Sent to Waste-To-Energy Incineration Plant (This amount should not be included in the recycled amount) = _____ in cubic yards or tons, as appropriate.

3.9 HISTORICAL, ARCHAEOLOGICAL, AND CULTURAL RESOURCES

If during excavation or other construction activities any previously unidentified or unanticipated historical, archaeological, and cultural resources are discovered or found, all activities that may damage or alter such resources shall be temporarily suspended. Resources covered by this paragraph include but are not limited to: any human skeletal remains or burials; artifacts; shell, midden, bone, charcoal, or other deposits; rock or coral alignments, pavings, wall, or other constructed features; and any indication of agricultural or other human activities. Upon such discovery or find, the Contractor shall immediately notify the Contracting Officer so that the appropriate authorities may be notified and a determination made as to their significance and what, if any, special disposition of the finds should be made. The Contractor shall cease all activities that may result in impact to or the destruction of these resources. The Contractor shall secure the area and prevent employees or other persons from trespassing on, removing, or otherwise disturbing such resources.

3.10 BIOLOGICAL RESOURCES

The Contractor shall minimize interference with, disturbance to, and damage to fish, wildlife, and plants including their habitat. The Contractor shall be responsible for the protection of threatened and endangered animal

and plant species including their habitat in accordance with Federal, State, Regional, and local laws and regulations.

3.11 INTEGRATED PEST MANAGEMENT

In order to minimize impacts to existing fauna and flora, the Contractor, through the Contracting Officer, shall coordinate with the Installation Pest Management Coordinator (IPMC)Project Pesticide Coordinator (PPC) at the earliest possible time prior to pesticide application. The Contractor shall discuss integrated pest management strategies with the IPMC and receive concurrence from the IPMC through the COR prior to the application of any pesticide associated with these specifications. Installation Project Office Pest Management personnel shall be given the opportunity to be present at all meetings concerning treatment measures for pest or disease control and during application of the pesticide. The use and management of pesticides are regulated under 40 CFR 152 - 186.

3.11.1 Pesticide Delivery and Storage

Pesticides 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. Pesticides shall be stored according to manufacturer's instructions and under lock and key when unattended.

3.11.2 Qualifications

For the application of pesticides, the Contractor shall use the services of a subcontractor whose principal business is pest control. The subcontractor shall be licensed and certified in the state where the work is to be performed.

3.11.3 Pesticide Handling Requirements

The Contractor shall formulate, treat with, and dispose of pesticides and associated containers in accordance with label directions and shall use the clothing and personal protective equipment specified on the labeling for use during all phases of the application. Material Safety Data Sheets (MSDS)shall be available for all pesticide products.

3.11.4 Application

Pesticides shall be applied by a State Certified Pesticide Applicator in accordance with EPA label restrictions and recommendation. The Certified Applicator shall wear clothing and personal protective equipment as specified on the pesticide label. Water used for formulating shall only come from locations designated by the Contracting Officer. The Contractor shall not allow the equipment to overflow. Prior to application of pesticide, all equipment shall be inspected for leaks, clogging, wear, or damage and shall be repaired prior to being used.

3.12 PREVIOUSLY USED EQUIPMENT

The Contractor shall clean all previously used construction equipment prior to bringing it onto the project site. The Contractor shall ensure that the equipment is free from soil residuals, egg deposits from plant pests, noxious weeds, and plant seeds. The Contractor shall consult with the USDA jurisdictional office for additional cleaning requirements.

3.13 MAINTENANCE OF POLLUTION FACILITIES

The Contractor shall maintain permanent and temporary pollution control facilities and devices for the duration of the contract or for that length of time construction activities create the particular pollutant.

3.14 MILITARY MUNITIONS

In the event the Contractor discovers or uncovers military munitions as defined in 40 CFR 260, the Contractor shall immediately stop work in that area and immediately inform the Contracting Officer.

3.15 TRAINING OF CONTRACTOR PERSONNEL

The Contractor's personnel shall be trained in all phases of environmental protection and pollution control. The Contractor shall conduct environmental protection/pollution control meetings for all Contractor personnel prior to commencing construction activities. Additional meetings shall be conducted for new personnel and when site conditions change. The training and meeting agenda shall include: methods of detecting and avoiding pollution; familiarization with statutory and contractual pollution standards; installation and care of devices, vegetative covers, and instruments required for monitoring purposes to ensure adequate and continuous environmental protection/pollution control; anticipated hazardous or toxic chemicals or wastes, and other regulated contaminants; recognition and protection of archaeological sites, artifacts, wetlands, and endangered species and their habitat that are known to be in the area.

3.16 CONTAMINATED MEDIA MANAGEMENT

Not used.

3.17 POST CONSTRUCTION CLEANUP

The Contractor shall clean up all areas used for construction in accordance with Contract Clause: "Cleaning Up". The Contractor shall, unless otherwise instructed in writing by the Contracting Officer, obliterate all signs of temporary construction facilities such as haul roads, work area, structures, foundations of temporary structures, stockpiles of excess or waste materials, and other vestiges of construction prior to final acceptance of the work. The disturbed area shall be graded, filled and the entire area seeded unless otherwise indicated.

-- End of Section --

SECTION 01420

SOURCES FOR REFERENCE PUBLICATIONS
09/01

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. The designations "AOK" and "LOK" are for administrative purposes and should not be used when ordering publications.

ACI INTERNATIONAL (ACI)
P.O. Box 9094
Farmington Hills, MI 48333-9094
Ph: 248-848-3700
Fax: 248-848-3701
Internet: www.aci-int.org
AOK 5/01
LOK 2/01

ACOUSTICAL SOCIETY OF AMERICA (ASA)
2 Huntington Quadrangle
Melville, NY 11747-4502
Ph: 516-576-2360
Fax: 516-576-2377
email: asa@aip.org
Internet: www.asa.aip.org

To order ASA Standards, contact:
Standards and Publications Fulfillment Center
P.O. Box 1020
Sewickley, PA 15143-9998
Phone: 412-741-1979
Fax: 412-741-0609
Email: asapubs@abdintl.com

AOK 5/01
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AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

4301 North Fairfax Dr., Suite 425
ATTN: Pubs Dept.
Arlington, VA 22203
Ph: 703-524-8800
Fax: 703-528-3816
E-mail: ari@ari.org
Internet: www.ari.org
AOK 5/01
LOK 2/01

AIR CONDITIONING CONTRACTORS OF AMERICA (ACCA)
2800 Shirlington Road, Suite 300
Arlington, VA 22206
Ph: 703-575-4477
FAX: 703-575-4449
Internet: www.acca.org
AOK 5/01
LOK 6/00

AIR DIFFUSION COUNCIL (ADC)
104 So. Michigan Ave., No. 1500
Chicago, IL 60603
Ph: 312-201-0101
Fax: 312-201-0214
Internet: www.flexibleduct.org
AOK 5/01
LOK 6/00

AIR MOVEMENT AND CONTROL ASSOCIATION (AMCA)
30 W. University Dr.
Arlington Heights, IL 60004-1893
Ph: 847-394-0150
Fax: 847-253-0088
Internet: www.amca.org
AOK 5/01
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ALUMINUM ASSOCIATION (AA)

900 19th Street N.W.
Washington, DC 20006
Ph: 202-862-5100
Fax: 202-862-5164
Internet: www.aluminum.org
AOK 5/01
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AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)
1827 Walden Ofc. Sq.
Suite 104
Schaumburg, IL 60173-4268
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Fax: 847-303-5774
Internet: www.aamanet.org
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AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

444 N. Capital St., NW, Suite 249
Washington, DC 20001
Ph: 800-231-3475 202-624-5800
Fax: 800-525-5562 202-624-5806
Internet: www.transportation.org
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AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS (AATCC)
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Research Triangle Park, NC 27709-2215
Ph: 919-549-8141
Fax: 919-549-8933
Internet: www.aatcc.org
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Washington, DC 20036
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Fax: 202-828-6042
Internet: www.abma-dc.org
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AMERICAN BOILER MANUFACTURERS ASSOCIATION (ABMA)
4001 North 9th Street, Suite 226
Arlington, VA 22203-1900
Ph: 703-522-7350
Fax: 703-522-2665
Internet: www.abma.com
AOK 5/01
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AMERICAN CONCRETE PIPE ASSOCIATION (ACPA)
222 West Las Colinas Blvd., Suite 641
Irving, TX 75039-5423
Ph: 972-506-7216
Fax: 972-506-7682
Internet: www.concrete-pipe.org
e-mail: info@concrete-pipe.org
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AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)
1330 Kemper Meadow Dr.
Suite 600
Cincinnati, OH 45240
Ph: 513-742-2020
Fax: 513-742-3355
Internet: www.acgih.org
E-mail: pubs@acgih.org
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AMERICAN FOREST & PAPER ASSOCIATION (AF&PA)
American Wood Council
ATTN: Publications Dept.

1111 Nineteenth St. NW, Suite 800
Washington, DC 20036
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Internet: www.afandpa.org
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Fax: 202-824-7115
Internet: www.aga.org
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400 N. Capitol St. N.W.Suite 450
Washington, D.C. 20001
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Internet: www.aga.org
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AMERICAN GEAR MANUFACTURERS ASSOCIATION (AGMA)
1500 King St., Suite 201
Alexandria, VA 22314-2730
Ph: 703-684-0211
Fax: 703-684-0242
Internet: www.agma.org
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AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)
One East Wacker Dr., Suite 3100
Chicago, IL 60601-2001
Ph: 312-670-2400
Publications: 800-644-2400
Fax: 312-670-5403
Internet: www.aisc.org
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7012 So. Revere Parkway, Suite 140
Englewood, CO 80112
Ph: 303-792-9559
Fax: 303-792-0669
Internet: www.aitc-glulam.org
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AMERICAN IRON AND STEEL INSTITUTE (AISI)
1101 17th St., NW Suite 1300
Washington, DC 20036
Ph: 202-452-7100
Internet: www.steel.org

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AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)
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Fax: 202-293-9287
Internet: www.ansi.org/

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AMERICAN NURSERY AND LANDSCAPE ASSOCIATION (ANLA)
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Washington, DC 20005-3922
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FAX: 202-789-1893
Internet: www.anla.org
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AMERICAN PETROLEUM INSTITUTE (API)
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Fax: 202-682-8223
Internet: www.api.org
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AMERICAN PUBLIC HEALTH ASSOCIATION (APHA)
800 I Street, NW
Washington, DC 20001
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FAX: 202-777-2534
Internet: www.apha.org
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AMERICAN RAILWAY ENGINEERING & MAINTENANCE-OF-WAY ASSOCIATION (AREMA)
8201 Corporate Dr., Suite 1125
Landover, MD 20785-2230
Ph: 301-459-3200
Fax: 301-459-8077
Internet: www.arema.org
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Columbus, OH 43228-0518
Ph: 800-222-2768
Fax: 614-274-6899
Internet: www.asnt.org
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AMERICAN SOCIETY FOR QUALITY (ASQ)
600 North Plankinton Avenue
Milwaukee, WI 53202-3005
Ph: 800-248-1946
Fax: 414-272-1734
Internet: www.asq.org
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AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
100 Barr Harbor Drive
West Conshohocken, PA 19428-2959
Ph: 610-832-9585
Fax: 610-832-9555
Internet: www.astm.org
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AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)
1801 Alexander Bell Drive
Reston, VA 20191-4400
Ph: 703-295-6300 - 800-548-2723
Fax: 703-295-6222
Internet: www.asce.org
e-mail: marketing@asce.org
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AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)
1791 Tullie Circle, NE
Atlanta, GA 30329
Ph: 800-527-4723 or 404-636-8400
Fax: 404-321-5478
Internet: www.ashrae.org
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AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)
901 Canterbury, Suite A
Westlake, OH 44145
Ph: 440-835-3040
Fax: 440-835-3488
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Internet: www.asse-plumbing.org
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AMERICAN WATER WORKS ASSOCIATION(AWWA)

6666 West Quincy
Denver, CO 80235
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Fax: 303-794-7310
Internet: www.awwa.org
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550 N.W. LeJeune Road
Miami, FL 33126
Ph: 800-443-9353 - 305-443-9353
Fax: 305-443-7559
Internet: www.amweld.org
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AMERICAN WOOD-PRESERVERS' ASSOCIATION (AWPA)
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Grandbury, TX 76049-0690
Ph: 817-326-6300
Fax: 817-326-6306
Internet: www.awpa.com
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APA - THE ENGINEERED WOOD ASSOCIATION (APA)
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Tacoma, WA 98411-0700
Ph: 253-565-6600
Fax: 253-565-7265
Internet: www.apawood.org
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ARCHITECTURAL & TRANSPORTATION BARRIERS COMPLIANCE BOARD (ATBCB)

The Access Board
1331 F Street, NW, Suite 1000
Washington, DC 20004-1111
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FAX: 202-272-5447
Internet: www.access-board.gov
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ARCHITECTURAL WOODWORK INSTITUTE (AWI)
1952 Isaac Newton Square West
Reston, VA 20190
Ph: 703-733-0600
Fax: 703-733-0584
Internet: www.awinet.org
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ASBESTOS CEMENT PIPE PRODUCERS ASSOCIATION (ACPPA)
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ASME INTERNATIONAL (ASME)
Three Park Avenue
New York, NY 10016-5990
Ph: 212-591-7722
Fax: 212-591-7674
Internet: www.asme.org
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ASPHALT INSTITUTE (AI)
Research Park Dr.
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Lexington, KY 40512-4052
Ph: 859-288-4960
Fax: 859-288-4999
Internet: www.asphaltinstitute.org
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ASSOCIATED AIR BALANCE COUNCIL (AABC)
1518 K St., NW, Suite 503
Washington, DC 20005
Ph: 202-737-0202
Fax: 202-638-4833
Internet: www.aabchq.com
E-mail: aabchq@aol.com
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ASSOCIATION FOR THE ADVANCEMENT OF MEDICAL INSTRUMENTATION (AAMI)
1110 N. Glebe Rd., Suite 220
Arlington, VA 22201-5762
Ph: 703-525-4890
Fax: 703-276-0793
Internet: www.aami.org
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ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)
600 No. 18th St.
P.O. Box 2641
Birmingham, AL 35291
Ph: 205-257-2530
Fax: 205-257-2540
Internet: www.aeic.org
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ASSOCIATION OF HOME APPLIANCE MANUFACTURERS (AHAM)
1111 19th St. NW., Suite 402
Washington, DC 20036
Ph: 202-872-5955
Fax: 202-872-9354
Internet: www.aham.org
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ASSOCIATION OF IRON AND STEEL ENGINEERS (AISE)
Three Gateway Center, Suite 1900
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Fax: 412-281-4657
Internet: www.aise.org
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BRITISH STANDARDS INSTITUTE (BSI)
389 Chiswick High Road
London W4 4AL
United Kingdom
Phone: +44 (0)20 8996 9000
Fax: +44 (0)20 8996 7400
Email: Info@bsi-global.com
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BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)
355 Lexington Ave.
17th floor
New York, NY 10017-6603
Ph: 212-297-2122
Fax: 212-370-9047
Internet: www.buildershardware.com

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4051 W. Flossmoor Rd.
Country Club Hills, IL 60478
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Internet: www.bocai.org
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Novato, CA 94949
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Dalton, GA 30720
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Dalton, GA 30722-2048
Ph: 706-278-0232
Fax: 706-278-8835
Internet: www.carpet-rug.com
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CAST IRON SOIL PIPE INSTITUTE (CISPI)
5959 Shallowford Rd., Suite 419
Chattanooga, TN 37421
Ph: 423-892-0137
Fax: 423-892-0817
Internet: www.cispi.org
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CEILINGS & INTERIOR SYSTEMS CONSTRUCTION ASSOCIATION (CISCA)
1500 Lincoln Highway, Suite 202
St. Charles, IL 60174
Ph: 630-584-1919
Fax: 630-584-2003
Internet: www.cisca.org
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CENTERS FOR DISEASE CONTROL AND PREVENTION (CDC)

1600 Clifton Road
Atlanta, GA 30333
PH: 404-639-3534
FAX:
Internet: www.cdc.gov
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CHEMICAL FABRICS & FILM ASSOCIATION (CFFA)

1300 Sumner Ave.
Cleveland OH 44115-2851
PH: 216-241-7333
FAX: 216-241-0105
www.chemicalfabricsandfilm.com/welcome.htm
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CHLORINE INSTITUTE (CI)
2001 L St., NW Suite 506
Washington, DC 20036
Ph: 202-775-2790
Fax: 202-223-7225
Internet: www.cl2.com
AOK 5/01
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COMPRESSED AIR AND GAS INSTITUTE (CAGI)

1300 Sumner Ave.
Cleveland OH 44115-2851
PH: 216-241-7333
FAX: 216-241-0105
www.cagi.org/welcome.htm
AOK 6/01

COMPRESSED GAS ASSOCIATION (CGA)
1725 Jefferson Davis Highway, Suite 1004
Arlington, VA 22202-4102
Ph: 703-412-0900
Fax: 703-412-0128
Internet: www.cganet.com
e-mail: Customer_Service@cganet.com
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CONCRETE REINFORCING STEEL INSTITUTE (CRSI)
933 N. Plum Grove Rd.
Schaumburg, IL 60173-4758
Ph: 847-517-1200
Fax: 847-517-1206
Internet: www.crsi.org
AOK 5/01
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CONSUMER PRODUCT SAFETY COMMISSION (CPSC)
4330 East-West Highway
Bethesda, Maryland 20814-4408
Ph: 301-504-0990
Fx: 301-504-0124 and 301-504-0025
Internet: www.cpsc.gov
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CONVEYOR EQUIPMENT MANUFACTURERS ASSOCIATION (CEMA)
6724 Lone Oak Blvd.
Naples, Florida 34109

Ph: 941-514-3441
Fax: 941-514-3470
Internet: www.cemanet.org
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COOLING TECHNOLOGY INSTITUTE (CTI)
530 Wells Fargo Dr., Suite 218, Houston, TX 77090
Ph: 281-583-4087
Fax: 281-537-1721
Internet: www.cti.org
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COPPER DEVELOPMENT ASSOCIATION (CDA)
260 Madison Ave.
New York, NY 10016
Ph: 212-251-7200
Fax: 212-251-7234
Website: www.copper.org
E-mail: staff@cda.copper.org
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CRANE MANUFACTURERS ASSOCIATION OF AMERICA (CMAA)
8720 Red Oak Blvd., Ste, 201
Charlotte, NC 28217 USA
Ph: 704-676-1190/800722-6832
Fx: 704-676-1199
Internet: www.mhia.org/psc/psc_products_cranes.cfm
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DIAMOND CORE DRILL MANUFACTURERS ASSOCIATION (DCDMA)

Organization no longer exists. See National Drilling Association.

DISTRICT OF COLUMBIA MUNICIPAL REGULATIONS (DCMR)

441 4th Street NW
Wachington DC 20001
PH: 202-727-1000
http://pw2.netcom.com/~flowers
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DOOR AND ACCESS SYSTEM MANUFACTURERS ASSOCIATION (DASMA)
1300 Sumner Avenue
Cleveland, OH 44115-2851
Ph: 216-241-7333
Fax: 216-241-0105
Internet: www.dasma.com
e-mail: dasma@dasma.com
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DOOR AND HARDWARE INSTITUTE (DHI)
14150 Newbrook Dr.Suite 200
Chantilly, VA 20151-2223
Ph: 703-222-2010

Fax: 703-222-2410
Internet: www.dhi.org
e-mail: techdept@dhi.org
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DUCTILE IRON PIPE RESEARCH ASSOCIATION (DIPRA)
245 Riverchase Parkway East, Suite 0
Birmingham, AL 35244
Ph: 205-402-8700
Fax: 205-402-8730
Internet: www.dipra.org
E-mail: info@dipra.org
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EIFS INDUSTRY MEMBERS ASSOCIATION (EIMA)
3000 Corporate Center Drive, Suite 270
Morrow, GA 30260
Ph: 800-968-7945
Fax: 770-294-3462
Internet: www.eifsfacts.com
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ELECTRICAL GENERATING SYSTEMS ASSOCIATION (EGSA)
1650 South Dixie Highway, Ste. 500
Boca Raton, FL 33432
Ph: 561-750-5575
Fax: 561-395-8557
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-- End of Section --

SECTION 01451A

CONTRACTOR QUALITY CONTROL
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.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (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	(2000b) 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.

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 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 and is subject to removal by the Contracting Officer for non-compliance with the quality requirements specified in the 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, and shall be responsible for all construction and construction related activities at the site.

3.2 QUALITY CONTROL PLAN

The Contractor shall furnish for review by the Government, not later than 15 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 15 days of operation. Construction 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 construction operations, both onsite and offsite, including work by subcontractors, fabricators, suppliers, and purchasing agents:

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 superintendent.

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 subcontractors, offsite fabricators, suppliers, and purchasing agents. 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 will be approved by the Contracting Officer.)

f. Procedures for tracking preparatory, initial, and follow-up control phases and control, verification, and acceptance tests including documentation.

g. Procedures for tracking construction 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 construction. Acceptance is conditional and will be predicated on satisfactory performance during the construction. 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 Preconstruction Conference, before start of construction, 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 15 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 operations, 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 CQC System Manager and sufficient number of additional qualified personnel to ensure safety and contract compliance. The Safety and Health Manager shall receive direction and authority from the CQC System Manager and shall serve as a member of the CQC staff. 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, show 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 have 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

In addition to CQC personnel specified elsewhere in the contract, the Contractor shall provide as part of the CQC organization specialized personnel to assist the CQC System Manager for the following areas: electrical, mechanical, civil, structural, environmental. These individuals may be employees of the prime or subcontractor; be responsible to the CQC System Manager; be physically present at the construction site during work on their areas of responsibility; have the necessary education and/or experience in accordance with the experience matrix listed herein. These individuals shall have no duties other than quality control.

Experience Matrix

Area	Qualifications
a. Concrete Installation:	Materials Technician with 4 years' related experience.
b. Fiberglass Liner Installation:	Materials Technician with 4 years' related experience.
c. Structural:	Graduate Structural Engineer with 2 years experience or person with 5 years related experience.
d. Welder:	Individual shall be a Level 1 Qualified Welding Inspector.
e. Civil:	Graduate Civil Engineer with 2 years experience in the type of work being performed on this project or technician with 5 yrs related experience
f. Mechanical:	Graduate Mechanical Engineer with 2 yrs experience or person with 5 yrs related experience
g. Electrical:	Graduate Electrical Engineer with 2 yrs related experience or person with 5 yrs related experience

h. Structural: Graduate Structural Engineer with 2 yrs experience or person with 5 yrs related experience

i. Environmental: Graduate Environmental Engineer with 3 yrs experience

j. Submittals: Submittal Clerk with 1 yr experience

k. Instrumentation and control system: process instrumentation and control engineer with five (5) years experience.

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". The Corps of Engineers periodically offers this course. Specific times and locations are available from the Contracting Officer.

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.

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 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. A copy of those sections of referenced codes and standards applicable to that portion of the work to be accomplished in the field shall be made available by the Contractor at the preparatory inspection. These copies shall be maintained in the field and available for use by Government personnel until final acceptance of the work.

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 a charge of the cost of the retest 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 Corps of Engineers Division Laboratory, f.o.b., at an address to be identified for each type of test. Coordination for each specific test, exact delivery location, and dates will be made through the Area 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 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.

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 Government daily within 4 hours after the date 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.

3.11.1 Guarantee

The work furnished under this Contract shall be guaranteed against defective materials and workmanship for a period of one (1) year from the date of acceptance by the Government and Alliant Techsystems Incorporated. Upon receipt of written notice from the Government or Alliant Techsystems of failure of any material and/or workmanship during the guarantee period, the contractor shall promptly correct all such faulty material and/or workmanship at no additional cost to Alliant Techsystems Incorporated or the Government.

SECTION 01440 ATTACHMENT NO.1
GUIDE FOR LISTING DEFINABLE FEATURES OF CONSTRUCTION WORK

****** Contractor shall modify this guide to accommodate the project *****

DIVISION 1 - GENERAL REQUIREMENTS

(a) Special Project procedures to include coordination of work, Project meetings, Submittals and Quality Control
(b) Administrative Requirements
(c) Environmental Protection
(d) Historic Preservation
(e) Job Conditions

DIVISION 2 - SITE WORK

(a) Demolition
(b) Removal and Disposal of Asbestos Materials
(c) Excavation, Trenching and Backfilling for Utilities Systems to include sewer gravity drainage and water lines
(d) Clearing and Grubbing, Backfilling for Buildings
(e) Grading
(f) Fence, Chain-Link
(g) Concrete for sidewalks and Curbs
(h) Drilled Pile Foundation
(i) Bituminous Paving
(j) Underground Sprinkler Systems

DIVISION 3 - CONCRETE

(a) Concrete Materials, Concrete Procedures, Concrete Formwork, Forms, Form Ties and Accessories, Concrete Reinforcement, Concrete Accessories to Include Cast-in-Place Concrete, Specially Placed Concrete, Concrete Finishing, Concrete Curing and Grouting
(b) Concrete Restoration and Cleaning
(c) Precast Concrete
(d) Electrical and Mechanical Inserts
(e) Testing
(f) Approval of Samples

DIVISION 4 - MASONRY

(a) Masonry Procedures, Mortar, Mortar Accessories, Unit Masonry, Cavity Wall Construction to Include Bringing Inner and Outer Wythes Up Simultaneously, Reinforcement, Wall Ties, Flashing, Masonry Restoration and Cleaning
(b) Acceptance of Sample Panel for Cavity Wall Construction
(c) Composite Wall Construction
(d) Acceptance of Sample Panel for Composite Wall Construction
(e) CMU Partition Wall Construction to Include Prepared Openings for Ducts, Fire Dampers, Door Frames, Lintels and Bond Beams
(f) Acceptance of CMU Partition Wall Sample Panel
(g) Insulation and Waterproofing
(h) Testing

ATTACHMENT NO.1 (continued)

DIVISION 5 - METALS

(a) Structural Steel Framing To Include Metal Materials and Methods, Metal Fastening, Metal Joints, Welding, Expansion Control and Miscellaneous Metals
(b) Steel Roof Decking
(c) High Strength Bolts

DIVISION 6 - WOODS AND PLASTICS

(a) Rough Carpentry To Include Framing, Prefabricated Structural Wood, Fasteners and Supports, Roof Sheeting, Siding and Sub-Flooring, Insulation and Flashing
(b) Finish Carpentry To Include Wood Treatment, Finish Flooring, Cabinets and Closets

DIVISION 7 - THERMAL AND MOISTURE PROTECTION

(a) Damproofing and Waterproofing
(b) Fireproofing
(c) Insulation, Flashing and Sheet Metal, Roof Accessories, Sealants, Shingles, Roof Tiles and Membrane Roofing (Built-Up and EPDM)

DIVISION 8 - DOORS AND WINDOWS

(a) Metal Doors and Frames, Wood and Plastic Doors, Special Doors, Door Opening Assemblies, Metal Windows, Wood and Plastic Windows, Special Windows, Glazing and Miscellaneous Hardware, Caulking

DIVISION 9 - FINISHES

(a) Ceramic Tile
(b) Gypsum Wallboard To Include Special Framing, Shaft Wall Framing System, Ceiling and Wall Opening
(c) Acoustical Treatment to include Metal Suspension System for Acoustical Tile and Lay-In-Panel Ceiling
(d) Wall Covering
(e) Carpeting
(f) Resilient Flooring
(g) Painting
(h) Furring (Metal)
(i) Plastering

DIVISION 10 - SPECIALTIES

(a) Metal Toilet Partitions
(b) Raised Floor System
(c) Movable Partitions
(d) Wardrobe
(e) Fire Extinguisher Cabinets
(f) Toilet Accessories

ATTACHMENT NO.1 (continued)
DIVISION 11 - EQUIPMENT

(a) Centrifugal pumps
(b) Mixers

DIVISION 12 - FURNISHINGS

(a) Theater Chairs
(b) Blinds
(c) Drapes
(d) Lockers
(e) Training Equipment
(f) Furniture and Accessories
(g) Rugs and Mats
(h) Fabrics

DIVISION 13 - SPECIAL CONSTRUCTION

(a) Stainless Steel Process Tanks
(b) Pre-Engineered Structures
(c)
Energy Monitoring and Control System (EMCS)
(d) Liquid and Gas Storage Tanks
(e) Vaults

DIVISION 14 - CONVEYING SYSTEMS

(a) Shaft Construction To Include Guides and Guide Rails
(b) Car Assembly
(c) Machine Room Layout
(d) Entrances
(e) Operating and Signal Devices
(f) Fire/Emergency Power Operations
(g) Lighting, Power and Wiring
(h) Elevator Power Unit
(i) Acceptance Testing To Include Communications, Safety, Weights, Emergency and Fire Operations, Dispatch System

DIVISION 15 - MECHANICAL

(a) Insulation to Include:
(1) Pipes
(2) Ducts
(3) Equipment
(4) High Density Inserts, Insulation Protective Shields, Clips or U Bolt Supports for Multiple Pipe Hanger Supports
(5) Perimeter Insulation

ATTACHMENT NO. 1 (continued)

(b) Plumbing Systems
(1) Waste/Vent Piping To Include: Underground Soil Piping, Above Ground Soil Piping
(2) Interior Piping Rough-In To Include: Galvanized Black Iron and Copper Including Drains, Fittings, Valves and Piping Supports
(3) Plumbing Fixtures To Include Flush Valves, Faucets and Accessories
(4) Cleaning, Balancing and Operational Testing

(c) Heating systems
(1) Equipment and System Accessories
(2) Hot Water/Steam Piping Supports
(3) Fuel Oil/Gas Piping and Supports
(4) System Testing and Balancing

(d) Air Distribution Systems
(1) Equipment and Accessories
(2) Duct Work To Include Galvanized, Aluminum, Flexible and Fiberglass, Supports, Dampers, Louvers, Diffusers, Duct Line Supports and Fire-Dampers

(e) Refrigeration Systems
(1) Equipment and Accessories
(2) Chilled Water/Condenser Water Piping and Supports
(3) Refrigerant Piping and Supports
(4) System Testing

(f) Automatic Temperature Control Systems
(1) Equipment and Materials
(2) Installation of Materials and Equipment
(3) System Testing

(g) Underground Heat Distribution Systems
(1) Manholes
(2) Piping and Supports
(3) Cathodic Protection

(h) Sprinkler Systems
(1) Equipment
(2) Piping and Supports
(3) Accessories

(i) Water Treatment Systems

(j) Welding - Piping Systems

DIVISION 16 - ELECTRICAL

(a) Exterior Electrical Distribution, Aerial
(1) Pole Setting
(2) Placement of Crossarms, Pins, Insulators, Pole Line Hardware and Conductors
(3) Placement of Fuse Cutouts, Surge Arresters, Reclosers, Potheads, Pole Mounted Transformers to Include Grounding Conductors, Testing and Cable Terminations

(b) Exterior Electrical Distribution, Underground
(1) Duct Line Excavation, Placement of Ducts and Misc. Materials
(2) Placement of In Ground Junction or Pull Boxes and Manholes
(3) Placement of Duct Bank Concrete Encasement
(4) Transformer Pad Placement
(5) Mounting of Pad Mounted Transformers

ATTACHMENT NO.1 (continued)

(6) Cable Placement to Include Splicing, Fire-Proofing and Cable Terminations

(7) Grounding Conductors and Testing

(c) Electrical Distribution, Interior

(1) Wiring Methods to Include Conduit Rough-in, Raceway Boxes, Outlet Boxes, Panelboard Cabinets, Placement of Conductors and Conduit Placement Below the Slab for Slab-On-Grade Construction

(2) Wiring Devices, Panelboards, Switch-Boards and Lighting Fixtures

(3) Motors and Transformers

(4) Testing

(d) Fire Detection and Alarm System

(1) Wiring Methods to Include Conduit, Ground Rods, Detectors, Control Panels, Power Supply, Door Holders, Audible Fire Alarm and Annunciator Panel

(2) Testing

---End of Attachment No.1---

SECTION 01440 ATTACHMENT NO.2
PREPARATORY PHASE CHECKLIST

CONTRACTOR'S NAME (Address)

Contract No.:_____ Date Preparatory Held:_____

Title: _____ Spec Section:_____

_____ Drawing No(s):_____

Definable Feature of Work:_____

_____

A. PERSONNEL PRESENT:

Name	Position	Company
1._____	_____	_____
2._____	_____	_____
3._____	_____	_____
4._____	_____	_____
5._____	_____	_____
6._____	_____	_____
7._____	_____	_____
8._____	_____	_____

(List additional personnel on reverse side)

B. DRAWINGS AND SPECS:

I. Has each spec paragraph, contract drawing, and shop drawing been studied? YES _____ NO _____

II. Do all parties have up-to-date drawings and specifications?
YES _____ NO_____

C. SHOP DRAWINGS INVOLVED:

Transmittal/Item	Code	Contractor or Gov't Approval
1. _____	_____	_____
2. _____	_____	_____
3. _____	_____	_____
4. _____	_____	_____

ATTACHMENT NO.2 (continued)

D. MATERIALS:

I. Are all materials on hand? YES _____ NO _____

II. Have all materials been checked for contract compliance against approved shop drawings? YES _____ NO _____

III. Items not on hand or not in accordance with transmittals (if not on hand, check during initial phase):

1. _____

2. _____

3. _____

4. _____

E. TESTS required in accordance with contract requirements:

Test/Paragraph	Frequency
1. _____	_____
2. _____	_____
3. _____	_____
4. _____	_____
5. _____	_____
6. _____	_____

F. ACCIDENT PREVENTION: Has Hazard Analysis been completed?
YES _____ NO _____
If yes, attach a copy, if no, explain:

_____

_____

_____

_____

_____

ATTACHMENT NO.2 (continued)

G. EQUIPMENT Requiring Operational Check:

1._____

2._____

3._____

4._____

H. WORKMANSHIP: Have procedures for accomplishing work been reviewed with appropriate people? YES _____ NO _____

I. PREVIOUS WORK: Has all preliminary work been accomplished in accordance with contract requirements and is this feature of work ready to start? YES _____ NO _____

Explain any problems: _____

_____

_____

_____

J. HI-LIGHTING SPECIFIC ITEMS: Hi-light specific items noted during the Preparatory Phase inspection. ie, (Med. Voltage cable shall be hi-pot tested).

K. OTHER COMMENTS: _____

_____

_____

_____

_____
Quality Control Representative
Signature

SECTION 01440 ATTACHMENT NO.3
INITIAL PHASE CHECKLIST

CONTRACTOR'S NAME (Address)

Contract No.:_____ Date Initial Held: _____

Title:_____ Spec Section:_____

Drawing No(s).:_____

Definable Feature of Work:_____

_____

_____

A. PERSONNEL PRESENT:

Name Position Company

1._____

2._____

3._____

4._____

5._____

6._____

B. MATERIALS being used are in strict accordance with the contract plans and specifications? YES _____ NO _____

If not, explain:_____

_____

_____

_____

ATTACHMENT NO.3 (continued)

C. WORKMANSHIP:

I. Procedures and/or work methods witnessed are in strict compliance with the requirement of the contract specifications? YES _____ NO _____

If not, explain: _____

_____

_____

II. Workmanship is acceptable? YES _____ NO _____

State area where improvement is needed: _____

_____

_____

D. SAFETY violations and corrective action taken:_____

_____

_____

E. COMMENTS: _____

_____

_____

_____

_____

_____
Quality Control Representative
Signature

SECTION 01440 ATTACHMENT NO.4
DAILY CONSTRUCTION QUALITY CONTROL REPORT
(Sample of Typical Contractor Daily Quality Control Report)

CONTRACTORS NAME (Address)

Date _____ Report No. _____ Contract No. DAC( )
65-__-C-_____ Project Name and Location of work: _____

Weather:Clear P.Cloudy Cloudy Rain: ___ inches Temp.____min.____max. Other
Weather Conditions _____

1. Contractor (C) or Sub-contractor (S), and Area of Responsibility:

a. ( )_____
b. ( )_____
c. ( )_____
d. ( )_____
e. ( )_____

2. Equipment Data. (Indicate items of construction equipment, other than hand tools, at the job site and whether or not used):

_____
_____
_____
_____

3. Work Performed Today (Indicate identity of Contractor and Sub-contractors, location , and description of work:

_____
_____
_____
_____

4. Results of Surveillance: (Include satisfactory work completed, or deficiencies with action to be taken):

a. Preparatory Phase:_____
_____
_____
_____

b. Initial Phase:_____
_____
_____
_____

c. Follow-up Phase:_____
_____
_____
_____

DAILY CONSTRUCTION QUALITY CONTROL REPORT (Continued)

5. Tests performed as required by plans and specifications and the results:

_____
_____
_____

6. Verbal instructions received (List instructions given by Government personnel on construction deficiencies, retesting required, etc. Include the name of Government person, time and place instructions given, and action taken to comply:

_____
_____
_____

7. Job Safety (Include deficiencies and corrective action taken:

_____
_____
_____

8. Equipment Data (Indicate items of construction equipment, other than hand tools, at the job site, and whether or not used):_____

_____
_____
_____

9. Material and equipment items that arrived at the job site. Indicate compliance or non-compliance of these items with approved shop drawings, the contract plans and specifications, and the storage of the item is required prior to the time of installation, indicate how this storage was provided and whether or not it is adequate:_____

_____
_____

10. Remarks (Cover any conflicts in the plans and specifications, instructions, or delays):_____

_____

_____

CONTRACTOR'S VERIFICATION: THE ABOVE REPORT IS COMPLETE AND ALL DATA LISTED IS CORRECT. ALL MATERIALS PROVIDED, EQUIPMENT USED, AND WORKMANSHIP FOR THIS REPORTING PERIOD ARE IN COMPLIANCE WITH THE CONTRACT PLANS AND SPECIFICATIONS EXCEPT AS NOTED ABOVE.

SIGNED

_____ CONTRACTOR'S QC SYSTEM MANAGER

SECTION 01440 ATTACHMENT NO.5
TEST REPORT

CONTRACTOR'S NAME (Address)

STRUCTURE OR BUILDING_____
CONTRACT NO._____

DESCRIPTION OF ITEM, SYSTEM OR PART OF SYSTEM TESTED:_____
_____
_____
_____
_____

DESCRIPTION OF TEST:_____
_____
_____
_____
_____

NAME AND TITLE OF PERSON IN CHARGE OF PERFORMING TESTS FOR CONTRACTOR:

NAME_____

TITLE_____

SIGNATURE_____

I HEREBY CERTIFY THAT THE ABOVE DESCRIBED ITEM, SYSTEM OR PART OF SYSTEM HAS BEEN TESTED AS INDICATED ABOVE AND FOUND TO BE ENTIRELY SATISFACTORY AS REQUIRED IN THE CONTRACT SPECIFICATIONS.

SIGNATURE OF CONTRACTOR QUALITY CONTROL INSPECTOR

_____

DATE_____

REMARKS:_____
_____
_____
_____
_____

SECTION 01440 ATTACHMENT NO. 6
DEFICIENCY TRACKING LOG

_____ Construction Deficiency Contract No. _____
_____ Safety Deficiency Project Title _____

Date Reported	Reported By	Deficient Work	Description of Corrective Actions Taken	Date Corrected	Verified By

-- End of Section --

SECTION 01500A

TEMPORARY CONSTRUCTION FACILITIES
02/97

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

1.1.1 Site Plan

The Contractor shall prepare a site plan indicating the proposed location and dimensions of any area to be fenced and used by the Contractor, the number of trailers to be used, avenues of ingress/egress to the fenced area and details of the fence installation. Any areas which may have to be graveled to prevent the tracking of mud shall also be identified. The Contractor shall also indicate if the use of a supplemental or other staging area is desired.

1.1.2 Identification of Employees

The Contractor shall be responsible for furnishing to each employee, and for requiring each employee engaged on the work to display, identification as approved and directed by the Contracting Officer. Prescribed identification shall immediately be delivered to the Contracting Officer for cancellation upon release of any employee. When required, the Contractor shall obtain and provide fingerprints of persons employed on the project. Contractor and subcontractor personnel shall wear identifying markings on hard hats clearly identifying the company for whom the employee works.

1.1.3 Employee Parking

Contractor employees shall park privately owned vehicles in an area designated by the Contracting Officer. This area will not necessarily be within reasonable walking distance of the construction site. The contractor shall provide transportation between the parking area and the construction site. Contractor employee parking shall not interfere with existing and established parking requirements of the military installation.

1.2 AVAILABILITY AND USE OF UTILITY SERVICES

1.2.1 Payment for Utility Services

The Government will make all reasonably required 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.

1.2.2 Meters and Temporary Connections

The Contractor, at its expense and in a manner satisfactory to the

Contracting Officer, shall provide and maintain necessary temporary connections, distribution lines, and meter bases (Government will provide meters) required to measure the amount of each utility used for the purpose of determining charges. The Contractor shall notify the Contracting Officer, in writing, 5 working days before final electrical connection is desired so that a utilities contract can be established. The Government will provide a meter and make the final hot connection after inspection and approval of the Contractor's temporary wiring installation. The Contractor shall not make the final electrical connection.

1.2.3 Advance Deposit

An advance deposit for utilities consisting of an estimated month's usage or a minimum of $50.00 will be required. The last monthly bills for the fiscal year will normally be offset by the deposit and adjustments will be billed or returned as appropriate. Services to be rendered for the next fiscal year, beginning 1 October, will require a new deposit. Notification of the due date for this deposit will be mailed to the Contractor prior to the end of the current fiscal year.

1.2.4 Final Meter Reading

Before completion of the work and final acceptance of the work by the Government, the Contractor shall notify the Contracting Officer, in writing, 5 working days before termination is desired. The Government will take a final meter reading, disconnect service, and remove the meters. The Contractor shall then remove all the temporary distribution lines, meter bases, and associated paraphernalia. The Contractor shall pay all outstanding utility bills before final acceptance of the work by the Government.

1.2.5 Sanitation

The Contractor shall provide and maintain within the construction area minimum field-type sanitary facilities approved by the Contracting Officer. Government toilet facilities will not be available to Contractor's personnel.

1.2.6 Telephone

The Contractor shall make arrangements and pay all costs for telephone facilities desired.

1.3 Safety Indoctrination Certificates

The Contractor shall obtain from each of his employees, prior to his employment at the Radford Army Ammunition Plant, a signed certificate indicating that the employee has read and understands a statement prepared by the Plant Commander setting forth the hazards and restrictions incident to construction operations in buildings used for powder production. The certificates shall be delivered to the CO on the first day the employee is admitted to the Radford Army Ammunition Plant.

1.4 BULLETIN BOARD, PROJECT SIGN, AND PROJECT SAFETY SIGN (See Attachement 1)

1.4.1 Bulletin Board

Immediately upon beginning of work, the Contractor shall provide a

weatherproof glass-covered bulletin board not less than 36 by 48 inches in size for displaying the Equal Employment Opportunity poster, a copy of the wage decision contained in the contract, Wage Rate Information poster, and other information approved by the Contracting Officer. The bulletin board shall be located at the project site in a conspicuous place easily accessible to all employees, as approved by the Contracting Officer. Legible copies of the aforementioned data shall be displayed until work is completed. Upon completion of work the bulletin board shall be removed by and remain the property of the Contractor.

1.4.2 Project and Safety Signs

The requirements for the signs, their content, and location shall be as shown on the drawings. The signs shall be erected within 15 days after receipt of the notice to proceed. The data required by the safety sign shall be corrected daily, with light colored metallic or non-metallic numerals. Upon completion of the project, the signs shall be removed from the site.

1.5 PROTECTION AND MAINTENANCE OF TRAFFIC

During construction the Contractor shall provide access and temporary relocated roads as necessary to maintain traffic. The Contractor shall maintain and protect traffic on all affected roads during the construction period except as otherwise specifically directed by the Contracting Officer. Measures for the protection and diversion of traffic, including the provision of watchmen and flagmen, erection of barricades, placing of lights around and in front of equipment and the work, and the erection and maintenance of adequate warning, danger, and direction signs, shall be as required by the State and local authorities having jurisdiction. The traveling public shall be protected from damage to person and property. The Contractor's traffic on roads selected for hauling material to and from the site shall interfere as little as possible with public traffic. The Contractor shall investigate the adequacy of existing roads and the allowable load limit on these roads. The Contractor shall be responsible for the repair of any damage to roads caused by construction operations.

1.5.1 Haul Roads

The Contractor shall, at its own expense, construct access and haul roads necessary for proper prosecution of the work under this contract. Haul roads shall be constructed with suitable grades and widths; sharp curves, blind corners, and dangerous cross traffic shall be avoided. The Contractor shall provide necessary lighting, signs, barricades, and distinctive markings for the safe movement of traffic. The method of dust control, although optional, shall be adequate to ensure safe operation at all times. Location, grade, width, and alignment of construction and hauling roads shall be subject to approval by the Contracting Officer. Lighting shall be adequate to assure full and clear visibility for full width of haul road and work areas during any night work operations. Upon completion of the work, haul roads designated by the Contracting Officer shall be removed.

1.5.2 Barricades

The Contractor shall erect and maintain temporary barricades to limit public access to hazardous areas. Such barricades shall be required whenever safe public access to paved areas such as roads, parking areas or sidewalks is prevented by construction activities or as otherwise necessary

to ensure the safety of both pedestrian and vehicular traffic. Barricades shall be securely placed, clearly visible with adequate illumination to provide sufficient visual warning of the hazard during both day and night.

1.6 CONTRACTOR'S TEMPORARY FACILITIES

1.6.1 Administrative Field Offices

The Contractor shall provide and maintain administrative field office facilities within the construction area at the designated site. Government office and warehouse facilities will not be available to the Contractor's personnel.

1.6.2 Storage Area

The Contractor shall construct a temporary 6 foot high chain link fence around trailers and materials. The fence shall include plastic strip inserts, colored green, so that visibility through the fence is obstructed. Fence posts may be driven, in lieu of concrete bases, where soil conditions permit. Trailers, materials, or equipment shall not be placed or stored outside the fenced area unless such trailers, materials, or equipment are assigned a separate and distinct storage area by the Contracting Officer away from the vicinity of the construction site but within the military boundaries. Trailers, equipment, or materials shall not be open to public view with the exception of those items which are in support of ongoing work on any given day. Materials shall not be stockpiled outside the fence in preparation for the next day's work. Mobile equipment, such as tractors, wheeled lifting equipment, cranes, trucks, and like equipment, shall be parked within the fenced area at the end of each work day.

1.6.3 Supplemental Storage Area

Upon Contractor's request, the Contracting Officer will designate another or supplemental area for the Contractor's use and storage of trailers, equipment, and materials. This area may not be in close proximity of the construction site but shall be within the military boundaries. Fencing of materials or equipment will not be required at this site; however, the Contractor shall be responsible for cleanliness and orderliness of the area used and for the security of any material or equipment stored in this area. Utilities will not be provided to this area by the Government.

1.6.4 Appearance of Trailers

Trailers utilized by the Contractor for administrative or material storage purposes shall present a clean and neat exterior appearance and shall be in a state of good repair. Trailers which, in the opinion of the Contracting Officer, require exterior painting or maintenance will not be allowed on the military property.

1.6.5 Maintenance of Storage Area

Fencing shall be kept in a state of good repair and proper alignment. Should the Contractor elect to traverse, with construction equipment or other vehicles, grassed or unpaved areas which are not established roadways, such areas shall be covered with a layer of gravel as necessary to prevent rutting and the tracking of mud onto paved or established roadways; gravel gradation shall be at the Contractor's discretion. Grass located within the boundaries of the construction site shall be mowed for

the duration of the project. Grass and vegetation along fences, buildings, under trailers, and in areas not accessible to mowers shall be edged or trimmed neatly.

1.6.6 New Building

In the event a new building is constructed for the temporary project field office, it shall be a minimum 12 feet in width, 16 feet in length and have a minimum of 7 feet headroom. It shall be equipped with approved electrical wiring, at least one double convenience outlet and the required switches and fuses to provide 110-120 volt power. It shall be provided with a work table with stool, desk with chair, two additional chairs, and one legal size file cabinet that can be locked. The building shall be waterproof, shall be supplied with heater, shall have a minimum of two doors, electric lights, a telephone, a battery operated smoke detector alarm, a sufficient number of adjustable windows for adequate light and ventilation, and a supply of approved drinking water. Approved sanitary facilities shall be furnished. The windows and doors shall be screened and the doors provided with dead bolt type locking devices or a padlock and heavy duty hasp bolted to the door. Door hinge pins shall be non-removable. The windows shall be arranged to open and to be securely fastened from the inside. Glass panels in windows shall be protected by bars or heavy mesh screens to prevent easy access to the building through these panels. In warm weather, air conditioning capable of maintaining the office at 50 percent relative humidity and a room temperature 20 degrees F below the outside temperature when the outside temperature is 95 degrees F, shall be furnished. Any new building erected for a temporary field office shall be maintained by the Contractor during the life of the contract and upon completion and acceptance of the work shall become the property of the Contractor and shall be removed from the site. All charges for telephone service for the temporary field office shall be borne by the Contractor, including long distance charges up to a maximum of $75.00 per month.

1.6.7 Security Provisions

Adequate outside security lighting shall be provided at the Contractor's temporary facilities. The Contractor shall be responsible for the security of its own equipment; in addition, the Contractor shall notify the appropriate law enforcement agency requesting periodic security checks of the temporary project field office.

1.7 GOVERNMENT FIELD OFFICE

1.7.1 Resident Engineer's Office

The Resident Engineer office is located on Radford Army Ammunition Plant, Bldg 449.

1.7.2 Trailer-Type Mobile Office

N/A.

1.8 PLANT COMMUNICATION

Whenever the Contractor has the individual elements of its plant so located that operation by normal voice between these elements is not satisfactory, the Contractor shall install a satisfactory means of communication, such as telephone or other suitable devices. The devices shall be made available for use by Government personnel.

1.9 TEMPORARY PROJECT SAFETY FENCING

As soon as practicable, but not later than 15 days after the date established for commencement of work, the Contractor shall furnish and erect temporary project safety fencing at the work site. The safety fencing shall be a high visibility orange colored, high density polyethylene grid or approved equal, a minimum of 42 inches high, supported and tightly secured to steel posts located on maximum 10 foot centers, constructed at the approved location. The safety fencing shall be maintained by the Contractor during the life of the contract and, upon completion and acceptance of the work, shall become the property of the Contractor and shall be removed from the work site.

1.10 CLEANUP

Construction debris, waste materials, packaging material and the like shall be removed from the work site daily. Any dirt or mud which is tracked onto paved or surfaced roadways shall be cleaned away. Materials resulting from demolition activities which are salvageable shall be stored within the fenced area described above or at the supplemental storage area. Stored material not in trailers, whether new or salvaged, shall be neatly stacked when stored.

1.11 RESTORATION OF STORAGE AREA

Upon completion of the project and after removal of trailers, materials, and equipment from within the fenced area, the fence shall be removed and will become the property of the Contractor. Areas used by the Contractor for the storage of equipment or material, or other use, shall be restored to the original or better condition. Gravel used to traverse grassed areas shall be removed and the area restored to its original condition, including top soil and seeding as necessary.

-- End of Section --

SECTION 01780A

CLOSEOUT SUBMITTALS
11/99

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. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. "TSCS" is the code for the Radford Area Office. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

As-Built Drawings; G, TSCS

Drawings showing final as-built conditions of the project. The final CADD as-built drawings shall consist of one set of electronic CADD drawing files in the specified format, one set of mylar drawings, 2 sets of blue-line prints of the mylars, and one set of the approved working as-built drawings.

SD-03 Product Data

As-Built Record of Equipment and Materials; G, TSCS

Two copies of the record listing the as-built materials and equipment incorporated into the construction of the project.

Warranty Management Plan; TSCS

One set of the warranty management plan containing information relevant to the warranty of materials and equipment incorporated into the construction project, including the starting date of warranty of construction. The Contractor shall furnish with each warranty the name, address, and telephone number of each of the guarantor's representatives nearest to the project location.

Warranty Tags; TSCS

Two record copies of the warranty tags showing the layout and design.

Final Cleaning; TSCS

Two copies of the listing of completed final clean-up items.

1.2 PROJECT RECORD DOCUMENTS

1.2.1 As-Built Drawings

This paragraph covers as-built drawings complete, as a requirement of the

contract. The terms "drawings," "contract drawings," "drawing files," "working as-built drawings" and "final as-built drawings" refer to contract drawings which are revised to be used for final as-built drawings.

1.2.1.1 Government Furnished Materials

One set of electronic CADD files in the specified software and format revised to reflect all bid amendments will be provided by the Government at the preconstruction conference for projects requiring CADD file as-built drawings.

1.2.1.2 Working As-Built and Final As-Built Drawings

The Contractor shall revise 2 sets of paper drawings by red-line process to show the as-built conditions during the prosecution of the project. These working as-built marked drawings shall be kept current on a weekly basis and at least one set shall be available on the jobsite at all times. Changes from the contract plans which are made in the work or additional information which might be uncovered in the course of construction shall be accurately and neatly recorded as they occur by means of details and notes. Final as-built drawings shall be prepared after the completion of each definable feature of work as listed in the Contractor Quality Control Plan (Foundations, Utilities, Structural Steel, etc., as appropriate for the project). The working as-built marked prints and final as-built drawings will be jointly reviewed for accuracy and completeness by the Contracting Officer and the Contractor prior to submission of each monthly pay estimate. If the Contractor fails to maintain the working and final as-built drawings as specified herein, the Contracting Officer will deduct from the monthly progress payment an amount representing the estimated cost of maintaining the as-built drawings. This monthly deduction will continue until an agreement can be reached between the Contracting Officer and the Contractor regarding the accuracy and completeness of updated drawings. The working and final as-built drawings shall show, but shall not be limited to, the following information:

a. The actual location, kinds and sizes of all sub-surface utility lines. In order that the location of these lines and appurtenances may be determined in the event the surface openings or indicators become covered over or obscured, the as-built drawings shall show, by offset dimensions to two permanently fixed surface features, the end of each run including each change in direction. Valves, splice boxes and similar appurtenances shall be located by dimensioning along the utility run from a reference point. The average depth below the surface of each run shall also be recorded.

b. The location and dimensions of any changes within the building structure.

c. Correct grade, elevations, cross section, or alignment of roads, earthwork, structures or utilities if any changes were made from contract plans.

d. Changes in details of design or additional information obtained from working drawings specified to be prepared and/or furnished by the Contractor; including but not limited to fabrication, erection, installation plans and placing details, pipe sizes, insulation material, dimensions of equipment foundations, etc.

e. The topography, invert elevations and grades of drainage installed or affected as part of the project construction.

f. Changes or modifications which result from the final inspection.

g. Where contract drawings or specifications present options, only the option selected for construction shall be shown on the final as-built prints.

h. If borrow material for this project is from sources on Government property, or if Government property is used as a spoil area, the Contractor shall furnish a contour map of the final borrow pit/spoil area elevations.

i. Systems designed or enhanced by the Contractor, such as HVAC controls, fire alarm, fire sprinkler, and irrigation systems.

j. Modifications (change order price shall include the Contractor's cost to change working and final as-built drawings to reflect modifications) and compliance with the following procedures.

(1) Directions in the modification for posting descriptive changes shall be followed.

(2) A Modification Circle shall be placed at the location of each deletion.

(3) For new details or sections which are added to a drawing, a Modification Circle shall be placed by the detail or section title.

(4) For minor changes, a Modification Circle shall be placed by the area changed on the drawing (each location).

(5) For major changes to a drawing, a Modification Circle shall be placed by the title of the affected plan, section, or detail at each location.

(6) For changes to schedules or drawings, a Modification Circle shall be placed either by the schedule heading or by the change in the schedule.

(7) The Modification Circle size shall be 1/2 inch diameter unless the area where the circle is to be placed is crowded. Smaller size circle shall be used for crowded areas.

1.2.1.3 Drawing Preparation

The as-built drawings shall be modified as may be necessary to correctly show the features of the project as it has been constructed by bringing the contract set into agreement with approved working as-built prints, and adding such additional drawings as may be necessary. These working as-built marked prints shall be neat, legible and accurate. These drawings are part of the permanent records of this project and shall be returned to the Contracting Officer after approval by the Government. Any drawings damaged or lost by the Contractor shall be satisfactorily replaced by the Contractor at no expense to the Government.

1.2.1.4 Computer Aided Design and Drafting (CADD) Drawings

Only personnel proficient in the preparation of CADD drawings shall be employed to modify the contract drawings or prepare additional new drawings. Additions and corrections to the contract drawings shall be

equal in quality and detail to that of the originals. Line colors, line weights, lettering, layering conventions, and symbols shall be the same as the original line colors, line weights, lettering, layering conventions, and symbols. If additional drawings are required, they shall be prepared using the specified electronic file format applying the same graphic standards specified for original drawings. The title block and drawing border to be used for any new final as-built drawings shall be identical to that used on the contract drawings. Additions and corrections to the contract drawings shall be accomplished using CADD files. The electronic files will be supplied on compact disc, read-only memory (CD-ROM). The Contractor shall be responsible for providing all program files and hardware necessary to prepare final as-built drawings. The Contracting Officer will review final as-built drawings for accuracy and the Contractor shall make required corrections, changes, additions, and deletions.

a. CADD colors shall be the "base" colors of red, green, and blue. Color code for changes shall be as follows:

(1) Deletions (red) - Deleted graphic items (lines) shall be colored red with red lettering in notes and leaders.

(2) Additions (Green) - Added items shall be drawn in green with green lettering in notes and leaders.

(3) Special (Blue) - Items requiring special information, coordination, or special detailing or detailing notes shall be in blue.

b. The Contract Drawing files shall be renamed in a manner related to the contract number (i.e., 98-C-10.DGN) as instructed in the Pre-Construction conference. Marked-up changes shall be made only to those renamed files. All changes shall be made on the layer/level as the original item. There shall be no deletions of existing lines; existing lines shall be over struck in red. Additions shall be in green with line weights the same as the drawing. Special notes shall be in blue on layer #63.

c. When final revisions have been completed, the cover sheet drawing shall show the wording "RECORD DRAWING AS-BUILT" followed by the name of the Contractor in letters at least 3/16 inch high. All other contract drawings shall be marked either "AS-Built" drawing denoting no revisions on the sheet or "Revised As-Built" denoting one or more revisions. Original contract drawings shall be dated in the revision block.

d. Within 10 days for contracts less than $5 million after Government approval of all of the working as-built drawings for a phase of work, the Contractor shall prepare the final CADD as-built drawings for that phase of work and submit two sets of blue-lined prints of these drawings for Government review and approval. The Government will promptly return one set of prints annotated with any necessary corrections. Within 7 days for contracts less than $5 million the Contractor shall revise the CADD files accordingly at no additional cost and submit one set of final prints for the completed phase of work to the Government. Within 10 days for contracts less than $5 million of substantial completion of all phases of work, the Contractor shall submit the final as-built drawing package for the entire project. The submittal shall consist of one set of electronic files on compact disc, read-only memory (CD-ROM), one set of mylars, two sets of blue-line prints and one set of the approved working as-built drawings. They shall be complete in all details and identical in form and

function to the contract drawing files supplied by the Government. Any transactions or adjustments necessary to accomplish this is the responsibility of the Contractor. The Government reserves the right to reject any drawing files it deems incompatible with the customer's CADD system. Paper prints, drawing files and storage media submitted will become the property of the Government upon final approval. Failure to submit final as-built drawing files and marked prints as specified shall be cause for withholding any payment due the Contractor under this contract. Approval and acceptance of final as-built drawings shall be accomplished before final payment is made to the Contractor.

1.2.1.5 Manually Prepared Drawings

Only personnel proficient in the preparation of manually prepared drawings shall be employed to modify the original contract drawing or prepare additional new drawings. Additions and corrections to the contract drawings shall be neat, clean and legible, shall be done to the same level of detail, and shall match the adjacent existing line work, and lettering being annotated in type, density, size and style. Drafting work shall be done using the same medium (pencil, plastic lead or ink) that was employed on the original contract drawings and with graphite lead on paper base material. The Contracting Officer will review as-built drawings for accuracy and conformance to the above specified drafting standards. Corrections, changes, additions, and deletions required shall meet these standards. The title block to be used for any new as-built drawings shall be similar to that used on the original drawings.

a. When final revisions have been completed, each drawing shall be lettered or stamped with the words "RECORD DRAWING AS-BUILT" followed by the name of the Contractor in letters at least 3/16 inch high. Original contract drawings shall be marked either "As-Built" drawings denoting no revisions on the sheet or "Revised As-Built" denoting one or more revisions All original contract drawings shall be dated in the revision block.

b. Within10 days for contracts less than $5 million after Government approval of all of the working as-built drawings for a phase of work, the Contractor shall prepare the final as-built drawings for that phase of work and submit two sets of blue-line prints of these drawings for Government review and approval. The Government will promptly return one set of prints annotated with any necessary corrections. Within 7 days for contracts less than $5 million the Contractor shall revise the drawings accordingly at no additional cost and submit one set of final prints for the completed phase of work to the Government. Within 10 days for contracts less than $5 million of substantial completion of all phases of work, the Contractor shall submit the final as-built drawing package for the entire project. The submittal shall consist of the completed final as-built drawings, two blue-line prints of these drawings and the return of the approved marked as-built prints. The drawings shall be complete in all details. Paper prints and reproducible drawings will become the property of the Government upon final approval. Failure to submit final as-built drawings and marked prints, as required herein, will be cause for withholding any payment due the Contractor under this contract. Approval and acceptance of final as-built drawings shall be accomplished before final payment is made to the Contractor.

1.2.1.6 Payment

No separate payment will be made for as-built drawings required under this contract, and all costs accrued in connection with such drawings shall be

considered a subsidiary obligation of the Contractor.

1.2.2 As-Built Record of Equipment and Materials

The Contractor shall furnish one copy of preliminary record of equipment and materials used on the project 15 days prior to final inspection. This preliminary submittal will be reviewed and returned 2 days after final inspection with Government comments. Two sets of final record of equipment and materials shall be submitted 10 days after final inspection. The designations shall be keyed to the related area depicted on the contract drawings. The record shall list the following data:

RECORD OF DESIGNATED EQUIPMENT AND MATERIALS DATA

Description	Specification Section	Manufacturer and Catalog, Model, and Serial Number	Composition and Size	Where Used

1.2.3 Final Approved Shop Drawings

The Contractor shall furnish final approved project shop drawings 30 days after transfer of the completed facility.

1.2.4 Construction Contract Specifications

The Contractor shall furnish final as-built construction contract specifications, including modifications thereto, 30 days after transfer of the completed facility.

1.2.5 Real Property Equipment

The Contractor shall furnish a list of installed equipment furnished under this contract. The list shall include all information usually listed on manufacturer's name plate. The "EQUIPMENT-IN-PLACE LIST" shall include, as applicable, the following for each piece of equipment installed: description of item, location (by room number), model number, serial number, capacity, name and address of manufacturer, name and address of equipment supplier, condition, spare parts list, manufacturer's catalog, and warranty. A draft list shall be furnished at time of transfer. The final list shall be furnished 30 days after transfer of the completed facility.

1.3 WARRANTY MANAGEMENT

1.3.1 Warranty Management Plan

The Contractor shall develop a warranty management plan which shall contain information relevant to the Warranty of Construction contract clause. At least 30 days before the planned pre-warranty conference, the Contractor shall submit the warranty management plan for Government approval and to TSCS. The warranty management plan shall include all required actions and documents to assure that the Government receives all warranties to which it is entitled. The plan shall be in narrative form and contain sufficient detail to render it suitable for use by future maintenance and repair personnel, whether tradesmen, or of engineering background, not necessarily familiar with this contract. The term "status" as indicated below shall include due date and whether item has been submitted or was accomplished. Warranty information made available during the construction phase shall be

submitted to the Contracting Officer for approval prior to each monthly pay estimate. Approved information shall be assembled in a binder and shall be turned over to the Government upon acceptance of the work. The construction warranty period shall begin on the date of project acceptance and shall continue for the full product warranty period. A joint 4 month and 9 month warranty inspection shall be conducted, measured from time of acceptance, by the Contractor, Contracting Officer and the Customer Representative. Information contained in the warranty management plan shall include, but shall not be limited to, the following:

a. Roles and responsibilities of all personnel associated with the warranty process, including points of contact and telephone numbers within the organizations of the Contractors, subcontractors, manufacturers or suppliers involved.

b. Listing and status of delivery of all Certificates of Warranty for extended warranty items, to include roofs, HVAC balancing, pumps, motors, transformers, and for all commissioned systems such as fire protection and alarm systems, sprinkler systems, lightning protection systems, etc.

c. A list for each warranted equipment, item, feature of construction or system indicating:

1. Name of item.
2. Model and serial numbers.
3. Location where installed.
4. Name and phone numbers of manufacturers or suppliers.
5. Names, addresses and telephone numbers of sources of spare parts.
6. Warranties and terms of warranty. This shall include one-year overall warranty of construction. Items which have extended warranties shall be indicated with separate warranty expiration dates.
7. Cross-reference to warranty certificates as applicable.
8. Starting point and duration of warranty period.
9. Summary of maintenance procedures required to continue the warranty in force.
10. Cross-reference to specific pertinent Operation and Maintenance manuals.
11. Organization, names and phone numbers of persons to call for warranty service.
12. Typical response time and repair time expected for various warranted equipment.

d. The Contractor's plans for attendance at the 4 and 9 month post-construction warranty inspections conducted by the Government.

e. Procedure and status of tagging of all equipment covered by extended warranties.

f. Copies of instructions to be posted near selected pieces of equipment where operation is critical for warranty and/or safety reasons.

1.3.2 Performance Bond

The Contractor's Performance Bond shall remain effective throughout the construction period.

a. In the event the Contractor fails to commence and diligently

pursue any construction warranty work required, the Contracting Officer will have the work performed by others, and after completion of the work, will charge the remaining construction warranty funds of expenses incurred by the Government while performing the work, including, but not limited to administrative expenses.

b. In the event sufficient funds are not available to cover the construction warranty work performed by the Government at the Contractor's expense, the Contracting Officer will have the right to recoup expenses from the bonding company.

c. Following oral or written notification of required construction warranty repair work, the Contractor shall respond in a timely manner. Written verification will follow oral instructions. Failure of the Contractor to respond will be cause for the Contracting Officer to proceed against the Contractor.

1.3.3 Pre-Warranty Conference

Prior to contract completion, and at a time designated by the Contracting Officer, the Contractor shall meet with the Contracting Officer to develop a mutual understanding with respect to the requirements of this section. Communication procedures for Contractor notification of construction warranty defects, priorities with respect to the type of defect, reasonable time required for Contractor response, and other details deemed necessary by the Contracting Officer for the execution of the construction warranty shall be established/reviewed at this meeting. In connection with these requirements and at the time of the Contractor's quality control completion inspection, the Contractor shall furnish the name, telephone number and address of a licensed and bonded company which is authorized to initiate and pursue construction warranty work action on behalf of the Contractor. This point of contact will be located within the local service area of the warranted construction, shall be continuously available, and shall be responsive to Government inquiry on warranty work action and status. This requirement does not relieve the Contractor of any of its responsibilities in connection with other portions of this provision.

1.3.4 Contractor's Response to Construction Warranty Service Requirements

Following oral or written notification by the Contracting Officer, the Contractor shall respond to construction warranty service requirements in accordance with the "Construction Warranty Service Priority List" and the three categories of priorities listed below. The Contractor shall submit a report on any warranty item that has been repaired during the warranty period. The report shall include the cause of the problem, date reported, corrective action taken, and when the repair was completed. If the Contractor does not perform the construction warranty within the timeframes specified, the Government will perform the work and backcharge the construction warranty payment item established.

a. First Priority Code 1. Perform onsite inspection to evaluate situation, and determine course of action within 4 hours, initiate work within 6 hours and work continuously to completion or relief.

b. Second Priority Code 2. Perform onsite inspection to evaluate situation, and determine course of action within 8 hours, initiate work within 24 hours and work continuously to completion or relief.

c. Third Priority Code 3. All other work to be initiated within 3

work days and work continuously to completion or relief.

d. The "Construction Warranty Service Priority List" is as follows:

Code 1-Air Conditioning Systems
(1) Recreational support.
(2) Air conditioning leak in part of building, if causing damage.
(3) Air conditioning system not cooling properly.

Code 1-Doors
(1) Overhead doors not operational, causing a security, fire, or safety problem.
(2) Interior, exterior personnel doors or hardware, not functioning properly, causing a security, fire, or safety problem.

Code 3-Doors
(1) Overhead doors not operational.
(2) Interior/exterior personnel doors or hardware not functioning properly.

Code 1-Electrical
(1) Power failure (entire area or any building operational after 1600 hours).
(2) Security lights
(3) Smoke detectors

Code 2-Electrical
(1) Power failure (no power to a room or part of building).
(2) Receptacle and lights (in a room or part of building).

Code 3-Electrical
Street lights.

Code 1-Gas
(1) Leaks and breaks.
(2) No gas to family housing unit or cantonment area.

Code 1-Heat
(1). Area power failure affecting heat.
(2). Heater in unit not working.

Code 2-Kitchen Equipment
(1) Dishwasher not operating properly.
(2) All other equipment hampering preparation of a meal.

Code 1-Plumbing
(1) Hot water heater failure.
(2) Leaking water supply pipes.

Code 2-Plumbing
(1) Flush valves not operating properly.
(2) Fixture drain, supply line to commode, or any water pipe leaking.
(3) Commode leaking at base.

Code 3 -Plumbing
Leaky faucets.

Code 3-Interior

(1) Floors damaged.
(2) Paint chipping or peeling.
(3) Casework.

Code 1-Roof Leaks
Temporary repairs will be made where major damage to property is occurring.

Code 2-Roof Leaks
Where major damage to property is not occurring, check for location of leak during rain and complete repairs on a Code 2 basis.

Code 2-Water (Exterior)
No water to facility.

Code 2-Water (Hot)
No hot water in portion of building listed.

Code 3-All other work not listed above.

1.3.5 Warranty Tags

At the time of installation, each warranted item shall be tagged with a durable, oil and water resistant tag approved by the Contracting Officer. Each tag shall be attached with a copper wire and shall be sprayed with a silicone waterproof coating. The date of acceptance and the QC signature shall remain blank until project is accepted for beneficial occupancy. The tag shall show the following information.

a. Type of product/material_____.

b. Model number_____.

c. Serial number_____.

d. Contract number_____.

e. Warranty period_____from_____to_____.

f. Inspector's signature_____.

g. Construction Contractor_____.

Address_____.

Telephone number_____.

h. Warranty contact_____.

Address_____.

Telephone number_____.

i. Warranty response time priority code_____.

j. WARNING - PROJECT PERSONNEL TO PERFORM ONLY OPERATIONAL MAINTENANCE DURING THE WARRANTY PERIOD.

1.4 MECHANICAL TESTING, ADJUSTING, BALANCING, AND COMMISSIONING

Prior to final inspection and transfer of the completed facility; all reports, statements, certificates, and completed checklists for testing, adjusting, balancing, and commissioning of mechanical systems shall be submitted to and approved by the Contracting Officer as specified in applicable technical specification sections.

1.5 OPERATION AND MAINTENANCE MANUALS

Operation manuals and maintenance manuals shall be submitted as specified. Operation manuals and maintenance manuals provided in a common volume shall be clearly differentiated and shall be separately indexed.

1.6 FINAL CLEANING

The premises shall be left broom clean. Stains, foreign substances, and temporary labels shall be removed from surfaces. Carpet and soft surfaces shall be vacuumed. Equipment and fixtures shall be cleaned to a sanitary condition. Filters of operating equipment shall be replaced. Debris shall be removed from roofs, drainage systems, gutters, and downspouts. Paved areas shall be swept and landscaped areas shall be raked clean. The site shall have waste, surplus materials, and rubbish removed. The project area shall have temporary structures, barricades, project signs, and construction facilities removed. A list of completed clean-up items shall be submitted on the day of final inspection.

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PART 3 EXECUTION (NOT USED)

-- End of Section --

SECTION 01850

CONTRACT DRAWINGS
03/98

ALL REFERENCES TO 3056 NIC

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LINE C TANKS
NORFOLK DISTRICT

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G0007 TYPICAL DETAILS HANDRAILS & GREATING
G0008 MECHNICAL LEGEND & SYMOLS
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Note:
*Indicates B Size Drawings

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SITE WORK

SECTION 02080

REMOVAL AND DISPOSAL OF ASBESTOS CONTAINING MATERIALS

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SECTION 02210

GRADING

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 SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 1556	(1990) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(1991) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu.m.))
ASTM D 2487	(1992) Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 3017	(1988) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)

1.2 UNIT PRICE

1.2.1 Measurement

1.2.1.1 Rock

Separate excavation, hauling, and spreading or piling of topsoil and all miscellaneous operations attendant thereto will be considered subsidiary obligations of the Contractor, covered under the contract unit price for excavation.

1.2.2 Payment

1.2.2.1 Excavation

Excavation will be paid for at the contract unit price per cubic yard for "Excavation."

1.3 DEFINITIONS

1.3.1 Satisfactory Materials

Materials classified in ASTM D 2487 as GM, GC, SP, SM, ML, CB, CH, GW, GP, and SW, and free from roots and other organic matter, trash, debris, and frozen materials and stones larger than 6 inches in any dimension are satisfactory.

1.3.2 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials are unsatisfactory. Materials classified in ASTM D 2487 as MH, PT, OH, and OL are unsatisfactory. Unsatisfactory materials also include man-made fills, refuse, or backfills from previous construction.

1.3.3 Cohesionless and Cohesive Materials

Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Cohesionless materials include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Materials classified as GM and SM will be identified as cohesionless only when the fines have a plasticity index of zero.

1.3.4 Degree of Compaction

Degree of compaction is a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557.

1.3.5 Topsoil

Material obtained from excavations suitable for topsoils, is defined as GM, GC, SP, SM, ML, CB, CH.

1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL DESCRIPTIONS:

SD-08 Statements

Field Testing Control; FIO.

Qualifications of the commercial testing laboratory who will be performing all testing in accordance with paragraph FIELD TESTING CONTROL.

SD-09 Reports

Field Testing Control; FIO. Satisfactory Materials; FIO.

Certified test reports and analysis certifying that the satisfactory materials proposed for use at the project site conform to the specified requirements, and for all tests conducted in accordance with paragraph FIELD TESTING CONTROL.

1.5 SUBSURFACE DATA

Subsurface soil boring logs are appended to the SPECIAL CLAUSES. The subsoil investigation report may be examined at Radford Army Ammunition Plant. These data represent the best subsurface information available;

however, variations may exist in the subsurface between boring locations.

PART 2 PRODUCTS

2.1 ROCK FOR SLOPE PROTECTION

Coarse rock from excavations shall be conserved and used for constructing the slopes of embankments parallel or adjacent to streams, for constructing slopes or sides and bottom of channels, and for protection against erosion. Hand placing of coarse rock from excavation will not be required.

PART 3 EXECUTION

3.1 CONSERVATION OF TOPSOIL

Topsoil shall be removed to full depth and shall be stored separate from other excavated materials and piled free of roots, stones, and other undesirable materials. Any surplus of topsoil from excavations and grading shall be stockpiled in locations indicated.

3.2 EXCAVATION

After topsoil removal has been completed, excavation of every description, regardless of material encountered, within the grading limits of the project shall be performed to the lines and grades indicated. Satisfactory excavation material shall be transported to and placed in fill areas within the limits of the work. All unsatisfactory material including any soil which is disturbed by the Contractor's operations or softened due to exposure to the elements and water and surplus material shall be disposed of in areas approved for surplus material storage. Unsatisfactory material excavated below the grade shown and replaced with satisfactory material as directed shall be included in the contract unit price for excavation. Excavations carried below the depths indicated, without specific directions, shall, except as otherwise specified, be refilled to the proper grade with satisfactory material as directed. All additional work of this nature shall be at the Contractor's expense. Excavation and filling shall be performed in a manner and sequence that will provide drainage at all times. Excavations shall be kept free from water while construction therein is in progress. Material required for fills in excess of that produced by excavation within the grading limits shall be obtained from borrow areas at RMP, to be determined.

3.3 DITCHES, GUTTERS, AND CHANNEL CHANGES

Ditches, gutters, and channel changes shall be cut accurately to the cross sections and grades indicated. All roots, stumps, rock, and foreign matter in the sides and bottom of ditches, gutters, and channel changes shall be trimmed and dressed or removed to conform to the slope, grade, and shape of the section indicated. Care shall be taken not to excavate ditches and gutters below the grades indicated. Excessive ditch and gutter excavation shall be backfilled to grade either with satisfactory, thoroughly compacted material or with suitable stone or cobble to form an adequate gutter paving as directed. All ditches and gutters excavated under this section shall be maintained until final acceptance of the work. Satisfactory material excavated from ditches and channel changes shall be placed in fill areas.

Unsatisfactory and excess excavated material shall be disposed of in accordance with directions in paragraph EXCAVATION. No excavated material shall be deposited closer to the edges of the ditches than indicated and in no case less than 3 feet.

3.4 BACKFILL ADJACENT TO STRUCTURES

Backfill adjacent to structures shall be placed and compacted uniformly in such manner as to prevent wedging action or eccentric loading upon or against the structures. Slopes bounding or within areas to be backfilled shall be stepped or serrated to prevent sliding of the fill. During backfilling operations and in the formation of embankments, equipment that will overload the structure in passing over and compacting these fills shall not be used. Backfill for storm drains and subdrains, including the bedding and backfill for structures other than culverts and drains, shall conform to the additional requirements in other applicable sections.

3.5 PREPARATION OF GROUND SURFACE FOR FILL

All vegetation, such as roots, brush, heavy sods, heavy growth of grass, and all decayed vegetable matter, rubbish, and other unsatisfactory material within the area upon which fill is to be placed, shall be stripped or otherwise removed before the fill is started. In no case will unsatisfactory material remain in or under the fill area. Sloped ground surfaces steeper than one vertical to four horizontal on which fill is to be placed shall be plowed, stepped, or broken up, as directed, in such manner that the fill material will bond with the existing surface. Prepared surfaces on which compacted fill is to be placed shall be wetted or dried as may be required to obtain the specified moisture content and density.

3.6 FILLS AND EMBANKMENTS

Fills and embankments shall be constructed at the locations and to lines and grades indicated. The completed fill shall conform to the shape of the typical sections indicated or shall meet the requirements of the particular case. Satisfactory material obtained during excavation may be used in forming required fill. Fill shall be satisfactory material and shall be reasonably free from roots, other organic material, and trash and from stones having a maximum diameter greater than 3 inches. No frozen material will be permitted in the fill. Stones having a dimension greater than 4 inches shall not be permitted in the upper 6 inches of fill or embankment. The material shall be placed in successive horizontal layers of 8 in loose depth for the full width of the cross section and shall be compacted as specified. Each layer shall be compacted before the overlaying lift is placed. Moisture content of the fill or backfill material shall be adjusted by wetting or aerating, as required, to within plus or minus 90 percent of optimum moisture content as determined from laboratory tests specified in paragraph DEFINITIONS.

3.7 COMPACTION

Except for paved areas, each layer of the fill or embankment shall be compacted to at least 90 percent of laboratory maximum density. Areas to be paved and other areas indicated as requiring compaction

suitable for paved areas shall be compacted to at least the percentage of laboratory maximum density shown for specific ranges of depth below the surface of the pavement.

3.8 FINISHED EXCAVATION, FILLS, AND EMBANKMENTS

All areas covered by the project, including excavated and filled sections and adjacent transition areas, shall be uniformly smooth-graded. The finished surface shall be reasonably smooth, compacted, and free from irregular surface changes. The degree of finish shall be that ordinarily obtainable from blade-grader operations, except as otherwise specified. Ditches and gutters shall be finished to permit adequate drainage. The surface of areas to be turfed shall be finished to a smoothness suitable for the application of turfing materials. For subgrade areas to be paved, the following shall be accomplished as required: (a) soft or otherwise unsatisfactory material shall be replaced with satisfactory excavated material or other approved materials; (b) rock encountered in the cut sections shall be excavated to a depth of 6 inches below finished grade for the subgrade; (c) low areas resulting from removal of unsatisfactory material or from 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 shall be compacted as specified. The surface of embankments or excavated areas for road construction or other areas on which a base course or pavement is to be placed shall vary not more than 0.05 foot from the established grade and approved cross section. Surfaces other than those that are to be paved shall be finished not more than 0.15 foot above or below the established grade or approved cross section.

3.9 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 6 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 areas indicated.

3.10 FIELD TESTING CONTROL

Testing shall be the responsibility of the Contractor and shall be performed by an approved commercial testing laboratory or by the Contractor subject to approval. Field density and moisture content tests shall be performed on every 3,000 square feet of each 8 -inch lift placed. Field in-place density shall be determined in accordance with ASTM D 1556. The calibration curves furnished with the moisture gauges shall be checked along with density calibration checks as described in ASTM D 3017. 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.

3.11 PROTECTION

Newly graded areas shall be protected from traffic and from erosion, and any settlement or washing away that may occur from any cause, prior to acceptance, shall be repaired and grades reestablished to the required elevations and slopes. All work shall be conducted in accordance with the environmental protection requirements of the contract.

-- End of Section --

SECTION 02220A

DEMOLITION
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 basic designation only.

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(1996) U.S. Army Corps of Engineers Safety and Health Requirements Manual

1.2 GENERAL REQUIREMENTS

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.

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

Work Plan; G, TSCS

The procedures proposed for the accomplishment of the work. The procedures shall provide for safe conduct of the work, including procedures and methods to provide necessary supports, lateral bracing and shoring when required, careful removal and disposition of materials specified to be salvaged, protection of property which is to remain undisturbed, coordination with other work in progress, and timely disconnection of utility services. The procedures shall include a detailed description of the methods and equipment to be used for each operation, and the sequence of operations in accordance with EM 385-1-1.

1.4 DUST CONTROL

The amount of dust resulting from demolition shall be controlled to prevent the spread of dust to occupied portions of the construction site and to

avoid creation of a nuisance in the surrounding area. Use of water will not be permitted when it will result in, or create, hazardous or objectionable conditions such as ice, flooding and pollution.

1.5 PROTECTION

1.5.1 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.

1.5.2 Protection of Structures

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.

1.5.3 Protection of Existing Property

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.

A Professional Engineer, licensed in the state of Virginia, shall design the shoring, bracing, and temporary support systems required for the existing building structures. All designs shall be approved by the Contracting Officer prior to installation by the Contractor.

1.5.4 Protection From the Weather

The interior of buildings to remain; salvageable materials and equipment shall be protected from the weather at all times.

1.5.5 Protection of 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.

1.5.6 Environmental Protection

The work shall comply with the requirements of Section 01355 ENVIRONMENTAL PROTECTION.

1.6 BURNING

The use of burning at the project site for the disposal of refuse and debris will not be permitted.

1.7 USE OF EXPLOSIVES

Use of explosives will not be permitted.

1.8 AVAILABILITY OF WORK AREAS

Areas in which the work is to be accomplished will be available in accordance with Section 01006 PROJECT WORK REQUIREMENTS AND RESTRICTONS FOR RAAP.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 EXISTING STRUCTURES

Existing structures indicated shall be completely removed. All of the existing pits at all sites should be demolished and removed so that no question of any trace of contamination remains in the soil.

3.1.2 Wet Work requirement

Construction Contractor shall wet all work areas with water prior to starting work and keep all work areas water wet during demolition (or other hot work as defined in Section 01006 PROJECT WORK REQUIREMENTS AND RESTRICTONS FOR RAAP). Special care shall be taken to keep acid brick/concrete interface and brick joints (see demolition drawings} soaking wet, to guard against initiation of possible concealed NC (Nitrocellulose, which usually appears as a white or off-white cake, dust, film, or powder layer) during demolition. Remove acid-brick lining first, in pieces, to expose all joints and surfaces of each brick, to ensure that no hidden pockets of NC exist. Then remove concrete. If NC, suspected NC, or anything suspicious is discovered by Construction Contractor, stop work
immediately, leave area, and notify Contracting Officer.

3.2 UTILITIES

Disconnection of utility services, with related meters and equipment, are specified in Section 16370 ELECTRICAL DISTRIBUTION SYSTEM, AERIAL and Section 16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND. Existing utilities shall be removed as indicated. 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.

3.3 FILLING

Holes, open basements and other hazardous openings shall be filled in accordance with Section 02221 EXCAVATION, FILLING, AND BACKFILLING FOR BUILDINGS.

3.4 DISPOSITION OF MATERIAL

Title to material and equipment to be demolished, except Government salvage and historical items, is vested in the Contractor upon receipt of notice to proceed. The Government will not be responsible for the condition, loss or damage to such property after notice to proceed.

3.4.1 Salvageable Items and Material

Contractor shall salvage items and material to the maximum extent possible.

3.4.1.1 Material Salvaged for the Contractor

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.

3.4.1.2 Items Salvaged for the Government

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. The following items reserved as property of the Government shall be delivered to the areas designated by the Area office.

3.4.1.3 Items Salvaged for the Using Service

Not used.

3.4.1.4 Historical Items

Historical items shall be removed in a manner to prevent damage. The following historical items shall be delivered to the Government for disposition: Corner stones, contents of corner stones, and document boxes wherever located on the site.

3.4.2 Unsalvageable Material

Concrete, masonry, and other noncombustible material, except concrete permitted to remain in place, shall be disposed of in a disposal area located off-site. Combustible material shall be disposed of off the site. .

3.5 CLEAN UP

Debris and rubbish shall be removed from basement and similar 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.

3.6 PAVEMENTS

Existing pavements designated for removal shall be saw cut and removed in accordance with the details shown on the drawings and to the limits and depths indicated on the drawings.

-- End of Section --

SECTION 02221

EXCAVATION, FILLING AND BACKFILLING FOR BUILDINGS

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 SOCIETY OF TESTING AND MATERIALS (ASTM)

ASTM D 1556	(1990) Density and Unit Weight of Soil In-Place by the Sand-Cone Method
ASTM D 1557	(1991) Laboratry Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu. m.))
ASTM D 2167	(1984; R 1990) Density and Unit Weight of Soil In-Place by the Rubber Balloon Method
ASTM D 2216	(1990) Laboratory Determination of Water (Moisture) Content of Soil and Rock
ASTM D 2487	(1990) Classification of Soils For Engineering Purposes
ASTM D 2937	(1983; R 1990) Density of Soil In-Place by the Drive-Cylinder Method
ASTM D 4318	(1984) Liquid Limit, Plastic Limit, and Plasticity Index of Soils

VIRGINIA DEPARTMENT OF TRANSPORTATION (VDOT)

VDOT SPECS	(January 1991) Road and Bridge Specifications

1.2 DEFINITIONS

1.2.1 Satisfactory Materials

Materials classified by ASTM D 2487 as GW, GP, GM, GC, SW, SP, SM, SC, ML, CL, CH, are satisfactory as fill.

1.2.2 Unsatisfactory Materials

Materials classified by ASTM D 2487 as OL, OH and Pt are unsatisfactory in-situ. Unsatisfactory materials also include those materials containing roots and other organic matter, trash, debris, frozen materials, and stones larger than 3 inches.

1.2.3 Cohesionless and Cohesive Materials

Cohesionless materials include materials classified in ASTM D 2487as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesionless only when the fines are nonplastic.

1.2.4 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, Method D, abbreviated hereinafter as percent laboratory maximum density.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL DESCRIPTIONS:

SD-09 Reports

Compaction Tests; GA.

Copies of all laboratory and field test reports shall be submitted to the Contracting Officer within 72 hours of the completion of the test.

1.4 DELIVERY AND STORAGE

Soil treatment agents shall be delivered to the jobsite in sealed and labeled containers bearing the manufacturer's warnings. Delivery, handling and storage shall be performed in accordance with manufacturer's instructions and army safety regulations.

1.5 SUBSURFACE DATA

Subsurface soil boring logs are shown in the soils reports. The subsoil investigation report and samples of materials taken from subsurface investigations may be examined at the Norfolk District. These data represent the best subsurface information available; however, variations may exist in the subsurface between locations.

PART 2 PRODUCTS

2.1 CAPILLARY WATER BARRIER

2.1.1 Consistency

Capillary Water Barrier shall consist of clean, crushed, nonporous rock, crushed gravel, or uncrushed gravel. The maximum particle size shall be 1-1/2 inches and no more than 3 percent by weight shall pass the No. 8 size sieve.

2.1.2 Substitution

Coarse aggregate conforming to VDOT SPECS Section No.203, Table II-3, aggregate size No.57 is satisfactory as a capillary water barrier.

2.2 SOIL TREATMENT AGENT

Soil treatment agent shall be either cloryprifos, permethrin, fenvalerate, isofenphos or cypermethrin. Labels shall bear evidence of registration under the Federal Insecticide, and Rodenticide Act and shall provide the manufacturers recommended rates of application.

PART 3 EXECUTION

3.1 CLEARING AND GRUBBING

The areas within lines 5 feet outside of each building and structure line shall be cleared and grubbed of trees, stumps, roots, brush and other vegetation, debris, existing foundations, pavements, utility lines, structures, fences, and other items that would interfere with construction operations. Stumps, logs, roots, and other organic matter shall be completely removed and the resulting depressions shall be filled with satisfactory material, placed and compacted in accordance with paragraph "FILLING AND BACKFILLING." Materials removed shall be disposed of in the designated waste disposal areas.

3.2 STRIPPING OF TOPSOIL

Topsoil shall be stripped to full depth below existing grade within the designated excavations and grading lines and deposited in storage piles for later use. Excess topsoil shall be disposed as specified for excess excavated material.

3.3 EXCAVATION

Excavation shall conform to the dimensions and elevations indicated for each building, structure, and footing except as specified hereinafter, and shall include trenching for utility and foundation drainage systems to a point 5 feet beyond the building line of each building and structure, excavation for outside grease interceptors, underground fuel tanks, and all work incidental thereto. Excavation shall extend a sufficient distance from walls and footings to allow for placing and removal of forms. Excavations below indicated depths will not be permitted except to remove unsatisfactory material. Unsatisfactory material encountered below the grades shown shall be removed as directed and replaced with satisfactory material. Satisfactory material removed below the depths indicated without specific direction of the Contracting Officer shall be replaced at no additional cost to the Government to the indicated excavation grade with satisfactory materials, except that concrete footings shall be increased in thickness to the bottom of the overdepth excavations and over-break in rock excavation. Satisfactory material shall be placed and compacted as specified in paragraph "FILLING AND BACKFILLING." Determination of elevations and measurements of approved overdepth excavation of unsatisfactory material below grades indicated shall be done under the direction of the Contracting Officer.

3.4 DRAINAGE AND DEWATERING

3.4.1 Drainage

Surface water shall be directed away from excavation and construction sites so as to prevent erosion and undermining of foundations. Diversion ditches, dikes and grading shall be provided and maintained as necessary during construction. Excavated slopes and backfill surfaces shall be protected to prevent erosion and sloughing. Excavation shall be performed so that the site and the area immediately surrounding the site and affecting operations at the site shall be continually and effectively drained.

3.4.2 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 3 feet below the working level.

3.5 SHORING

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.

3.6 CLASSIFICATION OF EXCAVATION

Rock excavation shall consist of the removal and disposal of boulders 2 1/2 cubic yards or more in volume; solid rock; materials that cannot be removed without systematic drilling and blasting such as rock material in ledges or aggregate conglomerate deposits that are so firmly cemented as to possess the characteristics of solid rock; and concrete or masonry structures exceeding 2 1/2 cubic yard in volume, except sidewalks and paving. Hard and compact materials such as cemented gravel, glacial till, and relatively soft or disintegrated rock that can be removed without continuous and systematic drilling and blasting will not be considered as rock excavation. Rock excavation will not be considered as such because of intermittent drilling and blasting that is performed merely to increase production. Excavation of the material claimed as rock shall not be performed until the material has been cross sectioned by the Contractor and approved by the Contracting Officer. Common excavation shall consist of all excavation not classified as rock excavation.

3.7 BLASTING

Blasting will not be permitted.

3.8 UTILITY AND DRAIN TRENCHES

Trenches for underground utilities systems and drain lines shall be excavated to the required alignments and depths. The bottoms of trenches shall be graded to secure the required slope and shall be tamped if necessary to provide a firm pipe bed. Recesses shall be excavated to accommodate bells and joints so that pipe will be uniformly supported for the entire length. Rock, where encountered, shall be excavated to a depth of at least 6 inches below the bottom of the pipe, and the overdepth shall be backfilled with satisfactory material placed and compacted in conformance with paragraph FILLING AND BACKFILLING.

3.9 BORROW MATERIAL

Borrow materials shall be selected to meet requirements and conditions of the particular fill for which it is to be used. Necessary clearing, grubbing, disposal of debris, and satisfactory drainage of borrow pits shall be performed by the Contractor as incidental operations to the borrow excavation.

3.9.1 Selection

Borrow materials shall be obtained from sources within the limits of Govenrment-controlled land, subject to approval. Borrow materials shall be subject to approval. Borrow material from approved sources on Government-controlled land may be obtained without payment of royalties. Unless specificaly provided, no borrow shall be obtained within the limits of the project site without prior written approval.

3.9.2 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 to be taken of the undisturbed ground surface. Except as otherwise permitted, borrow pits shall be excavated to afford adequate drainage. Overburden and other soil material shall be disposed of or used for special purposes. Borrow pits shall be neatly trimmed and left in such shape as will facilitate taking accurate measurements after the excavation is completed.

3.10 EXCAVATED MATERIALS

Satisfactory excavated material required for fill or backfill shall be placed in the proper section of the permanent work required under this section or shall be separately stockpiled if it cannot be readily placed. Satisfactory material in excess of that required for the permanent work and all unsatisfactory material shall be disposed of as specified in Section 02225 EARTHWORK FOR ROADWAYS, RAILROADS AND AIRFIELDS.

3.11 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 or other erosion resulting from ponding or flow of water.

3.12 SUBGRADE PREPARATION

Unsatisfactory material in surfaces to receive fill or in excavated areas shall be removed and replaced with satisfactory materials. 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. 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 FILLING AND BACKFILLING.

3.13 FILLING AND BACKFILLING

Satisfactory materials shall be used in bringing fills and backfills to the lines and grades indicated and for replacing unsatisfactory materials. Satisfactory materials shall be placed in horizontal layers not exceeding 8 inches in loose thickness, or 6 inches when hand-operated compactors are used. After placing, each layer shall be plowed, disked, or otherwise broken up, moistened or aerated as necessary, thoroughly mixed and compacted as specified. Backfilling shall not begin until construction below finish grade has been approved, underground utilities systems have been inspected, tested and approved, forms removed, and the excavation cleaned of trash and debris. Backfill shall be brought to indicated finish grade and shall include backfill for outside grease interceptors and underground fuel tanks. Backfill shall not be placed in wet or frozen areas. Where pipe is coated or wrapped for protection against corrosion, the backfill material up to an elevation 2 feet above sewer lines and 1 foot above other utility lines shall be free from stones larger than 1 inch in any dimension. Heavy equipment for spreading and compacting backfill shall not be operated closer to foundation or retaining walls than a distance equal to the height of backfill above the top of footing; the area remaining shall be compacted in layers not more than 4 inches in compacted thickness with power-driven hand tampers suitable for the material being compacted. Backfill shall be placed carefully around pipes or tanks to avoid damage to coatings, wrappings, or tanks. Backfill shall not be

placed against foundation walls prior to 7 days after completion of the walls. 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. As far as practicable, backfill shall be brought up evenly on each side of the wall and sloped to drain away from the wall. Each layer of fill and backfill shall be compacted to not less than the percentage of maximum density specified below:

	Percent Laboratory maximum density	
	Cohesive material	Cohesionless material
Fill, embankment, and backfill		
Under structures, building slabs, steps, paved areas, around footings, and in trenches	90	95
Under sidewalks and grassed areas	85	90
Nonfrost susceptible materials		95
Subgrade		
Under building slabs, steps, and paved areas, top 6 inches	90	95
Under sidewalks, top 6 inches	85	90

Approved compacted subgrades that are disturbed by the Contractor's operations or adverse weather shall be scarified and compacted as specified herein before to the required density prior to further construction thereon. Recompaction over underground utilities and heating lines shall be by hand tamping.

3.14 COMPACTION TESTS

Testing shall be the responsibility of the Contractor and shall be performed by an approved commercial testing laboratory or may be performed by the Contractor subject to approval. Laboratory tests for moisture-density relations complete with zero air voids curve, gradation, and Atterberg limits shall be made in accordance with the procedures referenced in ASTM D 1557 and ASTM D 4318. Field tests for density and moisture content shall be made in accordance with ASTM D 1556 and ASTM D 2216 except that methods ASTM D 2167 or ASTM D 2937 may be used to supplement tests by method ASTM D 1556. ASTM D 2937 shall be used only for soft, fine grained cohesive soils.

The following submittals are required:

a. Copies of all test results and field and office worksheets shall be furnished to the Contracting Officer within 72 hours after the tests are complete.

b. A minimum of one moisture-density test shall be performed for each classification of fill material, backfill material, and existing subgrade material.

c. One Atterberg limits test and one gradation analysis is required for every six field density tests.

d. A minimum of one sand cone density test is required for every six field density tests or fraction thereof. Worksheets of sand density and sand cone calibration shall be submitted to the Contracting Officer prior to commencing work and eachg time a new supply of sand is used.

e. A quart jar sample of each moisture-density test material shall be delivered to the Contracting Officer at the time the test is obtained.

f. A pint jar sample of each field-density test material shall be delivered to the Contracting Officer at the time the test is obtained.

g. Field density tests shall be performed as follows: a minimum of one test per lift per 100 feet of wall length or fraction thereof and one test per lift for each column footing is required for fill material. Locations of all tests shall be at the direction of the Contracting Officer.

3.15 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.

3.16 GRADING

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.

3.17 SPREADING TOPSOIL

Areas outside the building lines from which topsoil has been removed shall be topsoiled. The surface shall be free of materials that would hinder planting or maintenance operations. The subgrade shall be pulverized to a depth of 2 inches by disking or plowing for the bonding of topsoil with the subsoil. Topsoil shall then be uniformly spread, graded, and compacted to the thickness, elevations, slopes shown, and left free of surface irregularities. Topsoil shall be compacted by one pass of a cultipacker, roller, or other approved equipment weighing 100 to 160 pounds per linear foot of roller. Topsoil shall not be placed when the subgrade is frozen, excessively wet, extremely dry, or in a condition otherwise detrimental to seeding, planting, or proper grading.

3.18 PROTECTION

Settlement or washing that occurs in graded, topsoiled, or backfilled areas prior to acceptance of the work shall be repaired and grades reestablished to the required elevations and slopes.

-- End of Section --

ATTACHMENT 1

SWMU 6 SAMPLING RESULTS REPORT

RADFORD ARMY AMMUNITION PLANT
RADFORD, VIRGINIA

Prepared for:

USACE Baltimore District

Delivery Order No. 0018
Contract No. DACA31-00-D-0011

May 2001

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EXECUTIVE SUMMARY

URS/Dames & Moore (URS) conducted Soil Sampling and Reporting at Solid Waste Management Unit (SWMU) 6, Acid Wastewater Lagoon at the Radford Army Ammunition Plant (RFAAP), Radford, Virginia in accordance with Work Plan Addendum No. 11 as approved by USEPA Region III. This effort is critical for the Production Base Support (PBS) project to construct nitrocellulose (NC) settling tanks in an area that includes SWMU 6. It will allow RFAAP to properly manage the excavated material during construction and to prevent future sampling under the tanks once the construction is complete.

The specific objectives of the soil sampling and reporting at SWMU 6 were: (1) to collect and chemically analyze composite and discrete subsurface soil samples from overburden soils; (2) to perform an evaluation of the data with respect to RCRA hazardous waste characteristics; and (3) to provide data that can be used to evaluate residual risk through comparison to USEPA residential and industrial Region III Risk Based Concentrations (RBCs).

To achieve these objectives, twelve soil borings were advanced. One representative composite sample was collected from the overburden soil, and one representative discrete sample of the soils at depth from each of the twelve soil borings. The composite overburden samples were analyzed for full Toxicity Characteristics Leaching Procedure (TCLP) including TCLP metals, TCLP volatile organic compounds (VOCs), TCLP semi-volatile organic compounds (SVOCs), TCLP pesticides, and TCLP herbicides, plus corrosivity, reactivity (percent nitrocellulose), and paint filter liquids, in accordance with SW-846 Methods. Results were compared to the Regulatory TCLP limits for hazardous waste set forth in 40 CFR 261, to assess the appropriate disposal methods for soil excavated as part of the PBS project.

Discrete samples were collected below the planned excavation depth of 25-feet below ground surface (bgs), or at probe refusal (if less than 25-feet bgs). Each of the twelve discrete samples was analyzed for Target Compound List (TCL) Volatile Organic Compounds (VOCs), TCL Semi-Volatile Organic Compounds (SVOCs), TCL pesticides/ aroclors, Target Analyte List (TAL) metals, and explosives following SW-846 Methods. Soil analytical results were compared to USEPA Region III Residential and Industrial RBC Tables to evaluate the residual risk of compounds detected in the discrete samples.

The results of the laboratory analysis indicate that several of the TCLP analytes (for evaluation of overburden soils as hazardous waste) were reported at values that are above the laboratory detection limits. However, none of the analytes detected exceeded the Regulatory TCLP limits for hazardous waste. Based on these results, the soil excavated as part of the construction project will likely not have to be disposed of as hazardous waste.

The results of the laboratory analysis indicate that several of the TAL/TCL analytes (for evaluation of discrete samples for residual risk) were reported at concentrations that are above the laboratory detection limits. Four (4) TCL VOCs, one (1) TCL SVOC, seven (7) TCL pesticide/PCBs, one (1) explosive and twenty-two (22) TAL metals were detected in the discrete samples. Of these detections, none of the TCL VOCs or SVOCs were present above the applicable RBC criteria. Detected TCL

Pesticides/PCBs and explosive concentrations were less than applicable RBC criteria. Aluminum (10,200 to 49,600 mg/Kg) detections were above the residential RBC of 7,800; however, these detections were below the industrial RBC of 200,000 mg/Kg. Arsenic detections (3.8 to 7.6 mg/Kg) were above the residential and industrial RBCs of 0.43 and 3.8 mg/kg, respectively. Chromium detections (18.6 to 51.5 mg/Kg) were above the residential RBC of (23 mg/kg); however, these detections were below the industrial RBC of 610 mg/kg. Iron detections (20,500 to 40,400 mg/Kg) were above the residential RBC of 2,300 mg/kg; however, these detections were below the industrial RBC of 61,000 mg/kg. Manganese detections (181 to 1,510 mg/Kg) were above the residential RBC of 160 mg/kg; however, these detections were below the industrial RBC of 4,100 mg/Kg. The thallium detection (1.2 mg/Kg) was above the residential RBC of 0.55 mg/kg; however, these detections were below the industrial RBC of 14 mg/Kg. Vanadium detections of greater than 55 to 89.9 mg/Kg were above the residential RBC of 55 mg/kg; however, these detections were below the industrial RBC of 1,400 mg/Kg.

1.0 INSTALLATION DESCRIPTION AND BACKGROUND

RFAAP is a government-owned, contractor-operated (GOCO) industrial complex located in Radford, Virginia. It is owned by the U.S. Department of the Army and was operated under contract with Hercules, Inc., from 1941 until 1995 when Alliant Techsystems (ATK) became the operating contractor. The installation consists of two noncontiguous areas: the Main Manufacturing Area (MMA) and the New River Unit (NRU). SWMU 6 is located in the MMA of RFAAP.

The MMA contains approximately 1,969 buildings and occupies 6,900 acres. Facility activities include the manufacturing of solid propellants used in small arms, anti-aircraft and anti-tank weapons, rockets, torpedoes, missile systems, igniters, gas generators, and related items.

2.1 LOCATION

The RFAAP MMA is located approximately 10 miles west of Blacksburg, Virginia and 47 miles southwest of Roanoke, Virginia (Figure 1). It lies in one of a series of narrow valleys typical of the Appalachian Mountain region. The valley is oriented in a northeast-southwest direction, and is approximately 25 miles long and 8 miles wide at the southwest end, narrowing to 2 miles at its northeast end.

SWMU 6 was historically used as an unlined surface impoundment (i.e., acidic wastewater lagoon). It is located approximately 2,000 feet northwest of the administration area (Figure 2). The lagoon is "tear-dropped" or "triangular" in shape. The boundaries of SWMU 6 were evaluated by reviewing aerial photographs of RFAAP for the period 1937 through 1986 (Figure 3). The earliest presence of SWMU 6 was observed in photographs from 1975 and was also apparent in photographs from 1981 and 1986. Changes in the appearance of SWMU 6 were not observed on the photographs in which it was visible. A copy of the 1986 aerial photograph, which shows the location and boundary of SWMU 6, is provided as Appendix A.

2.2 BACKGROUND INFORMATION

SWMU 6 was used from 1974 to 1980 as an unlined surface impoundment that received overflow and rinse waters from an acid storage tank area in the C-Line nitrocellulose (NC) manufacturing area. During its active life, SWMU 6 received wastewater that typically exhibited the characteristic of a corrosive liquid (RCRA hazardous waste characteristic code D002). There were no overflow controls at the lagoon.

Between 1980 and 1987, the C-Line NC manufacturing area was shut down and no wastewater was introduced to the lagoon. In 1987, the lagoon was filled with soil and replaced by a holding tank.

Dames & Moore (1992) conducted Verification Investigation (VI) sampling at SWMU 6 to assess whether soil contamination existed associated with acidic wastewater that was formerly discharged to the lagoon. Two boreholes (6SB1 and 6SB2) were drilled at SWMU 6 (Figure 4). Boring 6SB1 was advanced to a depth of 21.0 feet bgs in what was thought to be the deepest part of the former lagoon,

which would have likely contained wastewater over the longest time period. Dames & Moore did not observe indications of contamination. Dames & Moore collected two samples from this boring for chemical analysis at depths of 18.0 feet and 20.5 feet below ground surface (bgs). The samples were analyzed for Target Analyte List (TAL) metals and pH.

Dames & Moore drilled boring 6SB2 to a depth of 22.9 feet bgs in what was thought to be a shallower section of the former lagoon. Visual observations of the soil profile indicated the presence of a possible sludge-like material from 14.0 feet to 20.0 feet bgs. Dames & Moore collected two samples from this boring for chemical analysis, 6SB2A and 6SB2B, at depths of 14.0 and 22.0 feet bgs, respectively. The samples were analyzed for TAL metals and pH. Monitoring wells were not installed at SWMU 6 as part of the VI due to the uncertainty that wells would actually intercept groundwater flowing in the karst aquifer beneath the former lagoon area.

Nineteen (19) metals were detected in the four soil samples collected from the former wastewater lagoon. The sample data were compared to Health Based Numbers (HBNs), which were set forth in the installation's first RCRA permit, issued in 1989, which governed activities at the time. Soil sample concentrations of arsenic and cobalt exceeded the HBN criteria in the four samples. Thallium in one sample exceeded the soil HBN criterion in a duplicate analysis; however, the concentration was less than the Practical Quantitation Limit (PQL). No other metal concentrations exceeded HBN criteria.

3.0 ENVIRONMENTAL SETTING

3.1 TOPOGRAPHY

SWMU 6 is a flat grassy level area approximately 1,800 feet above mean sea level (msl), located between two upland ridges. To the north, the ridge rises approximately 6 feet; there are asphalt roads and buildings located on this ridge. The ridge to the south rises approximately 10 feet, where railroad tracks and an asphalt road are present. SWMU 6 is located within an industrial area composed of numerous buildings, overhead pipes, railroad tracks, and asphalt roads.

Based on topography, surface water runoff from these ridges on the northern and southern sides of the SWMU flows into the SWMU 6 area. Surface runoff within SWMU 6 likely flows into storm water catch basins located near the northeast and southeast ends of the SWMU.

3.2 GEOLOGY

The RFAAP is located in a region underlain by carbonate rocks (i.e., limestone and dolomite), and therefore, exhibits prominent karstic features including sinkholes, caves, and caverns. Karst landforms occur in carbonate rock formations as the result of the dissolution of rock by naturally occurring carbonic acid in rainwater.

According to previous studies (Dames & Moore, 1992), subsurface conditions observed in the vicinity of SWMU 6 consist of reddish-brown silty clay present in borings to bedrock or borehole termination. These residual deposits (clays and silts) are a result of chemical and physical weathering of the

underlying Elbrook Formation (limestone and dolomite). At RFAAP the depth to the Elbrook Formation ranges from 21 feet to greater than 45 feet (Dames & Moore, 1992).

3.3 SITE SOILS ENCOUNTERED - LITHOLOGIC DISCUSSION

During this field investigation, site soils encountered were similar to the soils described in previous investigations. Copies of the boring logs from this investigation are included as Appendix B. Figures 5 and 6 present cross-sections of soils encountered during the investigation. In general, soils encountered consisted of a thin surface layer of brown-to reddish-brown clayey silty fine sand, with organic matter and root material, which graded to red or strong brown fine sandy clay at approximately 0.5 feet bgs. From 0.5 feet bgs to depths ranging from 6.5 to 19.0 feet bgs, the soils consisted of red, dark yellowish brown or strong brown silty clay. This stratum is referred to as Stratum 1. Variations in sand and moisture content were observed, as well as plasticity in Stratum 1. In addition, variable amounts of gravel were present. In some borings, the sample recovery was limited at depths of 4.0 to 16.0 feet bgs. This was likely due to the presence of gravels, which prevented the soil from entering the sampling device.

Below Stratum 1, a gradational to sharp change to olive, grayish brown or dark- to very dark-gray silty clay/clayey silt was observed. This Stratum is referred to as Stratum 2. Stratum 2 is characterized by a distinct color change from the overlying soil and the presence small (<1 to 2 inches) pieces of wood chips and woody matter. Texturally, Stratum 2 ranged from soft silty clay (plastic) to sandy wet clay and silt mixtures, to stiff sandy plastic clay. Thin layers (1 to 2 inches) of sand were present in Stratum 2. It should be noted that the texture of Stratum 2 was consistent with that of a soil and did not appear to be sludge. Stratum 2 is therefore considered to be soil and is discussed as soil herein. The distinct color characteristics of Stratum 2 may be indicative of influence from former operations at the SWMU.

Below Stratum 2, the soil was generally stiff to hard silty clay, of medium to high plasticity, and varied in color from yellowish red to red to strong brown. This layer is identified as Stratum 3 in this report. Stratum 3 was observed to be the hardest of the three Strata and may act as a barrier to the downward movement of groundwater.

Geoprobe® refusal, or probe refusal, occurred in three boring locations at bedrock. Boring 6SB3 was terminated at a depth of 27.9 feet bgs. Boring 6SB5 was terminated at a depth of 17.4 feet bgs and boring 6SB10 was terminated at a depth of 20.4 feet bgs. The remainder of the borings were advanced to a depth of 27 feet bgs without probe refusal or indications of bedrock. The observed variations in depth to bedrock are typical of the carbonate rocks present in the region.

4.0 SUMMARY OF FIELD SAMPLING PROGRAM

The purpose of the SWMU 6 sampling program was to collect representative composite samples of the overburden soils and representative discrete samples of the soil at depth (25-feet bgs or at probe refusal) in twelve soil borings advanced in SWMU 6. Each of the twelve composite samples submitted to the laboratory was analyzed for full Toxicity Characteristic Leaching Procedure (TCLP) analysis

including TCLP metals, TCLP VOCs, TCLP SVOCs, TCLP pesticides, and TCLP herbicides, plus ignitability, corrosivity, reactivity (percent nitrocellulose) and paint filter liquids according to SW-846 Method protocols. Each of the 12 discrete samples was analyzed for SW-846 Methods: target compound list (TCL) VOCs; TCL semi-volatile organic compounds; TCL pesticides/aroclors; target analyte list (TAL), metals and explosives.

Figure 7 shows the locations of the 12 soil borings, and Figure 8 shows the approximate locations where the settling tanks will be placed relative to SWMU 6. In selecting the locations of subsurface soil samples to be collected, consideration was given to the size and shape of SWMU 6, as well as the overall project objective of evaluating the overburden soils relative to RCRA waste characteristics and providing the information necessary for evaluating the soils at depth relative to USEPA Region III residential and industrial RBCs.

The investigation activities were conducted in accordance with the EPA approved Work Plan Addendum No. 11.

Components of the investigation included subsurface soil sampling and sample collection by direct push technology (Geoprobe®) methods, boring abandonment, stratigraphic logging of the soil borings, sample management, field screening using a portable photoionization detector (PID), field documentation, laboratory analysis, quality assurance practices, and evaluation of the data relative to RCRA hazardous waste characteristics and USEPA Region III residential and industrial RBCs.

4.1 GEOPROBE® SAMPLING

During WPA development and subsequent USEPA concurrence, the number and locations of soil borings was deemed sufficient to provide an appropriate number of samples to: (1) characterize the volume of soil that will ultimately be excavated from SWMU 6; and (2) evaluate the residual risk, if applicable, of soil that will remain at depth. Given the objectives of the sampling program and the planned excavation of a significant portion of the SWMU 6 area, a distribution of 12 soil borings that provides adequate coverage of the SWMU area and allows for the collection of an appropriate number of samples to characterize soils within the SWMU 6 area was selected. Table 1 provides a summary of the samples collected from each boring. Samples collected for “Overburden Characterization” were composite samples while samples collected for “Residual Risk Screening” were discrete samples.

Boring logs, with information including lithology, boring depth, sample depth, and PID screenings are included in Appendix B. In addition to selecting borings locations that provided geographic coverage of the interior of the SWMU 6 area, borings were placed along the SWMU edges (and in some cases outside the boundaries of the SWMU) to evaluate the potential that constituents may have “leaked” beyond the boundaries of the SWMU.

Prior to the start of the investigation, a meeting was held at the SWMU 6 area to discuss the selected soil boring locations (which were flagged within the SWMU), and to evaluate the locations of underground utilities. Personnel present during this meeting represented RFAAP, URS, USACE and ATK. USACE personnel reviewed utility maps and marked potential underground utilities prior to

drilling. Subsequently, the proposed boring locations were modified (as flagged in the field and identified in the work plan for this investigation) in the field, based on the identification of the locations of potential underground utilities during this meeting. The approximate locations of underground utilities present at SWMU 6 are shown on Figure 9.

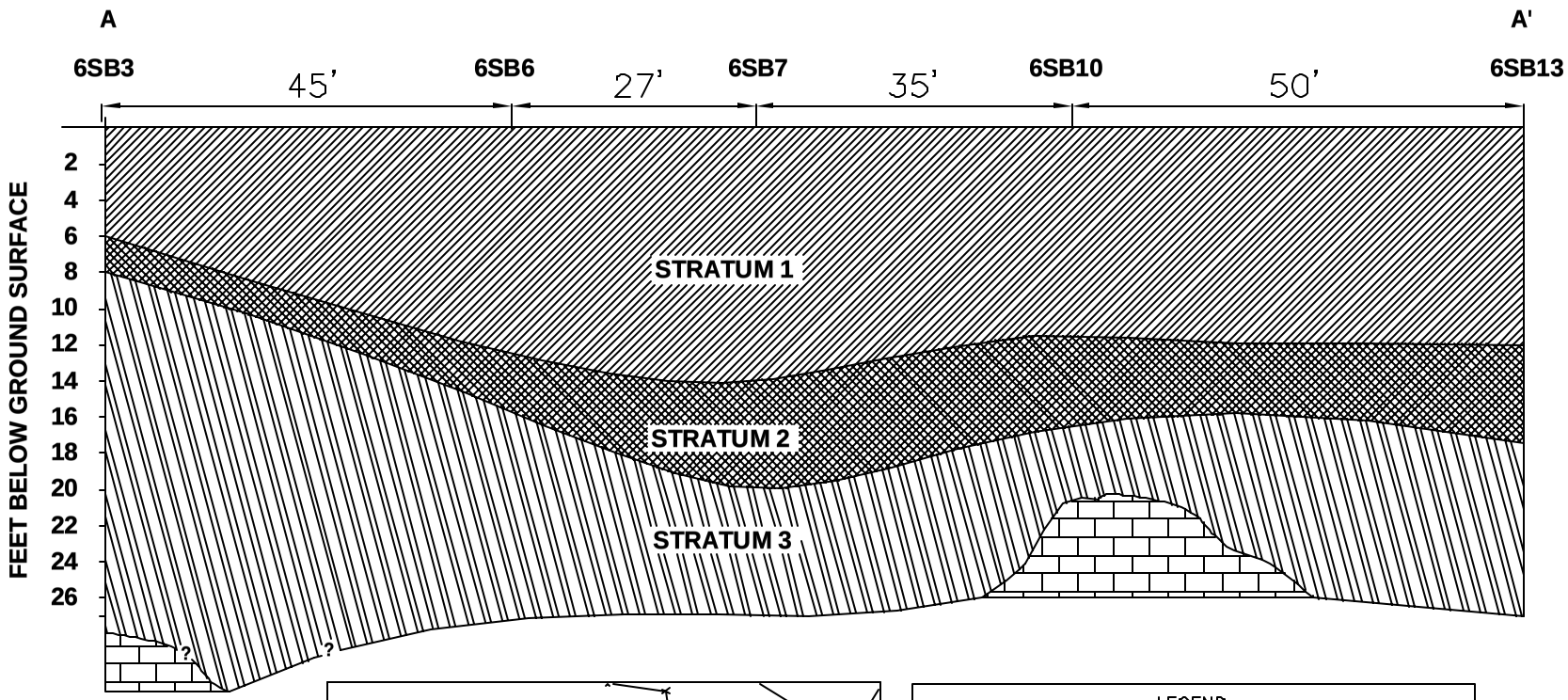
Figure 10 depicts the actual soil boring locations, versus the proposed boring locations identified in the WPA. As shown on Figure 10, borings 6SB3, 6SB5, 6SB9, and 6SB12 were offset to the south. One additional boring was re-positioned from the northern boundary to nearer the center of the SWMU (6SB6). Boring 6SB13 was offset to the east due to the presence of utilities. Boring 6SB12 was offset to the west slightly and boring 6SB10 was offset to the south due to the presence of utilities.

The Geoprobe® is a "direct push" technique, which incorporates a hydraulically powered percussion/probing machine designed specifically for use in the environmental industry. The Geoprobe® uses static force (the truck's weight) and a percussion hammer to advance small diameter sampling tools into the subsurface to collect soil cores. The macro soil core sample is collected inside a dedicated, pre-cleaned acetate liner; each acetate liner is used once, then discarded (handled as IDM).

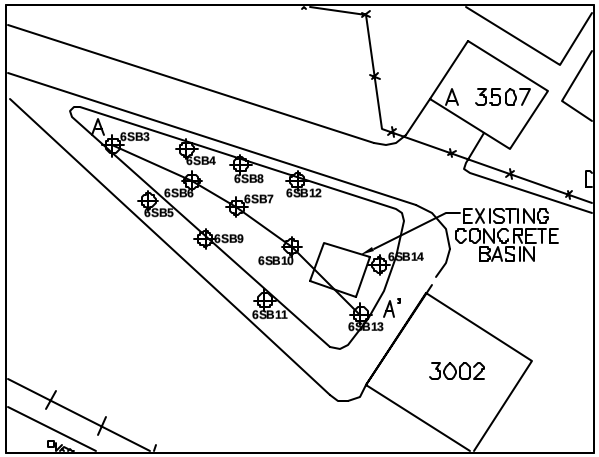
Soil borings were advanced using the direct push technology. A four-foot Macro-Core® device was used to collect the samples. Stratigraphic logs for each boring were prepared. During drilling, subsurface soil samples were screened for the presence of organic compounds using a PID. The PID was calibrated against a 100 ppm isobutylene standard calibration gas (since a single VOC constituent of concern was not previously identified) using a 10.2 eV lamp.

The Geoprobe® and other down hole equipment and tools were steam cleaned daily prior to use at the site. The down-hole equipment and tools were decontaminated on site between each boring location. Following each soil sampling interval (i.e., 4-foot section), the Macro-Core®-cutting shoe (the end of the Macro-Core® that comes in contact with the soil) was decontaminated in accordance with the WPA. Decontamination water was containerized on site.

Soil borings were abandoned (sealed) upon completion by pouring bentonite chips into the borehole in accordance with the WPA. In accordance with the WPA, the chips were not hydrated because the borings were less than three inches in diameter.



Scale
V: 1"=10'
H: 1"=20'
VE: 2x



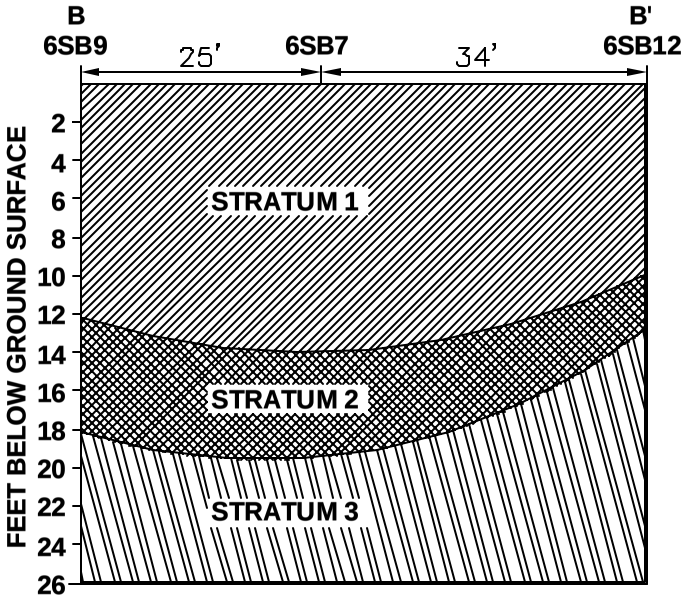
LEGEND

Layer 1 Red, dark yellowish brown or strong brown silty clay.

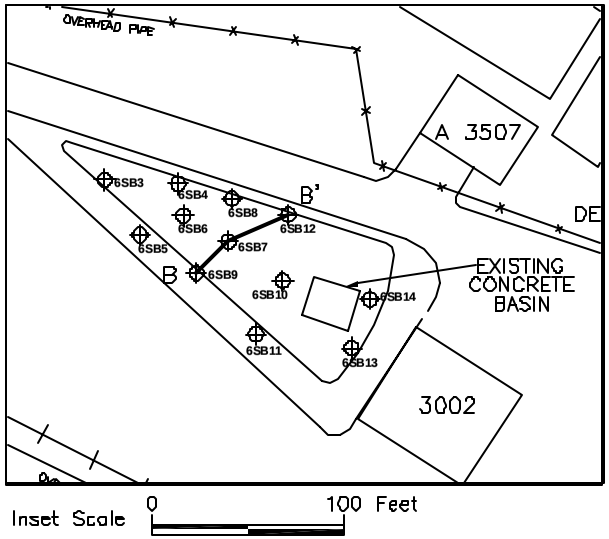
Layer 2 Olive, grayish brown, or dark gray silt and clay mixtures or silty clay mixtures often with the presence of woody matter.

Layer 3 Yellowish red, red to strong brown, stiff to hard plastic silty clay.

Radford Army Ammunition Plant (RFAAP) SWMU 6 Sampling Results Report	
Figure 5	Date/Drawing No. 09604.242.F5.DWG
SWMU 6 Interpreted Cross Section A to A'	Scale: As Shown



Scale
V: 1"=5'
H: 1"=10'
VE: 2x



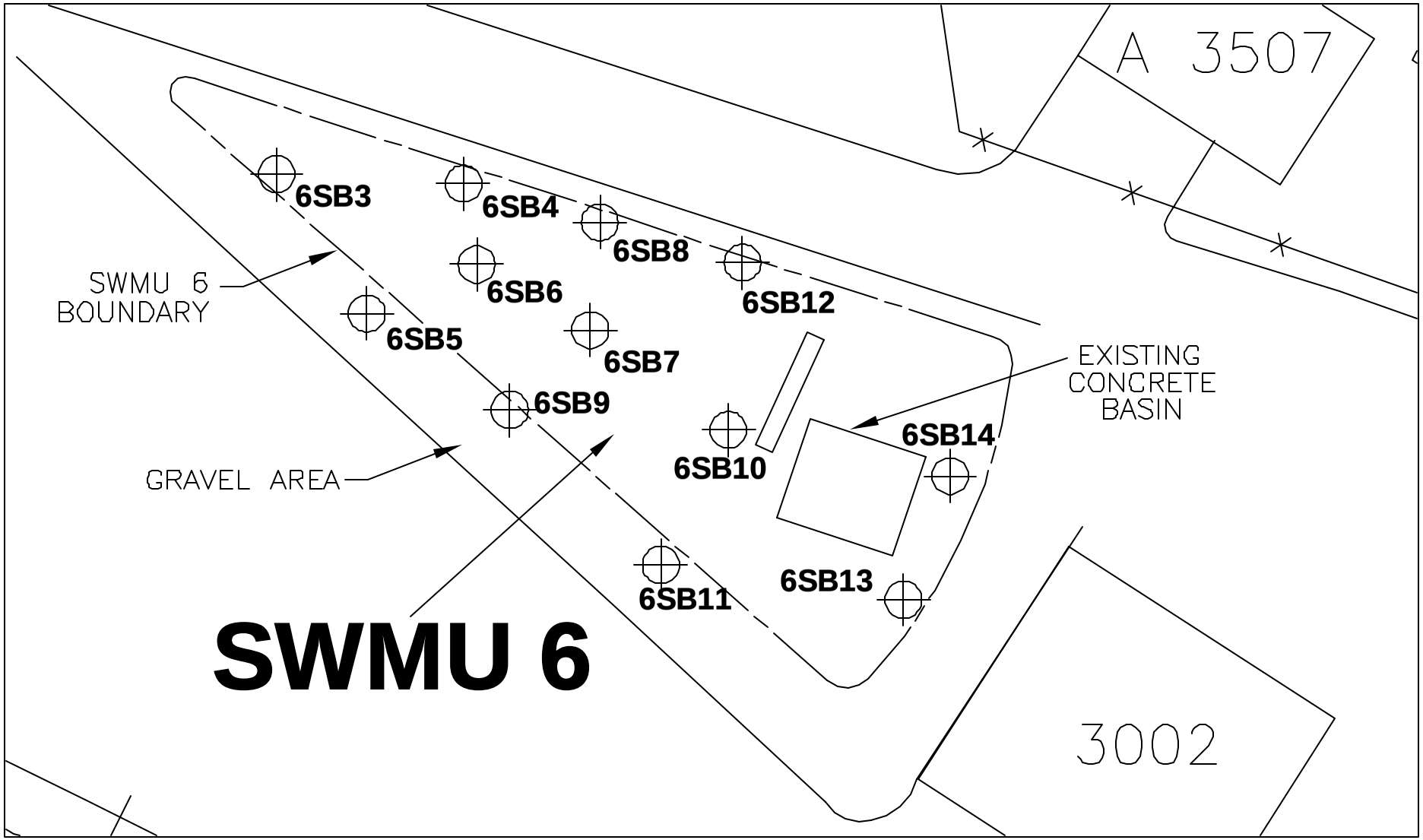
LEGEND

Layer 1 Red, dark yellowish brown or strong brown silty clay.

Layer 2 Olive, grayish brown, or dark gray silt and clay mixtures or silty clay mixtures often with the presence of woody matter.

Layer 3 Yellowish red, red to strong brown, stiff to hard plastic silty clay.

Radford Army Ammunition Plant (RFAAP) SWMU 6 Sampling Results Report	
Figure 6	Date/Drawing. No. 09604.242.F6.DWG
SWMU 6 Interpreted Cross Section B to B'	Scale: As Shown



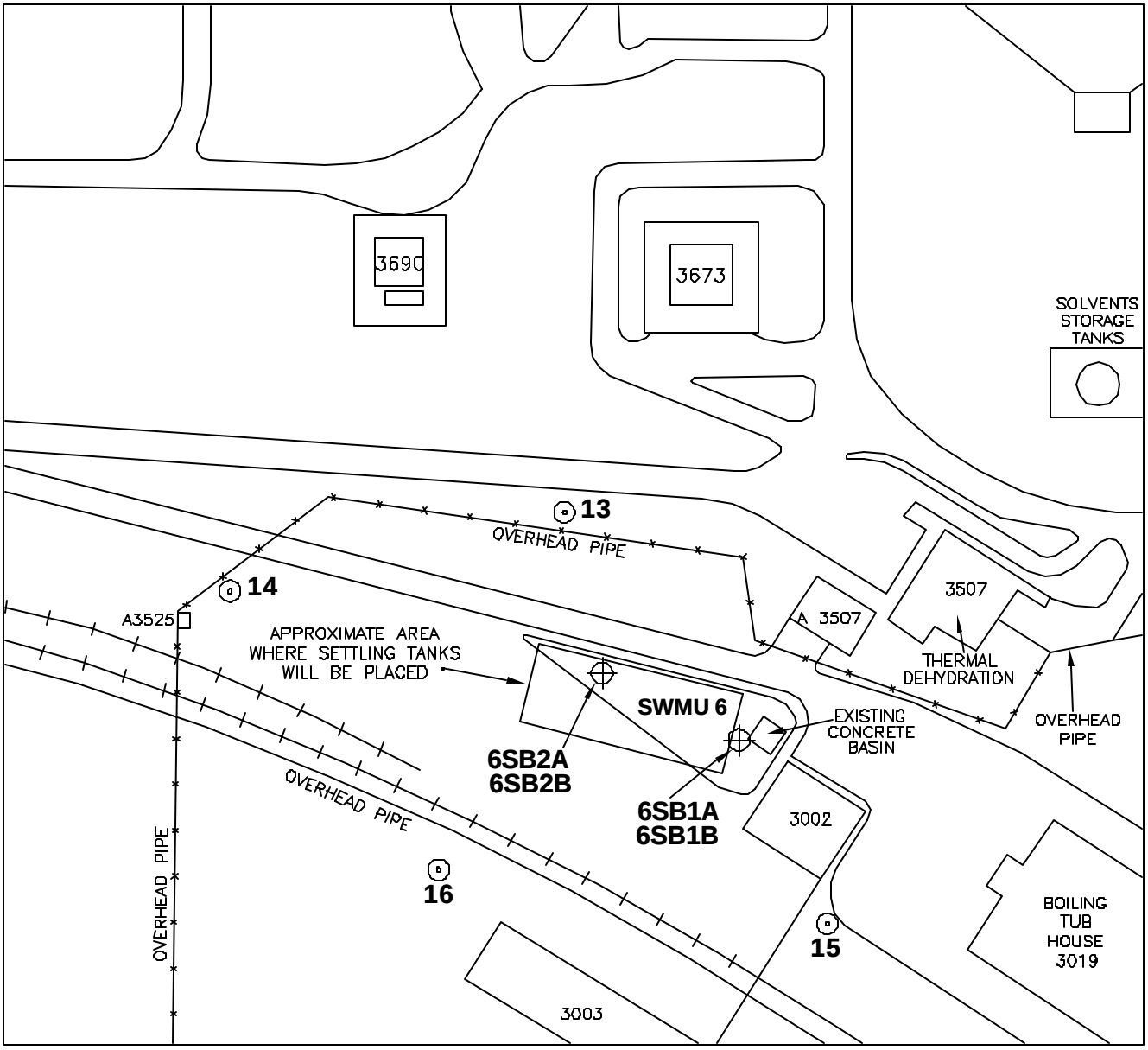
0 30 Feet

SCALE

LEGEND:

6SB3 Boring Location

Radford Army Ammunition Plant (RFAAP) SWMU 6 Sampling Results Report	
Figure 7	Date/Drawing. No. 09604.242.F7.DWG
SWMU 6 Boring Locations	Scale: As Shown



LEGEND:

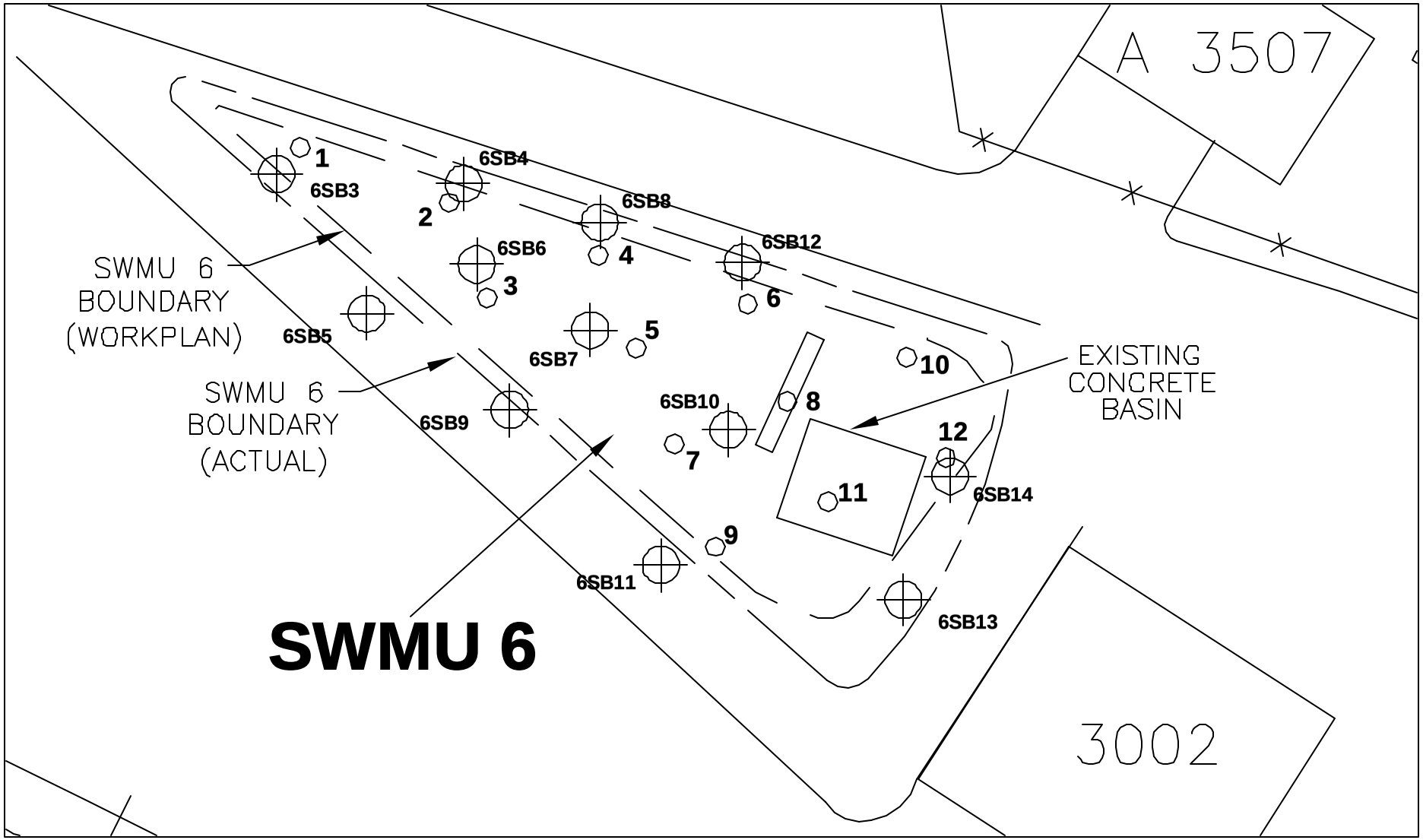
Existing Boring

Existing Monitoring Well/Boring

0 100 Feet

APPROXIMATE SCALE

Radford Army Ammunition Plant (RFAAP) SWMU 6 Sampling Results Report	
Figure 8	Date/Drawing. No. 09604.242.F8.DWG
Approximate Area Where Settling Tanks Will Be Placed	Scale: As Shown



0 30 Feet
SCALE

LEGEND:

6SB3 Actual Boring Location

3 Proposed Boring Location

Radford Army Ammunition Plant (RFAAP) SWMU 6 Sampling Results Report	
Figure 10	Date/Drawing. No. 09604.242.F10.DWG
SWMU 6 Proposed versus actual Boring Locations	Scale As Shown

URS Dames & Moore		Log of:	6SB3
		Project Number:	09604-242
Client:	U.S. Army Corps of Engineers	Drilling Company:	Marshall Miller & Assoc.
Project:	SWMU 6 Sampling and Reporting	Driller:	Keith Carr
Location:	Radford Army Ammunition Plant, Radford, VA	Boring Method:	Geoprobe
North:	East:	Logged by:	John H. Spangler
Total Depth: 27.9'	Elev GS: / Reference:	Date: Start: 11/14/00	Complete: 11/14/2000

PID	Ft. Driven / Ft. Recovered	Composite Sample Collection Depth	VOC Sample Depth	Sample Interval	Depth (Ft.)	Symbol	Description
ND	4.0' / 4.0'			0-4'	2	CL	Brown organics/roots/fine sandy clay 0.5': Dark red, (2.5y 3/6), fine sandy clay, moist, low plasticity, trace gravels. 2.5': Dark yellowish brown, (10 yr 5/6), silty clay, moist,medium plasticity some red and black mottling.
ND					4		4.0': Grading yellowish brown (10 yr 5/6), silty clay, wet, moist, trace gravels
ND	4.0' / 4.0'			4-8'	6		
ND					8	CL	6.5': Olive, (2.5 yr 5/4), silty clay, trace gravels
ND	4.0' / 2.2'			8-12'	10		8.0': Reddish yellow (7.5 yr 6/8) silty clay, moist, root material AT 10.9'
0.1					12		
4.0	4.0' / 1.2'			12-16'	14		12.0': Reddish yellow, (7.5 yr 6/8), silty clay, moist, high plasticity
6.0					16		
7.0	4.0' / 1.0'			16-20'	18	CL	Increased sand component
					20		
ND	4.0' / 0.8'			20-24'	22		Increased resistance, hard, at 23'
ND					24		
ND	3.9' / 3.5'			24-27.9'	26		
							27.9': Boring terminated at 27.9'. Refusal.

Notes:
ND = Not Detected
PID = Photo Ionization Detector

URS Dames & Moore			
		Log of:	6SB4
		Project Number:	09604-242
Client:	U.S. Army Corps of Engineers	Drilling Company:	Marshall Miller & Assoc.
Project:	SWMU 6 Sampling and Reporting	Driller:	Keith Carr
Location:	Radford Army Ammunition Plant, Radford, VA	Boring Method:	Geoprobe
North:	East:	Logged by:	John H. Spangler
Total Depth: 27.0'	Elev GS: / Reference:	Date: Start: 11/14/00	Complete: 11/14/2000

PID	Ft. Driven / Ft. Recovered	Composite Sample Collection Depth	VOC Sample Depth	Sample Interval	Depth (Ft.)	Symbol	Description
ND	4.0' / 3.4'			0-4'	2	SM	Brown root matter, grading to reddish brown, (2.5 yr 3/3), medium grained clayey sand, slightly micaceous, moist,
						CL	grading red.
						GW	Gravel layer
						CL	Strong brown, (7.5 yr 5/6), medium to coarse sandy clay, soft, high plasticity, moist
	4.0' / 2.8'			4-8'	4, 6		
	4.0' / 1.0'			8-12'	8, 10		Gravel lenses
	4.0' / 3.4'			12-16'	12, 14		Grading softer, increase in moisture
	4.0' / 4.0'			16-20'	16, 18		Grayish brown, (2.5 yr 5/2), stiff, sandy clay, low plasticity, wet
						SM	18.5': Silt/very fine sand mix
						CL	18.7': Yellowish red, (5 yr 5/6) stiff, fine sandy clay, wet with black matter (coal?)
	4.0' / 4.0'			20-24'	20, 22		
	3.0' / 3.0'			24-27'	24, 26		
							Boring terminated at 27' - No refusal.

Notes:
ND = Not Detected
PID = Photo Ionization Detector

URS Dames & Moore		Log of:	6SB5
		Project Number:	09604-242
Client:	U.S. Army Corps of Engineers	Drilling Company:	Marshall Miller & Assoc.
Project:	SWMU 6 Sampling and Reporting	Driller:	Keith Carr
Location:	Radford Army Ammunition Plant, Radford, VA	Boring Method:	Geoprobe
North:	East:	Logged by:	John H. Spangler
Total Depth: 17.4	Elev GS: Reference:	Date: Start: 11/15/00	Complete: 11/15/2000

PID	Ft. Driven / Ft. Recovered	Composite Sample Collection Depth	VOC Sample Depth	Sample Interval	Depth (Ft.)	Symbol	Description
ND	4.0' / 4.0'			0-4'	2, 4		Brownish red, sandy clay, stiff Strong brown, (7.5 yr 5/6), silty clay, stiff, moist Grading moist with moderate plasticity
	4.0' / 4.0'			4-8'	6, 8		Trace black matter (coal?). Trace fine to coarse sand, trace fine gravels Grading redder; hard at 7.9'
	4.0' / 3.0'			8-12'	10, 12	CL	Red (2.5 yr 4/6) fine to medium sandy clay, moist, grading with soft sandy clay
	4.0' / 0.5'			12-16'	14, 16		
	1.4' / 1.0'						Grading strong brown, soft sandy clay
				16-17.4'	18		Boring terminated at 17.4'. Refusal
				20-24'	20, 22		
				24-27'	24, 26		

Notes:
ND = Not Detected
PID = Photo Ionization Detector

URS Dames & Moore			
		Log of:	6SB6
		Project Number:	09604-242
Client:	U.S. Army Corps of Engineers	Drilling Company:	Marshall Miller & Assoc.
Project:	SWMU 6 Sampling and Reporting	Driller:	Keith Carr
Location:	Radford Army Ammunition Plant, Radford, VA	Boring Method:	Geoprobe
North:	East:	Logged by:	John H. Spangler
Total Depth: 27.0'	Elev GS: / Reference:	Date: Start: 11/15/00	Complete: 11/15/2000

PID	Ft. Driven / Ft. Recovered	Composite Sample Collection Depth	VOC Sample Depth	Sample Interval	Depth (Ft.)	Symbol	Description
ND	4.0' / 4.0'			0-4'	2	SC	Brown sandy clay, roots, grass Red, (2.5 yr 4/8), fine to medium sandy clay, moist
	4.0' / 4.0'			4-8'	4, 6	CL	5.6' to 5.9': Gravel seam, with strong brown mottlling, moist
	4.0' / 0.8'			8-12'	8, 10	CL/GP	8.0' to 12.0': Red gravelly clay,
	4.0' / 2.0'			12-16'	12, 14	CL/ML	Strong brown (10 yr 5/6), clayey silt to silty clay, wet with trace gravel in lenses 15.5': Very dark gray soft silty clay
	4.0' / 3.0'			16-20'	16, 18	CL	Dark brown, (10 yr 4/2), silty sandy clay, very stiff, moist
	4.0' / 4.0'			20-24'	20, 22		Grading softer, wet, with gravel
	4.0' / 3.0'			24-27'	24, 26		Increasing sand, wet
							Boring terminated at 27'. No refusal.

Notes:
ND = Not Detected
PID = Photo Ionization Detector

URS Dames & Moore			
		Log of:	6SB7
		Project Number:	09604-242
Client:	U.S. Army Corps of Engineers	Drilling Company:	Marshall Miller & Assoc.
Project:	SWMU 6 Sampling and Reporting	Driller:	Keith Carr
Location:	Radford Army Ammunition Plant, Radford, VA	Boring Method:	Geoprobe
North:	East:	Logged by:	John H. Spangler
Total Depth: 27.0'	Elev GS: / Reference:	Date: Start: 11/14/00	Complete: 11/14/2000

PID	Ft. Driven / Ft. Recovered	Composite Sample Collection Depth	VOC Sample Depth	Sample Interval	Depth (Ft.)	Symbol	Description
ND	4.0' / 4.0'			0-4'	2, 4	SM	Brown silty sandy clay with organics
						CL	Red (2.5 yr 4/8) fine to medium sandy clay, slightly micaceous, trace coarse sand , moist
							Red (2.5 yr 4/8) sandy clay, slightly plastic, moist
	4.0' / 4.0'			4-8'	6		Grading stiffer; trace gravels, trace yellow mottles; moist
					8		Increased gravels
0.2	4.0' / 4.0'			8-12'	10		10.0' to 10.8': Increased moisture and plasticity, soft
ND						CH	10.8': Brownish yellow (10 yr 6/6) soft, highly plastic clay trace coarse sand, moist
	4.0' / 3.4'			12-16'	12, 14		Grades to light olive brown (2.5 yr 5/3) soft, clay and silt, wet, with trace decomposed wood fragments
	4.0' / 4.0'			16-20'	16, 18	CL	
					20	CL	20.0': Strong brown (7.5 yr 5/3) soft silty clay, some sand, moist and gravel, moist
	4.0' / 4.0'			20-24'	22	CL/ML	21.0': Becomes brown (10 yr 5/3) soft, silty clay, some sand and gravel moist
	4.0' / 3.0'			24-27'	24, 26	CL	Red sandy clay, moist
							Boring terminated at 27'. No refusal.

Note:
ND = Not Detected
PID = Photo Ionization Detector

URS Dames & Moore		Log of:	6SB8
		Project Number:	09604-242
Client:	U.S. Army Corps of Engineers	Drilling Company:	Marshall Miller & Assoc.
Project:	SWMU 6 Sampling and Reporting	Driller:	Keith Carr
Location:	Radford Army Ammunition Plant, Radford, VA	Boring Method:	Geoprobe
North:	East:	Logged by:	John H. Spangler
Total Depth: 27.0'	Elev GS: / Reference:	Date: Start: 11/15/00	Complete: 11/15/2000

PID	Ft. Driven / Ft. Recovered	Composite Sample Collection Depth	VOC Sample Depth	Sample Interval	Depth (Ft.)	Symbol	Description
ND	4.0' / 4.0'			0-4'	2	CL	Red sandy clay, with grass and roots, micaceous, stiff Reddish yellow (7.5 yr 6/6) silty clay, moist grading harder with depth, trace rounded gravels
	4.0' / 4.0'			4-8'	4, 6	CL	6.0': Increased moisture with wood chips
	4.0' / 2.0'			8-12'	8, 10	CL	8.0' to 15.5': No wood chips
	4.0' / 4.0'			12-16'	12, 14	CL/CH	12.4': Dark grayish brown (10 yr 4/2) soft, sandy clay, plastic, moist 13.7': Stiffer 15.5': Wood chips present with yellowish brown mottles, increasing sand and moisture
	4.0' / 4.0'			16-20'	16, 18	GW / CL/CH	Gravel seam Yellowish red (5 yr 5/6) clay, very stiff to hard, moist, trace fine black matter (coal?)
	4.0' / 4.0'			20-24'	20, 22	CL/CH	
	3.0' / 3.0'			24-27'	24, 26	CL/CH	
							Boring terminated at 27'. No refusal.

Note:
ND = Not Detected
PID = Photo Ionization Detector

URS Dames & Moore		Log of:	6SB9
		Project Number:	09604-242
Client:	U.S. Army Corps of Engineers	Drilling Company:	Marshall Miller & Assoc.
Project:	SWMU 6 Sampling and Reporting	Driller:	Keith Carr
Location:	Radford Army Ammunition Plant, Radford, VA	Boring Method:	Geoprobe
North:	East:	Logged by:	John H. Spangler
Total Depth: 27.0'	Elev GS: / Reference:	Date: Start: 11/15/00	Complete: 11/15/00

PID	Ft. Driven / Ft. Recovered	Composite Sample Collection Depth	VOC Sample Depth	Sample Interval	Depth (Ft.)	Symbol	Description
ND	4.0' / 4.0'			0-4'	2, 4	GM	Silty gravels to 0.3'
						CL	Red (2.5 yr 4/6) sandy clay, medium plasticity
						CL	Yellowish brown (10 yr 5/8) soft clayey silt/silty clay, moist
	4.0' / 0.5'			4-8'	6, 8		4.8': Gravel seam
	4.0' / 2.3'			8-12'	10, 12		Very soft yellowish brown silty clay, moist
	4.0' / 1.0'			12-16'	14, 16		Strong brown (7.5 yr 5/6) very soft, silty clay, low plasticity trace fine sand, wet
	4.0' / 4.0'			16-20'	18		18.0': Brown (7.5 yr 4/4)
						CH	19.0': Brown (7.5 yr 4/4) stiff, sandy plastic clay with wood fragments
	4.0' / 4.0'			20-24'	20, 22		
						SC	22.5' to 22.8': Zone of wood fragments, underlain by brown (7.5 yr 4/4) fine to medium clayey sand, trace rounded gravels
	3.0' / 4.0'			24-27'	24, 26	ML	24.0' to 27.0': Brown (7.5 yr 4/4) sandy clayey silt, saturated
							Boring terminated at 27'. No refusal.

Note:
ND = Not Detected
PID = Photo Ionization Detector

URS Dames & Moore		Log of:	6SB10
		Project Number:	09604-242
Client:	U.S. Army Corps of Engineers	Drilling Company:	Marshall Miller & Assoc.
Project:	SWMU 6 Sampling and Reporting	Driller:	Keith Carr
Location:	Radford Army Ammunition Plant, Radford, VA	Boring Method:	Geoprobe
North:	East:	Logged by:	John H. Spangler
Total Depth: 20.4'	Elev GS: / Reference:	Date: Start: 11/15/00	Complete: 11/15/00

PID	Ft. Driven / Ft. Recovered	Composite Sample Collection Depth	VOC Sample Depth	Sample Interval	Depth (Ft.)	Symbol	Description
						SC	Brown silty clayey sand, grass and roots
ND	4.0' / 4.0'			0-4'	2	CL	Red, (2.5y 4/6), sandy clay, trace gravels, with yellowish brown mottles, moist
ND							
ND					4		
ND	4.0' / 4.0'			4-8'	6		Red, (2.5y 4/6), sandy clay, trace gravels, with yellowish brown mottles; moist
0.2							
ND					8		
ND	4.0' / 4.0'			8-12'	10		Grading stiffer.
0.1							
ND						CL/GP	11.0': Yellowish brown, (10 yr 5/4), hard gravelly clay, trace wood fragments, moist
ND	4.0' / 4.0'			12-16'	12		
0.6							
ND					14	CL	13.5': Brown, (7.5 yr 5/3), sandy clay with some red mottling.
ND							
						SM	15.2': Brown, (7.5 yr 5/3), soft silty sand, with wood fragments
ND	4.0' / 4.0'			16-20'	16	CL	16.0': Yellowish brown, (10 yr 5/6), hard sandy clay, moist
ND							
ND					18		
ND						SC	Grading to reddish brown, clayey silty fine sand, moist
ND	0.4' / 0.4'				20		Boring terminated at 20.4'. Refusal.
				20-24'	22		
					24		
				24-27'	26		

Notes:
ND = Not Detected
PID = Photo Ionization Detector

URS Dames & Moore			
		Log of:	6SB11
		Project Number:	09604-242
Client:	U.S. Army Corps of Engineers	Drilling Company:	Marshall Miller & Assoc.
Project:	SWMU 6 Sampling and Reporting	Driller:	Keith Carr
Location:	Radford Army Ammunition Plant, Radford, VA	Boring Method:	Geoprobe
North:	East:	Logged by:	John H. Spangler
Total Depth: 27.0'	Elev GS: / Reference:	Date: Start: 11/15/00	Complete: 11/15/00

PID	Ft. Driven / Ft. Recovered	Composite Sample Collection Depth	VOC Sample Depth	Sample Interval	Depth (Ft.)	Symbol	Description
ND	4.0'			0-4'		SC	Reddish brown, (2.5 yr 3/4), clayey silty sand becoming red (2.5 yr 4/8) softer, plastic sandy clay
ND						CL	1.5': Becomes brownish yellow, (10 yr 6/8), silty sandy clay, moist with strong brown, (7.5 yr 5/6), mottling, plasticity increasing.
ND					2		
ND	4.0'						
					4		
ND	4.0'			4-8'		GC	5.0' - 5.5': Gravel lense
ND					6	CH	Highly plastic brownish yellow, (10 yr 6/8), clay; moist, trace sand, trace black matter (coal?)
ND	3.0'						
ND					8		
ND	4.0'			8-12'			
ND					10		
ND	4.0'					CL	10.5': Becomes reddish brown, (5 yr 4/6), soft fine to medium sandy silty clay, trace gravel, moist
ND					12		11.5': Dark brown (7.5 yr 3/3) silty sand, moist, with root material
ND	4.0'			12-16'		SM	
0.1'					14		14.2': Dark grayish brown, (2.5 yr 4/2), sandy clay, plastic, trace gravel, trace dark yellow brown, sandy clay, moist
ND	3.5'					CL	
ND					16		grading softer with gray and red mottles
ND	4.0'			16-20'			
ND					18		Brownish yellow, (10 yr 6/8), hard silty clayey gravelly sand, red mottles, moist
ND	4.0'						
					20	SP	
ND	4.0'			20-24'			
ND					22		
ND	4.0'						
ND					24	GC	Brownish yellow, (10 yr 6/8), clayey sandy gravel, moist
ND	4.0'			24-27'			
ND					26	CL	Strong brown, (7.5 yr 5/6), slightly sandy clay, plastic, moist, trace black matter (coal?)
ND	3.0'						
							Boring terminated at 27' - No refusal.

Notes:
ND = Not Detected
PID = Photo Ionization Detector

URS Dames & Moore			
		Log of:	6SB12
		Project Number:	09604-242
Client:	U.S. Army Corps of Engineers	Drilling Company:	Marshall Miller & Assoc.
Project:	SWMU 6 Sampling and Reporting	Driller:	Keith Carr
Location:	Radford Army Ammunition Plant, Radford, VA	Boring Method:	Geoprobe
North:	East:	Logged by:	John H. Spangler
Total Depth: 27.0'	Elev GS: / Reference:	Date: Start: 11/15/00	Complete: 11/15/00

PID	Ft. Driven / Ft. Recovered	Composite Sample Collection Depth	VOC Sample Depth	Sample Interval	Depth (Ft.)	Symbol	Description
ND	4.0' / 4.0'			0-4'	2, 4	CL	Grass and root matter, becoming red (2.5 yr 4/6) hard sandy clay, 1.5' - 3.0' Micaceous sandy clay with gravel lense, moist
	4.0' / 2.8'			4-8'	6	ML	Yellow (10 yr 8/8) soft silt, dry
	4.0' / 1.5'			8-12'	8, 10	CL	7.0': Yellowish red (5 yr 5/6) sandy clay, soft, plastic, moist
	4.0' / 1.5'			12-16'	12, 14	CL	13.0': Stiff dark brown (7.5 yr 4/3) fine to coarse sandy clay, moist
	4.0' / 4.0'			16-20'	16, 18	CL	grading redder and gravelly
						GC	18.7' to 19.1': Sandy clayey gravel
	4.0' / 4.0'			20-24'	20, 22	CM	Yellowish red (5 yr 5/8) highly plastic stiff clay with strong brown and yellow mottles , moist
	4.0' / 3.0'			24-27'	24, 26	CL	Yellowish red (5 yr 5/8) medium stiff silty clay, trace sand lenses moist
							Boring terminated at 27'. No refusal.

Notes:
ND = Not Detected
PID = Photo Ionization Detector

URS Dames & Moore			
		Log of:	6SB13
		Project Number:	09604-242
Client:	U.S. Army Corps of Engineers	Drilling Company:	Marshall Miller & Assoc.
Project:	SWMU 6 Sampling and Reporting	Driller:	Keith Carr
Location:	Radford Army Ammunition Plant, Radford, VA	Boring Method:	Geoprobe
North:	East:	Logged by:	John H. Spangler
Total Depth: 27.0'	Elev GS: / Reference:	Date: Start: 11/16/00	Complete: 11/16/00

PID	Ft. Driven / Ft. Recovered	Composite Sample Collection Depth	VOC Sample Depth	Sample Interval	Depth (Ft.)	Symbol	Description
ND	4.0' / 4.0'			0-4'	2, 4	GM, CL	0' to 1.0': Surface gravel 1.0': Red (2.5 yr 4/6) clay, soft sandy (micaceous) silty, moist
	4.0' / 0.4'			4-8'	6, 8		
	4.0' / 2.0'			8-12'	10, 12	GC, CL	8.4' to 8.7' Gravel lense *8.7' to 8.8': Black tar-like matter with fiber-like matting attached to it (Resembles tar/matting of adjacent concrete basins) 8.8' to 12.0': Red clay, trace gravel, moist
	4.0' / 3.5'			12-16'	14, 16	SP	Dark grayish brown (2.5 yr 4/2) clayey silty fine sand, moist
	4.0' / 4.0'			16-20'	18, 20	CL, SC	Grades to soft silty clay 17.4': Yellowish brown (7.5 yr 5/4) soft, very silty clay, saturated 18.5' to 20.0': Strong brown (7.5 yr 5/8) soft sandy clay with fine gravel moist
	4.0' / 4.0'			20-24'	22, 24	CL/GP	Strong brown (7.5 yr 5/8) gravelly sandy plastic clay, trace silt moist
	3.0' / 3.0'			24-27'	26		Increased plasticity
							Boring terminated at 27'. No refusal.

Notes:
ND = Not Detected
PID = Photo Ionization Detector

URS Dames & Moore		Log of:	6SB14
		Project Number:	09604-242
Client:	U.S. Army Corps of Engineers	Drilling Company:	Marshall Miller & Assoc.
Project:	SWMU 6 Sampling and Reporting	Driller:	Keith Carr
Location:	Radford Army Ammunition Plant, Radford, VA	Boring Method:	Geoprobe
North:	East:	Logged by:	John H. Spangler
Total Depth: 27.0'	Elev GS: / Reference:	Date: Start: 11/16/00	Complete: 11/16/00

PID	Ft. Driven / Ft. Recovered	Composite Sample Collection Depth	VOC Sample Depth	Sample Interval	Depth (Ft.)	Symbol	Description
ND	4.0' / 4.0'			0-4'	2, 4	GM	Surface gravel/silt/clay
						CL	0.75': Red (2.5 yr 4/6) sandy clay, medium plasticity, with yellowish brown mottling, moist
	4.0' / 0.3'			4-8'	6, 8		4.0': Increasing yellowish brown mottles
	4.0' / 3.2'			8-12'	10, 12	GM	9.3' to 9.5': Gravel lense
						CL	9.5' to 10.0': Stiff red (2.5 yr 4/6) sandy clay, moist 10.0' - 12.0': Grading soft , with increasing gravels
	4.0' / 4.0'			12-16'	14, 16	SC/SM	14.7': Olive brown (2.5 yr 4/3) silty, trace clay, clayey fine sand, with occassional wood fragments, moist
	4.0' / 4.0'			16-20'	18, 20		Grading to dark brown (10 yr 4/3), trace wood fragments or sticks
	4.0' / 4.0'			20-24'	22, 24	CH	21.5': Strong brown (7.5 yr 5/6) highly plastic clay, trace reddish yellow mottles
						CL	23.0': Strong brown (7.5 yr 5/6) slightly silty, slightly gravelly clay occasional reddish yellow mottles.
	3.0' / 3.0'			24-27'	26		
							Boring terminated at 27' - No probe refusal.

Notes:
ND = Not Detected
PID = Photo Ionization Detector

SECTION 02222

EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS

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 SOCIETY OF TESTING AND MATERIALS (ASTM)

ASTM D 1556	(1990) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(1991) Laboratory Compaction Chacteristics of Soil Using Modified Effort (56,000 ft-lbf/cu.ft. (2,700 kN-m/cu.m.))
ASTM D 2167	(1984; R 1990) Density and Unit Weight of Soil In-Place by the Rubber Balloon Method
ASTM D 2216	(1990) Laboratory Determination of Water (Moisture) Content of Soil and Rock
ASTM D 2487	(1990) Classification of Soils for Engineering Purposes
ASTM D 2937	(1983; R 1990) Density of Soil In Place by the Drive-Cylinder Method
ASTM D 4318	(1984) Liquid Limit, Plastic Limit, and Plasticity Index of Soils

U. S. ARMY, CORPS OF ENGINEERS (COE)

EM 385-1-1	(1992) Safety and Health Requirements Manual

1.2 DEFINITIONS

1.2.1 Satisfactory Materials

Materials classified by ASTM D 2487 as GW, GP, GM, GC, SW, SP, SM, ML, CB, and CH are satisfactory in-situ and as final backfill.

1.2.2 Unsatisfactory Materials

Materials classified by ASTM D 2487 as OL, OH, and Pt are unsatisfactory in-situ and as any kind of fill. Materials classified as OL, MH, and OH are unsatisfactory as final backfill beneath pavement cuts. Unsatisfactory materials also include those materials containing roots and

other organic matter, trash, debris, frozen materials, and stones larger than 3 inches.

1.2.3 Cohesionless and Cohesive Materials

Cohesionless materials shall include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesionless only when the fines are nonplastic.

1.2.4 Rock

Rock shall consist of boulders measuring 2 1/2 cubic yard or more and materials that cannot be removed without systematic drilling and blasting such as rock material in ledges, bedded deposits, unstratified masses and conglomerate deposits, and below ground concrete or masonry structures, exceeding 2 1/2 cubic yard in volume, except that pavements will not be considered as rock.

1.2.5 Unyielding Material

Unyielding material shall consist of rock and gravelly soils with stones greater than 3 inches in any dimension or as defined by the pipe manufacturer, whichever is smaller.

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 Degree of Compaction

Degree of compaction shall be expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557.

1.3 SUBSURFACE DATA

Subsurface soil boring logs are in the soils report. The subsoil investigation report and samples of materials taken from subsurface investigations may be examined at the Norfolk District. These data represent the best subsurface information available; however, variations may exist in the subsurface between boring locations.

1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Sections 01300 SUBMITTAL DESCRIPTIONS and 01305 SUBMITTAL PROCEDURES:

SD-09 Reports

Compaction Tests; GA. Displacement of Sewers Tests; GA.

Copies of all laboratory and field test reports shall be submitted to the

Contracting Officer within 72 hours of the completion of the test.

PART 2 PRODUCTS

2.1 SELECT GRANULAR MATERIAL

Select granular material shall consist of well-graded sand, gravel, crushed gravel, crushed stone or crushed slag composed of hard, tough and durable particles, and shall contain not more than 10 percent by weight of material passing a No. 200 mesh sieve and no less than 95 percent by weight passing the 1-inch sieve.

2.2 INITIAL BACKFILL MATERIAL

Initial backfill shall consist of select granular material or satisfactory materials free from rocks 1 inch 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.

2.3 PLASTIC MARKING TAPE

Plastic marking tape shall be acid and alkali-resistant polyethylene film, 6-inches wide with minimum thickness of 0.004 inch. Tape shall have a minimum strength of 1750 psi lengthwise and 1500 psi crosswise. 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 tape shall be of a type specifically manufactured for marking and locating underground utilities. The metallic core of the tape shall be encased in a protective jacket or provided with other means to protect it from corrosion. Tape color shall be as specified in TABLE 1 and shall bear a continuous printed inscription describing the specific utility.

TABLE 1. Tape Color

Red:	Electric
Yellow:	Gas, Oil, Dangerous Materials
Orange:	Telephone, Telegraph, Television, Police, and Fire Communications
Blue:	Water Systems
Green:	Sewer Systems

PART 3 EXECUTION

3.1 EXCAVATION

Excavation shall be performed to the lines and grades indicated. Rock excavation shall include removal and disposition of material defined as rock in paragraph "MATERIALS." Earth excavation shall include removal and disposal of material not classified as rock excavation. During excavation, material satisfactory for backfilling shall be stockpiled in an orderly manner at a distance from the banks of the trench equal to 1/2 the depth of

the excavation, but in no instance closer than 2 feet. Excavated material not required or not satisfactory for backfill shall be removed from Government property or shall be disposed of by Contractor. Grading shall be done as may be necessary to prevent surface water from flowing into the excavation, and any water accumulating therein shall be removed to maintain the stability of the bottom and sides of the excavation. Unauthorized overexcavation shall be backfilled in accordance with paragraph "BACKFILLING AND COMPACTION" at no additional cost to the Government.

3.1.1 Trench Excavation

The trench shall be excavated in accordance with the safety criteria of EM 385-1-1 and the recommendations of 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 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 accordance with CofE EM 385-1-1. 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.

3.1.1.1 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.

3.1.1.2 Removal of Unyielding Material

Where overdepth is not indicated and 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.

3.1.1.3 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 fault or neglect of the Contractor in his performance of the work, the resulting material shall be excavated and replaced by the Contractor

without additional cost to the Government.

3.1.1.4 Excavation for Appurtenances

Excavation for manholes, catch-basins, inlets, or similar structures 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 shall be cleaned of loose debris and cut to a firm surface either level, stepped, or serrated, as shown or as directed. Loose disintegrated rock and thin strata shall be removed. 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.

3.1.1.5 Jacking, Boring, and Tunneling

Unless otherwise indicated, excavation shall be by open cut except that sections of a trench may be jacked, bored, or tunneled if, in the opinion of the Contracting Officer, the pipe, cable, or duct can be safely and properly installed and backfill can be properly compacted in such sections.

3.1.1.6 Stockpiles

Stockpiles of satisfactory materials and wasted materials shall be placed and graded as specified. 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 at no additional cost to the Government. Locations of stockpiles of satisfactory materials shall be subject to prior approval of the Contracting Officer.

3.1.1.7 Drainage

Surface water shall be directed away from excavation and construction sites so as to prevent erosion and undermining of foundations. Diversion ditches, dikes and grading shall be provided and maintained as necessary during construction. Excavated slopes and backfill surfaces shall be protected to prevent erosion and sloughing. Excavation shall be performed so that the site and area immediately surrounding the site and affecting operations at the site shall be continually and effectively drained.

3.1.1.8 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 contractural 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 below the working level.

3.2 BORROW MATERIAL

Borrow material shall be selected to meet requirements and conditions of the particular fill for which it is to be used. Necessary clearing, grubbing, disposal of debris, and satisfactory drainage of borrow pits shall be performed by the Contractor as incidental operations to the borrow excavation.

3.2.1 Selection

Borrow materials shall be obtained from sources within the limits of Government controlled land, subject to approval. Borrow materials shall be subject to approval. Borrow material from approved sources on Government-controlled land may be obtained without payment of royalties. Unless specifically provided, no borrow shall be obtained within the limits of the project site without prior written approval.

3.2.2 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 to be taken of the undisturbed ground surface. Except as otherwise permitted, borrow pits shall be excavated to afford adequate drainage. Overburden and other soil material shall be disposed of or used for special purposes. Borrow pits shall be neatly trimmed and left in such shape as will facilitate taking accurate measurements after the excavation is completed.

3.3 BACKFILLING AND COMPACTION

Backfill material shall consist of satisfactory material, select granular material, or initial backfill material as required. Before placing, material shall be moistened or aerated as necessary to obtain specified compaction. Backfill shall be placed in layers not exceeding 6 inches loose thickness for compaction by hand operated machine compactors, and 8 inches loose thickness for other than hand operated machines, unless otherwise specified. Each layer shall be compacted to at least 95 percent maximum density for cohesionless soils and 90 percent maximum density for cohesive soils, unless otherwise specified.

3.3.1 Trench Backfill

Trenches shall be backfilled to the grade shown. The trench shall not be backfilled until all specified tests are performed.

3.3.1.1 Replacement of Unyielding Material

Unyielding material removed from the bottom of the trench shall be replaced with select granular material or initial backfill material.

3.3.1.2 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.

3.3.1.3 Bedding and Initial Backfill

Bedding shall be of the type and thickness shown or specified. 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.

3.3.1.4 Final Backfill

The remainder of the trench, except for special materials for roadways, railroads and airfields, shall be filled with satisfactory material. Backfill material shall be placed and compacted as follows:

a. Roadways: Backfill shall be placed up to the elevation at which the requirements in Section 02225 EARTHWORK FOR ROADWAYS, RAILROADS, AND AIRFIELDS control. 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 85 percent maximum density for cohesive soils and 90 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.

3.3.2 Backfill for Appurtenances

After the manhole, catchbasin, inlet, or similar structure has been constructed and the concrete has been allowed to cure for 7 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.

3.4 SPECIAL REQUIREMENTS

Special requirements for both excavation and backfill relating to the specific utilities are as follows:

3.4.1 Water Lines

Trenches shall be of a depth to provide a minimum cover of 2.5 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 3.5 inches of cover is required.

3.4.2 Heat Distribution System

Initial backfill material shall be free of stones larger than 1/4 inch in any dimension.

3.4.3 Electrical Distribution System

Direct burial cable and conduit or duct line shall have a minimum cover of 24 inches from the finished grade, unless otherwise indicated. Special trenching requirements for direct-burial electrical cables and conduits are specified in Section 16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND.

3.4.4 Plastic Marking Tape

Warning tapes shall be installed directly above the pipe, at a depth of 18 inches below finished grade unless otherwise shown.

3.5 TESTING

3.5.1 Compaction Tests

Testing shall be the responsibility of the contractor and shall be performed by an approved commercial testing laboratory or may be performed by the contractor subject to approval. Laboratory tests for moisture-density relations complete with zero air voids curve, gradation, and Atterberg limits shall be made in accordance with the procedures referenced in ASTM D 1557 and ASTM D 4318. Field tests for density and moisture content shall be made in accordance with ASTM D 1556 and ASTM D 2216 except that methods ASTM D 2167 or ASTM D 2937 may be used to supplement tests by method ASTM D 1556. ASTM D 2937 shall be used only for soft, fine grained cohesive soils.

The following submittals are required:

a. Copies of all test results and field and office worksheets shall be furnished to the Contracting Officer within 72 hours after the tests are completed.

b. A minimum of one moisture-density test shall be performed for each classification of fill material, backfill material, and existing subgrade material.

c. One Atterberg limits test and one gradation analysis is required for every six field density tests.

d. A minimum of one sand cone density test is required for every six field density tests or fraction thereof. Worksheets of sand density and sand cone calibration shall be submitted to the

Contracting Officer prior to commencing work and each time a new supply of sand is used.

e. A quart jar sample of each moisture-density test material shall be delivered to the Contracting Officer at the time the test is obtained.

f. A pint jar sample of each field-density test material shall be delivered to the Contracting Officer at the time the test is obtained.

g. Field density tests shall be performed as follows: a minimum of one test per lift per 100 linear feet of trench or fraction thereof is required for fill material. Locations of all tests shall be at the direction of the Contracting Officer.

3.5.2 Displacement of Sewers

After other required tests have been performed and the trench backfill compacted to 2 feet above the top of the pipe, 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.

-- End of Section --

SECTION 02225

EARTHWORK FOR ROADWAYS

PART 1 GENERAL

1.1 SUMMARY (Not Applicable)

1.2 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 SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 136	(1984; Rev. a) Sieve Analysis of Fine and Coarse Aggregates
ASTM D 422	(1963; R 1990) Particle-Size Analysis of Soils
ASTM D 1140	(1954; R 1990) Amount of Material in Soils Finer than the No. 200 (75-um) Sieve
ASTM D 1556	(1990) Density of Soil In Place by the Sand-Cone Method
ASTM D 1557	(1978; R 1990) Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-Lb. (4.54-kg) Rammer and 18-In. (457-mm) Drop
ASTM D 2167	(1984; R 1990) Density and Unit Weight of Soil in Place by the Rubber-Ballon Method
ASTM D 2216	(1990) Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil Aggregate Mixtures
ASTM D 2487	(1990) Classification of Soils for Engineering Purposes
ASTM D 2922	(1981; R 1990) Density of Soil and Soil-Aggregate In Place by Nuclear Methods (Shallow Depth)
ASTM D 2937	(1983; R 1990) Density of Soil in Place by the Drive-Cylinder Method
ASTM D 3017	(1988) Water Content of Soil and Rock In Place by Nuclear Methods (Shallow Depth)
ASTM D 4318	(1984) Liquid Limit, Plastic Limit, and Plasticity Index of Soils

1.3 DEFINITIONS

1.3.1 Satisfactory Materials

Materials classified by ASTM D 2487 as GW, GP, GM, GC, SW, SP, and SM are satisfactory as fill. Satisfactory material to be free from roots, other organic matter, trash, debris, frozen materials, and stones larger than 3 inches in any dimension.

1.3.2 Unsatisfactory Materials

Materials classified by ASTM D 2487 as OL, OH, CH, ML, MH, and Pt are unsatisfactory in-situ. CH, ML, and MH should be removed to a depth of 3 feet beneath the road surface. Unsatisfactory materials also include those materials containing roots and other organic matter, trash, debris, frozen materials, and stones larger than 3 inches.

1.3.3 Cohesionless and Cohesive Materials

Cohesionless materials include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesionless only when the fines are nonplastic.

1.3.4 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, Method D. This will be abbreviated below as a percent of laboratory maximum density.

1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Sections 01300 SUBMITTAL DESCRIPTIONS and 01305 SUBMITTAL PROCEDURES:

SD-06 Instructions

Instructions; FIO.

Detailed instructions describing use of a product, system or material, including special notices and material safety data sheets, if any, concerning impedence, hazards, and safety precautions defining the Contractor's provisions for a blasting plan and blasting operations.

SD-09 Reports

Compaction Tests; FIO.

Tolerance Tests for Subgrade; FIO.

Copies of all laboratory and field test reports shall be submitted to the Contracting Officer within 72 hours of the completion of the test.

1.5 CLASSIFICATION OF EXCAVATION

Common excavation is the only classification applicable to the excavation of roadways as there are no rock excavation anticipated. Rock excavation is required in the excavation, refer to Section 02221 paragraph 3.6.

1.6 SUBSURFACE DATA

Subsurface soil boring logs are shown in the soils report. The subsoil investigation report and samples of materials taken from subsurface investigations may be examined at the Norfolk District. These data represent the best subsurface information available; however, variations may exist in the subsurface between boring locations. Refer to Section 01055 for soil boring data.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 STRIPPING OF TOPSOIL

Where indicated or directed, topsoil shall be stripped to full depth. Topsoil shall be spread on areas already graded and prepared for topsoil, or when so specified topsoil shall be 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.

3.2 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 herein. 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 below the grade shown shall be excavated below grade and replaced with satisfactory materials as directed. Rock encountered within the limits of work shall be excavated. 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 in designated waste or spoil areas. 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 the borrow areas indicated or from other approved areas selected by the Contractor as specified herein. Refer to Section 02935.)

3.2.1 Ditches, Gutters, and Channel Changes

Excavation of ditches, shall be accomplished by cutting accurately to the cross sections, grades, and elevations shown. Care shall be taken not to excavate ditches below grades shown. Excessive open ditch excavation shall be backfilled with satisfactory thoroughly compacted material to grades shown at no additional cost to the Government. Material excavated shall be disposed of as shown or as directed, except that in no case shall material be deposited less than 4 feet from the edge of a ditch. The Contractor shall maintain all excavations free from detrimental quantities of leaves, brush, sticks, trash, and other debris until final acceptance of the work.

3.2.2 Drainage Structures

Excavations shall be made accurately 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 surface either level, stepped, or serrated, as shown or as directed. Loose disintegrated rock and thin strata shall be removed. 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.

3.3 UTILIZATION OF EXCAVATED MATERIALS

All unsatisfactory materials removed from excavations shall be disposed of in designated waste disposal or spoil areas. 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 in designated areas approved for surplus material storage or designated waste areas as directed.

3.4 BORROW MATERIAL

Borrow material shall be selected to meet the requirements and conditions of the particular fill for which it is to be used. Borrow materials shall be obtained from sources outside of the limits of Government-controlled land, subject to approval.

3.5 GRADING AREAS

When so provided and where indicated, work under contract will be divided into grading areas, within which satisfactory excavated material shall be placed in, fills and required backfills. The Contractor shall not haul satisfactory material excavated in one grading area to another grading area except when so directed in writing.

3.6 BACKFILL

Backfill adjacent to any and all types of structures shall be placed and compacted to at least 95 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials, in such a manner as to prevent wedging action or eccentric loading upon or against any structure. 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. 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" below and Sections 02720 STORM-DRAINAGE SYSTEM and 02222 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment well suited to the material being compacted.

3.7 PREPARATION OF GROUND SURFACE FOR FILLS

Ground surface on which fill is to be placed shall be stripped of live, dead, or decayed vegetation, rubbish, debris, and other unsatisfactory material; plowed, disked, or otherwise broken up; pulverized; 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 shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment well suited to the material being compacted. The prepared ground surface shall be scarified and moistened or aerated as required just prior to placement of embankment materials to assure adequate bond between embankment material and the prepared ground surface.

3.8 FILL AREAS

3.8.1 Fill Areas

Fill areas 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 in such a manner 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 fill areas 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 well suited to the type of material being compacted.

3.9 SUBGRADE PREPARATION

3.9.1 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. After rolling, the surface of the subgrade for roadways shall not show deviation greater than 3/8 inch when tested with a 10-foot straightedge applied both parallel and at right angles to the centerline of the area.

3.9.2 Compaction

Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment well suited to the type of material being compacted.

3.9.2.1 Subgrade for Pavements

Subgrade for pavements shall be compacted to at least 95 percentage laboratory maximum density for the depth of 6 inches below the surface of the pavement shown.

3.9.2.2 Subgrade for Shoulders

Subgrade for shoulders shall be compacted to at least 95 percentage laboratory maximum density for the depth of 6 inches below the surface of shoulder shown.

3.10 SHOULDER CONSTRUCTION

Shoulders shall be constructed of satisfactory excavated or borrow materials or as otherwise shown or specified herein. Shoulders shall be constructed as soon as possible after adjacent paving is complete, but in the case of rigid pavements, shoulders shall not be constructed until permission of the Contracting Officer has been obtained. The entire shoulder area shall be compacted to at least the percentage of maximum density as specified in paragraph "SUBGRADE PREPARATION" above. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment well suited to the type of material being compacted. Shoulder construction shall be done in proper sequence in such a manner that adjacent ditches will be drained effectively and that no damage of any kind is done to the adjacent completed pavement. The completed shoulders shall be true to alignment and grade and shaped to drain in conformity with the cross section shown.

3.11 FINISHING

The surface of all 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 all 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" above. 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.

3.12 TESTING

3.12.1 Compaction Tests

Testing shall be the responsibility of the contractor and shall be performed by an approved commercial testing laboratory or may be performed by the contractor subject to approval. Laboratory tests for moisture-density relations complete with zero air voids curve, gradation, and Atterberg limits shall be made in accordance with the procedures referenced in ASTM D 1557 and ASTM D 4318. Field tests for density and moisture content shall be made in accordance with ASTM D 1556 and ASTM D 2216 except that methods ASTM D 2167 or ASTM D 2937 may be used to supplement tests by method ASTM D 1556. ASTM D 2937 shall be used only for soft, fine grained cohesive soils.

The following submittals are required:

a. Copies of all test results and field and office worksheets shall be furnished to the Contracting Officer within 72 hours after the tests are completed.

b. A minimum of one moisture-density test shall be performed for each classification of fill material, backfill material, and existing subgrade material.

c. One Atterberg limits test and one gradation analysis is required for every six field density tests.

d. A minimum of one sand cone density test is required for every six field density tests or fraction thereof. Worksheets of sand density and sand cone calibration shall be submitted to the Contracting Officer prior to commencing work and each time a new supply of sand is used.

e. A quart jar sample of each moisture-density test material shall be delivered to the Contracting Officer at the time the test is obtained.

f. A pint jar sample of each field-density test material shall be delivered to the Contracting Officer at the time the test is obtained.

g. Field density tests shall be performed as follows: a minimum of one test per lift per 1000 square yards or fraction thereof is required for fill material and a minimum of one test per 1500 square yards or fraction thereof is required for recompacted subgrades prior to filling. Locations of all tests shall be at the direction of the Contracting Officer.

3.12.2 Tolerance Tests for Subgrades

Continuous checks on the degree of finish specified in paragraph "SUBGRADE PREPARATION" shall be made during construction of the subgrades.

3.13 SUBGRADE AND EMBANKMENT PROTECTION

During construction, embankments and excavations shall be kept shaped and drained. Ditches and drains along subgrade shall be maintained in such a manner as 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.

-- End of Section --

SECTION 02239

PORTLAND CEMENT-STABILIZED BASE OR SUBBASE COURSE
02/89

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 81	(1975; Rev 1986) Cut-Back Asphalt (Rapid-Curing Type)
AASHTO M 82	(1975; Rev 1986) Cut-Back Asphalt (Medium-Curing Type)
AASHTO M 147	(1965; Rev 1980) Materials for Aggregate and Soil-Aggregate Subbase, Base and Surface Courses
AASHTO T 134	(1991I) Moisture-Density Relations of Soil-Cement Mixtures
AASHTO T 135	(1991I) Wetting-and-Drying Test of Compacted Soil-Cement Mixtures
AASHTO T 136	(1991I) Freezing-and-Thawing Tests of Compacted Soil-Cement Mixtures

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 136	(1992) Sieve Analysis of Fine and Coarse Aggregates
ASTM C 150	(1992) Portland Cement
ASTM C 171	(1992) Sheet Materials for Curing Concrete
ASTM C 595	(1993) Blended Hydraulic Cements
ASTM D 75	(1987; R 1992) Sampling Aggregates
ASTM D 422	(1963; R 1990) Particle-Size Analysis of Soils
ASTM D 490	(1992) Road Tar
ASTM D 558	(1982; R 1990) Moisture-Density Relations of Soil-Cement Mixtures
ASTM D 559	(1989) Wetting and Drying Compacted

	Soil-Cement Mixtures
ASTM D 560	(1989) Freezing and Thawing Compacted Soil-Cement Mixtures
ASTM D 633	(1987; R 1991) Volume Correction Table for Road Tar
ASTM D 977	(1991) Emulsified Asphalt
ASTM D 1241	(1968; R 1989) Materials for Soil-Aggregate Subbase, Base, and Surface Courses
ASTM D 1250	(1980; R 1990) Petroleum Measurement Tables
ASTM D 1556	(1990) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(1991) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft.(2,700 kN-m/cu. m.))
ASTM D 1632	(1987) Making and Curing Soil-Cement Compression and Flexure Test Specimens in the Laboratory
ASTM D 1633	(1984; R 1990) Compressive Strength of Molded Soil-Cement Cylinders
ASTM D 2027	(1976; R 1992) Cutback Asphalt (Medium-Curing Type)
ASTM D 2028	(1976; R 1992) Cutback Asphalt (Rapid-Curing Type)
ASTM D 2922	(1991) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(1988) Water Content of Soil and Rock In Place by Nuclear Methods (Shallow Depth)
ASTM D 4318	(1984) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM E 11	(1987) Wire-Cloth Sieves for Testing Purposes

FEDERAL SPECIFICATIONS (FS)

FS CCC-C-467	(Rev C; Notice 1) Cloth, Burlap, Jute (or Kenaf)

1.2 DEFINITION

Portland-cement-stabilized base or subbase course, as used herein, is a

mixture of portland cement and in-place or select borrow material uniformly blended and thoroughly compacted to produce a pavement course which meets all criteria as set forth in the plans and specifications.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL DESCRIPTIONS:

SD-01 Data

Stabilizing Course; FIO.

Proposed mix design, prior to start of stabilization work. Mix shall be developed using the aggregate or soil-aggregate material to be stabilized. Mix shall have a minimum compressive strength of 250 psi for subbase, 750 psi for base, a weight loss of 14 percent or less after 12 cycles of the durability test, and "low alkali" cement for alkali reactive aggregate.

SD-09 Reports

Stabilizing Course; FIO.

Certified copies of aggregate test results, not less than 30 days before the material is required in the work. Calibration curves and related test results, prior to using the device or equipment being calibrated.

SD-13 Certificates

Bituminous Material; FIO.

Certified copies of the manufacturer's test reports indicating compliance with applicable specified requirements, not less than 30 days before the material is required in the work.

SD-18 Records

Stabilizing Course; FIO.

Notification of sources from which aggregates are to be obtained, within 15 days after the award of contract.

Source of Bituminous Materials; FIO.

Notification of sources from which bituminous materials are to be obtained, within 15 days after the award of the contract.

1.4 PLANT, EQUIPMENT, MACHINES, AND TOOLS

1.4.1 Straightedge

The Contractor shall furnish and maintain at the site, in good condition, one 12-foot straightedge for each bituminous paver, for use in the testing of the finished surface. Straightedges shall be made available for Government use. Straightedges shall be constructed of aluminum or other lightweight metal and shall have blades of box or box-girder cross section with flat bottom reinforced to insure rigidity and accuracy. Straightedges

shall have handles to facilitate movement on pavement.

1.5 WEATHER LIMITATIONS

Cement shall not be applied when the atmospheric temperature is less than 40 degrees F. No cement shall be applied to soils that are frozen or contain frost, or when the underlying material is frozen. If the temperature falls below 35 degrees F, completed cement-treated areas shall be protected against detrimental effects of freezing. Any areas of completed base that are damaged by freezing, rainfall, or other weather conditions shall be brought to a satisfactory condition in conformance with this specification without additional cost to the Government.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Cement

Cement shall conform to ASTM C 150, Type I.

2.1.2 Material to be Stabilized

The material to be stabilized shall consist of in-place material. Stones retained on a 2-inch sieve and deleterious substances such as sticks, debris, and organic matter shall be removed. When the in-place material consists primarily of soil having high plasticity or otherwise undesirable characteristics, the course shall be constructed to produce fully hardened soil cement as determined by AASHTO T 135 and AASHTO T 136 or ASTM D 559 and ASTM D 560; not more than 45 percent of the material should be retained on the No. 4 sieve.

2.1.3 Water

Water shall be clean, fresh, and free from injurious amounts of oil, acid, salt, alkali, organic matter, and other substances deleterious to the hardening of soil-cement, and shall be subject to approval.

2.1.4 Burlap

Burlap shall conform to FS CCC-C-467.

2.1.5 Impervious Sheeting

Sheeting shall conform to ASTM C 171 and shall be white waterproof paper, white opaque polyethylene film or white burlap-polyethylene sheets.

2.2 SAMPLING AND TESTING

2.2.1 General Requirements

Sampling and testing shall be performed by an approved commercial testing laboratory or by facilities furnished by the Contractor. No work requiring testing shall be permitted until the facilities have been inspected and approved. The first inspection shall be at the expense of the Government. Cost incurred for any subsequent inspection required because of failure of the facilities to pass the first inspection will be charged to the Contractor. Tests shall be performed in sufficient numbers and as specified to insure that materials and compaction meet specified

requirements. Copies of the test results shall be furnished to the Contracting Officer within 24 hours of completion of tests.

2.2.2 Test Results

Results shall verify that materials comply with the specification. When a material source is changed, the new material will be tested for compliance. When deficiencies are found, the initial analysis shall be repeated and the material already placed shall be retested to determine the extent of unacceptable material. All in-place unacceptable material shall be replaced or repaired to conform to the contract requirements at no additional cost to the Government.

2.2.3 Aggregate

Tests for determining the suitability of aggregate shall include, but not be limited to: sieve analysis in accordance with ASTM C 136, and ASTM D 422 using sieves conforming to ASTM E 11, liquid limits and plasticity index in accordance with ASTM D 4318 . Aggregate samples for laboratory tests shall be taken in accordance with ASTM D 75. Specimens to be used for unconfined compression tests shall be prepared in accordance with ASTM D 1632 except that a 4-inch diameter by 8-inch high mold shall be used to prepare specimens when more than 35 percent of the material is retained on the No. 4 sieve.

2.2.4 Initial Sampling and Testing

2.2.4.1 Laboratory Density

Moisture-density tests shall be conducted in accordance with the procedure contained in AASHTO T 134 or ASTM D 558; however the apparatus and procedures outlined in ASTM D 1557 shall be used to compact the soil-cement mixture.

2.2.4.2 Unconfined Compression Testing

Unconfined compression tests shall be conducted in accordance with ASTM D 1633. Three tests shall be conducted for each mix design tested. Samples shall be cured at a constant moisture content and temperature for 7 days.

2.2.4.3 Durability Tests

Wet-dry tests shall be conducted in accordance with AASHTO T 135 or ASTM D 559. Three tests shall be conducted for each mix design tested.

2.2.5 Sieve Analysis

A minimum of one analysis shall be performed for each 1000 tons of material to be stabilized, with a minimum of three analyses for each day's run until the course is completed. When deficiencies are found, the analysis shall be repeated and the material already placed shall be retested to determine the extent of unacceptable material. All in-place unacceptable material shall be replaced at no additional cost to the Government.

2.2.6 Liquid Limit and Plasticity Index

One liquid limit and plasticity index shall be performed for each sieve analysis. Liquid limit and plasticity index shall be in accordance with

ASTM D 4318.

2.2.7 Sampling and Testing During Construction

Quality control sampling and testing during construction shall be performed as required in paragraph FIELD QUALITY CONTROL.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

Cement shall not be applied if the soil moisture content exceeds optimum moisture content specified for the cement-treated mixture. After mixing is completed, the proportions of the mixture shall be in accordance with the approved mix design. When application of water and mixing are completed, on the basis of dry weight, moisture shall not be below the optimum moisture content of the mixture nor shall it be more than 2 percent above the optimum moisture content. When the stabilized 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 construction period to prevent water from collecting or standing on the areas to be stabilized or on pulverized, mixed, or partially mixed material. Line and grade stakes shall be provided as necessary for control. Grade stakes shall be placed in lines parallel to the centerline of the area under construction and suitably spaced for string lining.

3.2 PREPARATION OF AREA TO BE STABILIZED

3.2.1 General Requirements

Area shall be cleaned of debris. It shall be inspected for adequate compaction and shall be capable of withstanding without displacement the compaction specified for the soil-cement mixture. Debris and removed unsatisfactory in-place material shall be disposed of as specified.

3.2.2 In-Place Material to be Stabilized

The entire area shall be graded and shaped to conform to the lines, grades, and cross sections shown in the plans prior to being processed. Soft or yielding areas shall be made stable before construction is begun.

3.2.3 In-Place Materials to Receive Stabilized Course

Subgrade shall conform to Section 02225 EARTHWORK FOR ROADWAYS, RAILROADS, AND AIRFIELDS.

3.2.4 Select Material

Sufficient select material shall be utilized to provide the required thickness of the soil-cement layer after compaction and shall be processed to meet the requirements specified before cement stabilization is undertaken.

3.3 INSTALLATION

3.3.1 Edges of Stabilized Course

Approved material shall be placed along the edges of the stabilized course in such quantity as will compact to the thickness of the course being constructed, or to the thickness of each layer in a multiple-layer course, allowing at least a 1-foot width of the shoulder to be rolled and compacted simultaneously with the rolling and compacting of each layer of the stabilized course.

3.3.2 Mixed-in-Place Method

3.3.2.1 Scarifying and Pulverizing of Soil

Prior to the application of cement, the soil shall be scarified and pulverized to the depth shown. Scarification shall be carefully controlled so that the layer beneath the layer to be stabilized is not disturbed. Depth of pulverizing shall not exceed the depth of scarification. Unless otherwise permitted, the area scarified and pulverized shall not exceed the area that can be completed in 2 working days.

3.3.2.2 Application of Cement

Pulverized material shall be shaped approximately to the cross section indicated. Cement shall be applied so that when uniformly mixed with the soil, the specified cement content is obtained, and a sufficient quantity of cement-treated soil is produced to construct a compacted cement-treated course conforming to the lines, grades, and cross section indicated. No equipment except that used in spreading and mixing operations shall pass over the freshly spread soil cement.

3.3.2.3 Dry Mixing

Immediately after the cement has been distributed, it shall be mixed with the soil. Care shall be exercised to prevent the cement from being mixed below the required depth. Mixing shall continue until the cement has been sufficiently blended with the soil to prevent the formation of cement balls when water is applied.

3.3.2.4 Water Application and Moist Mixing

Moisture content of the mixture will be determined immediately after completion of mixing of the soil and cement. Water-supply and pressure distributing equipment shall be provided that will permit the continuous application within 3 hours of all water required on the section being processed. Water shall be incorporated in the mix in such a manner to avoid concentration of water near the surface. After all the mixing water has been added, mixing shall be continued until the water is uniformly distributed throughout the full depth of the mixture, with no portion of the mixture remaining undisturbed during mixing for more than 30 minutes. Any portion of the mixture remaining undisturbed more than 30 minutes during mixing shall be disposed of as specified. Particular care shall be taken to ensure satisfactory moisture distribution along the edges of the section.

3.3.3 Central-Plant Method

The mixture shall be hauled to the job in trucks equipped with protective covers. Underlying course shall be thoroughly moistened and the material shall be deposited on the prepared area in such quantity that will produce a compacted base of uniform density to the required grade and cross section. Spreading or spreading-trimming equipment shall be so constructed

and operated as to produce a layer of material which is uniform in thickness and surface contour and free from irregularities in density. Spreading or spreading-trimming equipment shall be used in sufficient numbers and operated in staggered formation to obtain full-width spreading in one construction operation. Not more than 60 minutes shall elapse between the start of the moist mixing and the start of compaction of the treated layer. Not more than 30 minutes shall elapse between the placement of the cement-treated soil in adjacent lanes on two-lane structures at any location.

3.3.4 Layer Thickness

Compacted thickness of the stabilized course shall be as indicated. No layer shall be in excess of 8 inches nor less than 4 inches in compacted thickness.

3.3.5 Compaction

Before compaction operations are started and as a continuation of the mixing operation, the mixture shall be thoroughly loosened to the full depth. At the beginning of compaction, at least 80 percent of the soil shall pass a No. 4 sieve, and 100 percent shall pass the 1-inch sieve. Compaction shall be started immediately after mixing is completed. Density of compacted soil-cement mixture shall be at least 95 percent of the maximum density obtained from the laboratory prepared samples. Loose mixture shall be uniformly and continuously compacted until the entire depth and width of the area are compacted to the density specified herein. The moisture content at the surface shall be maintained near optimum at all times through the rolling but shall be less than that quantity which will cause the soil-cement mixture to become unstable during compaction. 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 at all times shall be such that displacement of the mixture does not occur. Areas inaccessible to rollers shall be compacted with mechanical tampers.

3.4 FINISHING

The surface shall be moistened, if necessary, and shaped to the required lines, grades, and cross section. If necessary, the surface shall be lightly scarified to eliminate any imprints made by the compacting or shaping equipment. The surface shall then be thoroughly compacted to the specified density with rubber-tired rollers and smooth-wheel tandem rollers to the extent necessary to provide a smooth, dense, uniform surface that is free of`surface checking, ridges, or loose material, and that conforms to the crown, grade, and line indicated. These finishing operations shall be completed within 2 hours after completion of mixing operations. In places not accessible to finishing and shaping equipment, the mixtures shall be compacted with mechanical tampers to the density specified and shall be shaped and finished by hand methods. Any portion of the compacted mix that has density less than that specified, that has not properly hardened, or that is improperly finished shall be corrected as specified below.

3.5 CONSTRUCTION JOINTS

At the end of each day's construction, a straight transverse construction joint shall be formed by cutting back into the completed work to form a true vertical face free of loose or shattered material. Material along

construction joints not properly compacted shall be removed and replaced with soil-cement that is mixed, moistened, and compacted in accordance with this specification.

3.6 CURING AND PROTECTION

The finished surface shall be protected against rapid drying for 7 days by one of the methods specified.

3.6.1 Moist Curing

A 2-inch covering of soil or not less than 4 pounds per square yard of straw shall be applied. The material shall be moistened initially and kept moistened throughout the curing period. In multiple-layer construction, the soil used in moist curing, if of approved select material, may be used for constructing the succeeding stabilized course.

3.6.2 Burlap

Burlap covers shall consist of two or more layers of burlap having a combined weight of 14 ounces or more per square yard in a dry condition. Burlap shall be either new or shall have been used only for curing concrete. Burlap strips shall have a length, after shrinkage, at least 1 foot greater than necessary to cover the entire width and edges of the finished stabilized area. Mats shall overlap each other at least 6 inches. Mats shall be thoroughly wetted before placing and shall be kept continuously wet and in intimate contact with the surface and edges of the finished stabilized area for the entire curing period.

3.6.3 Impervious Sheeting

The surface of the finished stabilized area shall be moistened with a fine spray of water and then covered with impervious sheeting. The burlap of the polyethylene-coated burlap shall be thoroughly saturated with water before placing. Sheeting shall be placed with the light-colored side up. Sheets shall extend over the edges of the stabilized area and shall be held securely in place throughout the curing period. Edges of sheets shall overlap each other at least 12 inches and shall be securely cemented or taped to form continuous closed joints. Tears and holes in sheets shall be repaired immediately.

3.7 FIELD QUALITY CONTROL

3.7.1 Grade Control

Underlying material shall be excavated to sufficient depth for the required stabilized-course thickness so that the finished stabilized course with the subsequent surface course will meet the fixed grade. Finished and completed stabilized area shall conform to the lines, grades, cross section, and dimensions indicated.

3.7.2 Smoothness Test

The surface of a stabilized layer shall show no deviations in excess of 3/8 inch when tested with the 12-foot straightedge. Deviations exceeding this amount shall be corrected by removing material and replacing new material, or by reworking existing material and compacting, as directed. Measurements for deviation from grade and cross section shown shall be taken in successive positions parallel to the road centerline with a

12-foot straightedge. Measurements shall also be taken perpendicular to the road centerline at 50-foot intervals.

3.7.3 Thickness Control

The completed thickness of the stabilized 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 mixture 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 with 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 thickness of the stabilized course shall be measured at intervals in such a manner as to ensure one measurement for each 400 square yards of stabilized course. Measurements shall be made in 3-inch diameter test holes penetrating the stabilized course.

3.7.4 Testing

Field tests shall be performed in sufficient numbers to assure that the specifications are being met. Testing shall be the responsibility of the Contractor and shall be performed by an approved commercial laboratory.

3.7.5 Field Density

Field density tests shall be performed in accordance with ASTM D 1556 or ASTM D 2922. 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. Calibration curves furnished along with the density gauge shall be checked as described in ASTM D 3017. Calibration checks of the density gauge shall be made at the beginning of a job on each type of material encountered. If ASTM D 2922 is used, in-place densities shall be checked by ASTM D 1556 at least once per lift for each 200 square yards of stabilized material. Calibration curves and calibration test results shall be furnished within 24 hours of conclusion of the tests. At least one field density test shall be performed for each 250 square yards of each layer of base material.

3.7.6 Samples of Bituminous Materials

A sample of the bituminous material used will be obtained by the Contractor under the supervision of the Contracting Officer. The sample will be retained by the Government.

3.7.7 Maintenance

The stabilized area shall be maintained in a satisfactory condition until the completed work is accepted. Maintenance shall include immediate repairs to any defects and shall be repeated as often as necessary to keep the area intact. Defects shall be remedied as specified herein.

3.7.8 Traffic

Completed portions of the cement-treated soil area may be opened immediately to light traffic provided the curing is not impaired. After the curing period has elapsed, completed areas may be opened to all traffic provided that the cement-stabilized course has hardened sufficiently to prevent marring or distorting of the surface by equipment or traffic.

Heavy equipment shall not be permitted on the area during the curing period. Cement and water may be hauled over the area with pneumatic-tired equipment as approved. Finished portions of cement-stabilized soil that are traveled on by equipment used in constructing an adjoining section shall be protected in a manner so as to prevent equipment from marring or damaging the completed work.

3.8 DISPOSAL OF UNSATISFACTORY MATERIALS

Removed in-place materials that are unsuitable for stabilization, material that is removed for the required correction of defective areas, waste material, and debris shall be disposed of as directed.

-- End of Section --

SECTION 02243

DRAINAGE LAYER
12/92

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 T 102	(1983) Spot Test of Asphaltic Materials

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 29	(1991a) Unit Weight and Voids in Aggregate
ASTM C 88	(1990) Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C 117	(1990) Materials Finer Than 75-micrometer (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 131	(1989) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(1992) Sieve Analysis of Fine and Coarse Aggregates
ASTM C 150	(1992) Portland Cement
ASTM C 595	(1993) Blended Hydraulic Cements
ASTM D 5	(1986) Penetration of Bituminous Materials
ASTM D 75	(1987; R 1992) Sampling Aggregates
ASTM D 140	(1988) Sampling Bituminous Materials
ASTM D 946	(1982) Penetration-Graded Asphalt Cement for Use in Pavement Construction
ASTM D 1250	(1980; R 1990) Petroleum Measurement Tables
ASTM D 1856	(1979; R 1984) Recovery of Asphalt From Solution By Abson Method
ASTM D 2172	(1992) Quantitative Extraction of Bitumen from Bituminous Paving Mixtures

ASTM D 2487	(1992) Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(1991) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(1988) Water Content of Soil and Rock In Place by Nuclear Methods (Shallow Depth)
ASTM D 3381	(1983) Viscosity-Graded Asphalt Cement for Use in Pavement Construction
ASTM D 4791	(1989) Flat or Elongated Particles in Coarse Aggregates
ASTM E 548	(1991) General Criteria Used for Evaluating Laboratory Competence

1.2 SYSTEM DESCRIPTION

The Contractor shall build a drainage layer under the roads pavements as indicated and in accordance with the following subparagraphs:

1.2.1 Aggregate Drainage Layer

A drainage layer consisting of rapid draining materials (RDM) or a combination of open graded materials (OGM) stabilized with choke stone meeting the gradations of Table I.

1.2.2 Cement Stabilized Drainage Layer

A drainage layer consisting of OGM stabilized with portland cement.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL DESCRIPTIONS:

SD-09 Reports

Sampling and Testing; FIO.

Copies of field test results within 24 hours of completion of tests.

Approval of Materials; FIO.

Material sources and material test results prior to field use.

Evaluation; FIO.

Test section construction report.

1.4 FIELD COMPACTION

Field compaction requirements shall be based on the results of a test section constructed by the Contractor, using the materials, methods, and

equipment proposed for use in the work. The test section shall meet the requirements of paragraph TEST SECTION.

1.5 EQUIPMENT

1.5.1 General Requirements

All plant, equipment, and tools used in the performance of the work will be subject to approval before the work is started and shall be maintained in satisfactory working condition at all times.

1.5.2 Placement Equipment

An asphalt paving machine shall be used to place drainage layer material. Alternate methods may be used if it can be demonstrated in the test section that these methods obtain the specified results.

1.5.3 Compaction Equipment

A dual or single smooth drum roller which provides a maximum compactive effort without crushing the drainage layer aggregate shall be used to compact drainage layer material.

1.6 WEATHER LIMITATION

Drainage layer material shall be placed when the atmospheric temperature is above 35 degrees F. Areas of completed drainage layer or underlying courses that are damaged by freezing, rainfall, or other weather conditions or by contamination from sediments, dust, dirt, or foreign material shall be corrected by the Contractor to meet specified requirements.

1.7 SAMPLING AND TESTING

1.7.1 General Requirements

Sampling and testing shall be the responsibility of the Contractor. Sampling and testing shall be performed by an approved commercial testing laboratory, or by the Contractor subject to approval. If the Contractor elects to establish testing facilities of his own, approval of such facilities shall be based on compliance with ASTM E 548, and no work requiring testing will be permitted until the Contractor's facilities have been inspected and approved. The first inspection of the facilities will be at the expense of the Government and any subsequent inspections required because of failure of the first inspection shall be at the expense of the Contractor. Such costs will be deducted from the total amount due the Contractor. Drainage layer materials shall be tested to establish compliance with the specified requirements.

1.7.2 Sampling

Aggregate samples shall be taken in accordance with ASTM D 75. Bituminous samples shall be taken in accordance with ASTM D 140. Bituminous or cement stabilized mixture samples shall be taken using methods approved by the Contracting Officer.

1.7.3 Test Methods

1.7.3.1 Sieve Analyses

Sieve analyses shall be made in accordance with ASTM C 117 and ASTM C 136.

1.7.3.2 Density Tests

Field density tests shall be made in accordance with ASTM D 2922. When using this method, ASTM D 3017 shall be used to determine the moisture content of the aggregate drainage layer material. The calibration curves furnished with the moisture gauges shall be checked along with density calibration checks as described in ASTM D 3017. The calibration checks of both the density and moisture gauges shall be made by the prepared containers of material method, as described in paragraph "Calibration" of ASTM D 2922, on each different type of material being tested at the beginning of a job and at intervals as directed by the Contracting Officer.

1.7.3.3 Soundness Test

Soundness tests shall be made in accordance with ASTM C 88.

1.7.3.4 Los Angeles Abrasion Test

Los Angeles abrasion tests shall be made in accordance with ASTM C 131.

1.7.3.5 Flat or Elongated Particles Tests

Flat and/or elongated particles tests shall be made in accordance with ASTM D 4791.

1.7.3.6 Fractured Faces Tests

When aggregates are supplied from crushed gravel, approved test methods shall be used to assure the aggregate meets the requirements for fractured faces in paragraph AGGREGATES.

1.7.4 Testing Frequency

1.7.4.1 Aggregate Drainage Layer

Sieve analyses, field density, and moisture content tests shall be performed at a rate of at least one test for every 1000 square yards of completed area and not less than one test for each day's production. Soundness tests, Los Angeles abrasion tests, fractured faces tests and flat and/or elongated particles tests shall be performed at the rate of one test for every 10 sieve analysis tests.

1.7.4.2 Cement Stabilized Drainage Layer

Sieve analyses shall be performed on aggregates prior to addition of asphalt or portland cement, at a rate of at least one test for every 250 tons of production and not less than one test for each days production. Soundness tests, Los Angeles abrasion tests, fractured faces tests, and flat and/or elongated particles tests shall be performed at the rate of one test for every 10 sieve analyses tests. Field density tests shall be performed at a rate of at least one test for every 1000 square yards of completed area and not less than one test for each days production.

1.7.5 Approval of Materials

1.7.5.1 Aggregate

The aggregate source shall be selected at least 60 days prior to field use in the test section. Tentative approval of the source will be based on certified test results to verify that materials proposed for use meet the contract requirements. Final approval of both the source and the material will be based on test section performance and tests for gradation, soundness, Los Angeles abrasion, flat and/or elongated particles tests and fractured faces tests. For aggregate drainage layer materials, these tests shall be performed on samples taken from the completed and compacted drainage layer course within the test section. For bituminous or cement stabilized drainage layer material, these tests shall be performed on aggregate samples taken prior to addition of bituminous or cementitious material and subsequent placement in the test section.

1.7.5.2 Cementitious Materials

Bituminous or cementitious sources and certified material test results shall be submitted for approval not less than 60 days prior to field use in the test section.

PART 2 PRODUCTS

2.1 GENERAL

Asphalt or cement stabilized material will require Government notification and delivery of approved materials in accordance with paragraph CEMENT STABILIZED JOB-MIX FORMULA.

2.2 AGGREGATES

Aggregates shall consist of clean, sound, hard, durable, angular particles of crushed stone, crushed slag, or crushed gravel which meet the specification requirements. Slag shall be an air-cooled, blast-furnace product having a dry weight of not less than 65 pcf determined by ASTM C 29. The aggregates shall be free of silt and clay as defined by ASTM D 2487, vegetable matter, and other objectionable materials or coatings.

2.2.1 Aggregate Quality

The aggregate shall have a soundness loss not greater than 18 percent weighted averaged at five cycles when tested in magnesium sulfate in accordance with ASTM C 88. The aggregate shall have a percentage of loss on abrasion not to exceed 40 after 500 revolutions as determined by ASTM C 131. The percentage of flat and/or elongated particles as determined by ASTM D 4791 shall not exceed 20 in the fraction retained on the 1/2-inch sieve, in the fraction passing the 1/2-inch sieve but retained on the No.4 sieve and in the percent passing the No.4 sieve but retained on the No.16 sieve. 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. When the aggregate is supplied from more than one source, aggregate from each source shall meet the requirements set forth herein. When the aggregate is supplied from crushed gravel it shall be manufactured from gravel particles 90 percent of which by weight are retained on the maximum-size sieve listed in TABLE I. In the portion retained on each sieve specified, the crushed gravel shall contain at least 90 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 face. 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.

2.2.2 Gradation Requirements

Drainage layer aggregates shall be well graded within the limits specified in TABLE I.

TABLE I. GRADATION OF DRAINAGE LAYER MATERIAL

Percentage by Weight Passing Square-Mesh Sieve

Sieve Designation	Rapid Draining Material (RDM)	Open Graded Material (OGM)	Choke Stone
1-1/2 inch	100	100	100
1-inch	70-100	95-100	100
3/4 inch	55-100	---	100
1/2 inch	40-80	25-80	100
3/8 inch	30-65	---	80-100
No. 4	10-50	0-10	10-100
No. 8	0-25	0-5	5-40
No. 16	0-5	---	0-10

NOTE 1: Particles having diameters less than 0.02 mm shall not be in excess of 1.5 percent by weight of the total sample tested.

NOTE 2: The values are based on aggregates of uniform specific gravity, and the percentages passing the various sieves may require appropriate correction by the Contracting Officer when aggregates of varying specific gravities are used.

NOTE 3: Portland cement will be required to stabilize the OGM.

NOTE 4: For RDM, the coefficient of uniformity (CU) shall be greater than 3.5. (CU = D60/D10).

2.3 CEMENTITIOUS MATERIALS

Portland cement to be mixed with aggregates shall conform to ASTM C 150, Type I, IA, II or IIA.

2.4 CEMENT STABILIZED JOB-MIX FORMULA

The cement stabilized mix shall consist of OGM and a minimum of 200 pounds of portland cement per cubic yard with a water/cement ratio of 0.37. Based on the test section performance, the Contractor shall be responsible for adjustments (increases) in asphalt cement or portland cement quantities to ensure the stabilized drainage layer will not rut or be disturbed by the Contractor's proposed paving method. The Contractor shall submit a job-mix formula (JMF) with the test section report for Contracting Officer approval.

PART 3 EXECUTION

3.1 STOCKPILING AGGREGATES

Aggregates shall be stockpiled at locations designated by the Contracting Officer. Stockpile areas shall be cleared and leveled prior to stockpiling aggregates. All aggregates shall be stockpiled so as to prevent segregation and contamination. Aggregates obtained from different sources shall be stockpiled separately.

3.2 TEST SECTION

3.2.1 General

A test section shall be constructed to evaluate the ability to carry traffic and the constructability of the drainage layer including required mixing, placement, and compaction procedures. Test section data will be used by the Contracting Officer to determine the required number of passes and the field dry density requirements for full scale production.

3.2.2 Scheduling

The test section shall be constructed a minimum of 30 days prior to the start of full scale production to provide sufficient time for an evaluation of the proposed materials, equipment and procedures including Government QA testing.

3.2.3 Location and Size

The test section shall be placed outside the production paving limits in an area with similar subgrade and subbase conditions approved by the Contracting Officer. The underlying courses and subgrade preparation, required for the pavement section, shall be completed, inspected and approved in the test section prior to constructing the drainage layer. The test section shall be a minimum of 100 feet long and one full paving lane wide.

3.2.4 Initial Testing

Certified test results, to verify that the materials proposed for use in the test section meet the contract requirements, shall be provided by the Contractor and approved by the Contracting Officer prior to the start of the test section.

3.2.5 Mixing, Placement, and Compaction

Mixing, placement, and compaction shall be accomplished using equipment meeting the requirements of paragraph EQUIPMENT. Compaction equipment speed shall be no greater than 1.5 miles per hour.

3.2.6 Procedure

3.2.6.1 Aggregate Drainage Layer

The test section shall be constructed with aggregate in a moist state so as to establish a correlation between number of roller passes and dry density achievable during field production. Density and moisture content tests shall be conducted at the surface and at intervals of 2 inches of depth down for the total layer thickness, in accordance with ASTM D 2922 and ASTM D 3017. Sieve analysis tests shall be conducted on composite samples, taken adjacent to the density test locations, which represent the total layer thickness. One set of tests (i.e. density, moisture, and sieve

analysis) shall be taken before compaction and after each subsequent compaction pass at three separate locations as directed by the Contracting Officer. Compaction passes and density readings shall continue until the difference between the average dry densities of any two consecutive passes is less than or equal to 0.5 pcf. If choke stone is used to stabilize the surface of OGM, the choke stone shall be placed after compaction of the final lift of OGM. The choke stone shall be spread in a thin layer no thicker than 1/2 inch and worked into the surface of the OGM using two passes of a vibratory roller and wetting. The test section shall be completed by making one final pass with the roller in the static mode and observing any change in the drainage layer surface texture.

3.2.6.2 Cement Stabilized Drainage Layer

Density tests shall be conducted at the surface and at intervals of 2 inches of depth for the total layer thickness in accordance with ASTM D 2922. A composite sample representing the total layer thickness, shall be taken adjacent to each density test location. Visual examination of each composite sample shall be made to determine if and when crushing of aggregate occurs. One density test and composite sample shall be taken before compaction and after each subsequent compaction pass at three separate locations as directed by the Contracting Officer. Compaction passes and density readings shall continue until the difference between the average total densities of any two consecutive passes is less than or equal to 0.5 pcf.

3.2.7 Evaluation

Within 10 days of completion of the test section, the Contractor shall submit to the Contracting Officer a Test Section Construction Report complete with all required test data and correlations. The Contracting Officer will evaluate the data and provide to the Contractor the required number of passes of the roller, the dry density for field density control during construction, the depth at which to check the density, and the need for a final static pass of the roller.

3.3 PREPARATION OF UNDERLYING COURSE

Prior to constructing the drainage layer, the underlying course shall be cleaned of all foreign materials. During construction, the underlying course shall contain no frozen material. The underlying course shall conform to Section 02225 EARTHWORK FOR ROADWAYS, RAILROADS, AND AIRFIELDS. Ruts or soft yielding spots in the underlying courses 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. 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 drainage layer is placed.

3.4 TRANSPORTING MATERIAL

3.4.1 Aggregate Drainage Layer Material

Aggregate drainage layer material shall be transported to the site in a manner which prevents segregation and contamination of materials.

3.4.2 Cement Stabilized Material

Cement stabilized material shall be transported from the mixing plant to the site in trucks equipped with protective covers. Loads that have crusts of unworkable material or have become excessively wet will be rejected. Hauling over freshly placed material will not be permitted.

3.5 PLACING

3.5.1 General

Drainage layer material shall be placed on the underlying course in lifts of uniform thickness using equipment meeting the requirements of paragraph EQUIPMENT. When a compacted layer 6 inches or less in thickness is required, the material shall be placed in a single lift. When a compacted layer in excess of 6 inches is required, the material shall be placed in lifts of equal thickness. No lift shall exceed 6 inches or be less than 3 inches when compacted. The lifts shall be so placed that when compacted they will be true to the grades or levels required with the least possible surface disturbance. Where the drainage layer is placed in more than one lift, the previously constructed lift shall be cleaned of loose and foreign material. Such adjustments in placing procedures or equipment shall be made to obtain true grades and minimize segregation and degradation of the drainage layer material. Choke stone used to stabilize the surface of the OGM shall be spread in a thin layer no thicker than 1/2 inch.

3.5.2 Hand Spreading

In areas where machine spreading is impractical, drainage layer material shall be spread by hand. The material shall be spread uniformly in a loose layer so as to prevent segregation along with conforming to the required grade and thickness after compaction.

3.6 COMPACTION REQUIREMENTS

Compaction shall be accomplished using rollers meeting the requirements of paragraph EQUIPMENT and operating at a rolling speed of no greater than 1.5 miles per hour. Each lift of drainage material, including shoulders when specified under the shoulders, shall be compacted with the number of passes of the roller as specified by the Contracting Officer. In addition, a minimum field dry density, as specified by the Contracting Officer, shall be maintained. If the required field dry density is not obtained, the number of roller passes shall be adjusted in accordance with paragraph DEFICIENCIES. Excessive rolling resulting in crushing of aggregate particles shall be avoided. Choke stone used to stabilize the surface of the OGM shall be worked into the surface of the OGM by two passes of a vibratory roller and wetting. Compaction of bituminous stabilized material shall begin immediately when the material has cooled to 170 degrees F. Not more than 30 minutes shall elapse between the start of moist mixing of cement stabilized material and the start of field compaction and field compaction shall be completed within 60 minutes. In all places not accessible to the rollers, the drainage layer material shall be compacted with mechanical hand operated tampers.

3.7 CURING OF CEMENT STABILIZED MATERIAL

The completed cement stabilized drainage layer shall be cured with water for a period of 12 hours following completion of compaction. Curing operations shall commence within 3 hours after compaction and shall consist of sprinkling the surface of the drainage layer with a fine spray of water

every 2 hours for the required 12 hour period. Curing water shall be applied such that the cement paste on the surface of the mixture will not be eroded. Water trucks shall not be permitted on the completed cement stabilized drainage layer.

3.8 FINISHING

The top surface of the drainage layer shall be finished after final compaction as determined from the test section. Adjustments in rolling and finishing procedures shall be made to obtain grades and minimize segregation and degradation of the drainage layer material.

3.9 EDGES OF DRAINAGE LAYER

Shoulder material shall be placed along the edges of the drainage layer course in such quantity as will compact to the thickness of the layer being constructed. When the drainage layer is being constructed in two or more lifts, at least a one foot width of the shoulder shall be rolled and compacted simultaneously with the rolling and compacting of each lift of the drainage layer.

3.10 SMOOTHNESS TEST

The surface of the top lift shall not deviate more than 3/8 inch when tested with a 12-foot straightedge applied parallel with and at right angles to the centerline of the area to be paved. Deviations exceeding 3/8 inch shall be corrected in accordance with paragraph DEFICIENCIES.

3.11 THICKNESS CONTROL

The completed thickness of the drainage layer shall be within 1/2 inch of the thickness indicated. Thickness shall be measured at intervals providing at least one measurement for each 500 square yards of drainage layer. Measurements shall be made in test holes at least 3 inches in diameter. Where the measured thickness is more than 1/2 inch deficient, such areas shall be corrected in accordance with paragraph DEFICIENCIES. Where the measured thickness is 1/2 inch more than indicated, it will be considered as conforming with the requirements plus 1/2 inch, provided the surface of the drainage layer is within 1/2 inch of established grade. The average job thickness shall be the average of all job measurements as specified above but within 1/4 inch of the thickness shown on the drawings.

3.12 DEFICIENCIES

3.12.1 Grade and Thickness

Deficiencies in grade and thickness shall be corrected such that both grade and thickness tolerances are met. In no case will thin layers of material be added to the top surface of the drainage layer to meet grade or increase thickness. If the elevation of the top of the drainage layer is more than 1/2 inch above the plan grade it shall be trimmed to grade and finished in accordance with paragraph FINISHING. If the elevation of the top surface of the drainage layer is 1/2 inch or more below the required grade, the surface of the drainage layer shall be scarified to a depth of at least 3 inches, new material shall be added, and the layer shall be blended and recompacted to bring it to grade. Where the measured thickness of the drainage layer is more than 1/2 inch deficient, such areas shall be corrected by excavating to the required depth and replaced with new material to obtain a compacted lift thickness of at least 3 inches. The

depth of required excavation shall be controlled to keep the final surface elevation within grade requirements and to preserve layer thicknesses of materials below the drainage layer.

3.12.2 Density

Density shall be considered deficient if the field dry density test results are below the dry density specified by the Contracting Officer. If the densities are deficient, the layer shall be rolled with 2 additional passes of the specified roller. If the dry density is still deficient, work will be stopped until the cause of the low dry densities can be determined by the Contracting Officer.

3.12.3 Smoothness

Deficiencies in smoothness shall be corrected as if they are deficiencies in grade or thickness. All tolerances for grade and thickness shall be maintained while correcting smoothness deficiencies.

-- End of Section --

SECTION 02511

CONCRETE SIDEWALKS AND CURBS AND GUTTERS
01/89

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 CONCRETE INSTITUTE (ACI)

ACI 306-78	Recommended Practice for Cold Weather Concreting.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 185	(1990a) Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM A 615	(1990) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 616	(1990) Rail-Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A 617	(1990) Axle-Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM C 31	(1991) Making and Curing Concrete Test Specimens in the Field
ASTM C 143	(1990a) Slump of Hydraulic Cement Concrete
ASTM C 171	(1991) Sheet Materials for Curing Concrete
ASTM C 172	(1990) Sampling Freshly Mixed Concrete
ASTM C 173	(1978) Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C 231	(1991b) Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 309	(1991) Liquid Membrane-Forming Compounds for Curing Concrete
ASTM D 1751	(1983; R 1991) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	(1984; R 1992) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete

Paving and Structural Construction

CORPS OF ENGINEERS (COE)

COE CRD-C 527	(1988) Standard Specification for Joint Sealants, Cold-Applied, Non-Jet-Fuel-Resistant, for Rigid and Flexible Pavements

FEDERAL SPECIFICATIONS (FS)

FS CCC-C-467	(Rev C) Cloth, Burlap, Jute (or Kenaf)
FS SS-S-1401	(Rev C; Notice 1) Sealant, Joint, Non-Jet-Fuel-Resistant, Hot-Applied, for Portland Cement and Asphalt Concrete Pavements

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL DESCRIPTIONS:

SD-09 Reports

Field Quality Control; GA.

Copies of all test reports within 24 hours of completion of the test.

SD-18 Records
Concrete; FIO.

Copies of certified delivery tickets for all concrete used in the construction.

1.3 WEATHER LIMITATIONS

1.3.1 Placing During Cold Weather

Concrete placement shall be discontinued when the air temperature reaches 40 degrees F and is falling. Placement may begin when the air temperature reaches 35 degrees F and is rising. Provisions shall be made to protect the concrete from freezing during the specified curing period. If necessary to place concrete when the temperature of the air, aggregates, or water is below 35 degrees F, placement shall be approved in writing. Approval shall be contingent upon full conformance with the following provisions. The underlying material shall be prepared and protected so that it is entirely free of frost when the concrete is deposited. Mixing water and/or aggregates shall be heated as necessary to result in the temperature of the in-place concrete being between 50 and 85 degrees F. Methods and equipment for heating shall be approved. The aggregates shall be free of ice, snow, and frozen lumps before entering the mixer. 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.

1.3.2 Placing During Warm Weather

The temperature of the concrete as placed shall not exceed 85 degrees F except where an approved retarder is used. The mixing water and/or aggregates shall be cooled, if necessary, to maintain a satisfactory placing temperature. In no case shall the placing temperature exceed 95 degrees F.

1.4 PLANT, EQUIPMENT, MACHINES, AND TOOLS

1.4.1 General Requirements

Plant, equipment, machines, and tools used in the work shall be subject to approval and shall be maintained in a satisfactory working condition at all times. The equipment shall have the capability of producing the required product, meeting grade controls, thickness control and smoothness requirements as specified. Use of the equipment shall be discontinued if it produces unsatisfactory results. The Contracting Officer shall have access at all times to the plant and equipment to ensure proper operation and compliance with specifications.

1.4.2 Slip Form Equipment

Slip form paver or curb forming machine, will be approved based on trial use on the job and shall be self-propelled, automatically controlled, crawler mounted, and capable of spreading, consolidating, and shaping the plastic concrete to the desired cross section in one pass.

PART 2 PRODUCTS

2.1 CONCRETE

Concrete shall conform to the applicable requirements of Section 03300 CONCRETE FOR BUILDING CONSTRUCTION except as otherwise specified. Concrete shall have a minimum compressive strength of 3000 psi at 28 days. Maximum size of aggregate shall be 1-1/2 inches.

2.1.1 Air Content

Mixtures shall have air content by volume of concrete of 5 to 7 percent, based on measurements made immediately after discharge from the mixer.

2.1.2 Slump

The concrete slump shall be 2 +/- 1 inches where determined in accordance with ASTM C 143.

2.1.3 Reinforcement Steel

Reinforcement bars shall conform to ASTM A 615. Wire mesh reinforcement shall conform to ASTM A 185.

2.2 CONCRETE CURING MATERIALS

2.2.1 Impervious Sheet Materials

Impervious sheet materials shall conform to ASTM C 171, type optional, except that polyethylene film, if used, shall be white opaque.

2.2.2 Burlap

Burlap shall conform to FS CCC-C-467.

2.2.3 White Pigmented Membrane-Forming Curing Compound

White pigmented membrane-forming curing compound shall conform to ASTM C 309, Type 2.

2.3 CONCRETE PROTECTION MATERIALS

Concrete protection materials shall be a linseed oil mixture of equal parts, by volume, of linseed oil and either mineral spirits, naphtha, or turpentine. At the option of the contractor, commercially prepared linseed oil mixtures, formulated specifically for application to concrete to provide protection against the action of deicing chemicals may be used, except that emulsified mixtures are not acceptable.

2.4 JOINT FILLER STRIPS

2.4.1 Contraction Joint Filler for Curb and Gutter

Contraction joint filler for curb and gutter shall consist of hard-pressed fiberboard.

2.4.2 Expansion Joint Filler, Premolded

Expansion joint filler, premolded, shall conform to ASTM D 1751 or ASTM D 1752, 3/8 inch thick, unless otherwise indicated.

2.5 JOINT SEALANTS

2.5.1 Joint Sealant, Cold-Applied

Joint sealant, cold-applied shall conform to COE CRD-C 527.

2.5.2 Joint Sealant, Hot-Poured

Joint sealant, hot-poured shall conform to FS SS-S-1401.

2.6 FORM WORK

Form work shall be designed and constructed to insure that the finished concrete will conform accurately to the indicated dimensions, lines, and elevations, and within the tolerances specified. Forms shall be of wood or steel, straight, of sufficient strength to resist springing during depositing and consolidating concrete. Wood forms shall be surfaced plank, 2-inch nominal thickness, straight and free from warp, twist, loose knots, splits or other defects. Wood forms shall have a nominal length of 10 feet. Radius bends may be formed with 3/4-inch boards, laminated to the required thickness. Steel forms shall be channel-formed sections with a flat top surface and with welded braces at each end and at not less than two intermediate points. Ends of steel forms shall be interlocking and self-aligning. Steel forms shall include flexible forms for radius forming, corner forms, form spreaders, and fillers. Steel forms shall have a nominal length of 10 feet with a minimum of two welded stake pockets per form. Stake pins shall be solid steel rods with chamfered heads and pointed tips designed for use with steel forms.

2.6.1 Sidewalk Forms

Sidewalk forms shall be of a height equal to the full depth of the finished sidewalk.

2.6.2 Curb and Gutter Forms

Curb and gutter outside forms shall have a height equal to the full depth of the curb or gutter. The inside form of curb shall have batter as indicated and shall be securely fastened to and supported by the outside form. Rigid forms shall be provided for curb returns, except that benders or thin plank forms may be used for curb or curb returns with a radius of 10 feet or more, where grade changes occur in the return, or where the central angle is such that a rigid form with a central angle of 90 degrees cannot be used. Back forms for curb returns may be made of 1-1/2 inch benders, for the full height of the curb, cleated together.

PART 3 EXECUTION

3.1 SUBGRADE PREPARATION

The subgrade shall be constructed to the specified grade and cross section prior to concrete placement. Subgrade shall be placed and compacted to conform with applicable requirements of Section 02511 CONCRETE SIDEWALKS AND CURBS AND GUTTERS, Section 02221 EXCAVATION, FILLING, AND BACKFILLING FOR BUILDINGS, and Section 02225 EARTHWORK FOR ROADWAYS, RAILROADS, AND AIRFIELDS.

3.1.1 Sidewalk Subgrade

The subgrade shall be tested for grade and cross section with a template extending the full width of the sidewalk and supported between side forms.

3.1.2 Curb and Gutter Subgrade

The subgrade shall be tested for grade and cross section by means of a template extending the full width of the curb and gutter. The subgrade shall be of materials equal in bearing quality to the subgrade under the adjacent pavement.

3.1.3 Maintenance of Subgrade

The subgrade shall be maintained in a smooth, compacted condition in conformity with the required section and established grade until the concrete is placed. The subgrade shall be in a moist condition when concrete is placed. The subgrade shall be prepared and protected so as to produce a subgrade free from frost when the concrete is deposited.

3.2 FORM SETTING

Forms shall be carefully set to the indicated alignment, grade and dimensions. Forms shall be held rigidly in place by a minimum of three stakes per form placed at intervals not to exceed 4 feet. Corners, deep sections, and radius bends shall have additional stakes and braces, as required. Clamps, spreaders, and braces shall be used where required to insure rigidity in the forms. Forms shall be removed without injuring the concrete. Bars or heavy tools shall not be used against the concrete in removing the forms. Any concrete found defective after form removal shall be promptly and satisfactorily repaired. 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.

3.2.1 Sidewalks

Forms for sidewalks shall be set with the upper edge true to line and grade with an allowable tolerance of 1/8 inch in any 10-foot long section. After forms are set, grade and alignment shall be checked with a 10-foot straightedge. Forms shall have a transverse slope of 1/4-inch per foot with the low side adjacent to the roadway. Side forms shall not be removed for 12 hours after finishing has been completed.

3.2.2 Curbs and Gutters

The forms of the front of the curb shall be removed not less than 2 hours nor more than 6 hours after the concrete has been placed. Forms back of curb shall remain in place until the face and top of the curb have been finished as specified for concrete finishing. Gutter forms shall not be removed while the concrete is sufficiently plastic to slump in any direction.

3.3 SIDEWALK CONCRETE PLACEMENT AND FINISHING

3.3.1 Formed Sidewalks

Concrete shall be placed in the forms in one layer of such thickness that when consolidated and finished the sidewalks will be a minimum of 4" thick. After concrete has been placed in the forms, a strike-off guided by side forms shall be used to bring the surface to proper section to be compacted. The concrete shall be consolidated with an approved vibrator, and the surface shall be finished to grade with a wood float, bull float, or darby, edged and broom finished.

3.3.2 Concrete Finishing

After straightedging, when most of the water sheen has disappeared, and just before the concrete hardens, the surface shall be finished to a smooth and uniformly fine granular or sandy texture free of waves, irregularities, or tool marks. A scored surface shall be produced by brooming with a fiber-bristle brush in a direction transverse to that of the traffic. Contractor will provide a sample panel of the broom finish for approval of the Contracting Officer that will establish the acceptable amplitude criteria upon which all sidewalk finishes will match.

3.3.3 Edge and Joint Finishing

All slab edges, including those at formed joints, shall be finished carefully 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. Corners and edges which have crumbled and areas which lack sufficient mortar for proper finishing shall be cleaned and filled solidly with a properly proportioned mortar mixture and then finished.

3.3.4 Surface and Thickness Tolerances

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.

3.4 CURB AND GUTTER CONCRETE PLACEMENT AND FINISHING

3.4.1 Formed Curb and Gutter

Concrete shall be placed to the section required in a single lift. Consolidation shall be achieved by using approved mechanical vibrators.

3.4.2 Concrete Finishing

Exposed surfaces shall be floated and finished with a smooth wood float until true to grade and section and uniform in texture. Floated surfaces shall then be brushed with a fine-hair brush with longitudinal strokes. The edges of the gutter and top of the curb shall be rounded with an edging tool to a radius of 1/2 inch. Immediately after removing the front curb form, the face of the curb shall be rubbed with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. The front curb surface, while still wet, shall be brushed in the same manner as the gutter and curb top. The top surface of gutter and entrance shall be finished to grade with a wood float.

3.4.3 Joint Finishing

Curb edges at formed joints shall be finished as indicated.

3.4.4 Surface and Thickness Tolerances

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.

3.5 SIDEWALK JOINTS

Sidewalk joints shall be constructed to divide the surface into rectangular areas. Transverse contraction joints shall be spaced at a distance equal to the sidewalk width or 5 feet on centers, whichever is less, and shall be continuous across the slab. Longitudinal contraction joints shall be constructed along the centerline of all sidewalks 10 feet or more in width. Transverse expansion joints shall be installed at sidewalk returns and opposite expansion joints in adjoining curbs. Where the sidewalk is not in contact with the curb, transverse expansion joints shall be installed as indicated. Expansion joints shall be formed about structures and features which project through or into the sidewalk pavement, using joint filler of the type, thickness, and width indicated.

3.5.1 Contraction Joints

The contraction joints shall be formed in the fresh concrete by cutting a groove in the top portion of the slab to a depth of at least one-fourth of the sidewalk slab thickness, using a jointer to cut the groove, or by sawing a groove in the hardened concrete with a power-driven saw, unless otherwise approved. Sawed joints shall be constructed by sawing a groove in the concrete with a 1/8-inch blade to the depth indicated. An ample supply of saw blades shall be available on the job before concrete placement is started, and at least one standby sawing unit in good working order shall be available at the jobsite at all times during the sawing operations.

3.5.2 Expansion Joints

Expansion joints shall be formed with 1/2 inch joint filler strips. Joint filler shall be placed with top edge 1/4 inch below the surface and shall be held in place with steel pins or other devices to prevent warping of the filler during floating and finishing. Immediately after finishing operations are completed, joint edges shall be rounded with an edging tool having a radius of 1/8 inch, and concrete over the joint filler shall be removed. At the end of the curing period, expansion joints shall be carefully cleaned and filled with joint sealer. Joints shall be sealed as specified in Section 02580 JOINT SEALING IN CONCRETE PAVEMENTS FOR ROADS AND AIRFIELDS.

The joint opening shall be thoroughly cleaned before the sealing material is placed. Sealing shall be done so that the material will not be spilled on exposed surfaces of the concrete. Concrete at the joint shall be surface dry and 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.

3.5.3 Reinforcement Steel Placement

Reinforcement steel shall be accurately and securely fastened in place with suitable supports and ties before the concrete is placed.

3.6 CURB AND GUTTER JOINTS

Curb and gutter joints shall be constructed at right angles to the line of curb and gutter.

3.6.1 Contraction Joints

Contraction joints shall be constructed directly opposite contraction joints in abutting portland cement concrete pavements and 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.

3.6.2 Expansion Joints

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 shall be provided in curb and gutter directly opposite expansion joints of abutting portland cement concrete pavement, and shall be of the same type and thickness as joints in the pavement. Where curb and gutter do not abut portland cement concrete pavement, expansion joints at least 1/2 inch in width shall be provided at intervals not exceeding 20 feet. Expansion joints shall be provided in nonreinforced concrete gutter at locations indicated. Expansion joints shall be sealed immediately following curing of the concrete or as soon thereafter as weather conditions permit. Joints shall be sealed as specified in Section 02580 JOINT SEALING IN CONCRETE PAVEMENTS FOR ROADS AND AIRFIELDS.

Expansion joints and the top 1-inch depth of curb and gutter contraction-joints shall be sealed with joint sealer. The joint opening

shall be thoroughly cleaned before the sealing material is placed. Sealing shall be done so that the material will not be spilled on exposed surfaces of the concrete. Concrete at the joint shall be surface dry and 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.

3.7 CURING AND PROTECTION

3.7.1 General Requirements

Concrete shall be protected against loss of moisture and rapid temperature changes for at least 7 days from the beginning of the curing operation. Unhardened concrete shall be protected from rain and flowing water. All equipment needed for adequate curing and protection of the concrete shall be on hand and ready for use before actual concrete placement begins. Protection shall be provided as necessary to prevent cracking of the pavement due to temperature changes during the curing period.

3.7.1.1 Mat Method

The entire exposed surface shall be covered with two 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.

3.7.1.2 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.

3.7.1.3 Membrane Curing Method

A uniform coating of white-pigmented membrane-curing compound shall be applied to the entire exposed surface of the concrete as soon after finishing as the free water has disappeared from the finished surface. Formed surfaces shall be coated immediately after the forms are removed and in no case longer than 1 hour after the removal of forms. Concrete shall not be allowed to dry before the application of the membrane. If any drying has occurred, the surface of the concrete shall be moistened with a fine spray of water and the curing compound applied as soon as the free water disappears. Curing compound shall be applied in two coats by hand-operated pressure sprayers at a coverage of approximately 200 square feet per gallon for both coats. The second coat shall be applied in a direction approximately at right angles to the direction of application of the first coat. The compound shall form a uniform, continuous, coherent film that will not check, crack, or peel and shall be free from pinholes or other imperfections. If pinholes, abrasion, or other discontinuities exist, an additional coat shall be applied to the affected areas within 30

minutes. Concrete surfaces that are subjected to heavy rainfall within 3 hours after the curing compound has been applied shall be resprayed by the method and at the coverage specified above. Areas where the curing compound is damaged by subsequent construction operations within the curing period shall be resprayed. Necessary precautions shall be taken to insure that the concrete is properly cured at sawed joints, and that no curing compound enters the joints. The top of the joint opening and the joint groove at exposed edges shall be tightly sealed before the concrete in the region of the joint is resprayed with curing compound. The method used for sealing the joint groove shall prevent loss of moisture from the joint during the entire specified curing period. Approved standby facilities for curing concrete pavement shall be provided at a location accessible to the jobsite for use in the event of mechanical failure of the spraying equipment or other conditions that might prevent correct application of the membrane-curing compound at the proper time. Concrete surfaces to which membrane-curing compounds have been applied shall be adequately protected during the entire curing period from pedestrian and vehicular traffic, except as required for joint-sawing operations and surface tests, and from any other possible damage to the continuity of the membrane.

3.7.2 Backfilling

After curing, debris shall be removed and the area adjoining the concrete shall be backfilled, graded, and compacted to conform to the surrounding area in accordance with lines and grades indicated.

3.7.3 Protection

Completed concrete shall be protected from damage until accepted. The Contractor shall repair damaged concrete and clean concrete discolored during construction. Concrete that is damaged shall be removed and reconstructed for the entire length between regularly scheduled joints. Refinishing the damaged portion will not be acceptable. Removed damaged portions shall be disposed of as directed.

3.7.4 Protective Coating

Protective coating of linseed oil mixture shall be applied to the exposed-to-view concrete surface.

3.7.4.1 Application

Curing and backfilling operation shall be completed prior to applying protective coating. Concrete shall be surface dry and thoroughly clean before each application. Coverage shall be not more than 50 square yards per gallon for first application and not more than 70 square yards per gallon for second application, except that the number of applications and coverage for each application for commercially prepared mixture shall be in accordance with the manufacturer's instructions. Coated surfaces shall be protected from vehicular and pedestrian traffic until dry.

3.7.4.2 Precautions

Protective coating shall not be heated by direct application of flame or electrical heaters and shall be protected from exposure to open flame, sparks, and fire adjacent to open containers or applicators. Material shall not be applied at temperatures lower than 50 degrees F.

3.8 FIELD QUALITY CONTROL

3.8.1 General Requirements

The Contractor shall perform the inspection and tests described and meet the specified requirements for inspection details and frequency of testing. Based upon the results of these inspections and tests, the Contractor shall take the action and submit reports as required below, and any additional tests to insure that the requirements of these specifications are met.

3.8.2 Concrete Testing

3.8.2.1 Strength Testing

The Contractor shall provide molded concrete specimens for strength tests. Samples of concrete placed each day shall be taken not less than once a day nor less than once for every 150 cubic yards of concrete. The samples for strength tests shall be taken in accordance with ASTM C 172. Cylinders for acceptance shall be molded in conformance with ASTM C 31 by an approved testing laboratory. Each strength test result shall be the average of two test cylinders from the same concrete sample tested at 28 days, unless otherwise specified or approved. Concrete specified on the basis of compressive strength will be considered satisfactory if the averages of all sets of three consecutive strength test results equal or exceed the specified strength, and no individual strength test result falls below the specified strength by more than 500 psi.

3.8.2.2 Air Content

Air content shall be determined in accordance with ASTM C 173 or ASTM C 231. ASTM C 231 shall be used with concretes and mortars made with relatively dense natural aggregates. Two tests for air content shall be made on randomly selected batches of each class of concrete placed during each shift. Additional tests shall be made when excessive variation in concrete workability is reported by the placing foreman or the Government inspector. If results are out of tolerance, the placing foreman shall be notified and he shall take appropriate action to have the air content corrected at the plant. Additional tests for air content will be performed on each truckload of material until such time as the air content is within the tolerance specified.

3.8.2.3 Slump Test

Two slump tests shall be made on randomly selected batches of each class of concrete for every 250 cubic yards, or fraction thereof, of concrete placed during each shift. Additional tests will be performed when excessive variation in the workability of the concrete is noted or when excessive crumbling or slumping is noticed along the edges of slip-formed concrete.

3.8.3 Thickness Evaluation

The anticipated thickness of the concrete shall be determined prior to placement by passing a template through the formed section or by measuring the depth of opening of the extrusion template of the curb forming machine. If a slip form paver is used for sidewalk placement, the subgrade shall be true to grade prior to concrete placement and the thickness will be determined by measuring each edge of the completed slab.

3.8.4 Surface Evaluation

The finished surface of each category of the completed work shall be uniform in color and free of blemishes and form or tool marks.

3.9 SURFACE DEFICIENCIES AND CORRECTIONS

3.9.1 Thickness Deficiency

When measurements indicate that the completed concrete section is deficient in thickness by more than 1/4 inch the deficient section will be removed, between regularly scheduled joints, and replaced.

3.9.2 High Areas

In areas not meeting surface smoothness and plan grade requirements, high areas shall be reduced either by rubbing the freshly finished concrete with carborundum brick and water when the concrete is less than 36 hours old or by grinding the hardened concrete with an approved surface grinding machine after the concrete is 36 hours old or more. The area corrected by grinding the surface of the hardened concrete shall not exceed 5 percent of the area of any integral slab, and the depth of grinding shall not exceed 1/4 inch. All pavement areas requiring grade or surface smoothness corrections in excess of the limits specified above shall be removed and replaced.

3.9.3 Appearance

Exposed surfaces of the finished work will be inspected by the Government and any deficiencies in appearance will be identified. Areas which exhibit excessive cracking, discoloration, form marks, or tool marks or which are otherwise inconsistent with the overall appearances of the work shall be removed and replaced.

-- End of Section --

SECTION 02531

ACID SEWERS
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.

AMERICAN RAILWAY ENGINEERING ASSOCIATION (AREA)

AREA-01	(1996) 1996-1997 Manual for Railway Engineering (Fixed Properties) 4 Vol.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 74	(1996) Cast Iron Soil Pipe and Fittings
ASTM A 123	(1989a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 999/ A 999M	(1998) Standard Specification for General Requirements for Alloy and Stainless Steel Pipe
ASTM C 14	(1995) Concrete Sewer, Storm Drain, and Culvert Pipe
ASTM C 14M	(1995) Concrete Sewer, Storm Drain, and Culvert Pipe (Metric)
ASTM C 32	(1999) Sewer and Manhole Brick (Made From Clay or Shale)
ASTM C 33	(1997) Concrete Aggregates
ASTM C 76	(1995a) Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C 76M	(1996) Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe (Metric)
ASTM C 94	(1997) Ready-Mixed Concrete
ASTM C 150	(1997) Portland Cement
ASTM C 138	(1992) Unit Weight, Yield, and Air Content (Gravimetric) of Concrete
ASTM C 231	(1991b) Air Content of Freshly Mixed Concrete by the Pressure Method

ASTM C 260	(1995) Air-Entraining Admixtures for Concrete
ASTM C 270	(1997) Mortar for Unit Masonry
ASTM C 307	(1994) Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacings
ASTM C 413	(1996) Absorption of Chemical-Resistant Mortars, Grouts, and Monolithic Surfacings
ASTM C 425	(1996) Compression Joints for Vitrified Clay Pipe and Fittings
ASTM C 443	(1994) Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
ASTM C 443M	(1994) Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets (Metric)
ASTM C 478	(1996) Precast Reinforced Concrete Manhole Sections
ASTM C 478M	(1996) Precast Reinforced Concrete Manhole Sections (Metric)
ASTM C 531	(1995) Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, and Monolithic Surfacings, and Polymer Concretes
ASTM C 564	(1995a) Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM C 579	(1996) Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes
ASTM C 580	(1996) Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes
ASTM C 700	(1996) Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated
ASTM C 828	(1991, R 1996) Low-Pressure Air Test of Vitrified Clay Pipe Lines
ASTM C 924	(1989) Concrete Pipe Sewer Lines by Low-Pressure Air Test Method
ASTM C 972	(1995) Compression-Recovery of Tape Sealant
ASTM D 412	(1992) Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension

ASTM D 448	(1980) Standard Sizes of Coarse Aggregate for Highway Construction
ASTM D 624	(1991; R 1996) Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
ASTM D 1784	(1996) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 2680	(1995a)Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping
ASTM D 2751	(1996) Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings
ASTM D 2996	(1995) Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe
ASTM D 2997	(1995) Centrifugally Cast "Fiberglass" (Glass-Fiber-Reinforced-Thermosetting-Resin) Pipe
ASTM D 3034	(1994) 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 3262	(1996) "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe
ASTM D 3350	(1996) Polyethylene Plastics Pipe and Fittings Materials
ASTM D 3753	(1981; R 1991) Glass-Fiber-Reinforced Polyester Manholes
ASTM D 3840	(1988) "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Fittings for Nonpressure Applications
ASTM E 96	(1995) Water Vapor Transmission of Materials
ASTM F 402	(1993) Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings
ASTM F 477	(1995) Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F 714	(1994) Polyethylene (PE) Plastic pipe

	(SDR-PR) Based on Outside Diameter
ASTM F 794	(1995a) Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter
ASTM F 894	(1995) Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe
ASTM F 949	(1994) Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA ANSI/AWWA C105/A21.5	(1993) Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA ANSI/AWWA C110/A21.10	(1993) Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (75 mm through 1200 mm), for Water and Other Liquids
AWWA ANSI/AWWA C111/A21.11	(1995) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA ANSI/AWWA C115/A21.15	(1994) Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
AWWA ANSI/AWWA C151/A21.51	(1996) Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids

FEDERAL SPECIFICATIONS (FS)

RR-F-621	Frames, Covers, Gratings, Steps, Sump and Catch Basins, Manhole

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS ANSI/MSS SP-58	(1993) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS ANSI/MSS SP-69	(1996) Pipe Hangers and Supports - Selection and Application

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 49	(1994) Hazardous Chemicals Data
NFPA 325-1	(1994) Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids
NFPA 704	(1996) Identification of the Fire Hazards of Materials for Emergency Response

UNI-BELL PVC PIPE ASSOCIATION (UBPPA)

UBPPA UNI-B-6	(1990) Recommended Practice for the Low-Pressure Air Testing of Installed Sewer Pipe
UBPPA UNI-B-9	(1990; Addenda 1994) Recommended Performance Specification for Polyvinyl Chloride (PVC) Profile Wall Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter (Nominal Pipe Sizes 4-48 inch)

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 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS. 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 "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL DESCRIPTIONS:

SD-01 Data

Stainless Steel Pipe; GA. Lockable Valves; GA. Expansion Joints; GA. Membrane; GA. Liner; GA. Silicate Concrete; GA

Manufacturer's literature including physical characteristics, storage and installation instructions for stainless steel pipe.

SD-13 Certificates

Portland Cement; GA.

Certificates of compliance stating the type of cement used in manufacture of concrete pipe, fittings and precast manholes.

Joints; FIO.

Certificates of compliance stating that the fittings or gaskets used for waste drains or lines designated on the plans as acid resistant.

PART 2 PRODUCTS

2.1 PIPE

Pipe shall conform to the respective specifications and other requirements specified below.

2.1.1 Stainless Steel Pipe

Stainless steel pipe shall be 316L. Pipe shall be minimum Schedule 40. Stainless steel pipe shall conform to ASTM A 999/ A 999M. Pipe shall be acid resistant for a concentration of 50% nitric acid and 50% sulfuric acid with a maximum temperature of 150 F.

2.1.2 Ductile Iron Pipe

Pipe shall conform to AWWA ANSI/AWWA C151/A21.51 unless otherwise shown or specified.

2.2 REQUIREMENTS FOR FITTINGS

Fittings shall be compatible with the pipe supplied and shall have a strength not less than that of the pipe. Fittings shall conform to the respective specifications and other requirements specified below.

2.3 JOINTS

Joints installation shall comply with the manufacturer's instructions. Fittings and gaskets utilized for waste drains or industrial waste lines shall be certified by the manufacturer as acid resistant.

2.3.1 Stainless Steel Pipe Jointing

All pipes buried beneath soil shall be continuous welded. Welding shall comply with Section 05090. All other pipes shall be flanged. Flanged gaskets shall be Teflon. Bolts, nuts, and washers for flanged joints shall be 316 stainless steel.

All joints for the pressure piping system shall have "see-thru" safety shields (RAMCO Vue-Gard Shield or equal). All safety shields shall be constructed of TFE coated fiberglass.

2.3.2 Ductile Iron Pipe Jointing

All ductile iron pipes shall have mechanical joints. Mechanical joints shall conform to AWWA ANSI/AWWA C111/A21.11 as modified by AWWA ANSI/AWWA C151/A21.51.

2.3.3 Expansion Joints

Expansion joints for stainless steel piping shall be PTFE lined rubber expansion joint. The body shall be constructed of polyester cord and fabric, wire reinforcement, chlorobutyl elastomer and PTFE liner. The expansion joint shall be double arch, spool type. It shall be provided with control rod plates and lateral compression sleeves, minimum four per expansion joint. Product shall be Proco Series 152/BT or approved equal.

2.3.4 Lockable Valves

Lockable valves shall be butterfly valves. These valves shall have a 316 ss body and disc and viton or teflon seats. Valves shall be acid resistant for a concentration of 30% nitric acid and 50% sulfuric acid with a maximum temperature of 150 F. Product shall be Ultraflo 392 Valve or equal.

2.4 CEMENT MORTAR

Cement mortar shall conform to ASTM C 270, Type M with Type II cement.

2.4.1 Portland Cement

Portland cement shall conform to ASTM C 150, Type II or V for concrete used in concrete pipe, concrete pipe fittings, and manholes and type optional with the Contractor for cement used in concrete cradle, concrete encasement, and thrust blocking.

2.4.2 Portland Cement Concrete

Portland cement concrete shall conform to ASTM C 94, 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. 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 aggregates exceeds 1 1/2 inches. Air content shall be determined in accordance with ASTM C 231. The concrete covering over steel reinforcing shall be not less than one 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 three inches between steel and ground.

2.5 STRUCTURES

2.5.1 Precast Reinforced Concrete Manhole Sections

General: Manholes shall be constructed of concrete with galvanized steel frames and load bearing galvanized steel grates as covers or with 1.5" diameter galvanized steel railing, as noted on the plans. Concrete manhole shall be stainless steel lined and acid resistant for a concentration of 50% nitric acid and 50% sulfuric acid with a maximum temperature of 150 F.

2.5.2 Liner

Concrete manholes shall be stainless steel lined. Liner shall be constructed of 316L stainless steel with 1/4 inch plate thickness. Inserts shall be welded at the corners to form a box type insert per dimensions shown on the plans. Stainless steel liner shall be attached to the concrete manhole as shown on the plans.

2.5.3 Primer

A two-component, liquid epoxy resinous primer shall be used. Product shall be PENNTROWEL Epoxy Primer CE-139 or equal. Primer shall be compatible with the membrane and shall be as recommended by the membrane manufacturer. Physical properties are as follows:

Water Absorption ASTM C 413	<1%

2.5.4 Membrane

Concrete manholes shall be provided with a chemically cured, elastomeric urethane asphalt membrane. Membrane shall be acid resistant for a concentration of 20% nitric acid and 50% sulfuric acid with a maximum temperature of 150 F. Product shall be TUFCHEM II Membrane CE-196 or equal. Physical properties are as follows:

Elongation at 74 degrees Fahrenheit ASTM D 412	147%
Tensile Strength at 74 degrees Fahrenheit ASTM D 412	216 psi
Bond Strength to Carbon Steel ASTM D 412	135 psi
Modulus of Elasticity @ 100% Elongation ASTM D 412	60 psi
Permeance ASTM E 96, Method E	0.245 Perms

2.5.5 Silicate Concrete

Concrete manholes shall be provided with a polymer concrete base. The polymer concrete shall be a totally inorganic potassium silicate based topping formulated to provide a chemical resistant lining to protect portland cement concrete. The silicate concrete shall be acid resistant for a concentration of 50% nitric acid and 50% sulfuric acid with a maximum temperature of 150 F. Product shall be TUFCHEM Silicate Concrete - Trowel Grade CE-257 or equal. Silicate concrete shall also be used to fill the voids between manhole walls and stainless steel insert. Silicate concrete shall be flowable for this application. Physical properties are as follows:

Density ASTM C 138	138 lbs cu ft
Tensile Strength ASTM C 307	600 psi (7 days)
Flexural Strength ASTM C 580	1000 psi (7 days)
Compressive Strength ASTM C 579 24 Hours 3 Days 28 Days	 2500 psi 4000 psi 4500 psi
Absorption ASTM C 413	5.6% maximum
Shrinkage: 3 days/28 days	0.16%/0.3%

Coefficient of Thermal Expansion 75 F to 210 F ASTM C 531	6.7 x 10^-6 / in/in/F
Modulus of Elasticity ASTM C 580	1.3 x 10^6 psi

2.6 BRICK GRADE RINGS

Brick Grade Rings: ASTM C 32, Grade MS

2.7 CEMENT MORTAR

Cement Mortar for Grade Ring: ASTM C 270, Type M

2.8 BEDDING MATERIAL

Crushed stone to be used for bedding shall conform to the sieve analysis as listed in ASTM D 448, size #67. Crushed stone for bedding of pipe in an acid environment shall consist of one of the following types of crystalline rocks: Granite, Gneiss, Biotite gneiss, Granite gneiss or quartzite. Specific gravity of the crystalline rock shall be a minimum of 2.60. Crushing strength shall be a minimum of 10,000 pounds per square inch. Toughness shall be a minimum of 7.0.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Adjacent Facilities

3.1.1.1 Roads, Railroads, and Airfields

Piping shall be encased in a sleeve of rigid conduit for the lengths shown. Sleeves under railroads shall be in accordance with the railroad company requirements. A minimum clearance of at least 2 inches between the inner wall of the sleeve and the maximum outside diameter of the sleeved pipe and joints shall be provided. Sleeves of ferrous material shall be provided with the corrosion protection as required for the conditions encountered at the site of installation.

3.1.1.2 Structural Foundations

Where sewer pipe is to be installed within 3 feet of an existing or proposed building or structural foundation such as a retaining wall, control tower footing, water tank footing, or any similar structure, the sewer pipe shall be sleeved as specified above. Contractor shall ensure there is no damage to these structures, and no settlement or movement of foundations or footing.

3.1.2 Pipe Laying

a. Pipe shall be protected during handling against impact shocks and free fall; the pipe interior shall be free of extraneous material.

b. Pipe laying shall proceed upgrade with the spigot ends of bell-and-spigot pipe pointing in the direction of the flow. Each pipe shall be laid accurately to the line and grade shown on the

drawings. Pipe shall be laid and centered so that the acid sewer has a uniform invert. As the work progresses, the interior of the acid sewer shall be cleared of all superfluous materials.

c. Before making pipe joints, all surfaces of the portions of the pipe to be joined shall be clean and dry.

3.1.2.1 Trenches

Trenches shall be kept free of water and as dry as possible during bedding, laying, and jointing and for as long a period as required. When work is not in progress, open ends of pipe and fittings shall be satisfactorily closed so that no trench water or other material will enter the pipe or fittings.

3.1.2.2 Backfill

As soon as possible after the joint is made, sufficient backfill material shall be placed along the pipe to prevent pipe movement off line or grade.

3.1.2.3 Width of Trench

If the maximum width of the trench at the top of the pipe, as specified in Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS, is exceeded for any reason other than by direction, the Contractor shall install, at no additional cost to the Government, concrete cradling, pipe encasement, or other bedding required to support the added load of the backfill.

3.1.2.4 Handling and Storage

Pipe, fittings and joint material shall be handled and stored in accordance with the manufacturer's recommendations. Storage facilities for plastic pipe, fittings, joint materials and solvents shall be classified and marked in accordance with NFPA 704, with classification as indicated in NFPA 49 and NFPA 325-1.

3.1.2.5 Location of Acid Sewer

Where the location of the acid sewer is not clearly defined by dimensions on the drawings, the acid sewer shall not be closer horizontally than 10 feet to a water-supply main or service line or underground electrical duct or cable, except that where the bottom of the water pipe will be at least 18 inches above the top of the acid sewer pipe, the horizontal spacing may be a minimum of 6 feet. Where gravity-flow acid sewers cross above waterlines or underground electrical duct or cable, the acids sewer pipe for a distance of 10 feet on each side of the crossing shall be fully encased in concrete. The thickness of the concrete encasement including that at the pipe joints shall be not less than 4 inches.

3.1.2.6 Bedding (Class B)

The pipe shall be bedded in the acid resistant granular material placed on a flat trench bottom. The granular material shall be hand shaped to fit the pipe barrel for a width of one-half the outside diameter of the pipe. The bedding material shall have a minimum thickness beneath the pipe of five inches and sliced under the haunches of the pipe with a shovel or

other suitable tool to a height of four inches above the bottom of the pipe.

3.1.2.7 Width of Trench

If the maximum width of the trench at the top of the pipe, as specified in SECTION : EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS, is exceeded for any reason other than by direction, the contractor shall install at no additional cost to the Government such concrete cradling, pipe encasement, or other bedding as may be required to satisfactorily support the added load of the backfill

3.1.3 Pipe Support

Pipe shall conform to MSS ANSI/MSS SP-58 and MSS ANSI/MSS SP-69. All pipes shall be supported as shown on the plans. Expansion joints shall be supported at manhole walls and at pipe supports located a maximum of four feet from the manhole exterior.

3.1.4 Leakage Tests

Lines shall be tested for leakage by infiltration tests or exfiltration tests, as appropriate. Prior to infiltration or exfiltration tests, the trench shall be backfilled up to at least the lower half of the pipe. If required, sufficient additional backfill shall be placed to prevent pipe movement during testing, leaving the joints uncovered to permit inspection. Visible leaks encountered shall be corrected regardless of leakage test results. When the water table is 2 feet or more above the top of the pipe at the upper end of the pipeline section to be tested, infiltration shall be measured using a suitable weir or other device acceptable to the Contracting Officer. When the Contracting Officer determines that infiltration cannot be properly tested, an exfiltration test shall be made by filling the line to be tested with water so that a head of at least 2 feet is provided above both the water table and the top of the pipe at the upper end of the pipeline to be tested. The filled line shall be allowed to stand until the pipe has reached its maximum absorption, but not less than 4 hours. After absorption, the head shall be re-established. The amount of water required to maintain this water level during a 2-hour test period shall be measured. Leakage as measured by either the infiltration test or exfiltration test shall not exceed 0.2 gal per inch diameter per 100 feet of pipeline per hour. When leakage exceeds the maximum amount specified, satisfactory correction shall be made and retesting accomplished. Testing, correction, and retesting shall be made at no additional cost to the Government.

3.2 INSTALLATION OF WYE BRANCHES

Wye branches shall be installed where sewer connections are indicated or where directed. Cutting into piping for connections shall not be done except in special approved cases. When the connecting pipe cannot be adequately supported on undisturbed earth or tamped backfill, the pipe shall be encased in concrete backfill or supported on a concrete cradle as directed. Concrete required because of conditions resulting from faulty construction methods or negligence by the Contractor shall be installed at no additional cost to the Government. The installation of wye branches in an existing sewer shall be made by a method which does not damage the integrity of the existing sewer. One acceptable method consists of removing one pipe section, breaking off the upper half of the bell of the next lower section and half of the running bell of wye section. After placing the new section, it shall be rotated so that the broken half of the

bell will be at the bottom. The two joints shall then be made with joint packing and cement mortar.

3.3 MANHOLE DETAILS

3.3.1 General Requirements

Manholes shall be constructed of precast concrete manhole sections. The invert channels shall be smooth and semicircular in shape conforming to the inside of the adjacent sewer section. Changes in direction of flow shall be made with a smooth curve of as large a radius as the size of the manhole will permit. Changes in size and grade of the channels shall be made gradually and evenly. The invert channels shall be formed directly in the concrete of the manhole base, or shall be built up with brick and mortar. Pipe connections shall be made to manhole using special manhole coupling as shown on the plans. The floor of the manhole outside the channels shall be smooth and shall slope toward the channels not less than 1 inch per foot nor more than 2 inches per foot. Free drop inside the manholes shall not exceed 18 inches, measured from the invert of the inlet pipe to the top of the floor of the manhole outside the channels; drop manholes shall be constructed whenever the free drop would otherwise be greater than 1 foot 6 inches. Concrete manhole shall be acid resistant and stainless steel lined as indicated on the drawings.

Primer, membrane and silicate concrete shall be installed as per manufacturer's specifications and instructions.

3.3.2 Jointing, Plastering and Sealing

Mortar joints shall be completely filled and shall be smooth and free from surplus mortar on the inside of the manhole.

3.3.3 Setting of Frames and Covers

Unless otherwise indicated, tops of frames and covers shall be set flush with finished grade in paved areas or 2 inches higher than finished grade in unpaved areas. Frame and cover assemblies shall be sealed to manhole sections using external preformed rubber joint seals that meet the requirements of ASTM D 412 and ASTM D 624, or other methods specified in paragraph Jointing, Plastering and Sealing, unless otherwise specified.

3.3.4 External Preformed Rubber Joint Seals

External preformed rubber joint seals and extruded rolls of rubber with mastic adhesive shall meet the requirements of ASTM D 412 and ASTM C 972 to ensure conformance with paragraph Leakage Tests. The seal shall be multi-section with neoprene rubber top section and all lower sections made of Ethylene Propylene Di Monomer (EPDM) rubber with a minimum thickness of 60 mils. Each unit shall consist of a top and a 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 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. One unit shall seal a casting and up to six, 2 inch adjusting rings. The bottom section shall be 12 inches in height. A 6 inch high top section will cover up to two, 2 inchadjusting rings. A 12 inch high bottom section will cover up to six, 2 inch adjusting rings. Extension sections shall cover up to two more adjusting rings. Each extension shall overlap the bottom section by 2 inches and shall be overlapped by the top section by 2 inches.

3.4 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.

3.5 BUILDING CONNECTIONS

Building connections shall include the lines to and connection with the building waste drainage piping at a point approximately 5 feet outside the building, unless otherwise indicated. Where building drain piping is not installed, the Contractor shall terminate the building connections approximately 5 feet from the site of the building at a point and in a manner designated.

3.6 CLEANOUTS AND OTHER APPURTENANCES

Cleanouts and other appurtenances shall be installed where shown on the drawings or as directed by the Contracting Officer, and shall conform to the detail of the drawings.

-- End of Section --

SECTION 02558

BITUMINOUS TACK COAT
01/89

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 20	(1970; Rev 1986) Penetration Graded Asphalt Cement
AASHTO M 81	(1975; Rev 1986) Cut-Back Asphalt (Rapid-Curing Type)
AASHTO M 226	(1980; Rev 1986) Viscosity Graded Asphalt Cement
AASHTO T 40	(1978; Rev 1986) Sampling Bituminous Materials

AMERICAN SOCIETY OF TESTING AND MATERIALS (ASTM)

ASTM D 140	(1988) Sampling Bituminous Materials
ASTM D 490	(1992) Road Tar
ASTM D 633	(1987; R 1991) Volume Correction Table for Road Tar
ASTM D 946	(1982) Penetration-Graded Asphalt Cement for Use in Pavement Construction
ASTM D 977	(1991) Emulsified Asphalt
ASTM D 1250	(1980; R 1990) Petroleum Measurement Tables
ASTM D 2028	(1976; R 1992) Cutback Asphalt (Rapid-Curing Type)
ASTM D 2397	(1991) Cationic Emulsified Asphalt
ASTM D 2995	(1984; R 1989) Determining Application Rate of Bituminous Distributors
ASTM D 3381	(1983) Viscosity-Graded Asphalt Cement for Use in Pavement Construction

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL DESCRIPTIONS:

SD-09 Reports

Tests; GA.

Copies of all test results, within 24 hours of completion of tests. Certified copies of the manufacturer's test reports indicating compliance with applicable specified requirements, not less than 30 days before the material is required in the work.

1.3 PLANT, EQUIPMENT, MACHINES AND TOOLS

1.3.1 General Requirements

All plant, equipment, machines and tools used in the work shall be subject to approval and shall be maintained in a satisfactory working condition at all times.

1.3.2 Bituminous Distributor

The distributor shall have pneumatic tires of such size and number to prevent rutting, shoving or otherwise damaging the base surface or other layers in the pavement structure. The distributor shall be designed and equipped to spray the bituminous material in a uniform coverage at the specified temperature, at readily determined and controlled rates with an allowable variation from the specified rate of not more than plus or minus 5 percent, and at variable widths. Distributor equipment shall include a separate power unit for the bitumen pump, full-circulation spray bars, tachometer, pressure gauges, volume-measuring devices, adequate heaters for heating of materials to the proper application temperature, a thermometer for reading the temperature of tank contents, and a hand hose attachment suitable for applying bituminous material manually to areas inaccessible to the distributor. The distributor shall be equipped to circulate and agitate the bituminous material during the heating process.

1.3.3 Power Brooms and Power Blowers

Power brooms and power blowers shall be suitable for cleaning the surfaces to which the tack coat is to be applied.

1.4 WEATHER LIMITATIONS

Tack coat shall be applied only when the surface to receive the tack coat is dry. Tack coat shall be applied only when the atmospheric temperature in the shade is 50 degrees F or above and when the temperature has not been below 35 degrees F for the 12 hours prior to application.

PART 2 PRODUCTS

2.1 BITUMINOUS MATERIAL

Emulsified asphalt shall conform to ASTM D 977 Grade RS-1.

PART 3 EXECUTION

3.1 PREPARATION OF SURFACE

Immediately before applying the tack coat all loose material, dirt, clay, or other objectionable material shall be removed from the surface to be treated. The area to be tacked shall also be dry and clean.

3.2 APPLICATION RATE

Bituminous material for the tack coat shall be applied in quantities of not less than 0.05 gallon nor more than 0.15 gallon per square yard of pavement surface. The exact quantities within the range specified, which may be varied to suit field conditions, will be determined by the Contracting Officer.

3.3 APPLICATION TEMPERATURE

Asphalt application temperature shall provide an application viscosity between 10 and 60 seconds, Saybolt Furol, or between 20 and 120 centistokes, kinematic. The temperature viscosity relation shall be furnished to the Contracting Officer.

3.4 APPLICATION

Following preparation and subsequent inspection of the surface, the tack coat shall be applied at the specified rate with uniform distribution over the surface to be treated. All areas and spots missed by the distributor shall be properly treated with the hand spray. Following application of the tack material and prior to application of the succeeding layer of pavement, the tack shall be allowed to cure and to obtain evaporation of any volatiles or moisture. Until the succeeding layer of pavement is placed, the tacked area shall be maintained by protecting the surface against damage and by repairing and retacking deficient areas at no additional cost to the Government. If required, clean dry sand shall be spread to effectively blot up any excess bituminous material. No smoking, fires, or flames other than the heaters that are a part of the equipment shall be permitted within 25 feet of heating, distributing, and transferring operations of bituminous material other than bituminous emulsions.

3.5 FIELD QUALITY CONTROL

Samples of the bituminous material used will be obtained by the Contractor as directed, under the supervision of the Contracting Officer. The sample will be retained and tested by the Government at no cost to the Contractor.

3.6 SAMPLING AND TESTING

3.6.1 General Requirements

Sampling and testing shall be performed by an approved commercial testing laboratory or by facilities furnished by the Contractor. No work requiring testing will be permitted until the facilities have been inspected and approved.

3.6.2 Sampling

The samples of bituminous material, unless otherwise specified, shall be in accordance with ASTM D 140 or AASHTO T 40.

3.6.3 Initial Sampling and Testing

3.6.3.1 Bituminous Materials

Sources from which bituminous materials are to be obtained shall be selected and notification thereof furnished the Contracting Officer within 15 days after the award of the contract.

3.6.3.2 Calibration Test

The Contractor shall furnish all equipment, materials, and labor necessary to calibrate the bituminous distributor. Calibration shall be made with the approved job material and prior to applying the tack coat material to the prepared surface. Calibration of the bituminous distributor shall be in accordance with ASTM D 2995.

3.6.3.3 Trial Applications

As a preliminary to providing the complete tack coat, three lengths of at least 100 feet for the full width of the distributor bar shall be tacked to evaluate the amount of tack that can be satisfactorily applied. Unless otherwise authorized, the trial application rate of bituminous materials shall be applied in the amount of 0.05 gallons per square yard. Other trial applications shall be made using various amounts of material as may be deemed necessary.

3.6.4 Sampling and Testing During Construction

Quality control sampling and testing shall be performed as required in paragraph FIELD QUALITY CONTROL.

-- End of Section --

SECTION 02559

BITUMINOUS PRIME COAT
01/89

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 81	(1975; Rev 1986) Cut-Back Asphalt (Rapid-Curing Type)
AASHTO M 82	(1975; Rev 1986) Cut-Back Asphalt (Medium-Curing Type)
AASHTO T 40	(1978; Rev 1986) Sampling Bituminous Materials

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 140	(1988) Sampling Bituminous Materials
ASTM D 490	(1992) Road Tar
ASTM D 633	(1987; R 1991) Volume Correction Table for Road Tar
ASTM D 977	(1991) Emulsified Asphalt
ASTM D 1250	(1980; R 1990) Petroleum Measurement Tables
ASTM D 2026	(1972; R 1985) Cutback Asphalt (Slow-Curing Type)
ASTM D 2027	(1976; R 1992) Cutback Asphalt (Medium-Curing Type)
ASTM D 2028	(1976; R 1992) Cutback Asphalt (Rapid-Curing Type)
ASTM D 2397	(1991) Cationic Emulsified Asphalt
ASTM D 2995	(1984; R 1989) Determining Application Rate of Bituminous Distributors

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL

DESCRIPTIONS:

SD-09 Reports

Field Quality Control; GA. Sampling and Testing; GA.

Copies of test results, within 24 hours of completion of tests. Sampling and testing shall be performed by an approved commercial testing laboratory or by facilities furnished by the Contractor.

1.3 PLANT, EQUIPMENT, MACHINES AND TOOLS

1.3.1 General Requirements

All plant, equipment, machines and tools used in the work shall be subject to approval and shall be maintained in a satisfactory working condition at all times. The equipment shall be adequate and shall have the capability of producing the results specified.

1.3.2 Bituminous Distributor

The distributor shall have pneumatic tires of such size and number to prevent rutting, shoving, or otherwise damaging the base surface or other layers in the pavement structure. It shall be designed and equipped to spray the bituminous material in a uniform double or triple lap at the specified temperature, at readily determined and controlled rates with an allowable variation from the specified rate of not more than plus or minus 5 percent, and at variable widths. Distributor equipment shall include a separate power unit for the bitumen pump, full-circulation spray bars, tachometer, pressure gauges, volume-measuring devices, adequate heaters for heating of materials to the proper application temperature, a thermometer for reading the temperature of tank contents, and a hand hose attachment suitable for applying bituminous material manually to areas inaccessible to the distributor. The distributor shall be equipped to circulate and agitate the bituminous material during the heating process.

1.3.3 Power Brooms and Power Blowers

Power brooms and power blowers shall be suitable for cleaning the surfaces to which the prime coat is to be applied.

1.3.4 Storage Tanks

Tanks shall be capable of heating the bituminous material, under effective and positive control at all times, to the required temperature. Heating shall be accomplished by steam coils, hot oil, or electricity. An armored thermometer shall be affixed to the tank so that the temperature of the bituminous material may be read at all times.

1.4 WEATHER LIMITATIONS

The prime coat shall be applied only when the subgrade, subbase, or base course is dry enough to promote uniform coverage and the desired penetration into the treated surface. The prime coat shall be applied only when the atmospheric temperature in the shade is 50 degrees F or above and when the temperature has not been below 35 degrees F for the 12 hours prior to the application.

PART 2 PRODUCTS

2.1 BITUMINOUS MATERIAL

Emulsified asphalt shall conform to ASTM D 977, Grade SS-1.

PART 3 EXECUTION

3.1 PREPARATION OF SURFACE

Immediately before applying the prime coat, all loose material, dirt, clay, or other objectionable material shall be removed from the surface to be treated. To assure a uniform spread of the bituminous material, the portion of the subgrade, subbase, or base course prepared for treatment, if excessively dry, shall be lightly sprinkled with water immediately before the application, as directed.

3.2 PRIME COATING

3.2.1 Application Rate

Bituminous material for the prime coat shall be applied in quantities of not less than 0.15 gallon nor more than 0.40 gallon per square yard of pavement surface. The exact quantities within the range specified, which may be varied to suit field conditions, will be determined by the Contracting Officer.

3.2.2 Application Temperature

Emulsified asphalt application temperature shall provide an application viscosity between 10 and 60 seconds, Saybolt Furol, or between 20 and 120 centistokes, kinematic. The temperature viscosity relation shall be furnished to the Contracting Officer.

3.2.3 Application

Following preparation and subsequent inspection of the surface, the prime coat shall be applied at the specified rate with uniform distribution over the surface to be treated. To obtain uniform application of the prime coat on the surface treated at the junction of previous and subsequent applications, building paper shall be spread on the surface for a sufficient distance back from the ends of each application so that the prime coat may be started and stopped on the paper. Immediately after application, the building paper shall be removed and destroyed. All areas and spots missed by the distributor shall be properly treated with the hand spray. Following application of the prime material, the surface shall be allowed to cure without being disturbed for a period of at least 48 hours or longer, as may be necessary to attain penetration into the treated course and evaporation of the volatiles from prime material. As directed, sand shall be spread to effectively blot up and cure any excess bituminous material. Until the succeeding layer of pavement is placed, the primed surface shall be maintained by protecting the surface against damage and by repairing and repriming deficient areas at no additional cost to the Government. No smoking, fire, or flames other than the heaters that are a part of the equipment shall be permitted within 25 feet heating, distributing, or transferring operation for bituminous materials other than emulsions.

3.3 FIELD QUALITY CONTROL

Samples of the bituminous material used will be obtained by the Contractor as directed, under the supervision of the Contracting Officer. The sample will be retained and tested by the Government at no cost to the Contractor.

3.4 SAMPLING AND TESTING

3.4.1 General Requirements

No work requiring testing will be permitted until the facilities have been inspected and approved. The first test will be at the expense of the Government. Costs incurred for subsequent inspections will be charged to the Contractor.

3.4.2 Sampling

The samples of bituminous material, unless otherwise specified, shall be taken in accordance with ASTM D 140 or AASHTO T 40.

3.4.3 Initial Sampling and Testing

3.4.3.1 Bituminous Materials

Sources from which bituminous materials are to be obtained shall be selected and notification thereof furnished the Contracting Officer within 15 days after the award of the contract. Certified copies of the manufacturer's test reports indicating compliance with applicable specified requirements shall be submitted to the Contracting Officer not less than 30 days before the material is required in the work.

3.4.3.2 Calibration Test

The Contractor shall furnish all equipment, materials, and labor necessary to calibrate the bituminous distributor. Calibration shall be made with the approved job material and prior to applying the prime coat material to the prepared surface. Calibration of the bituminous distributor shall be in accordance with ASTM D 2995.

3.4.3.3 Trial Applications

As a preliminary to providing the complete prime coat, three lengths of at least 100 feet for the full width of the distributor bar shall be primed to evaluate the amount of prime that can be satisfactorily applied. Unless otherwise authorized, the trial application rate of bituminous materials shall be applied in the amount of 0.25 gallon per square yard. Other trial applications shall be made using various amounts of material as may be deemed necessary.

3.4.4 Sampling and Testing During Construction

Quality control sampling and testing shall be performed as required in paragraph FIELD QUALITY CONTROL.

-- End of Section --

SECTION 02580

PAVEMENT MARKINGS
02/91

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.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 792	(1991) Density and Specific Gravity (Relative Density) of Plastics by Displacement
ASTM D 4280	(1992a) Extended Life Type, Nonplowable, Prismatic, Raised, Retroreflective Pavement Markers
ASTM D 4505	(1992) Preformed Plastic Pavement Marking Tape for Extended Service Life
ASTM E 28	(1992) Softening Point by Ring-and-Ball Apparatus

FEDERAL SPECIFICATIONS (FS)

FS TT-B-1325	(Rev B) Beads (Glass Spheres) Retro-Reflective
FS TT-P-85	(Rev E) Paint, Traffic and Airfield Marking, Solvent Base
FS TT-P-115	(Rev F) Paint, Traffic (Highway, White, and Yellow)
FS TT-P-1952	(Rev B) Paint, Traffic and Airfield Marking, Water Emulsion Base

FEDERAL STANDARDS (FED-STD)

FED-STD 595	(Rev B) Colors Used in Government Procurement

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL DESCRIPTIONS:

SD-01 Data

Equipment Lists; FIO.

Lists of proposed equipment to be used in performance of construction work, including descriptive data, and notifications of proposed Contractor actions as specified in this section.

SD-09 Reports

Material Tests; FIO.

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.

1.3 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.

1.4 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 will display low speed traffic markings and traffic warning lights.

1.4.1 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. Equipment used for marking streets and highways shall be capable of placing the prescribed number of lines at a single pass as solid lines, intermittent lines or a combination of solid and intermittent lines using a maximum of two different colors of paint as specified. 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 insure 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.

1.4.2 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.

1.5 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 shall 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.

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. Paint for roads and streets shall conform to FS TT-P-115 color as selected.

2.2 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.

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.

3.2 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 herein. 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.

-- End of Section --

SECTION 02630A

STORM-DRAINAGE SYSTEM
03/00

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 in the text by basic designation only.

ACI INTERNATIONAL (ACI)

ACI 346/346R	(1990) Standard Specification for Cast-in-Place Nonreinforced Concrete Pipe and Recommendations

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO HB-16	(1996) Standard Specifications for Highway Bridges
AASHTO M 167	(1994) Corrugated Steel Structural Plate, Zinc Coated, for Field Bolted Pipe
AASHTO M 190	(1995) Bituminous Coated Corrugated Metal Culvert Pipe and Pipe Arches
AASHTO M 198	(1998) Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets
AASHTO M 219	(1992; R 1995) Aluminum Alloy Structural Plate for Field Bolted Conduits
AASHTO M 243	(1996) Field Applied Coating of Corrugated Metal Structural Plate for Pipe, Pipe-Arches, and Arches
AASHTO M 294	(1998) Corrugated Polyethylene Pipe, 300- to 1200- mm Diameter
AASHTO MP 7	(1997) Corrugated Polyethylene Pipe, 1350 and 1500 mm Diameter

AMERICAN RAILWAY ENGINEERING & MAINTENANCE-OF-WAY ASSOCIATION (AREMA)

AREMA Manual	(1999) Manual for Railway Engineering (4 Vol.)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 48	(1994a) Gray Iron Castings
ASTM A 48M	(1994 el) Gray Iron Castings (Metric)
ASTM A 123/A 123M	(1997ael) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 536	(1999el) Ductile Iron Castings
ASTM A 716	(1995) Ductile Iron Culvert Pipe
ASTM A 742/A 742M	(1998) Steel Sheet, Metallic Coated and Polymer Precoated for Corrugated Steel Pipe
ASTM A 760/A 760M	(1997) Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains
ASTM A 762/A 762M	(1998) Corrugated Steel Pipe, Polymer Precoated for Sewers and Drains
ASTM A 798/A 798M	(1997a) Installing Factory-Made Corrugated Steel Pipe for Sewers and Other Applications
ASTM A 807	(1997) Installing Corrugated Steel Structural Plate Pipe for Sewers and Other Applications
ASTM A 849	(1997) Post-Applied Coatings, Pavings, and Linings for Corrugated Steel Sewer and Drainage Pipe
ASTM A 929/A 929M	(1997) Steel Sheet, Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe
ASTM B 26/B 26M	(1998) Aluminum-Alloy Sand Castings
ASTM B 745/B 745M	(1997) Corrugated Aluminum Pipe for Sewers and Drains
ASTM C 12	(1998el) Installing Vitrified Clay Pipe Lines
ASTM C 14	(1999) Concrete Sewer, Storm Drain, and Culvert Pipe
ASTM C 14M	(1999) Concrete Sewer, Storm Drain, and Culvert Pipe (Metric)
ASTM C 32	(1999el) Sewer and Manhole Brick (Made from Clay or Shale)
ASTM C 55	(1999) Concrete Brick
ASTM C 62	(1997a) Building Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C 76	(1999) Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe

ASTM C 76M	(1999a) Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe (Metric)
ASTM C 139	(1999) Concrete Masonry Units for Construction of Catch Basins and Manholes
ASTM C 231	(1997el) Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 270	(1997) Mortar for Unit Masonry
ASTM C 425	(1998b) Compression Joints for Vitrified Clay Pipe and Fittings
ASTM C 443	(1998) Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
ASTM C 443M	(1998) Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets (Metric)
ASTM C 478	(1997) Precast Reinforced Concrete Manhole Sections
ASTM C 478M	(1997) Precast Reinforced Concrete Manhole Sections (Metric)
ASTM C 506	(1999) Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe
ASTM C 506M	(1999) Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe (Metric)
ASTM C 507	(1999) Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe
ASTM C 507M	(1999) Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe (Metric)
ASTM C 655	(1995a) Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe
ASTM C 700	(1999) Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated
ASTM C 789	(1998) Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers
ASTM C 828	(1998) Low-Pressure Air Test of Vitrified Clay Pipe Lines
ASTM C 850	(1998) Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers with Less Than 2 Ft. of Cover Subjected to Highway Loadings

ASTM C 877	(1994) External Sealing Bands for Noncircular Concrete Sewer, Storm Drain, and Culvert Pipe
ASTM C 877M	(1994) External Sealing Bands for Noncircular Concrete Sewer, Storm Drain, and Culvert Pipe (Metric)
ASTM C 923	(1998) Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Materials
ASTM C 924	(1998) Concrete Pipe Sewer Lines by Low-Pressure Air Test Method
ASTM C 924M	(1998) Concrete Pipe Sewer Lines by Low-Pressure Air Test Method (Metric)
ASTM C 1103	(1994) Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
ASTM C 1103M	(1994) Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines (Metric)
ASTM D 1056	(1998) Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D 1171	(1994) Rubber Deterioration - Surface Ozone Cracking Outdoors or Chamber (Triangular Specimens)
ASTM D 1557	(1998) 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 1996el) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D 1784	(1999a) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 2167	(1994) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2321	(1989; R 1995) Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D 2922	(1996el) Density of Soil and Soil-Aggregate in Place by Nuclear Methods

	(Shallow Depth)
ASTM D 3017	(1988; R 1996el) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 3034	(1998) 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 3350	(1998a) Polyethylene Plastics Pipe and Fittings Materials
ASTM F 477	(1999) Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F 679	(1995) Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
ASTM F 714	(1997) Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
ASTM F 794	(1999) Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter
ASTM F 894	(1998a) Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe
ASTM F 949	(1999) Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings
ASTM F 1417	(1992; R 1998) Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air

1.2 MEASUREMENT AND PAYMENT

1.2.1 Pipe Culverts and Storm Drains

The length of pipe installed will be measured along the centerlines of the pipe from end to end of pipe without deductions for diameter of manholes. Pipe will be paid for at the contract unit price for the number of linear feet of culverts or storm drains placed in the accepted work.

1.2.2 Manholes and Inlets

The quantity of manholes and inlets will be measured as the total number of manholes and inlets of the various types of construction, complete with frames and gratings or covers and, where indicated, with fixed side-rail ladders, constructed to the depth of as shown feet, in the accepted work. The depth of manholes and inlets will be measured from the top of grating or cover to invert of outlet pipe. Manholes and inlets constructed to depths greater than the depth specified above will be paid for as units at the contract unit price for manholes and inlets, plus an additional amount

per linear foot for the measured depth beyond a depth of as shown feet.

1.2.3 Walls and Headwalls

Walls and headwalls will be measured by the number of cubic yards of reinforced concrete, plain concrete, or masonry used in the construction of the walls and headwalls. Wall and headwalls will be paid for at the contract unit price for the number of walls and headwalls constructed in the completed work.

1.2.4 Flared End Sections

Flared end sections will be measured by the unit. Flared end sections will be paid for at the contract unit price for the various sizes in the accepted work.

1.2.5 Sheeting and Bracing

Payment will be made for that sheeting and bracing ordered to be left in place, based on the number of square feet of sheeting and bracing remaining below the surface of the ground.

1.2.6 Rock Excavation

Payment will be made for the number of cubic yards of material acceptably excavated, as specified and defined as rock excavation in Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS measured in the original position, and computed by allowing actual width of rock excavation with the following limitations: maximum rock excavation width, 30 inches for pipe of 12 inch or less nominal diameter; maximum rock excavation width, 16 inches greater than outside diameter of pipe of more than 12 inch nominal diameter. Measurement will include authorized overdepth excavation. Payment will also include all necessary drilling and blasting, and all incidentals necessary for satisfactory excavation and disposal of authorized rock excavation. No separate payment will be made for backfill material required to replace rock excavation; this cost shall be included in the Contractor's unit price bid per cubic yard for rock excavation. In rock excavation for manholes and other appurtenances, 1 foot will be allowed outside the wall lines of the structures.

1.2.7 Backfill Replacing Unstable Material

Payment will be made for the number of cubic yards of select granular material required to replace unstable material for foundations under pipes or drainage structures, which will constitute full compensation for this backfill material, including removal and disposal of unstable material and all excavating, hauling, placing, compacting, and all incidentals necessary to complete the construction of the foundation satisfactorily.

1.2.8 Pipe Placed by Jacking

Payment will be made for the number of linear feet of jacked pipe accepted in the completed work measured along the centerline of the pipe in place.

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

Placing Pipe; G, SWAO

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; G, SWAO

Samples of the following materials, before work is started: .

SD-07 Certificates

Resin Certification; ,
Pipeline Testing; , G
Hydrostatic Test on Watertight Joints; G, SWAO
Determination of Density; ,
Frame and Cover for Gratings; G, SWAO

Certified copies of test reports demonstrating conformance to applicable pipe specifications, before pipe is installed. Certification on the ability of frame and cover or gratings to carry the imposed live load.

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 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.

1.4.2 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, or ASTM C 655, D-Load.

2.1.1.1 Reinforced Arch Culvert and Storm Drainpipe

ASTM C 506, Class A-III.

2.1.1.2 Reinforced Elliptical Culvert and Storm Drainpipe

ASTM C 507. Horizontal elliptical pipe shall be Class HE-II. Vertical elliptical pipe shall be Class VE-IV.

2.1.1.3 Nonreinforced Pipe

ASTM C 14, Class 2.

2.1.1.4 Cast-In-Place Nonreinforced Conduit

ACI 346/346R, except that testing shall be the responsibility of and at the expense of the Contractor. In the case of other conflicts between ACI 346/346R and project specifications, requirements of ACI 346/346R shall govern.

2.1.2 Clay Pipe

Standard or extra strength, as indicated, conforming to ASTM C 700.

2.1.3 Corrugated Steel Pipe

ASTM A 760/A 760M, zinc or aluminum (Type 2) coated pipe of either:

a. Type II pipe with helical 2-2/3 by 1/2 inch corrugations.

b. Type IR pipe with helical 3/4 by 3/4 by 7-1/2 inch corrugations.

2.1.3.1 Fully Bituminous Coated

AASHTO M 190 Type A and ASTM A 760/A 760M zinc or aluminum (Type 2) coated pipe of either:

a. Type I pipe with helical 2-2/3 by 1/2 inch corrugations.

b. Type IR pipe with helical 3/4 by 3/4 by 7-1/2 inch corrugations.

2.1.3.2 Half Bituminous Coated, Part Paved

AASHTO M 190 Type B and ASTM A 760/A 760M zinc or aluminum (Type 2) coated Type I pipe with helical 2-2/3 by 1/2 inch corrugations.

2.1.3.3 Fully Bituminous Coated, Part Paved

AASHTO M 190 Type C and ASTM A 760/A 760M zinc or aluminum (Type 2) coated Type II pipe with helical 2-2/3 by 1/2 inch corrugations.

2.1.3.4 Fully Bituminous Coated, Fully Paved

AASHTO M 190 Type D and ASTM A 760/A 760M zinc or aluminum (Type 2) coated Type II pipe with helical 2-2/3 by 1/2 inch corrugations.

2.1.3.5 Concrete-Lined

ASTM A 760/A 760M zinc coated Type I corrugated steel pipe with 2-2/3 by 1/2 inch corrugations and a concrete lining in accordance with ASTM A 849.

2.1.3.6 Polymer Precoated

ASTM A 762/A 762M corrugated steel pipe fabricated from ASTM A 742/A 742M Grade 10/10 polymer precoated sheet of either:

a. Type II pipe with helical 2-2/3 by 1/2 inch corrugations.

b. Type IIR pipe with helical 3/4 by 3/4 by 7-1/2 inch corrugations.

2.1.3.7 Polymer Precoated, Part Paved

ASTM A 762/A 762M Type II corrugated steel pipe and AASHTO M 190 Type B (modified), paved invert only, fabricated from ASTM A 742/A 742M Grade 10/10 polymer precoated sheet with helical 2-2/3 by 1/2 inch corrugations.

2.1.3.8 Polymer Precoated, Fully Paved

ASTM A 762/A 762M Type II corrugated steel pipe and AASHTO M 190 Type D (modified), fully paved only, fabricated from ASTM A 742/A 742M Grade 10/10 polymer precoated sheet with helical 2-2/3 by 1/2 inch corrugations.

2.1.4 Corrugated Aluminum Alloy Pipe

ASTM B 745/B 745M corrugated aluminum alloy pipe of either:

a. Type II pipe with helical corrugations.

b. Type IR pipe with helical corrugations.

2.1.4.1 Aluminum Fully Bituminous Coated

AASHTO M 190 Type A and ASTM B 745/B 745M corrugated aluminum alloy pipe of either:

a. Type II pipe with helical corrugations.

b. Type IR pipe with helical corrugations.

2.1.4.2 Aluminum Fully Bituminous Coated, Part Paved

AASHTO M 190 Type C and ASTM B 745/B 745M corrugated aluminum alloy pipe of either:

a. Type II pipe with helical corrugations.

b. Type IIR pipe with helical corrugations.

2.1.5 Structural Plate, Steel Pipe, Pipe Arches and Arches

Assembled with galvanized steel nuts and bolts, from galvanized corrugated steel plates conforming to AASHTO M 167. Pipe coating, when required, shall conform to the requirements of AASHTO M 243. Thickness of plates shall be as indicated.

2.1.6 Structural Plate, Aluminum Pipe, Pipe Arches and Arches

Assembled with either aluminum alloy, aluminum coated steel, stainless steel or zinc coated steel nuts and bolts. Nuts and bolts, and aluminum alloy plates shall conform to AASHTO M 219. Pipe coating, when required, shall conform to the requirements of . Thickness of plates shall be as indicated.

2.1.7 Ductile Iron Culvert Pipe

ASTM A 716.

2.1.8 PVC Pipe

The pipe manufacturer's resin certification, indicating the cell classification of PVC used to manufacture the pipe, shall be submitted prior to installation of the pipe.

2.1.8.1 Type PSM PVC Pipe

ASTM D 3034, Type PSM, maximum SDR 35, produced from PVC certified by the compounder as meeting the requirements of ASTM D 1784, minimum cell class 12454-B.

2.1.8.2 Profile PVC Pipe

ASTM F 794, Series 46, produced from PVC certified by the compounder as meeting the requirements of ASTM D 1784, minimum cell class 12454-B.

2.1.8.3 Smooth Wall PVC Pipe

ASTM F 679 produced from PVC certified by the compounder as meeting the requirements of ASTM D 1784, minimum cell class 12454-B.

2.1.8.4 Corrugated PVC Pipe

ASTM F 949 produced from PVC certified by the compounder as meeting the requirements of ASTM D 1784, minimum cell class 12454-B.

2.1.9 PE Pipe

The pipe manufacturer's resin certification indicating the cell classification of PE used to manufacture the pipe shall be submitted prior to installation of the pipe. The minimum cell classification for polyethylene plastic shall apply to each of the seven primary properties of the cell classification limits in accordance with ASTM D 3350.

2.1.9.1 Smooth Wall PE Pipe

ASTM F 714, maximum DR of 21 for pipes 3 to 24 inches in diameter and maximum DR of 26 for pipes 26 to 48 inches in diameter. Pipe shall be produced from PE certified by the resin producer as meeting the requirements of ASTM D 3350, minimum cell class 335434C.

2.1.9.2 Corrugated PE Pipe

AASHTO M 294, Type S or D, for pipes 12 to 48 inches and AASHTO MP 7, Type S or D, for pipes 54 to 60 inches produced from PE certified by the resin producer as meeting the requirements of ASTM D 3350, minimum cell class in accordance with AASHTO M 294. Pipe walls shall have the following properties:

Nominal Size (in.)	Minimum Wall Area (square in/ft)	Minimum Moment of Inertia of Wall Section (in to the 4th/in)
12	1.50	0.024
15	1.91	0.053
18	2.34	0.062
24	3.14	0.116
30	3.92	0.163
36	4.50	0.222
42	4.69	0.543
48	5.15	0.543
54	5.67	0.800
60	6.45	0.800

2.1.9.3 Profile Wall PE Pipe

ASTM F 894, RSC 160, produced from PE certified by the resin producer as meeting the requirements of ASTM D 3350, minimum cell class 334433C. Pipe walls shall have the following properties:

		Minimum Moment Of Inertia of Wall Section (in to the 4th/in)	
Nominal Size (in.)	Minimum Wall Area (square in/ft)	Cell Class 334433C	Cell Class 335434C
18	2.96	0.052	0.038
21	4.15	0.070	0.051
24	4.66	0.081	0.059
27	5.91	0.125	0.091
30	5.91	0.125	0.091
33	6.99	0.161	0.132
36	8.08	0.202	0.165
42	7.81	0.277	0.227
48	8.82	0.338	0.277

2.2 DRAINAGE STRUCTURES

2.2.1 Flared End Sections

Sections shall be of a standard design fabricated from zinc coated steel sheets meeting requirements of ASTM A 929/A 929M.

2.2.2 Precast Reinforced Concrete Box

For highway loadings with 2 feet of cover or more or subjected to dead load only, ASTM C 789; for less than 2 feet of cover subjected to highway loading, ASTM C 850.

2.3 MISCELLANEOUS MATERIALS

2.3.1 Concrete

Unless otherwise specified, concrete and reinforced concrete shall conform to the requirements for RFAAP 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.

2.3.2 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 THE MANUFACTURER'S 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.

2.3.3 Precast Concrete Segmental Blocks

Precast concrete segmental block shall conform to ASTM C 139, not more than 8 inches thick, not less than 8 inches long, and of such shape that joints can be sealed effectively and bonded with cement mortar.

2.3.4 Brick

Brick shall conform to ASTM C 62, Grade SW; ASTM C 55, Grade S-I or S-II; or ASTM C 32, Grade MS. Mortar for jointing and plastering shall consist of one part portland cement and two parts fine sand. Lime may be added to the mortar in a quantity not more than 25 percent of the volume of cement. The joints shall be filled completely and shall be smooth and free from surplus mortar on the inside of the structure. Brick structures shall be plastered with 1/2 inch of mortar over the entire outside surface of the walls. For square or rectangular structures, brick shall be laid in stretcher courses with a header course every sixth course. For round structures, brick shall be laid radially with every sixth course a stretcher course.

2.3.5 Precast Reinforced Concrete Manholes

Precast reinforced concrete manholes shall conform to ASTM C 478. Joints between precast concrete risers and tops shall be .

2.3.6 Prefabricated Corrugated Metal Manholes

Manholes shall be of the type and design recommended by the manufacturer. Manholes shall be complete with frames and cover, or frames and gratings.

2.3.7 Frame and Cover for Gratings

Frame and cover for gratings shall be cast gray iron, ASTM A 48, 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.

2.3.8 Joints

2.3.8.1 Flexible Watertight Joints

a. Materials: Flexible watertight joints shall be made with plastic or rubber-type gaskets for concrete pipe and with factory-fabricated resilient materials for clay pipe. The design of joints and the physical requirements for plastic gaskets shall conform to AASHTO M 198, and rubber-type gaskets shall conform to ASTM C 443. Factory-fabricated resilient joint materials shall conform to ASTM C 425. Gaskets shall have not more than one factory-fabricated splice, except that two factory-fabricated splices of the rubber-type gasket are permitted if the nominal diameter of the pipe being gasketed exceeds 54 inches.

b. Test Requirements: Watertight joints shall be tested and shall meet test requirements of paragraph HYDROSTATIC TEST ON WATERTIGHT JOINTS. Rubber gaskets shall comply with the oil resistant gasket requirements of ASTM C 443. Certified copies of test results shall be delivered to the Contracting Officer before gaskets or jointing materials are installed. Alternate types of watertight joint may be furnished, if specifically approved.

2.3.8.2 External Sealing Bands

Requirements for external sealing bands shall conform to ASTM C 877.

2.3.8.3 Flexible Watertight, Gasketed Joints

a. Gaskets: When infiltration or exfiltration is a concern for pipe lines, the couplings may be required to have gaskets. The closed-cell expanded rubber gaskets shall be a continuous band approximately 7 inches wide and approximately 3/8 inch thick, meeting the requirements of ASTM D 1056, Type 2 A1, and shall have a quality retention rating of not less than 70 percent when tested for weather resistance by ozone chamber exposure, Method B of ASTM D 1171. Rubber O-ring gaskets shall be 13/16 inch in diameter for pipe diameters of 36 inches or smaller and 7/8 inch in diameter for larger pipe having 1/2 inch deep end corrugation. Rubber O-ring gaskets shall be 1-3/8 inches in diameter for pipe having 1 inch deep end corrugations. O-rings shall meet the requirements of AASHTO M 198 or ASTM C 443. Flexible plastic gaskets shall conform to requirements of AASHTO M 198, Type B.

b. Connecting Bands: Connecting bands shall be of the type, size and sheet thickness of band, and the size of angles, bolts, rods and lugs as indicated or where not indicated as specified in the applicable standards or specifications for the pipe. Exterior rivet heads in the longitudinal seam under the connecting band shall be countersunk or the rivets shall be omitted and the seam welded. Watertight joints shall be tested and shall meet the test requirements of paragraph HYDROSTATIC TEST ON WATERTIGHT JOINTS.

2.3.8.4 PVC Plastic Pipes

Joints shall be solvent cement or elastomeric gasket type in accordance with the specification for the pipe and as recommended by the pipe manufacturer.

2.3.8.5 Smooth Wall PE Plastic Pipe

Pipe shall be joined using butt fusion method as recommended by the pipe manufacturer.

2.3.8.6 Corrugated PE Plastic Pipe

Water tight joints shall be made using a PVC or PE coupling and rubber gaskets as recommended by the pipe manufacturer. Rubber gaskets shall conform to ASTM F 477. Soil tight joints shall conform to the requirements in AASHTO HB-16, Division II, Section 26.4.2.4. (e) for soil tightness and shall be as recommended by the pipe manufacturer.

2.3.8.7 Profile Wall PE Plastic Pipe

Joints shall be gasketed or thermal weld type with integral bell in accordance with ASTM F 894.

2.3.8.8 Ductile Iron Pipe

Couplings and fittings shall be as recommended by the pipe manufacturer.

2.4 STEEL LADDER

Steel ladder shall be provided where the depth of the manhole exceeds 12 feet. These ladders shall be not less than 16 inches in width, with 3/4 inch diameter rungs spaced 12 inches apart. The two stringers shall be a minimum 3/8 inch thick and 2-1/2 inches wide. Ladders and inserts shall be galvanized after fabrication in conformance with ASTM A 123/A 123M.

2.5 DOWNSPOUT BOOTS

Boots used to connect exterior downspouts to the storm-drainage system shall be of gray cast iron conforming to ASTM A 48, Class 30B or 35B. Shape and size shall be as indicated.

2.6 RESILIENT CONNECTORS

Flexible, watertight connectors used for connecting pipe to manholes and inlets shall conform to ASTM C 923.

2.7 HYDROSTATIC TEST ON WATERTIGHT JOINTS

2.7.1 Concrete, Clay, PVC and PE 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. Test requirements for joints in clay pipe shall conform to ASTM C 425. Test requirements for joints in PVC and PE plastic pipe shall conform to ASTM D 3212.

2.7.2 Corrugated Steel and Aluminum Pipe

A hydrostatic test shall be made on the watertight joint system or coupling band type proposed. The moment strength required of the joint is expressed as 15 percent of the calculated moment capacity of the pipe on a transverse section remote from the joint by the AASHTO HB-16 (Division II, Section 26). The pipe shall be supported for the hydrostatic test with the joint located at the point which develops 15 percent of the moment capacity of the pipe based on the allowable span in feet for the pipe flowing full or 40,000 foot-pounds, whichever is less. Performance requirements shall be met at an internal hydrostatic pressure of 10 psi for a 10 minute period for both annular corrugated metal pipe and helical corrugated metal pipe with factory reformed ends.

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 02316 "Excavation, Trenching, and Backfilling for Utilities Systems"d and the requirements specified below.

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 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 Rock

Rock in either ledge or boulder formation shall be replaced with suitable materials to provide a compacted earth cushion having a thickness between unremoved rock and the pipe of at least 8 inches or 1/2 inch for each foot of fill over the top of the pipe, whichever is greater, but not more than three-fourths the nominal diameter of the pipe. Where bell-and-spigot pipe is used, the cushion shall be maintained under the bell as well as under the straight portion of the pipe. Rock excavation shall be as specified and defined in Section 02316 "Excavation, Trenching, and Backfilling for Utilities Systems".

3.1.3 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 in his performance of 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.

3.2.2 Clay Pipe Requirements

Bedding for clay pipe shall be as specified by ASTM C 12.

3.2.3 Corrugated Metal Pipe

Bedding for corrugated metal pipe and pipe arch shall be in accordance with ASTM A 798/A 798M. It is not required to shape the bedding to the pipe geometry. However, for pipe arches, the Contractor shall either shape the bedding to the relatively flat bottom arc or fine grade the foundation to a shallow v-shape. Bedding for corrugated structural plate pipe shall meet requirements of ASTM A 807.

3.2.4 Ductile Iron Pipe

Bedding for ductile iron pipe shall be as shown on the drawings.

3.2.5 Plastic Pipe

Bedding for PVC and PE pipe shall meet the requirements of ASTM D 2321. Bedding, haunching, and initial backfill shall be either Class IB or II material.

3.3 PLACING PIPE

Each pipe shall be thoroughly examined before being laid; defective or damaged pipe shall not be used. Plastic pipe shall be protected from exposure to direct sunlight prior to laying, if necessary to maintain adequate pipe stiffness and meet installation deflection requirements. 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. Deflection of installed flexible pipe shall not exceed the following limits:

TYPE OF PIPE	MAXIMUM ALLOWABLE DEFLECTION (%)
Corrugated Steel and Aluminum Alloy	5
Concrete-Lined Corrugated Steel	3
Ductile Iron Culvert	3
Plastic	7.5

Not less than 30 days after the completion of backfilling, the Government may perform a deflection test on the entire length of installed flexible pipe using a mandrel or other suitable device. Installed flexible pipe showing deflections greater than those indicated above shall be retested by a run from the opposite direction. If the retest also fails, the suspect pipe shall be replaced at no cost to the Government.

3.3.1 Concrete, Clay, PVC, Ribbed PVC and Ductile Iron 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.

3.3.2 Elliptical and Elliptical Reinforced Concrete Pipe

The manufacturer's reference lines, designating the top of the pipe, shall be within 5 degrees of a vertical plane through the longitudinal axis of the pipe, during placement. Damage to or misalignment of the pipe shall be prevented in all backfilling operations.

3.3.3 Corrugated PE Pipe

Laying shall be with the separate sections joined firmly on a bed shaped to line and grade and shall follow manufacturer's recommendations.

3.3.4 Corrugated Metal Pipe and Pipe Arch

Laying shall be with the separate sections joined firmly together, with the outside laps of circumferential joints pointing upstream, and with longitudinal laps on the sides. Part paved pipe shall be installed so that the centerline of bituminous pavement in the pipe, indicated by suitable markings on the top at each end of the pipe sections, coincides with the specified alignment of pipe. Fully paved steel pipe or pipe arch shall have a painted or otherwise applied label inside the pipe or pipe arch indicating sheet thickness of pipe or pipe arch. Any unprotected metal in the joints shall be coated with bituminous material as specified in AASHTO M 190 or AASHTO M 243. Interior coating shall be protected against damage from insertion or removal of struts or tie wires. Lifting lugs shall be used to facilitate moving pipe without damage to exterior or interior coatings. During transportation and installation, pipe or pipe arch and

coupling bands shall be handled with care to preclude damage to the coating, paving or lining. Damaged coatings, pavings and linings shall be repaired in accordance with the manufacturer's recommendations prior to placing backfill. Pipe on which coating, paving or lining has been damaged to such an extent that satisfactory field repairs cannot be made shall be removed and replaced. Vertical elongation, where indicated, shall be accomplished by factory elongation. Suitable markings or properly placed lifting lugs shall be provided to ensure placement of factory elongated pipe in a vertical plane.

3.3.5 Structural-Plate Steel

Structural plate shall be installed in accordance with ASTM A 807. Structural plate shall be assembled in accordance with instructions furnished by the manufacturer. Instructions shall show the position of each plate and the order of assembly. Bolts shall be tightened progressively and uniformly, starting at one end of the structure after all plates are in place. The operation shall be repeated to ensure that all bolts are tightened to meet the torque requirements of 200 foot-pounds plus or minus 50 foot-pounds. Any power wrenches used shall be checked by the use of hand torque wrenches or long-handled socket or structural wrenches for amount of torque produced. Power wrenches shall be checked and adjusted frequently as needed, according to type or condition, to ensure proper adjustment to supply the required torque.

3.3.6 Structural-Plate Aluminum

Structural plate shall be assembled in accordance with instructions furnished by the manufacturer. Instructions shall show the position of each plate and the order of assembly. Bolts shall be tightened progressively and uniformly, starting at one end of the structure after all plates are in place. The operation shall be repeated to ensure that all bolts are torqued to a minimum of 100 foot-pounds on aluminum alloy bolts and a minimum of 150 foot-pounds on galvanized steel bolts. Any power wrenches used shall be checked by the use of hand torque wrenches or long-handled socket or structural wrenches for the amount of torque produced. Power wrenches shall be checked and adjusted as frequently as needed, according to type or condition, to ensure that they are in proper adjustment to supply the required torque.

3.3.7 Multiple Culverts

Where multiple lines of pipe are installed, adjacent sides of pipe shall be at least half the nominal pipe diameter or 3 feet apart, whichever is less.

3.3.8 Jacking Pipe Through Fills

Methods of operation and installation for jacking pipe through fills shall conform to requirements specified in Volume 1, Chapter 1, Part 4 of AREMA Manual.

3.4 JOINTING

3.4.1 Concrete and Clay 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.

3.4.1.2 Cement-Mortar Oakum Joint for Bell-and-Spigot Pipe

A closely twisted gasket shall be made of jute or oakum of the diameter required to support the spigot end of the pipe at the proper grade and to make the joint concentric. Joint packing shall be in one piece of sufficient length to pass around the pipe and lap at top. This gasket shall be thoroughly saturated with neat cement grout. The bell of the pipe shall be thoroughly cleaned with a wet brush, and the gasket shall be laid in the bell for the lower third of the circumference and covered with mortar. The spigot of the pipe shall be thoroughly cleaned with a wet brush, inserted in the bell, and carefully driven home. A small amount of mortar shall be inserted in the annular space for the upper two-thirds of the circumference. The gasket shall be lapped at the top of the pipe and driven home in the annular space with a caulking tool. The remainder of the annular space shall be filled completely with mortar and beveled at an angle of approximately 45 degrees with the outside of the bell. If mortar is not sufficiently stiff to prevent appreciable slump before setting, the outside of the joint thus made shall be wrapped with cheesecloth. Placing of this type of joint shall be kept at least five joints behind laying operations.

3.4.1.3 Cement-Mortar Diaper Joint for Bell-and-Spigot Pipe

The pipe shall be centered so that the annular space is uniform. The annular space shall be caulked with jute or oakum. Before caulking, the inside of the bell and the outside of the spigot shall be cleaned.

a. Diaper Bands: Diaper bands shall consist of heavy cloth fabric to hold grout in place at joints and shall be cut in lengths that extend one-eighth of the circumference of pipe above the spring line on one side of the pipe and up to the spring line on the other side of the pipe. Longitudinal edges of fabric bands shall be rolled and stitched around two pieces of wire. Width of fabric bands shall be such that after fabric has been securely stitched around both edges on wires, the wires will be uniformly spaced not less than 8 inches apart. Wires shall be cut into lengths to pass around pipe with sufficient extra length for the ends to be twisted at top of pipe to hold the band securely in place; bands shall be accurately centered around lower portion of joint.

b. Grout: Grout shall be poured between band and pipe from the high side of band only, until grout rises to the top of band at the spring line of pipe, or as nearly so as possible, on the opposite side of pipe, to ensure a thorough sealing of joint around the portion of pipe covered by the band. Silt, slush, water, or polluted mortar grout forced up on the lower side shall be forced out by pouring, and removed.

c. Remainder of Joint: The remaining unfilled upper portion of the

joint shall be filled with mortar and a bead formed around the outside of this upper portion of the joint with a sufficient amount of additional mortar. The diaper shall be left in place. Placing of this type of joint shall be kept at least five joints behind actual laying of pipe. No backfilling around joints shall be done until joints have been fully inspected and approved.

3.4.1.4 Cement-Mortar Tongue-and-Groove Joint

The first pipe shall be bedded carefully to the established gradeline with the groove upstream. A shallow excavation shall be made underneath the pipe at the joint and filled with mortar to provide a bed for the pipe. The grooved end of the first pipe shall be thoroughly cleaned with a wet brush, and a layer of soft mortar applied to the lower half of the groove. The tongue of the second pipe shall be cleaned with a wet brush; while in horizontal position, a layer of soft mortar shall be applied to the upper half of the tongue. The tongue end of the second pipe shall be inserted in the grooved end of the first pipe until mortar is squeezed out on interior and exterior surfaces. Sufficient mortar shall be used to fill the joint completely and to form a bead on the outside.

3.4.1.5 Cement-Mortar Diaper Joint for Tongue-and-Groove Pipe

The joint shall be of the type described for cement-mortar tongue-and-groove joint in this paragraph, except that the shallow excavation directly beneath the joint shall not be filled with mortar until after a gauze or cheesecloth band dipped in cement mortar has been wrapped around the outside of the joint. The cement-mortar bead at the joint shall be at least 1/2 inch, thick and the width of the diaper band shall be at least 8 inches. The diaper shall be left in place. Placing of this type of joint shall be kept at least five joints behind the actual laying of the pipe. Backfilling around the joints shall not be done until the joints have been fully inspected and approved.

3.4.1.6 Plastic Sealing Compound Joints for Tongue-and-Grooved Pipe

Sealing compounds shall follow the recommendation of the particular manufacturer in regard to special installation requirements. Surfaces to receive lubricants, primers, or adhesives shall be dry and clean. Sealing compounds shall be affixed to the pipe not more than 3 hours prior to installation of the pipe, and shall be protected from the sun, blowing dust, and other deleterious agents at all times. Sealing compounds shall be inspected before installation of the pipe, and any loose or improperly affixed sealing compound shall be removed and replaced. The pipe shall be aligned with the previously installed pipe, and the joint pulled together. If, while making the joint with mastic-type sealant, a slight protrusion of the material is not visible along the entire inner and outer circumference of the joint when the joint is pulled up, the pipe shall be removed and the joint remade. After the joint is made, all inner protrusions shall be cut off flush with the inner surface of the pipe. If nonmastic-type sealant material is used, the "Squeeze-Out" requirement above will be waived.

3.4.1.7 Flexible Watertight Joints

Gaskets and jointing materials shall be as recommended by the particular manufacturer in regard to use of lubricants, cements, adhesives, and other special installation requirements. Surfaces to receive lubricants, cements, or adhesives shall be clean and dry. Gaskets and jointing materials shall be affixed to the pipe not more than 24 hours prior to the

installation of the pipe, and shall be protected from the sun, blowing dust, and other deleterious agents at all times. Gaskets and jointing materials shall be inspected before installing the pipe; any loose or improperly affixed gaskets and jointing materials shall be removed and replaced. The pipe shall be aligned with the previously installed pipe, and the joint pushed home. If, while the joint is being made the gasket becomes visibly dislocated the pipe shall be removed and the joint remade.

3.4.1.8 External Sealing Band Joint for Noncircular Pipe

Surfaces to receive sealing bands shall be dry and clean. Bands shall be installed in accordance with manufacturer's recommendations.

3.4.2 Corrugated Metal Pipe

3.4.2.1 Field Joints

Transverse field joints shall be designed so that the successive connection of pipe sections will form a continuous line free of appreciable irregularities in the flow line. In addition, the joints shall meet the general performance requirements described in ASTM A 798/A 798M. Suitable transverse field joints which satisfy the requirements for one or more of the joint performance categories can be obtained with the following types of connecting bands furnished with suitable band-end fastening devices: corrugated bands, bands with projections, flat bands, and bands of special design that engage factory reformed ends of corrugated pipe. The space between the pipe and connecting bands shall be kept free from dirt and grit so that corrugations fit snugly. The connecting band, while being tightened, shall be tapped with a soft-head mallet of wood, rubber or plastic, to take up slack and ensure a tight joint. The annular space between abutting sections of part paved, and fully paved pipe and pipe arch, in sizes 30 inches or larger, shall be filled with a bituminous material after jointing. Field joints for each type of corrugated metal pipe shall maintain pipe alignment during construction and prevent infiltration of fill material during the life of the installations. The type, size, and sheet thickness of the band and the size of angles or lugs and bolts shall be as indicated or where not indicated, shall be as specified in the applicable standards or specifications for the pipe.

3.4.2.2 Flexible Watertight, Gasketed Joints

Installation shall be as recommended by the gasket manufacturer for use of lubricants and cements and other special installation requirements. The gasket shall be placed over one end of a section of pipe for half the width of the gasket. The other half shall be doubled over the end of the same pipe. When the adjoining section of pipe is in place, the doubled-over half of the gasket shall then be rolled over the adjoining section. Any unevenness in overlap shall be corrected so that the gasket covers the end of pipe sections equally. Connecting bands shall be centered over adjoining sections of pipe, and rods or bolts placed in position and nuts tightened. Band Tightening: The band shall be tightened evenly, even tension being kept on the rods or bolts, and the gasket; the gasket shall seat properly in the corrugations. Watertight joints shall remain uncovered for a period of time designated, and before being covered, tightness of the nuts shall be measured with a torque wrench. If the nut has tended to loosen its grip on the bolts or rods, the nut shall be retightened with a torque wrench and remain uncovered until a tight, permanent joint is assured.

3.5 DRAINAGE STRUCTURES

3.5.1 Manholes and Inlets

Construction shall be of reinforced concrete, plain concrete, brick, precast reinforced concrete, precast concrete segmental blocks, prefabricated corrugated metal, or bituminous coated corrugated metal; 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.

3.5.2 Walls and Headwalls

Construction shall be as indicated.

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 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 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 airfield and heliport pavements, 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.

3.8 PIPELINE TESTING

Lines shall be tested for leakage by low pressure air or water testing or exfiltration tests, as appropriate. Low pressure air testing for vitrified clay pipes shall conform to ASTM C 828. Low pressure air testing for concrete pipes shall conform to ASTM C 924. Low pressure air testing for plastic pipe shall conform to ASTM F 1417. Low pressure air testing procedures for other pipe materials shall use the pressures and testing times prescribed in ASTM C 828 or ASTM C 924, after consultation with the pipe manufacturer. Testing of individual joints for leakage by low pressure air or water shall conform to ASTM C 1103. Prior to exfiltration tests, the trench shall be backfilled up to at least the lower half of the pipe. If required, sufficient additional backfill shall be placed to prevent pipe movement during testing, leaving the joints uncovered to permit inspection. Visible leaks encountered shall be corrected regardless of leakage test results. When the water table is 2 feet or more above the top of the pipe at the upper end of the pipeline section to be tested, infiltration shall be measured using a suitable weir or other device acceptable to the Contracting Officer. An exfiltration test shall be made by filling the line to be tested with water so that a head of at least 2 feet is provided above both the water table and the top of the pipe at the upper end of the pipeline to be tested. The filled line shall be allowed to stand until the pipe has reached its maximum absorption, but not less than 4 hours. After absorption, the head shall be reestablished. The amount of water required to maintain this water level during a 2-hour test period shall be measured. Leakage as measured by the exfiltration test shall not exceed . When leakage exceeds the maximum amount specified, satisfactory correction shall be made and retesting accomplished. Testing, correcting, and retesting shall be made at no additional cost to the Government.

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SECTION 02660

WATER LINES AND OTHER MISC PIPING
(Including Services for Piping Class: 47P)

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 SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53	(1990b) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM B 88	(1993a) Seamless Copper Water Tube
ASTM D 1599	(1988) Short-Time Hydraulic Failure Pressure of Plastic Pipe, Tubing, and Fittings
ASTM D 1784	(1992) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 1785	(1993) Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2241	(1993) Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D 2464	(1991) Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2466	(1993) Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2467	(1993) Socket-Type Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2564	(1991) Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D 2657	(1990) Heat-Joining Polyolefin Pipe and Fittings
ASTM D 2774	(1972; R 1983) Underground Installation

ASTM D 2774	(1972; R 1983) Underground Installation of Thermoplastic Pressure Piping
ASTM D 2855	(1990) Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D 3839	(1939) Underground Installation of "Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Pipe
ASTM F 477	(1993) Elastomeric Seals (Gaskets) for Joining Plastic Pipe

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B1.20.1	(1983; R 1992) Pipe Threads, General Purpose (Inch)
ASME B16.1	(1989) Cast Iron Pipe Flanges and Flanged Fittings
ASME B16.3	(1992) Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.26	(1988) Cast Copper Alloy Fittings for Flared Copper Tubes

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA B301	(1992) Liquid Chlorine
AWWA C104	(1990) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C110	(1993) Ductile-Iron Fittings, 3 In. Through 48 In., for Water and Other Liquids
AWWA C111	(1990) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115	(1988) Flanged Ductile-Iron Pipe with Threaded Flanges
AWWA C151	(1991) Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids
AWWA C203	(1991) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines-Enamel and Tape - Hot-Applied
AWWA C207	(1986) Steel Pipe Flanges for Waterworks Service - Sizes 4 In. through 144 In.

AWWA C500	(1986) Gate Valves for Water and Sewerage Systems
AWWA C504	(1987) Rubber-Seated Butterfly Valves
AWWA C509	(1987) Resilient-Seated Gate Valves for Water and Sewerage Systems
AWWA C600	(1987) Installation of Ductile-Iron Water Mains and Their Appurtenances
AWWA C606	(1987) Grooved and Shouldered Joints
AWWA C651	(1992) Disinfecting Water Mains
AWWA C800	(1989) Underground Service Line Valves and Fittings
AWWA C900	(1989; C900a) Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. Through 12 In., for Water Distribution
AWWA C901	(1988; Errata) Polyethylene (PE) Pressure Pipe and Tubing, 1/2 In. Through 3 In., for Water Service
AWWA C902	(1988) Polybutylene (PB) Pressure Pipe and Tubing, 1/2 In. Through 3 In., for Water
AWWA C950	(1988) Fiberglass Pressure Pipe
AWWA M23	(1980) PVC Pipe - Design and Installation

DUCTILE IRON PIPE RESEARCH ASSOCIATION (DIPRA)

DIPRA-01	(1989) Thrust Restraint Design for Ductile Iron Pipe

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-80	(1987) Bronze Gate, Globe, Angle and Check Valves

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 49	(1975) Hazardous Chemicals Data
NFPA 325M	(1991) Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids

NFPA 704 (1990) Identification of the Fire Hazards of Materials

NSF INTERNATIONAL (NSF)

NSF Std 14 (1965; Rev Nov 1990) Plastics Piping System Components and Related Materials

1.2 PIPING

This section covers water distribution, service lines, and connections to building service at a point approximately 1.5 m 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 less than 80 mm (3 inches) 3 inches in diameter shall be galvanized steel or copper tubing, unless otherwise shown or specified. Piping for water service lines for sizes 80 mm (3 inches) 3 inches and larger shall be ductile iron, unless otherwise shown.

1.2.2 Distribution Lines 80 mm (3 Inches) 3 Inches or Larger

Piping for water distribution lines 80 mm (3 inches) 3 inches or larger shall be ductile iron through 300 mm (12 inch) 12 inch nominal diameter unless otherwise shown or specified.

1.2.3 Excavation, Trenching, and Backfilling

Excavation, trenching, and backfilling shall be in accordance with the applicable provisions of Section 02222 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS, except as modified herein.

1.3 SUBMITTALS

Statement of Satisfactory Installation; GA.

A statement signed by the principal officer of the contracting firm stating that the installation is satisfactory and in accordance with the contract plans and specifications and the manufacturer's prescribed procedures and techniques, upon completion of the project and before final acceptance.

1.4 HANDLING

Pipe and accessories shall be handled so as to insure delivery to the trench in sound, undamaged condition. Particular care shall be taken not to injure 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 at his expense in a satisfactory manner. No other pipe or material of any kind 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 Polyethylene (PE) and Polybutylene (PB) Pipe

PE pipe, fittings, and accessories shall be handled in conformance with AWWA C901; PB pipe, fittings, and accessories shall be handled in conformance with AWWA C902.

1.4.2 Miscellaneous Plastic Pipe and Fittings

Polyvinyl Chloride (PVC), Reinforced Thermosetting Resin Pipe (RTRP), and Reinforced Plastic Mortar Pressure (RPMP) pipe 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 325M.

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 Polyethylene Plastic (PE)

Pipe, tubing, and heat-fusion fittings shall conform to AWWA C901.

2.1.1.2 Polybutylene Plastic (PB)

Pipe and fusion fittings shall conform to AWWA C902.

2.1.1.3 Polyvinyl Chloride (PVC) Plastic Pipe

Pipe, couplings and fittings shall be manufactured of material conforming to ASTM D 1784, Class 12454B.

a. Pipe Less Than 100 mm (4 inch) 4 inch Diameter:

(1) Screw-Joint: Pipe shall conform to dimensional requirements of ASTM D 1785 Schedule 80, with joints meeting requirements of 1.03 MPa (150 psi) 150 psi working pressure, 1.38 MPa (200 psi) 200 psi hydrostatic test pressure, unless otherwise shown or specified. Pipe couplings when used, shall be tested as required by ASTM D 2464.

(2) Elastomeric-Gasket Joint: Pipe shall conform to dimensional requirements of ASTM D 1785. Schedule 40 with joints meeting the requirements of 1.03 MPa (150 psi) 150 psi working pressure, 1.38

SDR	Maximum Working Pressure Psi	Minimum Hydrostatic Pressure Psi
26	100	133
21	120	160
17	150	200
13/5	200	266

In additional to the above requirements, the pipe, couplings and fittings shall be hydrostatically tested as required by AWWA C900, and shall conform to iron pipe (I.P.S.) or cast iron outside diameter (CIOD) size dimensions.

(3) Solvent Cement Joint: Pipe shall conform to dimensional requirements of ASTM D 1785 or ASTM D 2241 with joints meeting the requirements of 1.03 MPa (150 psi) 150 psi working pressure and 1.38 MPa (200 psi) 200 psi hydrostatic test pressure.

b. Pipe 100 mm (4 inch) 4 Inch through 300 mm (12 Inch) 12 Inch Diameter: Pipe, couplings and fittings 100 mm (4 inch) 4 inch through 300 mm (12 inch) 12 inch diameter shall conform to AWWA C900, Class 150, CIOD pipe dimensions, elastomeric-gasket joint, unless otherwise shown or specified.

2.1.2 Ductile-Iron Pipe

Ductile-iron pipe shall conform to AWWA C151, working pressure not less than 1.03 MPa (150 psi), 150 psi, unless otherwise shown or specified. Pipe shall be cement-mortar lined in accordance with AWWA C104. Linings shall be standard.

2.1.3 Steel Pipe

2.1.3.1 Galvanized-Steel Pipe

Galvanized-steel pipe shall conform to ASTM A 53, standard weight.

2.1.3.2 Protective Materials for Steel Pipe

Protective materials for steel pipe, except as otherwise specified, shall be mechanically applied in a factory or plant especially equipped for the purpose. The materials shall, unless otherwise indicated on the drawings, consist of the following for the indicated pipe material and size:

a. Steel pipe and fittings less than 80 mm (3 inches) 3 inches in diameter shall be thoroughly cleaned of foreign material by wire brushing and solvent cleaning, and then given one coat of coal-tar primer and two coats of coal-tar enamel conforming to AWWA C203; threaded ends of pipe and fittings shall be adequately protected prior to coating.

2.1.4 Copper Tubing

****

NOTE: Use copper tubing for water service lines.
Joints are limited to pipe sizes less than 2-1/2 inches in diameter.

****

Copper tubing shall conform to ASTM B 88, Type K, annealed.

2.2 FITTINGS AND SPECIALS

2.2.1 Polyvinyl Chloride (PVC) Pipe

a. For pipe less than 100 mm (4 inch) 4 inch diameter, fittings for threaded pipe shall conform to requirements of ASTM D 2464, threaded to conform to the requirements of ASME B1.20.1 for use with Schedule 80 pipe and fittings, fittings for solvent cement jointing shall conform to ASTM D 2466 or ASTM D 2467, and fittings for elastomeric-gasket joint pipe shall be iron conforming to AWWA C110 or AWWA C111.

b. For pipe 100 mm (4 inch) 4 inch diameter and larger, fittings and specials shall be cast iron, bell end in accordance with AWWA C110, 1.03 MPa (150 psi) 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 may be fittings and specials of the same material as the pipe with elastomeric gaskets, all in conformance with AWWA C900. Cast 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.

2.2.2 RTRP and RPMP Pipe

Fittings and specials shall be compatible with the pipe supplied. Filament wound or molded fittings up to 150 mm (6 inches) 6 inches shall conform to AWWA C950. Iron fittings shall be cement-mortar lined in accordance with AWWA C104 and shall conform to AWWA C110 and AWWA C111. Fittings shall be suitable for working and testing pressures specified for the pipe.

2.2.3 Ductile-Iron Pipe

Fittings and special shall be suitable for 1.03 MPa (150 psi) 150 psi pressure rating, unless otherwise specified. Fittings and specials for mechanical joint pipe shall conform to AWWA C110. Fittings and specials for use with push-on joint pipe shall conform to AWWA C110 and AWWA C111. Fittings and specials for grooved and shouldered end pipe shall conform to AWWA C606. Fittings and specials shall be cement-mortar lined (standard thickness) in accordance with AWWA C104.

2.2.3.1 Galvanized-Steel Pipe

Steel fittings shall be galvanized. Screwed fittings shall conform to ASME B16.3. Flanged fittings shall conform to AWWA C207.

2.2.3.2 Dielectric Fittings

Dielectric fittings shall be installed between threaded ferrous and nonferrous metallic pipe, fittings and valves, except where corporation stops join mains. Dielectric fittings shall prevent metal-to-metal contact of dissimilar metallic piping elements and shall be suitable for the required working pressure.

2.2.4 Copper Tubing

Fittings and specials shall be flared and conform to ASME B16.26.

2.3 JOINTS

2.3.1 Plastic Pipe

2.3.1.1 Polyethylene (PE) and Polybutylene (PB) Pipe

Joints for pipe fittings and couplings shall be strong tight joints as specified for PE and PB in Paragraph INSTALLATION. Joints connecting pipe of differing materials shall be made in accordance with the manufacturer's recommendation as approved by the Contracting Officer.

2.3.1.2 Polyvinyl Chloride 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 as approved by the Contracting Officer.

2.3.2 RPMP Pipe

Joints shall be mechanical or bell and spigot type with elastomeric gasket.

2.3.3 RTRP

2.3.3.1 RTRP-I, Grade I and 2

Joints shall be bell and spigot with elastomeric gasket, mechanical coupling with elastomeric gasket, threaded and bonded coupling, or tapered bell and spigot with compatible adhesive. All RTRP-I materials shall be products of a single manufacturer.

2.3.3.2 RTRP-II, Grade 1 and 2

Joints shall be the bell and spigot type with elastomeric gasket, bell and spigot with adhesive, butt-jointed with adhesive bonded reinforced overlay, mechanical, flanged, threaded or commercially available proprietary joints, provided they are capable of conveying water at the pressure and temperature of the pipe.

2.3.4 Ductile-Iron Pipe

a. Mechanical joints shall be of the stuffing box type and shall conform to AWWA C111.

b. Push-on joints shall conform to AWWA C111.

c. Rubber gaskets and lubricant shall conform to the applicable requirements of AWWA C111.

2.3.5 Isolation Joints

Isolation joints shall be installed between nonthreaded ferrous and nonferrous metallic pipe, fittings and valves. Isolation joints shall consist of a sandwich-type flange isolation gasket of the dielectric type,

isolation washers, and isolation sleeves for flange bolts. Isolation gaskets shall be full faced with outside diameter equal to the flange outside diameter. Bolt isolation sleeves shall be full length. Units shall be of a shape to prevent metal-to-metal contact of dissimilar metallic piping elements.

2.3.6 Copper Tubing

Joints shall be compression-pattern flared and shall be made with fittings hereinafter specified.

2.4 VALVES

2.4.1 Check Valves

Check valves shall be designed for a minimum working pressure of 1.03 MPa (150 psi) 150 psi or as indicated. Valves shall have a clear waterway equal to the full nominal diameter of the valve. Valves shall open to permit flow when inlet pressure is greater than the discharge pressure, and shall close tightly to prevent return flow when discharge pressure exceeds inlet pressure. The size of the valve, working pressure, manufacturer's name, initials, or trademark shall be cast on the body of each valve.

a. Valves 50 mm (2 inches) 2 inches and smaller shall be all bronze designed for screwed fittings, and shall conform to MSS SP-80, Class 150, Types 3 and 4 as suitable for the application.

b. Valves larger than 50 mm (2 inches) 2 inches shall be iron body, bronze mounted, shall have flanged ends, and shall be the non-slam type. Flanges shall be the Class 125 type conforming to ASME B16.1.

2.4.2 Gate Valves

Gate valves shall be designed for a working pressure of not less than 1.03 MPa (150 psi) 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 smaller than 80 mm (3 inches) 3 inches shall be all bronze and shall conform to MSS SP-80, Type 1, Class 150.

b. Valves 80 mm (3 inches) 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.

c. Resilient-Seated Gate Valves: For valves 80 to 300 mm (3 to 12 inches) 3 to 12 inches in size, resilient-seated gate valves shall conform to AWWA C509.

2.4.3 Rubber-Seated Butterfly Valves

Rubber-seated butterfly valves shall conform to the performance requirements of AWWA C504. Wafer type valves conforming to the performance requirements of AWWA C504 in all respects, but not meeting laying length requirements will be acceptable if supplied and installed with a spacer providing the specified laying length. All tests required by AWWA C504 shall be met. Flanged-end valves shall

be installed in an approved pit and provided with a union or sleeve-type coupling in the pit to permit removal. Mechanical-end valves 80 mm (3 inches) 3 inches through 250 mm (10 inches) 10 inches in diameter may be direct burial if provided with a suitable valve box, means for manual operation, and an adjacent pipe joint to facilitate valve removal. Valve operators shall restrict closing to a rate requiring approximately 60 seconds, from fully open to fully closed.

2.4.4 Pressure Reducing Valves

Pressure reducing valves shall maintain a constant downstream pressure regardless of fluctuations in demand. The valves shall be of the hydraulically-operated, pilot controlled, globe or angle type, and may be actuated either by diaphragm or piston. The pilot control shall be the diaphragm-operated, adjustable, spring-loaded type, designed to permit flow when controlling pressure exceeds the spring setting. Ends shall be threaded. Valve bodies shall be bronze. Valve stem shall be stainless steel. Valve discs and diaphragms shall be synthetic rubber. Valve seats shall be bronze. Pilot controls shall be bronze with stainless steel working parts.

2.4.5 Vacuum and Air Relief Valves

Vacuum and air relief valves shall be of the size shown and shall be of a type that will release air and prevent the formation of a vacuum. The valves shall automatically release air when the lines are being filled with water and shall admit air into the line when water is being withdrawn in excess of the inflow. Valves shall be iron body with bronze trim and stainless steel float.

2.5 VALVE BOXES

Valve boxes shall be cast iron 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 4.8 mm (3/16 inch). 3/16 inch. 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 VALVE PITS

Valve pits shall be constructed at locations indicated or as required above and in accordance with the details shown. Concrete shall be in accordance with Section 03300 CONCRETE FOR BUILDING CONSTRUCTION.

2.7 MISCELLANEOUS ITEMS

2.7.1 Service Clamps

Service clamps shall have a pressure rating not less than that of the pipe to be connected and shall be either the single or double flattened strap type. Clamps shall have a galvanized malleable-iron body with cadmium plated straps and nuts. Clamps shall have a rubber gasket cemented to the body.

2.7.2 Corporation Stops

Corporation stops shall have standard corporation stop thread conforming to AWWA C800 on the inlet end, with flanged joints, compression pattern flared tube couplings, or wiped joints for connections to goosenecks.

2.7.3 Goosenecks

Copper tubing for gooseneck connections shall conform to the applicable requirements of ASTM B 88, Type K, annealed. Length of cable requirement connections shall be in accordance with standard practice.

2.7.4 Service Stops

Service stops shall be water-works inverted-ground-key type, oval or round flow way, tee handle, without drain. Pipe connections shall be suitable for the type of service pipe used. All parts shall be of bronze with female iron-pipe-size connections or compression-pattern flared tube couplings, and shall be designed for a hydrostatic test pressure not less than 1.375 kPa (200 psi). 200 psi.

2.7.5 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 67.8 Newton meters (50 foot-pound). 50 foot-pound.

2.7.6 Service Boxes

Service boxes shall be cast iron or concrete and shall be extension service boxes of the length required for the depth of the line, with either screw or slide-type adjustment. The boxes shall have housings of sufficient size to completely cover the service stop or valve and shall be complete with identifying covers.

2.7.7 Disinfection

Chlorinating materials shall conform to the following:

Chlorine, Liquid: AWWA B301.

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. Copper

tubing shall be cut square and all burrs shall be removed. Squeeze type mechanical cutters shall not be used for ductile iron.

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 3 m 10 feet from a sewer except where the bottom of the water pipe will be at least 300 mm 12 inches above the top of the sewer pipe, in which case the water pipe shall not be laid closer horizontally than 1.8 m 6 feet from the sewer. Where water lines cross under gravity-flow sewer lines, the sewer pipe for a distance of at least 3 m 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 900 mm 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 600 mm 2 feet above the sewer main. Joints in the sewer main, closer horizontally than 900 mm 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 Copper Tubing

Copper tubing shall not be installed in the same trench with ferrous piping materials.

3.1.2.4 Nonferrous Metallic Pipe

Where nonferrous metallic pipe, e.g., copper tubing, crosses any ferrous piping material, a minimum vertical separation of 300 mm 12 inches shall be maintained between pipes.

3.1.2.5 Roads, Railroads, and Airfields

Water pipe shall be encased in a sleeve of rigid conduit for the lengths shown. Sleeves under railroads shall be in accordance with the railroad company requirements. Where sleeves are required, the pipe sleeve shall be as specified for storm drains in Section 02720 STORM-DRAINAGE SYSTEM. A minimum clearance of at least 50 mm 2 inches between the inner wall of the sleeve and the maximum outside diameter of the sleeved pipe and joints shall be provided. Sand bedding shall be provided for the water pipe through the sleeve. Sleeves of ferrous material shall be provided with corrosion protection as required for the conditions encountered at the site of installation.

3.1.2.6 Structures

Where water pipe is required to be installed within 1 m 3 feet of existing structures, the water pipe shall be sleeved as required for roads, railroads, and airfields. Care shall be exercised and proper precautions taken during installation of the water pipe and sleeve to assure 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 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 in no case shall it exceed 5 degrees.

3.1.3.2 Ductile-Iron Pipe

The maximum allowable deflection shall be as given in AWWA C600. If the alignment requires deflection in excess of the above limitations, special bends or a sufficient number of shorter lengths of pipe shall be furnished to provide angular deflections within the limit set forth.

3.1.3.3 Steel Pipe

For pipe with bell-and-spigot rubber-gasket joints, maximum allowable deflections from a straight line or grade, as required by vertical curves, horizontal curves, or offsets shall be 5 degrees unless a lesser amount is recommended by the manufacturer. Short-radius curves and closures shall be formed by short lengths of pipe or fabricated specials specified.

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. Under no circumstances shall any of the water-line materials be dropped or dumped into the trench. Care shall be taken to avoid abrasion of the pipe coating. 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 the Contractor at his 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 recommendations of the manufacturer. PE and PB shall be installed in accordance with ASTM D 2774. PVC shall be installed in accordance with AWWA M23.

3.1.4.2 PE, PB, RTRP, and RPMP Manufacturer's Representative

The name and written qualifications of the manufacturer's field representative and written certification that the representative is technically qualified in all phases of PE, PB, RTRP, and/or RPMP pipe laying and jointing and experienced to supervise the work and train the Contractor's field installers shall be submitted to the Contracting Officer prior to commencing installation. The representative shall be present at the job site during the installation and testing to provide technical assistance and to verify that

the materials are being installed in accordance with the manufacturer's prescribed procedures. When the representative feels that the Contractor is installing and testing the PE, PB, RTRP, and/or RPMP pipe in a satisfactory manner, he shall certify this in writing and note which individuals employed by the Contractor are capable of properly installing the pipe. The field representative shall advise the Contractor of unsatisfactory conditions immediately when they occur. Such conditions include improper diameter of pipe ends, damaged interior liner, poorly prepared joints, improper curing of joints, moving pipe before joints are cured, bending pipe to follow abrupt changes in trench contours, leaving pipe ends open in trench overnight, not properly drying joints after rain storms, exceeding effective adhesive life, sharp objects in trench bed, backfill that could damage pipe, improper procedure for concrete encasement of pipe, omission of thrust blocks at changes in direction or any other conditions which could have an adverse effect on the satisfactory completion and operation of the piping system.

3.1.4.3 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. Where made under pressure, these connections shall be installed using standard methods as approved by the Contracting Officer.

3.1.4.4 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.

3.1.4.5 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 Polyethylene (PE) and Polybutylene (PB) Pipe

Jointing shall comply with ASTM D 2657, Technique I-Socket Fusion.

3.1.5.2 Polyvinyl Chloride (PVC) Plastic Pipe

a. Pipe less than 100 mm (4 inch) 4 inch diameter: Threaded joints shall be made by wrapping the male threads with approved thread tape or applying an approved lubricant, then threading the joining members together. The joint shall be tightened using strap wrenches to prevent damage to the pipe and/or fitting. To avoid excessive torque, joints shall be tightened no more than one thread past hand-tight. Preformed rubber-ring gaskets for elastomeric-gasket joints shall be made in accordance with requirements of ASTM F 477 and as required herein. All pipe ends for push-on joints shall be beveled to facilitate assembly and marked to indicate when the pipe is fully seated. The gasket shall be prelubricated to prevent displacement. The gasket and ring groove in the bell or coupling shall match. The manufacturer of the pipe or fitting shall supply the elastomeric gasket. Couplings shall be provided with stops or centering rings to assure that the coupling is centered on the joint. Solvent cement joints shall use sockets conforming to the requirements of ASTM D 2467. The solvent cement used shall meet the requirements of ASTM D 2564; the joint assembly shall be made in accordance with ASTM D 2855 and the manufacturer's specific recommendations.

b. Pipe 100 mm (4 inch) 4 inch through 300 mm (12 inch) 12 inch diameter: Joints shall be elastomeric-gasket as specified in AWWA C900. Jointing procedure shall be as specified for pipe less than 100 mm (4 inch) 4 inch diameter with configuration using elastomeric ring gasket.

3.1.5.3 RTRP I, RTRP II and RPMP Pipe

a. RTRP I: Assembly of the pipe shall be done in strict conformance with the manufacturer's written instruction and installation procedures. Field joints shall be prepared as specified by the pipe manufacturer. Several pipe joints having interference-fit type couplings may be field bonded and cured simultaneously. However, the pipe shall not be moved nor shall additional joints be made until the previously laid joints are completely cured. Joints not having interference-fit type coupling shall be fitted with a clamp which shall hold the joint rigidly in place until the joint cement has completely cured. The clamps shall have a protective material on the inner surface to prevent damage to the plastic pipe when the clamp is tightened in place. The pipe manufacturer shall provide a device or method to determine when the joint is pulled against the pipe stop. Additionally, the pipe manufacturer shall furnish a gauge to measure the diameter of the spigot ends to ensure the diameter conforms to the tolerances specified by the manufacturer. All pipe ends shall be gauged. Factory certified tests shall have been satisfactorily performed to verify that short-term rupture strength is 10.3 MPa (1,500 psi) 1,500 psi or greater when carried out in accordance with ASTM D 1599. All field bonded epoxy-cemented joints, regardless of ambient temperature, shall be cured with a self-regulating thermostatically temperature controlled electrical heating blanket for the time and temperature recommended by the manufacturer for the applicable size and type of joint, or by an alternate heating method recommended by the manufacturer and approved by the Contracting Officer. The joint sections shall not be moved during heating or until the joint has cooled to ambient temperature.

b. RTRP II: A reinforced overlay joint shall be used to join sections together through a placement of layers of reinforcement fiberglass roving, mat, tape or fabric thoroughly saturated with compatible catalyzed resin.

c. Fittings and Specials for RTRP and RPMP Pipe: Metal to RTRP and RPMP pipe connections shall be made by bolting steel flanges to RTRP and RPMP pipe flanges. Cast-iron fitting with gasket bell or mechanical joint may be used with RTRP if pipe has cast iron outside diameter. Steel flanges shall be flat-faced type. Where raised-face steel flanges are used, spacer rings shall be used to provide a flat-face seat for RTRP and RPMP pipe flanges. A full-face Buna "N" gasket 3.2 mm (1/8 inch) 1/8 inch thick with a shore hardness of 50-60 shall be used between all flanged connections. The RTRP and RPMP pipe flange shall have raised sealing rings. Flat washers shall be used under all nuts and bolts on RTRP and RPMP pipe flanges. Bolts and nuts shall be of noncorrosive steel and torqued to not more than 135.6 Newton meters. 100 foot pounds. Flanges shall not be buried. A concrete pit shall be provided for all flanged connections.

3.1.5.4 Ductile-Iron Pipe

Mechanical and push-on type joints shall be installed in accordance with AWWA C600 for buried lines or AWWA C606 for grooved and shouldered pipe above ground or in pits.

3.1.5.5 Galvanized-Steel Pipe

Screw joints shall be made tight with a stiff mixture of graphite and oil, inert filler and oil, or with an approved graphite compound, applied with a brush to the male threads only. Compounds shall not contain lead.

3.1.5.6 Copper Tubing

Joints shall be made with flared fittings. The flared end tube shall be pulled tightly against the tapered part of the fitting by a nut which is part of the fitting, so there is metal-to-metal contact.

3.1.5.7 Bonded Joints

Bonded joints shall be installed in accordance with details specified for joints in paragraph JOINTS.

3.1.5.8 Isolation Joints and Dielectric Fittings

Isolation joints and dielectric fittings shall be installed in accordance with details specified in paragraph JOINTS. Dielectric unions shall be encapsulated in a field-poured coal-tar covering, with at least 3.2 mm 1/8 inch thickness of coal tar over all fitting surfaces.

3.1.5.9 Connections

Connections between different types of pipe and accessories shall be made with transition fittings approved by the Contracting Officer.

3.1.6 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 1.5 m 5 feet outside the building where such building service exists. Where building services are not installed, the Contractor shall terminate the service lines approximately 1.5 m 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 2 Inches and Smaller

Service lines 2 inches and smaller shall be connected to the main by a directly-tapped corporation stop or by a service clamp. A corporation stop and a copper gooseneck shall be provided with either type of connection. Maximum sizes for directly-tapped corporation stops and for outlets with service clamps shall be as in TABLE I. Where 2 or more gooseneck connections to the main are required for an individual service, such connections shall be made with standard branch connections. The total clear area of the branches shall be at least equal to the clear area of the service which they are to supply.

300 (12) & larger	50 (2)	50 (2)

3.1.6.2 Service Lines Larger than 50 mm (2 Inches) 2 Inches

Service lines larger than 50 mm (2 inches) 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 80 mm (3 inches) 3 inches and larger may use rubber-seated butterfly valves as specified above, or gate valves.

3.1.6.3 Valves

After delivery, valves shall be drained to prevent freezing and shall have the interiors cleaned of all foreign matter before installation. Stuffing boxes shall be tightened and valves shall be fully opened and fully closed to ensure that all parts are in working condition.

3.1.6.4 Service Boxes

Where water lines are located below paved streets having curbs, the boxes shall be installed directly back of the curbs. Where no curbing exists, service boxes shall be installed in accessible locations, beyond the limits of street surfacing, walks and driveways.

3.1.7 Thrust Restraint

Plugs, caps, tees and bends deflecting 11-1/4 degrees or more, either vertically or horizontally, on waterlines 100 mm (4 inches) 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.

3.1.7.1 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 14 MPa 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.

3.1.7.2 Restrained Joints

For ductile-iron pipe, restrained joints shall be designed by the Contractor or the pipe manufacturer in accordance with DIPRA-01.

3.2 HYDROSTATIC TESTS

Where any section of a water line is provided with concrete thrust blocking for fitting 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.

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 contract.

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 02222 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS.

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. Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved or approved section thereof, necessary to maintain pressure within 34.5 kPa (5 psi) 5 psi of the specified leakage test pressure after the pipe has been filled with water and the air expelled. No piping installation will be accepted if leakage exceeds the allowable leakage which is determined by the following formula:

L = 0.0001351ND(P raised to 1/2 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 satisfactory as specified. All 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 DISINFECTION

Before acceptance of potable water operation, each unit of completed waterline shall be disinfected as prescribed by AWWA C651. 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. In no case will the agent 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. All 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. From several points in the unit, the Contracting Officer will take samples of water in proper sterilized containers for bacterial examination. 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.

-- End of Section --

SECTION 02722A

AGGREGATE AND/OR GRADED-CRUSHED AGGREGATE BASE COURSE
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 basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO T 180	(1997) Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and an 457 mm (18-in) Drop
AASHTO T 224	(1996) Correction for Coarse Particles in the Soil Compaction Test

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 29/C 29M	(1997) Bulk Density ("Unit Weight") and Voids in Aggregates
ASTM C 88	(1999a) Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C 117	(1995) Materials Finer Than 75 micrometer (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 127	(1988; R 1993el) Specific Gravity and Absorption of Course Aggregate
ASTM C 128	(1997) Specific Gravity and Absorption of Fine Aggregate
ASTM C 131	(1996) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(1996a) Sieve Analysis of Fine and Coarse Aggregates
ASTM D 75	(1987; R 1997) Sampling Aggregates
ASTM D 422	(1963; R 1998) Particle-Size Analysis of Soils
ASTM D 1556	(2000) Density and Unit Weight of Soil in Place by the Sand-Cone Method

ASTM D 1557	(1991; R 1998) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu.m.))
ASTM D 2167	(1994) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2487	(2000) Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(1996el) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(1988; R 1996el) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 4318	(2000) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM E 11	(1995) Wire-Cloth Sieves for Testing Purposes

1.2 DEFINITIONS

For the purposes of this specification, the following definitions apply.

1.2.1 Aggregate Base Course

Aggregate base course (ABC) is well graded, durable aggregate uniformly moistened and mechanically stabilized by compaction.

1.2.2 Graded-crushed Aggregate Base Course

Graded-crushed aggregate (GCA) base course is well graded, crushed, durable aggregate uniformly moistened and mechanically stabilized by compaction. GCA is similar to ABC, but it has more stringent requirements and it produces a base course with higher strength and stability.

1.2.3 Degree of Compaction

Degree of compaction shall be expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557.

1.3 UNIT PRICES

1.3.1 Measurement

1.3.1.1 Area

The quantity of ABC and GCA completed and accepted, as determined by the Contracting Officer, will be measured in square yards.

1.3.1.2 Volume

The quantity of ABC and GCA completed and accepted, as determined by the

Contracting Officer, will be measured in cubic yards. The volume of material in-place and accepted will be determined by the average job thickness obtained in accordance with paragraph THICKNESS CONTROL and the dimensions shown.

1.3.1.3 Weight

The tonnage of ABC and GCA material will be the number of tons of aggregate, placed and accepted in the completed course plus the amount placed in authorized stockpiles, as determined by the Contracting Officer. Deductions will be made for any material wasted, unused, rejected, or used for convenience of the Contractor, and for water exceeding specified amount at time of weighing.

1.3.2 Payment for Quantities

Quantities of ABC and GCA, determined as specified above, will be paid for at the respective contract unit prices, which shall constitute full compensation for the construction and completion of the ABC and GCA.

1.3.3 Payment for Stabilization of Underlying Course

Stabilization of cohesionless subgrade or subbase courses, as specified in paragraph PREPARATION OF UNDERLYING COURSE, will be paid for as a special item on a tonnage basis. This tonnage price shall include the price of extra manipulation as required.

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-03 Product Data

Plant, Equipment, and Tools; FIO, TSCS

List of proposed equipment to be used in performance of construction work, including descriptive data.

Waybills and Delivery Tickets; FIO, TSCS

Copies of waybills and delivery tickets during the progress of the work. Before the final statement is allowed, the Contractor shall file certified waybills and certified delivery tickets for all aggregates actually used.

SD-06 Test Reports

Sampling and testing; FIO, TSCS
Field Density Tests; FIO, TSCS

Calibration curves and related test results prior to using the device or equipment being calibrated. Copies of field test results within 24 hours after the tests are performed. Certified copies of test results for approval not less than 30 days before material is required for the work.

1.5 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. Copies of test results shall be furnished to the Contracting Officer within 24 hours of completion of the tests.

1.5.1 Sampling

Samples for laboratory testing shall be taken in conformance with ASTM D 75. When deemed necessary, the sampling will be observed by the Contracting Officer.

1.5.2 Tests

The following tests shall be performed in conformance with the applicable standards listed.

1.5.2.1 Sieve Analysis

Sieve analysis shall be made in conformance with ASTM C 117 and ASTM C 136. Sieves shall conform to ASTM E 11.

1.5.2.2 Liquid Limit and Plasticity Index

Liquid limit and plasticity index shall be determined in accordance with ASTM D 4318.

1.5.2.3 Moisture-Density Determinations

The maximum density and optimum moisture content shall be determined in accordance with ASTM D 1557.

1.5.2.4 Field Density Tests

Density shall be field measured in accordance with ASTM D 2922. For the method presented in ASTM D 2922 the calibration curves shall be checked and adjusted if necessary using only the sand cone method as described in paragraph Calibration, of the ASTM publication. Tests performed in accordance with ASTM D 2922 result 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 also be checked along with density calibration checks as described in ASTM D 3017. The calibration checks of both the density and moisture gauges shall be made by the prepared containers of material method, as described in paragraph Calibration of ASTM D 2922, on each different type of material being tested at the beginning of a job and at intervals as directed.

1.5.2.5 Wear Test

Wear tests shall be made on ABC and GCA course material in conformance with ASTM C 131.

1.5.2.6 Soundness

Soundness tests shall be made on GCA in accordance with ASTM C 88.

1.5.2.7 Weight of Slag

Weight per cubic foot of slag shall be determined in accordance with ASTM C 29/C 29M on the ABC and GCA course material.

1.5.3 Testing Frequency

1.5.3.1 Initial Tests

One of each of the following tests shall be performed on the proposed 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.

b. Liquid limit and plasticity index.

c. Moisture-density relationship.

d. Wear.

e. Soundness.

f. Weight per cubic foot of Slag.

1.5.3.2 In Place Tests

Each of the following tests shall be performed on samples taken from the placed and compacted ABC and GCA. Samples shall be taken and tested at the rates indicated.

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 shall be performed for every 1000 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.

1.5.4 Approval of Material

The source of the material shall be selected 90 days prior to the time the material will be required in the work. Tentative approval of material will be based on initial test results. 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 ABC and GCA.

1.6 WEATHER LIMITATIONS

Construction 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.

1.7 PLANT, EQUIPMENT, AND TOOLS

All plant, equipment, and tools used in the performance of the work will 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 the required compaction, meeting grade controls, thickness control, and smoothness requirements as set forth herein.

PART 2 PRODUCTS

2.1 AGGREGATES

The ABC and GCA shall consist of clean, sound, durable particles of crushed stone, crushed slag, crushed gravel, crushed recycled concrete, angular sand, or other approved material. ABC shall be free of lumps of clay, organic matter, and other objectionable materials or coatings. GCA shall be free of silt and clay as defined by ASTM D 2487, organic matter, and other objectionable materials or coatings. 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.

2.1.1 Coarse Aggregate

Coarse aggregates shall be angular particles of uniform density. When the coarse aggregate is supplied from more than one source, aggregate from each source shall meet the specified requirements and shall be stockpiled separately.

a. Crushed Gravel: Crushed gravel shall be manufactured by crushing gravels, and shall meet all the requirements specified below.

b. Crushed Stone: Crushed stone shall consist of freshly mined quarry rock, and shall meet all the requirements specified below.

c. Crushed Recycled Concrete: Crushed recycled concrete shall consist of previously hardened portland cement concrete or other concrete containing pozzolanic binder material. The recycled material shall be free of all reinforcing steel, bituminous concrete surfacing, and any other foreign material and shall be crushed and processed to meet the required gradations for coarse aggregate. Crushed recycled concrete shall meet all other applicable requirements specified below.

d. Crushed Slag: Crushed slag shall be an air-cooled blast-furnace product having an air dry unit weight of not less than 65 pcf as determined by ASTM C 29/C 29M, and shall meet all the requirements specified below.

2.1.1.1 Aggregate Base Course

ABC coarse aggregate shall not show more than 50 percent loss when subjected to the Los Angeles abrasion test in accordance with ASTM C 131. 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 listed in TABLE 1.

2.1.1.2 Graded-Crushed Aggregate Base Course

GCA coarse aggregate shall not show more than 40 percent loss when subjected to the Los Angeles abrasion test in accordance with ASTM C 131. GCA coarse aggregate shall not exhibit a loss greater than 40 percent weighted average, at five cycles, when tested for soundness in magnesium sulfate in accordance with ASTM C 88. The amount of flat and elongated particles shall not exceed 20 percent for the fraction retained on the 1/2 inch sieve nor 20 percent for the fraction passing the 1/2 inch sieve. 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 aggregate shall contain at least 90 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 90 percent of which by weight are retained on the maximum size sieve listed in TABLE 1.

2.1.2 Fine Aggregate

Fine aggregates shall be angular particles of uniform density. When the fine aggregate is supplied from more than one source, aggregate from each source shall meet the specified requirements.

2.1.2.1 Aggregate Base Course

ABC 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.

2.1.2.2 Graded-Crushed Aggregate Base Course

GCA fine aggregate shall consist of angular particles produced by crushing stone, slag, recycled concrete, or gravel that meets the requirements for wear and soundness specified for GCA coarse aggregate. Fine aggregate shall be manufactured from gravel particles 95 percent of which by weight are retained on the 1/2 inch sieve.

2.1.3 Gradation Requirements

The specified gradation requirements shall apply to the completed base course. The aggregates shall have a maximum size of 2 inches and shall be continuously well graded within the limits specified in TABLE 1. Sieves shall conform to ASTM E 11.

TABLE I. GRADATION OF AGGREGATES

Percentage by Weight Passing Square-Mesh Sieve

Sieve Designation	No. 1	No. 2	No. 3
2 inch	100	----	----
1-1/2 inch	70-100	100	----
1 inch	45-80	60-100	100
1/2 inch	30-60	30-65	40-70
No. 4	20-50	20-50	20-50
No. 10	15-40	15-40	15-40
No. 40	5-25	5-25	5-25
No. 200	0-8	0-8	0-8

NOTE 1: Particles having diameters less than 0.0008 inch shall not be in excess of 3 percent by weight of the total sample tested.

NOTE 2: The values are based on aggregates of uniform specific gravity. If materials from different sources are used for the coarse and fine aggregates, they shall be tested in accordance with ASTM C 127 and ASTM C 128 to determine their specific gravities. If the specific gravities vary by more than 10 percent, the percentages passing the various sieves shall be corrected as directed by the Contracting Officer.

2.1.4 Liquid Limit and Plasticity Index

Liquid limit and plasticity index requirements shall apply to the completed course and shall also apply to any component that is blended to meet the required gradation. The portion of any component or of the completed course passing the No. 40 sieve shall be either nonplastic or have a liquid limit not greater than 25 and a plasticity index not greater than 5.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

When the ABC or GCA 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.

3.2 OPERATION OF AGGREGATE SOURCES

Aggregates shall be obtained from offsite sources.

3.3 STOCKPILING MATERIAL

Prior to stockpiling of material, storage sites shall be cleared and

leveled by the Contractor. All materials, including approved material available from excavation and grading, shall be stockpiled in the manner and at the locations designated. Aggregates shall be stockpiled on the cleared and leveled areas designated by the Contracting Officer to prevent segregation. Materials obtained from different sources shall be stockpiled separately.

3.4 PREPARATION OF UNDERLYING COURSE

Prior to constructing the ABC and GCA, the underlying course or subgrade shall be cleaned of all foreign substances. At the time of construction of the ABC and GCA, the underlying course shall contain no frozen material. The surface of the underlying course or subgrade shall meet specified compaction and surface tolerances. The underlying course shall conform to Section 02300A EARTHWORK. 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. For cohesionless underlying courses containing sands or gravels, as defined in ASTM D 2487, the surface shall be stabilized prior to placement of the ABC and GCA. Stabilization shall be accomplished by mixing ABC or GCA into the underlying course and compacting by approved methods. The stabilized material shall be considered as part of the underlying course and shall meet all requirements of the underlying course. 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 ABC and GCA is placed.

3.5 INSTALLATION

3.5.1 Mixing the Materials

The coarse and fine aggregates shall be mixed in a stationary plant, or in a traveling plant or bucket loader on an approved paved working area. 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 ABC and GCA meeting all requirements of this specification.

3.5.2 Placing

The mixed material shall be placed on the prepared subgrade or subbase 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. Where the ABC and GCA is placed in more than one layer, the previously constructed layers shall be cleaned of loose and foreign matter by sweeping with power sweepers, power brooms, or hand brooms, as directed. Such 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 ABC and GCA.

3.5.3 Grade Control

The finished and completed ABC and GCA shall conform to the lines, grades, and cross sections shown. Underlying material(s) shall be excavated and prepared at sufficient depth for the required ABC and GCA thickness so that the finished ABC and GCA with the subsequent surface course will meet the designated grades.

3.5.4 Edges of Base Course

The ABC and GCA shall be placed so that the completed section will be a minimum of 5 feet wider, on all sides, than the next layer that will be placed above it. Additionally, approved fill material shall be placed along the outer edges of ABC and GCA in sufficient quantities to compact to the thickness of the course being constructed, or to the thickness of each layer in a multiple layer course, allowing in each operation at least a 2 foot width of this material to be rolled and compacted simultaneously with rolling and compacting of each layer of ABC and GCA. If this base course material is to be placed adjacent to another pavement section, then the layers for both of these sections shall be placed and compacted along this edge at the same time.

3.5.5 Compaction

Each layer of the ABC and GCA shall be compacted as specified with approved compaction equipment. Water content shall be maintained during the compaction procedure to within plus or minus 2 percent of the optimum water content determined from laboratory tests as specified in paragraph SAMPLING AND TESTING. 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 ABC and GCA. 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.

3.5.6 Thickness

Compacted thickness of the aggregate course shall be 12.7 inches. No individual layer shall exceed 6 inches nor be less than 3 inches in compacted thickness. The total compacted thickness of the ABC and GCA 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 ABC and GCA course shall be measured at intervals in such a manner as to ensure one measurement for each 500 square yards of base course. Measurements shall be made in 3 inch diameter test holes penetrating the base course.

3.5.7 Proof Rolling

Proof rolling of the areas indicated shall be in addition to the compaction specified and shall consist of the application of 30 coverages with a heavy pneumatic-tired roller having four or more tires, each loaded to a minimum of 30,000 pounds and inflated to a minimum of 150 psi. In areas designated, proof rolling shall be applied to the top of the underlying material on which ABC and GCA is laid and to each layer of ABC and GCA. Water content of the underlying material shall be maintained at optimum or at the percentage directed from start of compaction to completion of proof rolling of that layer. Water content of each layer of the ABC and GCA shall be maintained at the optimum percentage directed from start of compaction to completion of proof rolling. Any ABC and GCA materials or any underlying materials that produce unsatisfactory results by proof rolling shall be removed and replaced with satisfactory materials, recompacted and proof rolled to meet these specifications.

3.5.8 Finishing

The surface of the top layer of ABC and GCA shall be finished after final compaction and proof rolling 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 of ABC and GCA 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 , compacted and proof rolled 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 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.

3.5.9 Smoothness

The surface of the top layer shall show no deviations in excess of 3/8 inch when tested with a 10 foot straightedge. 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.

3.6 TRAFFIC

Traffic shall not be allowed on the completed ABC and GCA course.

3.7 MAINTENANCE

The ABC and GCA shall be maintained in a satisfactory condition until the full pavement section is completed and accepted. Maintenance shall include immediate repairs to any defects and shall be repeated as often as necessary to keep the area intact. Any ABC and GCA that is not paved over prior to the onset of winter, shall be retested to verify that it still complies with the requirements of this specification. Any area of ABC and GCA that is damaged shall be reworked or replaced as necessary to comply with this specification.

3.8 DISPOSAL OF UNSATISFACTORY MATERIALS

Any unsuitable materials that must be removed shall be disposed of as directed. No additional payments will be made for materials that must be replaced.

-- End of Section --

SECTION 02741

BITUMINOUS PAVING FOR ROADS, STREETS AND OPEN STORAGE AREAS
09/98

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.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 29/C 29M	(1997) Bulk Density (Unit Weight) and Voids in Aggregate
ASTM C 88	(1990) Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C 117	(1995) Materials Finer than 75 micrometer (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 127	(1988; R 1993) Specific Gravity and Absorption of Coarse Aggregate
ASTM C 128	(1993) Specific Gravity and Absorption of Fine Aggregate
ASTM C 131	(1996) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(1996a) Sieve Analysis of Fine and Coarse Aggregates
ASTM C 183	(1995a) Sampling and the Amount of Testing of Hydraulic Cement
ASTM D 5	(1995) Penetration of Bituminous Materials
ASTM D 75	(1987; R 1992) Sampling Aggregates
ASTM D 140	(1993) Sampling Bituminous Materials
ASTM D 242	(1995) Mineral Filler for Bituminous Paving Mixtures
ASTM D 422	(1963; R 1990) Particle-Size Analysis of Soils
ASTM D 946	(1982; R 1993) Penetration-Graded Asphalt Cement for Use in Pavement Construction

ASTM D 1250	(1980; R 1997) Petroleum Measurement Tables
ASTM D 1856	(1995a) Recovery of Asphalt from Solution by Abson Method
ASTM D 2041	(1995) Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
ASTM D 2172	(1995) Quantitative Extraction of Bitumen from Bituminous Paving Mixtures
ASTM D 2216	(1992) Laboratory Determination of Water (Moisture) Content of Soil and Rock
ASTM D 3381	(1992) Viscosity-Graded Asphalt Cement for Use in Pavement Construction
ASTM D 3515	(1996) Hot-Mixed, Hot-Laid Bituminous Paving Mixtures
ASTM D 4791	(1995) Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate

VIRGINIA DEPARTMENT OF TRANSPORTATION (VDOT)

VDOT Standard	(1994) Virginia Department of Transportation - Road and Bridge Specifications

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL DESCRIPTIONS:

SD-09 Reports

Bituminous Pavement; GA.

Copies of test results.

SD-14 Samples

Bituminous Pavement; FIO.

Samples of the materials in the quantities indicated below for the job mix formula.

Aggregate and mineral filler (if needed) to be blended in approximately the same proportions as used in the project	200 pounds
Asphalt Cement	5 gallons

SD-18 Records

Waybills and Delivery Tickets; FIO.

Waybills and delivery tickets, during progress of the work.

1.3 PLANT, EQUIPMENT, MACHINES, AND TOOLS

1.3.1 General

The bituminous plant shall be of such capacity to produce the quantities of bituminous mixtures required. Hauling equipment, paving machines, rollers, miscellaneous equipment, and tools shall be provided in sufficient numbers and capacity and in proper working condition to place the bituminous paving mixtures at a rate equal to the plant output.

1.3.2 Mixing Plants

The mixing plant shall be an automatic or semiautomatic controlled commercially manufactured unit designed and operated to consistently produce a mixture within the job-mix formula (JMF). Drum mixers shall be prequalified at the production rate to be used during actual mix production. The prequalification tests will include extraction and recovery of the asphalt cement in accordance with ASTM D 2172 and ASTM D 1856. The penetration of the recovered asphalt binder shall not be less than 60 percent of the original penetration, as measured in accordance with ASTM D 5.

1.3.3 Straightedge

The Contractor shall furnish and maintain at the site, in good condition, one 10-foot straightedge for each bituminous paver. Straightedge shall be made available for Government use. Straightedges shall be constructed of aluminum or other lightweight metal and shall have blades of box or box-girder cross section with flat bottom reinforced to ensure rigidity and accuracy. Straightedges shall have handles to facilitate movement on pavement.

1.4 SITE CONDITIONS

1.4.1 Weather Limitations

Apply tack and prime coats when ambient temperature is above 50 deg.F (10 deg.C), and when temperature has not been below 35 deg.F (1 deg.C) for 12 hours immediately prior to application. Do not apply when base is wet or contains an excess of moisture.

1.4.2 Conditions

Construct asphalt concrete surface course when atmospheric temperature is above 40 deg.F (4 deg.C), and when base is dry. Base course may be placed when air temperature is above 30 deg.F (-1 deg.C) and rising.

1.4.3 Grade Control

Establish and maintain required lines and elevations.

1.5 PROTECTION OF PAVEMENT

After final rolling, no vehicular traffic of any kind shall be permitted on the pavement until the pavement has cooled to 140 degrees F.

1.6 GRADE AND SURFACE-SMOOTHNESS REQUIREMENTS

Finished surface of bituminous courses, when tested as specified below and in paragraph ACCEPTABILITY OF WORK, shall conform to gradeline and elevations shown and to surface-smoothness requirements specified.

1.6.1 Plan Grade

The grade of the completed surface shall not deviate more than 0.05 foot from the plan grade.

1.6.2 Surface Smoothness

When a 10-foot straightedge is laid on the surface parallel with the centerline of the paved area or transverse from crown to pavement edge, the surface shall vary not more than 1/4 inch from the straightedge.

1.7 GRADE CONTROL

Lines and grades shall be established and maintained by means of line and grade stakes placed at site of work in accordance with the Special Contract Requirements. Elevations of bench marks used by the Contractor for controlling pavement operations at the site of work will be determined, established, and maintained by the Government. Finished pavement elevations shall be established and controlled at the site of work by the Contractor in accordance with bench mark elevations furnished by the Contracting Officer.

1.8 SAMPLING AND TESTING

1.8.1 Aggregates

1.8.1.1 General

Samples of aggregates shall be furnished by the Contractor for approval of aggregate sources and stockpiles prior to the start of production and at times during production of the bituminous mixtures. Times and points of sampling will be designated by the Contracting Officer. Samples will be the basis of approval of specific sources or stockpiles of aggregates for aggregate requirements. Unless otherwise directed, ASTM D 75 shall be used in sampling coarse and fine aggregate, and ASTM C 183 shall be used in sampling mineral filler. All tests necessary to determine compliance with requirements specified herein will be made by an approved commercial testing laboratory.

1.8.1.2 Sources

Sources of aggregates shall be selected well in advance of the time the materials are required in the work. If a previously developed source is selected, evidence shall be submitted 10 days before starting production, indicating that the central-plant hot-mix bituminous pavements constructed with the aggregates have had a satisfactory service record of at least five years under similar climatic and traffic conditions. The approved commercial testing laboratory will make such tests and other investigations as necessary to determine whether aggregates meeting requirements specified herein can be produced from proposed sources. If a sample of material from

a new source fails to meet specification requirements, the material represented by the sample shall be replaced, and the cost of testing the replaced sample will be at the expense of the Contractor. Approval of the source of aggregate does not relieve the Contractor of responsibility for delivery at the jobsite of aggregates that meet the requirements specified herein.

1.8.2 Bituminous Materials

Samples of bituminous materials shall be obtained by the Contractor; sampling shall be in accordance with ASTM D 140. Tests necessary to determine conformance with requirements specified herein will be performed by an approved commercial testing laboratory without cost to the Contractor. Sources where bituminous materials are obtained shall be selected in advance of the time when materials will be required in the work. In addition to initial qualification testing of bituminous materials, samples shall be taken before and during construction when shipments of bituminous materials are received or when necessary to assure some condition of handling or storage has not been detrimental to the bituminous material. The samples will be taken by the Contractor and tested by an approved commercial testing laboratory.

1.8.3 Bituminous Mixtures

Sampling and testing of bituminous mixtures will be accomplished by an approved commercial testing laboratory.

1.9 DELIVERY, STORAGE, AND HANDLING OF MATERIALS

1.9.1 Mineral Aggregates

Mineral aggregates shall be delivered to the site of the bituminous mixing plant and stockpiled in such manner as to preclude fracturing of aggregate particles, segregation, contamination, or intermingling of different materials in the stockpiles or cold-feed hoppers. Mineral filler shall be delivered, stored, and introduced into the mixing plant in a manner to preclude exposure to moisture or other detrimental conditions.

1.9.2 Bituminous Materials

Bituminous materials shall be maintained at appropriate temperature during storage but shall not be heated by application of direct flame to walls of storage tanks or transfer lines. Storage tanks, transfer lines, and weigh buckets shall be thoroughly cleaned before a different type or grade of bitumen is introduced into the system. The asphalt cement shall be heated sufficiently to allow satisfactory pumping of the material; however, the storage temperature shall be maintained below 300 degrees F.

1.10 ACCESS TO PLANT AND EQUIPMENT

The Contracting Officer shall have access at all times to all parts of the paving plant for checking adequacy of the equipment in use; inspecting operation of the plant; verifying weights, proportions, and character of materials; and checking temperatures maintained in preparation of the mixtures.

1.11 WAYBILLS AND DELIVERY TICKETS

Before the final statement is allowed, the Contractor shall file with the

Contracting Officer certified waybills and certified delivery tickets for all aggregates and bituminous materials actually used in construction.

PART 2 PRODUCTS

2.1 ASPHALT CONCRETE MIXTURES

Asphalt Concrete: VDOT Standard SM-2A surface mix, BM-2 base mix.

2.1.1 Additives

The use of additives such as antistripping and antifoaming agents is subject to approval.

2.2 TACK COAT

VDOT Standard RC-250, applied at 0.10 gal. per square yard of surface.

2.3 HERBICIDE TREATMENT

Commercial chemical for weed control, registered by the Environmental Protection Agency, "Round-Up" or equal.

2.4 PRIME COAT

VDOT Standard RC-70, applied at 0.20 gal. per square yard of surface.

2.5 AGGREGRATES

2.5.1 Aggregate Base

Course Aggregate: VDOT Standard Type I Size 21A Stone or crushed concrete having a gradation equivalent to VDOT Standard Type I Size 21A Stone.

2.5.2 Mineral Filler

Rock or slag dust, hydraulic cement, or other inert material complying with ASTM D 242.

PART 3 EXECUTION

3.1 BASE COURSE CONDITIONING

The surface of the base course will be inspected for adequate compaction. Unsatisfactory areas shall be corrected.

3.2 SURFACE PREPARATION

3.2.1 Preparation

Remove loose material from compacted subbase surface immediately before applying herbicide treatment when required.

3.2.2 Proof Roll

Proof roll prepared subbase surface under the direction of the Government's independent testing laboratory, to check for unstable areas and areas requiring additional compaction.

3.2.3 Unsatisfactory Conditions

Notify Contracting Officer of unsatisfactory conditions. Do not begin paving work until deficient subbase areas have been corrected and are ready to receive paving. Removal and replacement of deficient subbase areas to be performed at the direction and under the direction of the Government's independent testing laboratory.

3.2.4 Herbicide Treatment

Apply chemical weed control agent in strict compliance with manufacturer's recommended dosages and application instructions. Apply to compacted, dry subbase.

3.2.5 Tack Coat

Apply to contact surfaces of previously constructed asphalt or portland cement concrete and surfaces abutting or projecting into asphalt concrete pavement. Distribute at rate of 0.10 gal. per sq. yd. of surface.

3.2.6 Prime Coat

Apply between base course and aggregate as indicated on the plans and pavement sections. Distribute at rate of 0.20 gal. per sq. yd. of surface. Allow to dry until at proper condition to receive paving. Exercise care in applying bituminous materials to avoid smearing of adjoining concrete surfaces. Remove and clean damaged surfaces. If tack coat damage cannot be completely removed then concrete shall be removed and replaced as directed by the COntracting Officer, at no additional cost to the Government.

3.2.7 Patching

Contractor to prepare areas indicated by the drawings to be sawcut and remove existing asphalt pavement and patch in accordance with the pavement patch detail shown on the plans.

3.3 PREPARATION OF BITUMINOUS MIXTURES

Rates of feed of aggregates shall be regulated so that the moisture content and temperature of aggregates will be within specified tolerances. Aggregates, mineral filler, and bitumen shall be conveyed into the mixer in proportionate quantities required to meet the JMF. Mixing time shall be as required to obtain a uniform coating of the aggregate with the bituminous material. Temperature of bitumen at time of mixing shall not exceed 300 degrees F. Temperature of aggregate and mineral filler in the mixer shall not exceed 325 degrees F when bitumen is added. Overheated and carbonized mixtures or mixtures that foam shall not be used.

3.4 WATER CONTENT OF AGGREGATES

Drying operations shall reduce the water content of mixture to less than 0.75 percent. The water content test will be conducted in accordance with ASTM D 2216; the weight of the sample shall be at least 500 grams. If the water content is determined on hot bin samples, the water content will be a weighted average based on composition of blend.

3.5 STORAGE OF BITUMINOUS PAVING MIXTURE

Storage shall conform to the applicable requirements of ASTM D 3515; however, in no case shall the mixture be stored for more than 4 hours.

3.6 TRANSPORTATION OF BITUMINOUS MIXTURE

Transportation from paving plant to site shall be in trucks having tight, clean, smooth beds lightly coated with an approved releasing agent to prevent adhesion of the mixture to the truck bodies. Excessive releasing agent shall be drained prior to loading. Each load shall be covered with canvas or other approved material of ample size to protect mixture from weather and to prevent loss of heat. Loads that have crusts of cold, unworkable material or that have become wet will be rejected. Hauling over freshly placed material will not be permitted.

3.7 SURFACE PREPARATION OF UNDERLYING COURSE

Prior to placing of the intermediate or wearing course, the underlying course shall be cleaned of all foreign or objectionable matter with power brooms and hand brooms.

3.8 PRIME COATING

Surfaces of previously constructed base course shall be sprayed with a coat of bituminous material.

3.9 TACK COATING

Contact surfaces of previously constructed pavement, curbs, manholes, and other structures shall be sprayed with a thin coat of bituminous material.

3.10 PLACING

Bituminous courses shall be constructed only when the base course or existing pavement has no free water on the surface. Bituminous mixtures shall not be placed without ample time to complete spreading and rolling during daylight hours, unless approved satisfactory artificial lighting is provided.

3.10.1 Offsetting Joints

The wearing course shall be placed so that longitudinal joints of the wearing course will be offset from joints in the intermediate course by at least 1 foot. Transverse joints in the wearing course shall be offset by at least 2 feet from transverse joints in the intermediate course.

3.10.2 General Requirements for Use of Mechanical Spreader

Range of temperatures of mixtures, when dumped into the mechanical spreader, shall be as determined by the Contracting Officer. Mixtures having temperatures less than 225 degrees F when dumped into the mechanical spreader shall not be used. The mechanical spreader shall be adjusted and the speed regulated so that the surface of the course being laid will be smooth and continuous without tears and pulls, and of such depth that, when compacted, the surface will conform to the cross section indicated. Placing with respect to center line areas with crowned sections or high side of areas with one-way slope shall be as directed. Each lot of material placed shall conform to requirements specified in paragraph ACCEPTABILITY OF WORK. Placing of the mixture shall be as nearly continuous as possible, and speed of placing shall be adjusted, as

directed, to permit proper rolling. When segregation occurs in the mixture during placing, the spreading operation shall be suspended until the cause is determined and corrected.

3.10.3 Placing Strips Succeeding Initial Strips

In placing each succeeding strip after initial strip has been spread and compacted as specified below, the screed of the mechanical spreader shall overlap the previously placed strip 2 to 3 inches and be sufficiently high so that compaction produces a smooth dense joint. Mixture placed on the edge of a previously placed strip by the mechanical spreader shall be pushed back to the edge of the strip by use of a lute. Excess mixture shall be removed and wasted.

3.10.4 Handspreading in Lieu of Machine Spreading

In areas where the use of machine spreading is impractical, the mixture shall be spread by hand. Spreading shall be in a manner to prevent segregation. The mixture shall be spread uniformly with hot rakes in a loose layer of thickness that, when compacted, will conform to required grade, density, and thickness.

3.11 COMPACTION OF MIXTURE

Rolling shall begin as soon after placing as the mixture will bear a roller without undue displacement. Delays in rolling freshly spread mixture will not be permitted. After initial rolling, preliminary tests of crown, grade, and smoothness shall be made by the Contractor. Deficiencies shall be corrected so that the finished course will conform to requirements for grade and smoothness specified herein. Crown, grade, and smoothness will be checked in each lot of completed pavement by the Contracting Officer for compliance and will be evaluated as specified in paragraph ACCEPTABILITY OF WORK. After the Contractor is assured of meeting crown, grade, and smoothness requirements, rolling shall be continued until a mat density of 97.0 to 100.0 percent and a joint density of 95.0 to 100.0 percent of density of laboratory-compacted specimens of the same mixture is obtained. The density will be determined and evaluated as specified in paragraph ACCEPTABILITY OF WORK. Places inaccessible to rollers shall be thoroughly compacted with hot hand tampers.

3.11.1 Testing of Mixture

At the start of the plant operation, a quantity of mixture shall be prepared that is sufficient to construct a test section at least 50 feet long, two spreader widths wide and of thickness to be used in the project. Mixture shall be placed, spread, and rolled with equipment to be used in the project and in accordance with the requirements specified above. This test section shall be tested and evaluated as a lot and shall conform to all specified requirements. If test results are satisfactory, the test section shall remain in place as part of the completed pavement. If tests indicate that the pavement does not conform to specification requirements, necessary adjustments to plant operations and rolling procedures shall be made immediately, and test section will be evaluated as specified in paragraph ACCEPTABILITY OF WORK. Additional test sections, as directed, shall be constructed and sampled for conformance to specification requirements. In no case shall the Contractor start full production of an intermediate or wearing course mixture without approval.

3.11.2 Correcting Deficient Areas

Mixtures that become contaminated or are defective shall be removed to the full thickness of the course. Edges of the area to be removed shall be cut so that sides are perpendicular and parallel to the direction of traffic and so that the edges are vertical. Edges shall be sprayed with bituminous materials. Fresh paving mixture shall be placed in the excavated areas in sufficient quantity so that the finished surface will conform to grade and smoothness requirements. Paving mixture shall be compacted to the density specified herein. Skin patching of an area that has been rolled shall not be permitted.

3.12 JOINTS

3.12.1 General

Joints between old and new pavements, between successive work days, or joints that have become cold (less than 175 degrees F) shall be made to ensure continuous bond between the old and new sections of the course. All joints shall have the same texture and smoothness as other sections of the course. Contact surfaces of previously constructed pavements coated by dust, sand, or other objectionable material shall be cleaned by brushing or shall be cut back as directed. When directed by the Contracting Officer, the surface against which new material is placed shall be sprayed with a thin, uniform coat of bituminous material. Material shall be applied far enough in advance of placement of a fresh mixture to ensure adequate curing. Care shall be taken to prevent damage or contamination of the sprayed surface.

3.12.2 Transverse Joints

The roller shall pass over the unprotected end of a strip of freshly placed material only when placing is discontinued or delivery of the mixture is interrupted to the extent that the material in place may become cold. In all cases, prior to continuing placement, the edge of previously placed pavement shall be cut back to expose an even vertical surface for full thickness of the course. In continuing placement of a strip, the mechanical spreader shall be positioned on the transverse joint so that sufficient hot mixture will be spread to obtain a joint after rolling that conforms to the required density and smoothness specified herein.

3.12.3 Longitudinal Joints

Edges of a previously placed strip shall be prepared such that the pavement in and immediately adjacent to the joint between this strip and the succeeding strip meets the requirements for grade, smoothness, and density specified in paragraph ACCEPTABILITY OF WORK.

3.13 ROLLING

3.13.1 General

Begin rolling when mixture will bear roller weight without excessive displacement.

3.13.2 Compact

Compact mixture with hot hand tampers or vibrating plate compactors in areas inaccessible to rollers.

3.13.3 Breakdown Rolling

Accomplish breakdown or initial rolling immediately following rolling of joints and outside edge. Check surface after breakdown rolling, and repair displaced areas by loosening and filling, if required, with hot material.

3.13.4 Second Rolling

Follow breakdown rolling as soon as possible, while mixture is hot. Continue second rolling until mixture has been thoroughly compacted.

3.13.5 Finish Rolling

Perform finish rolling while mixture is still warm enough for removal of roller marks. Continue rolling until roller marks are eliminated and course has attained maximum density.

3.13.6 Patching

Remove and replace paving areas mixed with foreign materials and defective areas. Cut-out such areas and fill with fresh, hot asphalt concrete. Compact by rolling to maximum surface density and smoothness.

3.13.7 Protection

After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

3.13.8 Barricades

Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.14 ACCEPTABILITY OF WORK

3.14.1 General

A lot shall be that quantity of construction that will be evaluated for compliance with specification requirements. A lot shall be equal to 4 hours of production. The Government will conduct all initial acceptance tests. Additional tests required to determine acceptability of nonconforming material will be preformed by the Government at the expense of the Contractor. Test in-place asphalt concrete courses for compliance with requirements for thickness and surface smoothness. Repair or remove and replace unacceptable paving as directed by Contracting Officer.

3.14.1.1 Lot Evaluation

In order to evaluate aggregate gradation, asphalt content, and density, each lot shall be divided into four equal sublots. For density determination, one random sample shall be taken from the mat, and one random sample shall be taken from the joint of each sublot. A coring machine will be used for taking mat and joint samples from the completed pavement. Core samples will be taken with the coring machine centered over the joint. After air drying to a constant weight, random samples obtained from the mat shall be used for density determination. Samples for determining asphalt content and aggregate gradation shall be taken from loaded trucks within each sublot. Asphalt content shall be determined in accordance with ASTM D 2172, Method A or B. Aggregate gradation shall be

determined for the mix by testing the recovered aggregate in accordance with ASTM C 136 and ASTM C 117.

3.14.1.2 Lot Failure

When a lot of material fails to meet the specification requirements, that lot shall be removed and replaced or accepted at a reduced price.

3.14.1.3 Optional Sampling and Testing

The Contracting Officer reserves the right to sample and test any area which appears to deviate from the specification requirements. Testing in these areas will be in addition to the lot testing, and the requirements for these areas will be the same as those for a lot.

3.14.2 Grade

Grade-conformance tests will be conducted by the Government. The finished surface of the pavement will be tested for conformance with plan-grade requirements. Within 5 working days after completion of placement of a particular lot, the Contracting Officer will inform the Contractor in writing of results of grade-conformance tests. The finished grade of each pavement area shall be determined by running lines of levels at intervals of 25 feet or less longitudinally and transversely to determine the elevation of the completed pavement. When more than 5 percent of all measurements made within a lot are outside the tolerances specified in paragraph GRADE AND SURFACE-SMOOTHNESS REQUIREMENTS, the payment for that lot will not exceed 95 percent of the bid price. In areas where the grade exceeds the plan-grade tolerances given in paragraph GRADE AND SURFACE-SMOOTHNESS REQUIREMENTS by more than 50 percent, the Contractor shall remove the deficient area and replace with fresh paving mixture at no additional cost to the Government. Sufficient material shall be removed to allow at least 1 inch of asphalt concrete to be placed. Skin patching for correcting low areas or planing for correcting high areas shall not be permitted.

3.14.3 Surface Smoothness

After completion of final rolling of a lot, the compacted surface will be tested by the Contracting Officer with a 10-foot straightedge. Measurements will be made perpendicular to and across all mats at distances along the mat not to exceed 25 feet. Location and deviation from straightedge of all measurements will be recorded. Any joint or mat area surface deviation which exceeds the tolerance given in paragraph GRADE AND SURFACE-SMOOTHNESS REQUIREMENTS by more than 50 percent shall be corrected to meet the specification requirements. The Contractor shall remove the deficient area and replace with fresh paving mixture at no additional cost to the Government. Sufficient material shall be removed to allow at least 1 inch of asphalt concrete to be placed. Skin patching for correcting low areas or planing for correcting high areas shall not be permitted.

Surfaces will not be acceptable if exceeding the following tolerances for smoothness:

1. Base Course Surface: 1/4"
2. Wearing Course Surface: 3/16"
3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template, 1/4"

3.14.4 Thickness

In-place compacted thickness will not be acceptable if exceeding following allowable variation from required thickness:

1. Base Course: 1/2", plus or minus.
2. Surface Course: 1/4", plus or minus.

-- End of Section --

SECTION 02831

CHAIN LINK FENCE
07/92

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 SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 94	(1992a) Ready-Mixed Concrete
ASTM F 883	(1990) Padlocks

AMERICAN WELDING SOCIETY (AWS)

AWS WZC	(1972) Welding Zinc-Coated Steels

FEDERAL SPECIFICATIONS (FS)

FS RR-F-191/GEN	(Rev K) Fencing, Wire and Post Metal (and Gates, Chain-Link Fence Fabric, and Accessories)
FS RR-F-191/1	(Rev D) Fencing, Wire and Post, Metal (Chain-Link Fence Fabric)
FS RR-F-191/2	(Rev D) Fencing, Wire and Post, Metal (Chain-Link Fence Gates)
FS RR-F-191/3	(Rev D) Fencing, Wire and Post, Metal (Chain-Link Fence Posts, Top Rails and Braces)
FS RR-F-191/4	(Rev D) Fencing, Wire and Post, Metal (Chain-Link Fence Accessories)

MILITARY SPECIFICATIONS (MS)

MS MIL-B-52489	(Rev E) Barbed Tape, Concertina

PART 2 PRODUCTS

2.1 MATERIALS

Materials shall conform to the following:

2.1.1 Chain Link Fence

FS RR-F-191/GEN.

2.1.1.1 Fabric

FS RR-F-191/1, Type I, zinc-coated steel wire with minimum coating weight of 1.2 ounces of zinc per square foot of coated surface, or Type II, aluminum-coated steel wire. Fabric shall be fabricated of 9-gauge wire woven in 2-inch mesh. Fabric height shall be 8 feet. Fabric shall be twisted and barbed on the top selvage and knuckled on the bottom selvage.

2.1.1.2 Gates

FS RR-F-191/2. Gate shall be the type and swing shown. Gate frames shall be constructed of Class 1 Grade A or B, steel pipe, size SP2, as specified in FS RR-F-191/3. Gate fabric shall be as specified for chain-link fabric. Gate leaves less than 8 feet wide shall have truss rods or intermediate braces. Intermediate braces shall be provided on all gate frames with an electro-mechanical lock. 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.

2.1.1.3 Posts

FS RR-F-191/3, zinc-coated; Class 1 Grade A or B, steel pipe; Class 3, formed steel sections; or Class 6, steel square sections. Class 4, 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 class throughout the fence. Gate post shall be either round or square, subject to the limitation specified in FS RR-F-191/3.

2.1.1.4 Braces and Rails

FS RR-F-191/3, zinc-coated, Class 1, Grade A or B, steel pipe, size SP1. Class 3, formed steel sections, size FS1, conforming to FS RR-F-191/3, may be used as braces if Class 3 line posts are furnished.

2.1.1.5 Accessories

FS RR-F-191/4. 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.

2.1.2 Concrete

ASTM C 94, 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.

2.1.3 Padlocks

ASTM F 883, Type PO1, Grade 2, Size 1-3/4 inch. Padlocks shall be keyed alike and each lock shall be furnished with two keys.

PART 3 EXECUTION

3.1 GENERAL

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. Damage to the galvanized surface due to welding shall be repaired with "repair sticks" of zinc-cadmium alloys or zinc-tin-lead alloys per AWS WZC.

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 POSTS

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. Class 3 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. 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 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.

3.5 TENSION WIRES

Tension wires shall be installed along the top and bottom of the fence line and attached to the terminal posts of each stretch of the fence. Top tension wires shall be installed within the top 4 inches of the installed fabric. Bottom tension wire shall be installed within the bottom 6 inches of the installed fabric. Tension wire shall be pulled taut and shall be free of sag.

3.6 GATES

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 and hinge pins, and hardware shall be welded or otherwise secured to prevent removal.

-- End of Section --

SECTION 02921

SEEDING
06/98

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.

AGRICULTURAL MARKETING SERVICE (AMS)

AMS-01	(Aug 95) Federal Seed Act Regulations Part 201

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 602	(1995a) Agricultural Liming Materials
ASTM D 977	(1991) Emulsified Asphalt
ASTM D 2028	(1976; R 1992) 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	(1996) Standard Guide for Use of Rotary Kiln Produced Expanded Shale, Clay or Slate (ESCS) as a Mineral Amendment in Topsoil Used for Landscaping and Related Purposes

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL DESCRIPTIONS:

SD-01 Data

Equipment; GA. Surface Erosion Control Material; GA. Chemical Treatment Material; GA.

Manufacturer's literature including physical characteristics, application and installation instructions for equipment, surface erosion control material and chemical treatment material.

SD-07 Schedules

Equipment; FIO.

A listing of equipment to be used for the seeding operation.

SD-08 Statements

Delivery; FIO.

Delivery schedule.

Finished Grade and Topsoil; FIO.

Finished grade status.

Topsoil; FIO.

Availability of topsoil from the stripping and stock piling operation.

SD-09 Reports

Equipment Calibration; FIO.

Certification of calibration tests conducted on the equipment used in the seeding operation.

Soil Test; FIO.

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-13 Certificates

Seed; FIO. Topsoil; FIO. pH Adjuster; FIO. Fertilizer; FIO. Organic Material; FIO. Soil Conditioner; FIO. Mulch; FIO. Asphalt Adhesive; FIO. Pesticide; FIO.

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.

i. Pesticide. EPA registration number and registered uses.

SD-14 Samples

Delivered Topsoil; FIO.

Samples taken from several locations at the source.

Soil Amendments; FIO.

A 10 pound sample.

SD-18 Records

Quantity Check; FIO.

Bag count or bulk weight measurements of material used compared with area covered to determine the application rate and quantity installed.

Seed Establishment Period; FIO.

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; FIO.

Maintenance work performed, area repaired or reinstalled, diagnosis for unsatisfactory stand of grass plants.

Application of Pesticide; FIO.

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.

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-01 and applicable state seed laws.

2.1.2 Permanent Seed Species and Mixtures

Permanent seed species and mixtures shall be proportioned by weight as indicated on the drawings.

2.1.3 Temporary Seed Species

Temporary seed species for surface erosion control or overseeding shall be as indicated on drawings.

2.1.4 Quality

Weed seed shall be a maximum 1 percent by weight of the total mixture.

2.1.5 Seed Mixing

The mixing of seed may be done by the seed supplier prior to delivery, or on site as directed.

2.1.6 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 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS. 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 18 percent nitrogen, 24 percent phosphorus, and 6 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

The nutrients ratio shall be 18 percent nitrogen, 24 percent phosphorus, and 6 percent potassium. Nitrogen carrier fertilizer shall be commercial grade, free flowing, and uniform in composition. The fertilizer may be a liquid nitrogen solution.

2.3.4 Organic Material

Organic material shall consist of either bonemeal, rotted manure, decomposed wood derivatives, recycled compost, or worm castings.

2.3.4.1 Bonemeal

Bonemeal shall be finely ground, steamed bone product containing from 2 to 4 percent nitrogen and 16 to 40 percent phosphoric acid.

2.3.4.2 Rotted Manure

Rotted manure shall be unleached horse, chicken or cattle manure containing a maximum 25 percent by volume of straw, sawdust, or other bedding materials. It shall contain no chemicals or ingredients harmful to plants. The manure shall be heat treated to kill weed seeds and be free of stones, sticks, and soil.

2.3.4.3 Decomposed Wood Derivatives

Decomposed wood derivatives shall be ground bark, sawdust, yard trimmings, or other wood waste material that is free of stones, sticks, soil, and toxic substances harmful to plants, and is fully composted or stabilized with nitrogen.

2.3.4.4 Recycled Compost

Compost shall be a well decomposed, stable, weed free organic matter source. Compost shall be derived from food; agricultural or industrial residuals; biosolids (treated sewage sludge); yard trimmings; or source-separated or mixed solid waste. The compost shall possess no objectionable odors and shall not resemble the raw material from which it was derived. The material shall not contain substances toxic to plants. Gradation: The compost material shall pass through a 3/8 inch screen, possess a pH of 5.5 to 8.0, and have a moisture content between 35-55 percent by weight. The material shall not contain more than 1 percent by weight of man-made foreign matter. Compost shall be cleaned of plastic

materials larger than 2 inches in length.

2.3.4.5 Worm Castings

Worm castings shall be screened from worms and food source, and shall be commercially packaged.

2.3.5 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.

2.3.5.1 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.

2.3.5.2 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.

2.3.5.3 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.

2.3.5.4 Gypsum

Gypsum shall be commercially packaged, free flowing, and a minimum 95 percent calcium sulfate by volume.

2.3.5.5 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.

2.4.3 Wood Cellulose Fiber

Wood cellulose fiber shall not contain any growth or germination-inhibiting factors and shall be dyed an appropriate color to facilitate placement during application. Composition on air-dry weight basis: 9 to 15 percent moisture, pH range from 4.5 to 6.0.

2.4.4 Paper Fiber

Paper fiber mulch shall be recycled news print that is shredded for the purpose of mulching seed.

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 as indicated on the drawings.

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 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS, 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 at the rate recommended on the plans. . 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 application rate shall be 1000 pounds per acre. 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 applied at the raterecommended on the plans. 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.

3.2.3 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 Field Area Debris

Debris and stones over a minimum 3 inch in any dimension shall be removed from the surface.

3.2.4.4 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 Broadcast 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 Broadcast Seeding

Half the total rate of seed application shall be broadcast in 1 direction, with the remainder of the seed rate broadcast at 90 degrees from the first direction. Seed shall be covered a maximum 1/4 inch depth by disk harrow, steel mat drag, cultipacker, or other approved device.

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.

3.3.2.3 Asphalt Adhesive Tackifier

Asphalt adhesive tackifier shall be sprayed at a rate between 10 to 13 gallons per 1000 square feet. Sunlight shall not be completely excluded from penetrating to the ground surface.

3.3.2.4 Non-Asphaltic Tackifier

Hydrophilic colloid shall be applied at the rate recommended by the manufacturer, using hydraulic equipment suitable for thoroughly mixing with water. A uniform mixture shall be applied over the area.

3.3.2.5 Asphalt Adhesive Coated Mulch

Hay or straw mulch may be spread simultaneously with asphalt adhesive applied at a rate between 10 to 13 gallons per 1000 square feet, using power mulch equipment which shall be equipped with suitable asphalt pump and nozzle. The adhesive-coated mulch shall be applied evenly over the surface. Sunlight shall not be completely excluded from penetrating to the ground surface.

3.3.2.6 Wood Cellulose Fiber, Paper Fiber, and Recycled Paper

Wood cellulose fiber, paper fiber, or recycled paper shall be applied as part of the hydroseeding operation. The mulch shall be mixed and applied in accordance with the manufacturer's recommendations.

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

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 work under this contract and shall end 3 months after the last day of the seeding operation. 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 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 20 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.

3.9.2.2 Field Area

A satisfactory stand of grass plants from the seeding operation for a field area shall be a minimum 10 grass plants per square foot. The total bare spots shall not exceed 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 and ditches 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.

b. Field Areas: Field areas shall be mowed once during the season to a minimum 3 inch height. Clippings shall be removed when the amount cut prevents sunlight from reaching the ground surface.

3.9.3.2 Post-Fertilization

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 --

SECTION 02935

TURF
06/90

PART 1 GENERAL

1.1 SUMMARY (Not Applicable)

1.2 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.

AGRICULTURAL MARKETING SERVICE (AMS)

AMS-01	(Sep 1977; Amended Oct 29, 1986) Federal Seed Act Regulations (Part 20): Certified Seed Regulations

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 977	(1986) Emulsified Asphalt
ASTM D 2028	(1976; R 1986) Cutback Asphalt (Rapid-Curing Type)

FEDERAL SPECIFICATIONS (FS)

FS O-F-241	(Rev D) Fertilizers, Mixed, Commercial
FS JJJ-S-181	(Rev B) Seeds, Agricultural

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL DESCRIPTIONS:

SD-01 Data

Manufacturer's Literature; FIO.

Manufacturer's literature discussing physical characteristics, application and installation instructions for erosion control material, and for chemical treatment material.

SD-07 Schedules

Equipment List; FIO.

A list of proposed pesticide application, seeding and mulching equipment to be used in performance of turfing operation, including descriptive data and calibration tests.

SD-08 Statements

Delivery; FIO.

Delivery schedule, at least 10 days prior to the intended date of the first delivery.

Maintenance Report; FIO.

Written record of maintenance work performed.

Turf Establishment Period; FIO.

Written calendar time period for the turf establishment period. When there is more than one turf establishment period, the boundaries of the turfed area covered for each period shall be described.

SD-13 Certificates

Certificates of compliance certifying that materials meet the requirements specified, prior to the delivery of materials. Certified copies of the reports for the following materials shall be included:

a. Seed: For mixture, percent pure live seed, minimum percent germination and hard seed, maximum percent weed seed content, date tested and state certification.

b. Sod: For species, mixture percentage, percent purity, field location.

c. Fertilizer: For chemical analysis, composition percent.

d. Agricultural Limestone: For calcium carbonate equivalent and sieve analysis.

g. Topsoil: For pH, particle size, chemical analysis and mechanical analysis.

1.4 SOURCE INSPECTIONS

Sod material will be subject to inspection by the Contracting Officer at the growing site.

1.5 DELIVERY, INSPECTION, STORAGE, AND HANDLING

1.5.1 Delivery

1.5.1.1 Protection

Sod shall be protected from drying out and contamination during delivery.

1.5.1.2 Topsoil

A soil test shall be provided for existing topsoil and topsoil delivered to the site.

1.5.1.3 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.

1.5.2 Inspection

Seed and sod shall be inspected upon arrival at the job site by the Contracting Officer for conformity to type and quality in accordance with paragraph MATERIALS. Other materials shall be inspected for meeting specified requirements and unacceptable materials shall be removed from the job site.

1.5.3 Storage

Materials shall be stored in areas designated by the Contracting Officer. Sod shall be lightly sprinkled with water, covered with moist burlap, straw, or other covering and protected from exposure to wind and direct sunlight until planted. Covering for sod shall allow air to circulate and prevent internal heat from building up. Seed, lime and fertilizer shall be stored in cool, dry locations away from contaminants. Chemical treatment materials shall not be stored with other landscape materials.

1.5.4 Handling

1.5.4.1 Materials

Care shall be taken to avoid injury to sod. Except for bulk deliveries, materials shall not be dropped or dumped from vehicles.

1.5.4.2 Time Limitation

a. Sod: Limitation of the time between harvesting and placing of sod shall be 36 hours.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Seed

2.1.1.1 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-01 and applicable state seed laws.

2.1.1.2 Seed Mixtures

Seed mixtures shall be proportioned by weight as follows:

Botanical Name	Common Name	Mixture Percent by Weight	Percent Pure Live Seed
Festuca Arundinacea	Kentucky31 Tall Fescue	50	44

Botanical Name	Common Name	Mixture Percent by Weight	Percent Pure Live Seed

2.1.1.3 Quality

Seed shall conform to FS JJJ-S-181. Weed seed shall not exceed 1 percent by weight of the total mixture. Wet, moldy, or otherwise damaged seed shall be rejected.

2.1.2 Topsoil

2.1.2.1 Topsoil Materials

Topsoil shall be natural, friable, loam topsoil possessing the characteristics of representative soils in the vacinity that produce heavy growths of crops, grass, or other vegetation, and shall be obtained from naturally well drained areas. The topsoil shall be free from subsoil, clay lumps, brush, objectionable weeds, and other litter, and shall be free from stones, stumps, and other objects larger than one-half inch in diameter, from roots and toxic substances, and from any other material or substance that might be harmful to plant growth or to be a hindrance to grading, planting, and maintenance operations.

2.1.2.2 Existing Topsoil

Existing topsoil on the project site, providing it meets the aforementioned characteristics, shall be stripped to the depth indicated and stockpiled on the site in accordance with Section 02210 GRADING, and amended by the addition of lime as a pH adjuster at the rate necessary to bring the soil pH within a range of 6.2 to 7.0.

2.1.2.3 Additional Topsoil

Additional topsoil, if required beyond that available from stripping operations, shall be a natural, friable soil representative of productive soils in the vicinity. It shall be obtained from well-drained borrow areas, provided by the Contractor, and shall be free of any admixture of subsoil, foreign matter, objects larger than one inch in any dimension, toxic substances, and any material or substance that may be harmful to plant growth. The pH range shall be 6.2 to 7.0. Topsoil that does not meet this pH range shall be amended by the addition of pH adjusters, at a rate recommended based on soil tests.

2.1.3 Soil Amendments

Soil amendments shall consist of lime, fertilizer, and soil conditioners meeting the following requirements.

2.1.3.1 Lime

Lime shall be agricultural limestone and shall have a minimum calcium carbonate equivalent of 90 percent and shall be ground to such a fineness that at least 90 percent will pass a 10-mesh sieve and at least 50 percent will pass a 60-mesh sieve.

2.1.3.2 Fertilizer

Fertilizer shall be commercial grade, free flowing, uniform in composition

and conforming to FS O-F-241. Granular Fertilizer: As recommended by the soil test.

2.1.3.3 Calcined Clay

Granular particles produced from montmorillonite clay calcined to minimum temperature of 1200 degrees F to the following gradation: minimum 90 percent passing 8-mesh screen, 99 percent retained on 60-mesh screen and maximum 2 percent passing 100-mesh screen. Bulk density: maximum 40 pounds per cubic foot.

2.1.4 Mulch

Mulch shall be free from weeds, mold, and other deleterious materials.

2.1.4.1 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.

2.1.4.2 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.

2.1.4.3 Wood Cellulose Fiber

Wood cellulose fiber shall not contain any growth or germination-inhibiting factors and shall be dyed an appropriate color to facilitate visual metering during application. Composition on air-dry weight basis: 9 to 15 percent moisture, pH range from 4.5 to 6.0.

2.1.4.4 Paper Fiber Mulch

Paper fiber mulch shall be recycled news print that is shredded for the purpose of mulching seed.

2.1.5 Water

Water shall not contain elements toxic to plant life.

2.1.6 Erosion Control Material

Soil erosion control shall conform to the following:

2.1.6.1 Soil Erosion Control Blanket

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.

2.1.6.2 Soil Erosion Control Fabric

Knitted construction of polypropylene yarn with uniform mesh openings 3/4 to 1 inch square with strips of biodegradable paper. Filler paper strips shall last 6 to 8 months.

2.1.6.3 Soil Erosion Control Net

Heavy, twisted jute mesh weighing approximately 1.22 pounds per linear yard and 4 feet wide with mesh openings of approximately 1 inch square.

2.1.6.4 Soil Erosion Control Chemicals

High-polymer synthetic resin or cold-water emulsion of selected petroleum resins.

2.1.6.5 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 must resist mold growth.

2.1.6.6 Anchors

Erosion control anchor material shall be as recommended by the manufacturer.

PART 3 EXECUTION

3.1 SEEDING AND SODDING TIMES, CONDITIONS, AND AREAS

3.1.1 Seeding Time

Seed shall be sown from February to April for spring planting and from September to November for fall planting.

3.2 SITE PREPARATION

3.2.1 Grading

The Contracting Officer shall verify that finished grades are as indicated on drawings, and the placing of topsoil and the smooth grading has been completed in accordance with Section 02210 GRADING.

3.2.2 Application of Soil Amendments

3.2.2.1 Soil Test

A soil test shall be performed for pH, chemical analysis and mechanical analysis to establish the quantities and type of soil amendments required to meet local growing conditions for the type and variety of turf specified.

3.2.2.2 Lime

Lime shall be applied at the rate recommended by the soil test. Lime shall be incorporated into the soil to a minimum depth of 4 inches or may be incorporated as part of the tillage operation.

3.2.2.3 Fertilizer

Fertilizer shall be applied at the rate recommended by the soil test. Fertilizer shall be incorporated into the soil to a minimum depth of 4 inches or may be incorporated as part of the tillage or hydroseeding operation.

3.2.3 Placing Topsoil

Topsoil shall be distributed uniformily and spread evenly to an average thickness of three inches, with a minimum thickness of two inches. Topsoil shall be spread so that planting can proceed with little additional soil preparation or additional tillage. Surface irregularities resulting from topsoiling or other operations shall be leveled to prevent depressions. Grade shall be adjusted to assure that planted grade will be one inch below adjoining grade of any surfaced area. Topsoil shall not be placed when the subgrade is frozen, excessively wet, extremely dry, excessively compacted, or in a condition detrimental to the proposed planting or grading. Soil compacted by construction equipment or soil on compacted cut slopes of grades shall be pullverised to a minimum depth of two inches by disking or plowing before applying topsoil.

3.2.4 Tillage

3.2.4.1 Minimum Depth

Soil on slopes gentler than 3-horizontal-to-1-vertical shall be tilled to a minimum depth of 4 inches. On slopes between 3-horizontal-to-1-vertical and 1-horizontal-to-1 vertical, the soil shall be tilled to a minimum depth of 2 inches 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.

3.2.5 Finished Grading

3.2.5.1 Preparation

Turf areas shall be filled as needed or have surplus soil removed to attain the finished grade. Drainage patterns shall be maintained as indicated on drawings. Turf areas compacted by construction operations shall be completely pulverized by tillage. Soil used for repair of erosion or grade deficiencies shall conform to topsoil requirements specified in Section 02210 GRADING. Finished grade shall be 1 inch below the adjoining grade of any surfaced area. New surfaces shall be blended to existing areas.

3.2.5.2 Lawn Area Debris

Lawn areas shall have debris and stones larger than 1 inch in any dimension removed from the surface.

3.3 SEEDING

3.3.1 General

Prior to seeding, any previously prepared seedbed areas compacted or damaged by interim rain, traffic or other cause, shall be reworked to restore the ground condition previously specified. Seeding operations shall not take place when the wind velocity will prevent uniform seed distribution.

3.3.2 Equipment Calibration

The equipment to be used and the methods of turfing shall be subject to the inspection and approval of the Contracting Officer prior to commencement of turfing operations. Immediately prior to the commencement of turfing

operations, the Contractor shall conduct turfing equipment calibration tests in the presence of the Contracting Officer.

3.3.3 Applying Seed

3.3.3.1 Broadcast Seeding

Seed shall be uniformly broadcast at the rate of 5 pounds per 1000 square feet using broadcast seeders. Half of seed shall be broadcast in one direction, and the remainder at right angles to the first direction. Seed shall be covered to an average depth of 1/4 inch by disk harrow, steel mat drag, cultipacker, or other approved device.

3.3.3.2 Rolling

Immediately after seeding, except for slopes 3-horizontal-to-1 vertical and greater, the entire area shall be firmed with a roller not exceeding 90 pounds for each foot of roller width. Areas seeded with seed drills equipped with rollers shall not be rolled.

3.3.4 Hydroseeding

Seed and fertilizer shall be added to water and thoroughly mixed at the rates specified. Slurry shall be uniformly applied under pressure over the entire area. The hydroseeded area shall not be rolled.

3.3.5 Mulch

3.3.5.1 Straw or Hay Mulch

Straw or hay 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 a steep slope and continued uniformly until the area is covered. The mulch shall not be bunched. All seeded areas shall be mulched on the same day as the seeding.

3.3.5.2 Mechanically Anchoring

Immediately following spreading, the mulch shall be anchored to the soil by a V-type-wheel land packer, a scalloped-disk land packer designed to force mulch into the soil surface, or other suitable equipment.

3.3.5.3 Non-Asphaltic Tackifier

Hydrophilic colloid shall be applied at rate recommended by manufacturer. Apply with hydraulic equipment suitable for mixing and applying uniform mixture of tackifier.

3.3.5.4 Wood Cellulose Fiber

Wood cellulose fiber mulch for use with the hydraulic application of seed and fertilizer shall be applied as part of the hydroseeding operation.

3.3.6 Water

Watering shall be started within 7 days after completing the seeded area. Water shall be applied at a rate sufficient to ensure moist soil conditions to a minimum depth of 1 inch. Run-off and puddling shall be prevented.

3.4 EROSION CONTROL

3.4.1 Erosion Control Material

Erosion control material, where indicated or required, shall be installed in accordance with manufacturer's instructions. Placement of the erosion control material shall be accomplished without damage to installed material or without deviation to finished grade.

3.4.2 Temporary Turf Cover

3.4.2.1 General

When there are contract delays in the turfing operation or a quick cover is required to prevent erosion, the areas designated for turf shall be seeded with a temporary seed as directed by the Contracting Officer.

3.4.2.2 Application

When no other turfing materials have been applied, the quantity of one half of the required soil amendments shall be applied and the area tilled in accordance with paragraph SITE PREPARATION. Seed shall be uniformly broadcast and applied at the rate of 5 pounds per 1000 square feet. The area shall be watered as required.

3.5 RESTORATION AND CLEAN UP

3.5.1 Restoration

Existing turf areas, pavements and facilities that have been damaged from the turfing operation shall be restored to original condition at Contractor's expense.

3.5.2 Clean Up

Excess and waste material shall be removed from the planting operation and shall be disposed of off the site. Adjacent paved areas shall be cleaned.

3.6 PROTECTION OF TURFED AREAS

Immediately after turfing, the area shall be protected against traffic or other use by erecting barricades and providing signage as required, or as directed by the Contracting Officer.

3.7 TURF ESTABLISHMENT PERIOD

3.7.1 Commencement

The Turf Establishment Period for establishing a healthy stand of turf shall begin on the first day of work under this contract and shall end three (3) months after the last day of turfing operations required by this contract. Written calendar time period shall be furnished to the Contracting Officer for the Turf Establishment Period. When there is more than one turf establishment period, describe the boundaries of the turfed area covered for each period.

3.7.2 Satisfactory Stand of Turf

3.7.2.1 Seeded Area

a. Lawn Area: A satisfactory stand of turf from the seeding operation for a lawn area is defined as a minimum of 15 grass plants per square foot. Bare spots shall reseeded.

b. Field Area: A satisfactory stand of turf from the seeding operation for a field area is defined as a minimum of 10 grass plants per square foot. Bare spots shall be reseeded.

3.7.2.2 Sodded Area

A satisfactory stand of turf from the sodding operation is defined as living sod uniform in color and leaf texture. Bare spots shall be no larger than 2 inches square.

3.7.3 Maintenance During Establishment Period

3.7.3.1 General

Maintenance of the turfed areas shall include eradicating weeds, eradicating insects and diseases, protecting embankments and ditches from erosion, maintaining erosion control materials and mulch, protecting turfed areas from traffic, mowing, watering, and post-fertilization.

3.7.3.2 Mowing

a. Lawn Areas: Lawn areas shall be mowed to a minimum height of 2 inches when the average height of the turf becomes 4 inches. Clippings shall be removed when the amount of cut turf is heavy enough to damage the turfed areas.

b. Field Areas: Field areas shall be mowed once during the season to a minimum height of 8 inches.

3.7.3.3 Watering

Watering shall be at intervals to obtain a moist soil condition to a minimum depth of 1 inch. Frequency of watering and quantity of water shall be adjusted in accordance with the growth of the turf. Run-off, puddling and wilting shall be prevented.

3.7.3.4 Post-Fertilization

Nitrogen carrier fertilizer shall be applied at the rate of 5 pounds per 1000 square feet after the first month and again prior to the final acceptance. The application shall be timed prior to the advent of winter dormancy and shall avoid excessively high nitrogen levels.

3.7.3.5 Repair

The Contractor shall re-establish as specified herein, eroded, damaged or barren areas. Mulch shall also be repaired or replaced as required.

3.7.3.6 Maintenance Report

A written record shall be furnished to the Contracting Officer of the maintenance work performed.

3.8 FINAL ACCEPTANCE

3.8.1 Preliminary Inspection

Prior to the completion of the Turf Establishment Period, a preliminary inspection shall be held by the Contracting Officer. Time for the inspection shall be established in writing. The acceptability of the turf in accordance with the Turf Establishment Period shall be determined. An unacceptable stand of turf shall be repaired as soon as turfing conditions permit.

3.8.2 Final Inspection

A final inspection shall be held by the Contracting Officer to determine that deficiencies noted in the preliminary inspection have been corrected. Time for the inspection shall be established in writing.

-- End of Section --

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 578	(1995) Rigid, Cellular Polystyrene Thermal Insulation

U.S. DEPARTMENT OF COMMERCE (DOC)

DOC PS 1	(1996) Voluntary Product Standard - Construction and Industrial Plywood

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

Formwork; G, SWVAO

Drawings showing details of formwork, including dimensions of fiber voids, joints, supports, studding and shoring, and sequence of form and shoring removal.

SD-03 Product Data

Design; G, SWVAO

Design analysis and calculations for form design and methodology used in the design.

Form Materials; G, SWVAO

Manufacturer's data including literature describing form materials, accessories, and form releasing agents.

Form Releasing Agents; G, SWVAO

Manufacturer's recommendation on method and rate of application of form releasing agents.

SD-04 Samples

Fiber Voids; G, SWVAO

One sample unit of fiber voids prior to installation of the voids.

SD-07 Certificates

Fiber Voids; G, SWVAO

Certificates attesting that fiber voids conform to the specified requirements.

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.

1.4 STORAGE AND HANDLING

Fiber voids shall be stored above ground level in a dry location. Fiber voids shall be kept dry until installed and overlaid with 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 DOC PS 1, 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. Forms for round columns shall be the prefabricated seamless type.

2.1.2 Forms For Class C Finish

Forms for Class C finished surfaces shall be shiplap lumber; plywood conforming to DOC PS 1, 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. Forms for round columns may have one vertical seam.

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 Retain-In-Place Metal Forms

Retain-in-place metal forms for concrete slabs and roofs shall be as specified in Section 05300 STEEL DECKING.

2.1.5 Pan-Form Units

Pan-form units for one-way or two-way concrete joist and slab construction shall be factory-fabricated units of the approximate section indicated. Units shall consist of steel or molded fiberglass concrete form pans. Closure units shall be furnished as required.

2.1.6 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.

2.1.7 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.

2.1.8 Fiber Voids

Fiber voids shall be the product of a reputable manufacturer regularly engaged in the commercial production of fiber voids. The voids shall be constructed of double faced, corrugated fiberboard. The corrugated fiberboard shall be fabricated of [wet strength] [standard kraft] paper liners, impregnated with paraffin, and laminated with moisture resistant adhesive, and shall have a board strength of 275 psi. Voids which are impregnated with paraffin after construction, in lieu of being constructed with paraffin impregnated fiberboard, are acceptable. Voids shall be designed to support not less than 1000 psf. To prevent separation during concrete placement fiber voids shall be assembled with steel or plastic banding at 4 feet on center maximum, or by adequate stapling or gluing as recommended by the manufacturer. Fiber voids placed under concrete slabs and that are 8 inches in depth may be heavy duty "waffle box" type, constructed of paraffin impregnated corrugated fiberboard.

2.2 FIBER VOID RETAINERS

2.2.1 Polystyrene Rigid Insulation

Polystyrene rigid insulation shall conform to ASTM C 578, Type V, VI, or

VII, square edged. Size shall be 1-1/2 inches thick by 16 inches in height by 3 feet in length, unless otherwise indicated.

2.2.2 Precast Concrete

Precast concrete units shall have a compressive strength of not less than 2500 psi, reinforced with 6 inch by 6 inch by W1.4 WWF wire mesh, and 12 inches (height) by 3 feet (length) by 1-5/8 inches (thickness) in size unless indicated.

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.

3.1.2 Fiber Voids

Voids shall be placed on a smooth firm dry bed of suitable material, to avoid being displaced vertically, and shall be set tight, with no buckled cartons, in order that horizontal displacement cannot take place. Each section of void shall have its ends sealed by dipping in paraffin, with any additional cutting of voids at the jobsite to be field dipped in the same type of sealer, unless liners and flutes are completely impregnated with paraffin. Prior to placing reinforcement, the entire formed area for slabs shall be covered with a 4 x 8 feet minimum flat sheets of fiber void corrugated fiberboard. Joints shall be sealed with a moisture resistant tape having a minimum width of 3 inches. If voids are destroyed or damaged and are not capable of supporting the design load, they shall be replaced prior to placing of concrete.

3.1.3 Fiber Void Retainers

Fiber void retainers shall be installed, continuously, on both sides of fiber voids placed under grade beams in order to retain the cavity after the fiber voids biodegrade.

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. Supporting forms and shores shall not be removed from beams, floors and walls until the structural units are strong enough to carry their own weight and any other construction or natural loads. Supporting forms or shores shall not be removed before the concrete strength has reached 70 percent of design strength, as determined by field cured cylinders or other approved methods. This strength shall be demonstrated by job-cured test specimens, and by a structural analysis considering the proposed loads in relation to these test strengths and the strength of forming and shoring system. The job-cured test specimens for form removal purposes shall be provided in numbers as directed and shall be in addition to those required for concrete quality control. The specimens shall be removed from molds at the age of 24 hours and shall receive, insofar as possible, the same curing and protection as the structures they represent.

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
b. For exposed corner columns,control-joint grooves, and other conspicuous lines	In any 20 feet of length ---------- ---- 1/4 inch Maximum for entire length---------- 1/2 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 slab soffits, ceilings, beam soffits, and in arises, measured before removal of supporting shores	Maximum for entire length ---------- 3/4 inch

TABLE 1

TOLERANCES FOR FORMED SURFACES

b. In exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines	In any bay or in any 20 feet of length ---------- ----- 1/4 inch 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 beams 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

-- End of Section --

SECTION 03150A

EXPANSION JOINTS, CONTRACTION JOINTS, AND WATERSTOPS
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.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO T 111	(1983; R 1996)) Inorganic Matter or Ash in Bituminous Materials

AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.4	(1995) Basic Hardboard

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 109/A 109M	(1998a) Steel, Strip, Carbon, Cold-Rolled
ASTM A 167	(1999) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 480/A 480M	(1999b) General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip
ASTM A 570/A 570M	(1998) Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality
ASTM B 152	(1997a) Copper Sheet, Strip, Plate, and Rolled Bar
ASTM B 152M	(1997a) Copper Sheet, Strip, Plate, and Rolled Bar (Metric)
ASTM B 370	(1998) Copper Sheet and Strip for Building Construction
ASTM C 919	(1984; R 1998) Use of Sealants in Acoustical Applications
ASTM C 920	(1998) Elastomeric Joint Sealants
ASTM D 4	(1986; R 1998) Bitumen Content

ASTM D 6	(1995) Loss on Heating of Oil and Asphaltic Compounds
ASTM D 412	(1998a) Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension
ASTM D 471	(1998el) Rubber Property - Effect of Liquids
ASTM D 1190	(1997) Concrete Joint Sealer, Hot-Applied Elastic Type
ASTM D 1191	(1984; R 1994el)

Concrete Joint Sealers

ASTM D 1751	(1999) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	(1984; R 1996el) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D 1854	(1996) Jet-Fuel-Resistant Concrete Joint Sealer, Hot-Poured Elastic Type
ASTM D 2628	(1991; R 1998) Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements
ASTM D 2835	(1989; R 1998) Lubricant for Installation of Preformed Compression Seals in Concrete Pavements
ASTM D 5249	(1995) Backer Material for Use With Cold and Hot-Applied Joint Sealants in Portland-Cement Concrete and Asphalt Joints
ASTM D 5329	(1996) Standard Test Method for Sealants and Fillers, Hot-Applied, for Joints and Cracks in Asphaltic and Portland Cement Concrete Pavements

U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 513	(1974) Corps of Engineers Specifications for Rubber Waterstops
COE CRD-C 572	(1974) Corps of Engineers Specifications for Polyvinylchloride Waterstop

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

Waterstops

Shop drawings and fabrication drawings provided by the manufacturer or prepared by the Contractor.

SD-03 Product Data

Preformed Expansion Joint Filler
Sealant

Waterstops

Manufacturer's literature, including safety data sheets, for preformed fillers and the lubricants used in their installation; field-molded sealants and primers (when required by sealant manufacturer); preformed compression seals; and waterstops.

Manufacturer's recommended instructions for installing preformed fillers, field-molded sealants; preformed compression seals; and waterstops; and for splicing non-metallic waterstops.

SD-07 Certificates

Preformed Expansion Joint Filler
Sealant
Waterstops

Certificates of compliance stating that the joint filler and sealant materials and waterstops conform to the requirements specified.

1.3 DELIVERY AND STORAGE

Material delivered and placed in storage shall be stored off the ground and protected from moisture, dirt, and other contaminants. Sealants shall be delivered in the manufacturer's original unopened containers. Sealants whose shelf life has expired shall be removed from the site.

PART 2 PRODUCTS

2.1 CONTRACTION JOINT STRIPS

Contraction joint strips shall be 1/8 inch thick tempered hardboard conforming to AHA A135.4, Class 1. In lieu of hardboard strips, rigid polyvinylchloride (PVC) or high impact polystyrene (HIPS) insert strips specifically designed to induce controlled cracking in slabs on grade may be used. Such insert strips shall have removable top section.

2.2 PREFORMED EXPANSION JOINT FILLER

Expansion joint filler shall be preformed material conforming to ASTM D 1751 or ASTM D 1752. Unless otherwise indicated, filler material shall be 3/8 inch thick and of a width applicable for the joint formed. Backer material, when required, shall conform to ASTM D 5249.

2.3 SEALANT

Joint sealant shall conform to the following:

2.3.1 Preformed Polychloroprene Elastomeric Type

ASTM D 2628.

2.3.2 Lubricant for Preformed Compression Seals

ASTM D 2835.

2.3.3 Hot-Poured Type

ASTM D 1190 tested in accordance with ASTM D 1191.

2.3.4 Field-Molded Type

ASTM C 920, Type M for horizontal joints or Type NS for vertical joints, Class 25, and Use NT. Bond breaker material shall be polyethylene tape, coated paper, metal foil or similar type materials. The back-up material shall be compressible, non-shrink, nonreactive with sealant, and non-absorptive material type such as extruded butyl or polychloroprene rubber.

2.3.5 Hot-Applied Jet-Fuel Resistant Type

ASTM D 1854 tested in accordance with ASTM D 5329.

2.4 WATERSTOPS

Intersection and change of direction waterstops shall be shop fabricated.

2.4.1 Flexible Metal

Copper waterstops shall conform to ASTM B 152 and ASTM B 370, O60 soft anneal temper and 20 oz mass per sq ft sheet thickness. Stainless steel waterstops shall conform to ASTM A 167 and ASTM A 480/A 480M, UNS S30453 (Type 304L), and 20 gauge thick strip.

2.4.2 Rigid Metal

Flat steel waterstops shall conform to ASTM A 109/A 109M, No. 2 (half hard) temper, No. 2 edge, No. 1 (matte or dull) finish or ASTM A 570/A 570M, Grade 40.

2.4.3 Non-Metallic Materials`

Non-metallic waterstops shall be manufactured from a prime virgin resin; reclaimed material is not acceptable. The compound shall contain plasticizers, stabilizers, and other additives to meet specified requirements. Rubber waterstops shall conform to COE CRD-C 513. Polyvinylchloride waterstops shall conform to COE CRD-C 572. Thermoplastic elastomeric rubber waterstops shall conform to ASTM D 471.

2.4.4 Non-Metallic Hydrophilic

Swellable strip type compound of polymer modified chloroprene rubber that swells upon contact with water shall conform to ASTM D 412 as follows: Tensile strength 420 psi minimum; ultimate elongation 600 percent minimum. Hardness shall be 50 minimum on the type A durometer and the volumetric expansion ratio in distilled water at 70 degrees F shall be 3 to 1 minimum.

2.4.5 Preformed Elastic Adhesive

Preformed plastic adhesive waterstops shall be produced from blends of refined hydrocarbon resins and plasticizing compounds reinforced with inert mineral filler, and shall contain no solvents, asbestos, irritating fumes or obnoxious odors. The compound shall not depend on oxidizing, evaporating, or chemical action for its adhesive or cohesive strength.

2.4.5.1 Chemical Composition

The chemical composition of the sealing compound shall meet the requirements shown below:

	PERCENT BY WEIGHT		
COMPONENT	MIN.	MAX.	TEST
Bitumen (Hydrocarbon plastic)	50	70	ASTM D 4
Inert Mineral Filler	30	50	AASHTO T 111
Volatile Matter		2	ASTM D 6

2.4.5.2 Adhesion Under Hydrostatic Pressure

The sealing compound shall not leak at the joints for a period of 24 hours under a vertical 6 foot head pressure. In a separate test, the sealing compound shall not leak under a horizontal pressure of 10 psi which is reached by slowly applying increments of 2 psi every minute.

2.4.5.3 Sag of Flow Resistance

Sagging shall not be detected when tested as follows: Fill a wooden form 1 inch wide and 6 inches long flush with sealing compound and place in an oven at 135 degrees F in a vertical position for 5 days.

2.4.5.4 Chemical Resistance

The sealing compound when immersed separately in a 5% solution of caustic potash, a 5% solution of hydrochloric acid, 5% solution of sulfuric acid and a saturated hydrogen sulfide solution for 30 days at ambient room temperature shall show no visible deterioration.

PART 3 EXECUTION

3.1 JOINTS

Joints shall be installed at locations indicated and as authorized.

3.1.1 Contraction Joints

Contraction joints may be constructed by inserting tempered hardboard strips or rigid PVC or HIPS insert strips into the plastic concrete using a steel parting bar, when necessary, or by cutting the concrete with a saw after concrete has set. Joints shall be approximately 1/8 inch wide and shall extend into the slab one-fourth the slab thickness, minimum, but not less than 1 inch.

3.1.1.1 Joint Strips

Strips shall be of the required dimensions and as long as practicable. After the first floating, the concrete shall be grooved with a tool at the joint locations. The strips shall be inserted in the groove and depressed until the top edge of the vertical surface is flush with the surface of the slab. The slab shall be floated and finished as specified. Working of the concrete adjacent to the joint shall be the minimum necessary to fill voids and consolidate the concrete. Where indicated, the top portion of the strip shall be sawed out after the curing period to form a recess for sealer. The removable section of PVC or HIPS strips shall be discarded and the insert left in place. True alignment of the strips shall be maintained

during insertion.

3.1.1.2 Sawed Joints

Joint sawing shall be early enough to prevent uncontrolled cracking in the slab, but late enough that this can be accomplished without appreciable spalling. Concrete sawing machines shall be adequate in number and power, and with sufficient replacement blades to complete the sawing at the required rate. Joints shall be cut to true alignment and shall be cut in sequence of concrete placement. Sludge and cutting debris shall be removed.

3.1.2 Expansion Joints

Preformed expansion joint filler shall be used in expansion and isolation joints in slabs around columns and between slabs on grade and vertical surfaces where indicated. The filler shall extend the full slab depth, unless otherwise indicated. The edges of the joint shall be neatly finished with an edging tool of 1/8 inch radius, except where a resilient floor surface will be applied. Where the joint is to receive a sealant, the filler strips shall be installed at the proper level below the finished floor with a slightly tapered, dressed and oiled wood strip temporarily secured to the top to form a recess to the size shown on the drawings. The wood strip shall be removed after the concrete has set. Contractor may opt to use a removable expansion filler cap designed and fabricated for this purpose in lieu of the wood strip. The groove shall be thoroughly cleaned of laitance, curing compound, foreign materials, protrusions of hardened concrete, and any dust which shall be blown out of the groove with oil-free compressed air.

3.1.3 Joint Sealant

Sawed contraction joints and expansion joints in slabs shall be filled with joint sealant, unless otherwise shown. Joint surfaces shall be clean, dry, and free of oil or other foreign material which would adversely affect the bond between sealant and concrete. Joint sealant shall be applied as recommended by the manufacturer of the sealant.

3.1.3.1 Joints With Preformed Compression Seals

Compression seals shall be installed with equipment capable of installing joint seals to the prescribed depth without cutting, nicking, twisting, or otherwise distorting or damaging the seal or concrete and with no more than 5 percent stretching of the seal. The sides of the joint and, if necessary, the sides of the compression seal shall be covered with a coating of lubricant. Butt joints shall be coated with liberal applications of lubricant.

3.1.3.2 Joints With Field-Molded Sealant

Joints shall not be sealed when the sealant material, ambient air, or concrete temperature is less than 40 degrees F. When the sealants are meant to reduce the sound transmission characteristics of interior walls, ceilings, and floors the guidance provided in ASTM C 919 shall be followed. Joints requiring a bond breaker shall be coated with curing compound or with bituminous paint. Bond breaker and back-up material shall be installed where required. Joints shall be primed and filled flush with joint sealant in accordance with the manufacturer's recommendations.

3.2 WATERSTOPS, INSTALLATION AND SPLICES

Waterstops shall be installed at the locations shown to form a continuous water-tight diaphragm. Adequate provision shall be made to support and completely protect the waterstops during the progress of the work. Any waterstop punctured or damaged shall be repaired or replaced. Exposed waterstops shall be protected during application of form release agents to avoid being coated. Suitable guards shall be provided to protect exposed projecting edges and ends of partially embedded waterstops from damage when concrete placement has been discontinued. Splices shall be made by certified trained personnel using approved equipment and procedures.

3.2.1 Copper And Stainless Steel

Splices in copper waterstops shall be lap joints made by brazing. Splices in stainless steel waterstops shall be welded using a TIG or MIG process utilizing a weld rod to match the stainless. All welds shall not be annealed to maintain physical properties. Carbon flame shall not be used in the annealing process. Damaged waterstops shall be repaired by removing damaged portions and patching. Patches shall overlap a minimum of 1 inch onto undamaged portion of the waterstop.

3.2.2 Flat Steel

Splices in flat steel waterstops shall be properly aligned, butt welded, and cleaned of excessive material.

3.2.3 Non-Metallic

Fittings shall be shop made using a machine specifically designed to mechanically weld the waterstop. A miter guide, proper fixturing (profile dependant), and portable power saw shall be used to miter cut the ends to be joined to ensure good alignment and contact between joined surfaces. The splicing of straight lengths shall be done by squaring the ends to be joined. Continuity of the characteristic features of the cross section of the waterstop (ribs, tabular center axis, protrusions, etc.) shall be maintained across the splice.

3.2.3.1 Rubber Waterstop

Splices shall be vulcanized or shall be made using cold bond adhesive as recommended by the manufacturer. Splices for TPE-R shall be as specified for PVC.

3.2.3.2 Polyvinyl Chloride Waterstop

Splices shall be made by heat sealing the adjacent waterstop edges together using a thermoplastic splicing iron utilizing a non-stick surface specifically designed for waterstop welding. The correct temperature shall be used to sufficiently melt without charring the plastic. The spliced area, when cooled, shall show no signs of separation, holes, or other imperfections when bent by hand in as sharp an angle as possible.

3.2.3.3 Quality Assurance

Edge welding will not be permitted. Centerbulbs shall be compressed or closed when welding to non-centerbulb type. Waterstop splicing defects which are unacceptable include, but are not limited to the following: 1) Tensile strength less than 80 percent of parent section. 2) Free lap joints. 3) Misalignment of centerbulb, ribs, and end bulbs greater than

1/16 inch. 4) Misalignment which reduces waterstop cross section more than 15 percent. 5) Bond failure at joint deeper than 1/16 inch or 15 percent of material thickness. 6) Misalignment of waterstop splice resulting in misalignment of waterstop in excess of 1/2 inch in 10 feet. 7) Visible porosity in the weld area, including pin holes. 8) Charred or burnt material. 9) Bubbles or inadequate bonding. 10) Visible signs of splice separation when cooled splice is bent by hand at a sharp angle.

3.2.4 Non-Metallic Hydrophilic Waterstop Installation

Ends to be joined shall be miter cut with sharp knife or shears. The ends shall be adhered with cyanacryiate (super glue) adhesive. When joining hydrophilic type waterstop to PVC waterstop, the hydrophilic waterstop shall be positioned as shown on the drawings. A liberal amount of a single component hydrophilic sealant shall be applied to the junction to complete the transition.

3.2.5 Preformed Plastic Adhesive Installation

The installation of preformed plastic adhesive waterstops shall be a prime, peel, place and pour procedure. Joint surfaces shall be clean and dry before priming and just prior to placing the sealing strips. The end of each strip shall be spliced to the next strip with a 1 inch overlap; the overlap shall be pressed firmly to release trapped air. During damp or cold conditions the joint surface shall be flashed with a safe, direct flame to warm and dry the surface adequately; the sealing strips shall be dipped in warm water to soften the material to achieve maximum bond to the concrete surface.

3.3 CONSTRUCTION JOINTS

Construction joints are specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE except that construction joints coinciding with expansion and contraction joints shall be treated as expansion or contraction joints as applicable.

-- End of Section --

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	(1995) Building Code Requirements for Structural Concrete and Commentary
ACI 318M	(1995) Building Code Requirements for Structural Concrete and Commentary (Metric)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53	(1999) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 82	(1997a) Steel Wire, Plain, for Concrete Reinforcement
ASTM A 184/A 184M	(1996) Fabricated Deformed Steel Bar Mats for Concrete Reinforcement
ASTM A 185	(1997) Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM A 496	(1997) Steel Wire, Deformed, for Concrete Reinforcement
ASTM A 497	(1997) Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement
ASTM A 615/A 615M	(1996a) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 675/A 675M	(1990a; R 1995e1) Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties
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
ASTM A 884/A 884M	(1996ae1) Epoxy-Coated Steel Wire and Welded Wire Fabric for Reinforcement
ASTM C 1116	(1995) Fiber-Reinforced Concrete and Shotcrete

AMERICAN WELDING SOCIETY (AWS)

AWS D1.4	(1998) Structural Welding Code - Reinforcing Steel

CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

CRSI MSP-1	(1996) 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, SWVAO

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-03 Product Data

Welding;

A list of qualified welders names.

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 WELDING

Welders shall be qualified in accordance with AWS D1.4. Qualification test shall be performed at the worksite and the Contractor shall notify the Contracting Officer 24 hours prior to conducting tests. Special welding procedures and welders qualified by others may be accepted as permitted by AWS D1.4.

1.4 DELIVERY AND STORAGE

Reinforcement and accessories shall be stored off the ground on platforms,

skids, or other supports.

PART 2 PRODUCTS

2.1 DOWELS

Dowels shall conform to ASTM A 675/A 675M, Grade 80. Steel pipe conforming to ASTM A 53, Schedule 80, may be used as dowels provided the ends are closed with metal or plastic inserts or with mortar.

2.2 FABRICATED BAR MATS

Fabricated bar mats shall conform to ASTM A 184/A 184M.

2.3 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. Cold drawn wire used for spiral reinforcement shall conform to ASTM A 82. 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.

2.4 WELDED WIRE FABRIC

Welded wire fabric shall conform to ASTM A 185, ASTM A 496, ASTM A 497and shall be furnished in flat sheets only. When directed by the Contracting Officer for special applications, welded wire fabric shall conform to ASTM A 884/A 884M.

2.5 WIRE TIES

Wire ties shall be 16 gauge or heavier black annealed steel wire.

2.6 SUPPORTS

Bar supports for formed surfaces shall be designed and fabricated in accordance with CRSI MSP-1 and shall be steel. 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. 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. The maximum acceptable size of precast concrete blocks shall be 4" x 4" when used for slabs-on-grade construction.

2.7 SYNTHETIC FIBER REINFORCEMENT

Synthetic fiber shall be polypropylene with a denier less than 100 and a nominal fiber length of 2 inches.

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 or welded butt connection; except that lap splices shall not be used for bars larger than No. 11 unless otherwise indicated. Welding shall conform to AWS D1.4. Welded butt splices shall be full penetration butt welds. 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 3 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.

3.3 DOWEL INSTALLATION

Dowels shall be installed in slabs on grade at locations indicated and at right angles to joint being doweled. Dowels shall be accurately positioned and aligned parallel to the finished concrete surface before concrete placement. Dowels shall be rigidly supported during concrete placement. One end of dowels shall be coated with a bond breaker.

-- End of Section --

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SECTION 03250

EXPANSION JOINTS, CONTRACTION JOINTS, AND WATERSTOPS

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 HARDBOARD ASSOCIATION (AHA)

AHA A135.4	(1982; R 1988) Basic Hardboard

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 1751	(1983; R 1991) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	(1984; R 1992) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D 2628	(1991) Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements
ASTM D 2835	(1989) Lubricant for Installation of Preformed Compression Seals in Concrete Pavements

CORPS OF ENGINEERS (COE)

COE CRD-C 513	(1974) Corps of Engineers Specifications for Rubber Waterstops
COE CRD-C 572	(1974) Corps of Engineers Specifications for Polyvinylchloride Waterstops

1.2 SUBMITTALS

Submittals of material that is used in exposed areas of secondary containment dikes, pump pads, parshall flumes and MH's to verify compatibility of specific product per the requirements of Para. IV of Attachment I to Section 01005 SPECIAL WORK RESTRICTIONS AND REQUIREMENTS.

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The

following shall be submitted in accordance with Section 01300 SUBMITTAL DESCRIPTIONS:

SD-01 Data

Materials; GA.

Manufacturer's catalog data and manufacturer's recommended instructions for splicing of waterstops.

SD-13 Certificates

Materials; GA.

Certificates of compliance stating that the joint filler and sealant materials and waterstops conform to the requirements specified.

1.3 DELIVERY AND STORAGE

Material delivered and placed in storage shall be stored off the ground and protected from moisture, dirt, and other contaminants. Sealants shall be delivered in the manufacturer's original unopened containers. Sealants whose shelf life has expired shall be removed from the site.

PART 2 PRODUCTS

2.1 CONTRACTION-JOINT STRIPS

Contraction-joint strips shall be 1/8-inch thick tempered hardboard conforming to AHA A135.4, Class 1. In lieu of hardboard strips, rigid polyvinylchloride (PVC) insert strips specifically designed to induce controlled cracking in slabs on grade may be used. Such insert strips shall have removable top section.

2.2 EXPANSION-JOINT FILLER

Expansion-joint filler shall be premolded material conforming to ASTM D 1751 or ASTM D 1752. Unless otherwise indicated, filler material shall be 3/8-inch thick and of a width applicable for the joint formed.

2.3 JOINT SEALANT

Joint sealant shall conform to the following:

2.3.1 Preformed Polychloroprene Elastomeric Joint Seals

ASTM D 2628.

2.3.2 Lubricant for Installation of Preformed Compression Seals

ASTM D 2835.

2.4 WATERSTOPS

Waterstops shall conform to COE CRD-C 513 or COE CRD-C 572.

PART 3 EXECUTION

3.1 JOINTS

Joints shall be installed at locations indicated and as authorized.

3.1 Joint Strips

Strips shall be of the required dimensions and as long as practicable. After the first floating, the concrete shall be grooved with a tool at the joint locations. The strips shall be inserted in the groove and depressed until the top edge of the vertical surface is flush with the surface of the slab. The slab shall be floated and finished as specified. Working of the concrete adjacent to the joint shall be the minimum necessary to fill voids and consolidate the concrete. Where indicated, the top portion of the strip shall be sawed out after the curing period to form a recess for sealer. The removable section of PVC strips shall be discarded and the insert left in place. Means shall be provided to insure true alignment of the strips is maintained during insertion.

3.1.1 Expansion Joints

Premolded expansion joint filler shall be used in expansion and isolation joints in slabs around columns and between slabs on grade and vertical surfaces where indicated. The filler shall extend the full slab depth, unless otherwise indicated. The edges of the joint shall be neatly finished with an edging tool of 1/8-inch radius, except where a resilient floor surface will be applied. Where the joint is to receive a sealant, the filler strips shall be installed at the proper level below the finished floor with a slightly tapered, dressed-and-oiled wood strip temporarily secured to the top thereof to form a recess 3/4-inch deep to be filled with sealant. The wood strip shall be removed after the concrete has set. In lieu of the wood strip a removable expansion filler cap designed and fabricated for this purpose may be used.

3.1.2 Joint Sealant

Sawed contraction joints and expansion joints in slabs shall be filled with joint sealant, unless otherwise shown. Types and locations of sealants shall be as indicated. Joint surfaces shall be clean, dry, and free of oil or other foreign material which would adversely affect the bond between sealant and concrete. Joint sealant shall be applied as recommended by the manufacturer of the sealant. Joints sealed with field molded sealant shall be completely filled with sealant.

3.2 WATERSTOPS

Waterstops shall be 3/8" x 6" PVC and shall be installed at the locations shown to form a continuous water-tight diaphragm. Adequate provision shall be made to support and completely protect the waterstops during the progress of the work. Any waterstop punctured or damaged shall be repaired

or replaced. Splices shall be made in conformance with the recommendations of the waterstop manufacturer. Continuity of cross sectional features shall be maintained across the splice. Splices showing evidence of separation after bending shall be remade.

-- End of Section --

SECTION 03300

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 117/117R	(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 211.2	(1998) Standard Practice for Selecting Proportions for Structural Lightweight Concrete
ACI 213R	(1987) Guide for Structural Lightweight Aggregate 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 303R	(1991) Guide to Cast-In-Place Architectural Concrete Practice
ACI 305R	(1999) Hot Weather Concreting
ACI 318/318R	(1999) Building Code Requirements for Structural Concrete and Commentary
ACI 350R	(1989) Environmental Engineering Concrete Structures

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 182	(1991; R 1996) Burlap Cloth Made from Jute or Kenaf

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 1017/C 1017M	(1998) Chemical Admixtures for Use in

	Producing Flowing Concrete
ASTM C 1059	(1999) Latex Agents for Bonding Fresh to Hardened 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	(1999) Packaged Dry, Hydraulic-Cement Grout(Nonshrink)
ASTM C 1116	(2000) Fiber-Reinforced Concrete and Shotcrete
ASTM C 1240	(2000) Silica Fume for Use as a Mineral Admixture in Hydraulic-Cement Concrete, Mortar and Grout
ASTM C 131	(1996) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(1996a) Sieve Analysis of Fine and Coarse Aggregates
ASTM C 143/C 143M	(2000) Slump of Hydraulic Cement Concrete
ASTM C 150	(1999a) 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	(2000) 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	(1999ae1) Concrete Aggregates
ASTM C 330	(2000) Lightweight Aggregates for

	Structural Concrete
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 496	(1996) Splitting Tensile Strength of Cyclindrical Concrete Specimens
ASTM C 552	(2000) Cellular Glass Thermal Insulation
ASTM C 567	(2000) Unit Weight of Structural Lightweight Concrete
ASTM C 578	(1995) Rigid, Cellular Polystyrene Thermal Insulation
ASTM C 591	(1994) Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM C 595	(2000a) Blended Hydraulic Cements
ASTM C 595M	(1997) Blended Hydraulic Cements (Metric)
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 937	(1997) Grout Fluidifier for Preplaced-Aggregate 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 1751	(1999) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)

ASTM D 1752	(1984; R 1996el) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D 75	(1987; R 1997) Sampling Aggregates
ASTM E 1155	(1996) Determining Floor Flatness and Levelness Using the F-Number System
ASTM E 1155M	(1996) Determining Floor Flatness and Levelness Using the F-Number System (Metric)
ASTM E 96	(2000) Water Vapor Transmission of Materials

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST HB 44	(1997) NIST Handbook 44: Specifications, Tolerances, and other Technical Requirements for Weighing and Measuring Devices

NATIONAL READY-MIXED CONCRETE ASSOCIATION (NRMCA)

NRMCA CPMB 100	(1996) Concrete Plant Standards \n/c\X
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
COE CRD-C 540	(1971; R 1981) Standard Specification for Nonbituminous Inserts for Contraction Joints in Portland Cement Concrete Airfield Pavements, Sawable Type
COE CRD-C 572	(1974) Corps of Engineers Specifications for Polyvinylchloride Waterstop
COE CRD-C 94	(1995) Surface Retarders

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, SWAO

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-03 Product Data

Perimeter Insulation

Certificate attesting that the polyurethane insulation furnished for the project contains recovered material, and showing an estimated percentage of such recovered material.

SD-06 Test Reports

Testing and Inspection for Contractor Quality Control; G

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 SPECIAL REQUIREMENTS

A pre-installation meeting with the Contracting Officer will be required at least 10 days prior to start of construction. The Contractor shall be responsible for calling the meeting; the Project Superintendent and active installation personnel shall be present.

1.6 GENERAL REQUIREMENTS

1.6.1 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 117/117R. 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.

1.6.2 Strength Requirements and w/c Ratio

1.6.2.1 Strength Requirements

Structural concrete shall have a 28-day compression strength of 3000 or 4000 or 5000 psi per regulatory requirements. 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.

1.6.2.2 Water-Cement Ratio

Maximum water-cement ratio (w/c) for normal weight concrete shall be per ACI procedures.

1.6.3 Air Entrainment

Concrete shall be air entrained to contain between 5 and 7 percent total air.

1.6.4 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, columns and beams	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.

1.6.5 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.

1.6.6 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.

1.6.7 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.

1.6.8 Lightweight Aggregate Structural Concrete for Precast Electrical Bldg

Lightweight aggregate structural concrete shall conform to the requirements

specified for normal weight concrete except as specified herein. Specified compressive strength shall be at least 3000 at 28 days, [Specified splitting tensile strength determined in accordance with ASTM C 496 shall be at least 4000 at 28 days, as determined by test specimens that have been air dried at 50 percent relative humidity for the last 21 days. Air-dry unit weight shall be not over 4000 at 28 days as determined by ASTM C 567. However, fresh unit weight shall be used for acceptance during concreting, using a correlation factor between the two types of unit weight as determined during mixture design studies.

1.6.9 Technical Service for Specialized Concrete

The services of a factory trained technical representative shall be obtained to oversee proportioning, batching, mixing, placing, consolidating, and finishing of specialized structural concrete. The technical representative shall be on the job full time until the Contracting Officer is satisfied that field controls indicate concrete of specified quality is furnished and that the Contractor's crews are capable of continued satisfactory work. The technical representative shall be available for consultation with, and advice to, Government forces.

1.7 MIXTURE PROPORTIONS

Concrete shall be composed of portland cement, other cementitious and pozzolanic materials as specified, aggregates, water and admixtures as specified.

1.7.1 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, silica fume, and ground granulated blast furnace slag (GGBF slag) by the weight equivalency method as described in ACI 211.1. In the case where silica fume or GGBF slag is used, the weight of the silica fume and GGBF slag shall be included in the equations in ACI 211.1 for the term P, which is used to denote the weight of pozzolan. 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.

1.7.2 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.

1.7.3 Proportioning Studies for Lightweight Aggregate Structural 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 as follows. Trial mixtures having proportions, consistencies and air content suitable for the work shall be made based on methodology described in ACI 211.2, using at least three different cement contents. Trial mixes shall be proportioned to produce air dry unit weight and concrete strengths specified in paragraph GENERAL REQUIREMENTS. Trial mixtures shall be proportioned for maximum permitted slump and air content. Test specimens and testing shall be as specified for normal weight concrete except that 28-day compressive strength splitting tensile strength in accordance with ASTM C 496 shall be determined from test cylinders that have been air dried at 50 percent relative humidity for the last 21 days. Air dry unit weight shall be determined in accordance with ASTM C 567 and shall be designed to be at least 2.0 pcf less than the maximum specified air dry unit weight in paragraph GENERAL REQUIREMENTS. Curves shall be plotted using these results showing the relationship between cement factor and strength and air dry unit weight. Normal weight fine aggregate may be substituted for part or all of the lightweight fine aggregate, provided the concrete meets the strength and unit weight. A correlation shall also be developed showing the ratio between air dry unit weight and fresh concrete unit weight for each mix.

1.7.4 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.

1.7.4.1 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

1.7.4.2 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

1.7.5 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.

1.7.6 Mix Design for Bonded Topping for Heavy Duty Floors

The concrete mix design for bonded topping for heavy duty floors shall contain the greatest practical proportion of coarse aggregate within the specified proportion limits. The mix shall be designed to produce concrete having a 28-day strength of at least 5000 psi. Concrete for the topping shall consist of the following proportions, by weight:

1.00 part portland cement
1.15 to 1.25 parts fine aggregate
1.80 to 2.00 parts coarse aggregate

Maximum w/c shall be 0.33. The topping concrete shall not be air-entrained. The concrete shall be mixed so as to produce a mixture of the driest consistency possible to work with a sawing motion of the strike-off and which can be floated and compacted as specified without producing water or excess cement at the surface. In no case shall slump exceed 1 inch as determined by ASTM C 143/C 143M.

1.8 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.

1.9 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.

1.9.1 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.

1.9.2 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.

1.9.3 Hardened Concrete

Tests on hardened concrete will be performed by the Government when such tests are considered necessary.

1.9.4 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 or ground granulated blast furnace slag or silica fume 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.

2.2 Portland Cement

ASTM C 150, Type I low alkali with a maximum 15 percent amount of tricalcium aluminate..

2.3 Ground Granulated Blast-Furnace (GGBF) Slag

ASTM C 989, Grade 120.

2.4 AGGREGATES

Aggregates shall conform to the following.

2.4.1 Fine Aggregate

Fine aggregate shall conform to the quality and gradation requirements of ASTM C 33.

2.4.2 Lightweight Aggregate

Lightweight fine and coarse aggregate shall conform to the quality and gradation requirements of ASTM C 330, size 3/4" for coarse aggregate.

Lightweight aggregate shall be prewetted in accordance with the Manufacturer's instructions unless otherwise specified. For pumped concrete, prewetting shall be sufficient to ensure that slump loss through the pump line does not exceed \4 inches.

2.5 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.

2.5.1 Air-Entraining Admixture

ASTM C 260 and shall consistently entrain the air content in the specified ranges under field conditions.

2.5.2 Accelerating Admixture

ASTM C 494/C 494M, Type C or E, except that calcium chloride or admixtures containing calcium chloride shall not be used.

2.5.3 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.

2.5.4 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.

2.5.5 Surface Retarder

COE CRD-C 94.

2.5.6 Expanding Admixture

Aluminum powder type expanding admixture conforming to ASTM C 937.

2.5.7 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.

2.6 CURING MATERIALS

2.6.1 Impervious-Sheet

Impervious-sheet materials shall conform to ASTM C 171, type optional, except, that polyethylene sheet shall not be used.

2.6.2 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.

2.6.3 Burlap and Cotton Mat

Burlap and cotton mat used for curing shall conform to AASHTO M 182.

2.7 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.

2.8 NONSHRINK GROUT

Nonshrink grout shall conform to ASTM C 1107, Grade [A] [B] [C], and shall be a commercial formulation suitable for the proposed application.

2.9 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.

2.10 LATEX BONDING AGENT

Latex agents for bonding fresh to hardened concrete shall conform to ASTM C 1059.

2.11 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.

2.12 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.

2.13 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.

2.14 JOINT MATERIALS

2.14.1 Joint Fillers, Sealers, and Waterstops

Floor sealeant shall be a water based based acrylic emulsion. Proprietary sealants may be used if approved by the CO. Floor sealeants are to be applied to the floor slab of Bldg 3059.

Expansion joint fillers shall be preformed materials conforming to ASTM D 1751 or ASTM D 1752. Materials for waterstops shall be in accordance with Section 03150 EXPANSION JOINTS, CONTRACTION JOINTS, AND WATERSTOPS. Materials for and sealing of joints shall conform to the requirements of Section 07920 JOINT SEALING .

2.14.2 Contraction Joints in Slabs

Sawable type contraction joint inserts shall conform to COE CRD-C 540. Nonsawable joint inserts shall have sufficient stiffness to permit placement in plastic concrete without undue deviation from a straight line and shall conform to the physical requirements of COE CRD-C 540, with the exception of Section 3.4 "Resistance to Sawing". Plastic inserts shall be polyvinyl chloride conforming to the materials requirements of COE CRD-C 572.

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 03100 STRUCTURAL CONCRETE FORMWORK. Reinforcing steel shall be in place, cleaned, tied, and adequately supported, in accordance with Section 03200 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.

3.1.2 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. For heavy duty floors and two-course floors a thin coat of neat cement grout of about the consistency of thick cream shall be thoroughly scrubbed into the existing surface immediately ahead of the topping placing. The grout shall be a 1:1 mixture of portland cement and sand passing the No. 8 sieve. The topping concrete shall be deposited before the grout coat has had time to stiffen.

3.1.2.1 Air-Water Cutting

Air-water cutting of a fresh concrete surface shall be performed at the proper time and only on horizontal construction joints. The air pressure used in the jet shall be 100 psi plus or minus, 10 psi, and the water pressure shall be just sufficient to bring the water into effective influence of the air pressure. When approved by the Contracting Officer, a surface retarder complying with the requirements of COE CRD-C 94 may be applied to the surface of the lift in order to prolong the period of time during which air-water cutting is effective. After cutting, the surface shall be washed and rinsed as long as there is any trace of cloudiness of the wash water. Where necessary to remove accumulated laitance, coatings, stains, debris, and other foreign material, high-pressure waterjet or sandblasting shall be used as the last operation before placing the next lift.

3.1.2.2 High-Pressure Water Jet

A stream of water under a pressure of not less than 3,000 psi shall be used for cutting and cleaning. Its use shall be delayed until the concrete is sufficiently hard so that only the surface skin or mortar is removed and there is no undercutting of coarse-aggregate particles. If the waterjet is incapable of a satisfactory cleaning, the surface shall be cleaned by sandblasting.

3.1.2.3 Wet Sandblasting

Wet sandblasting shall be used after the concrete has reached sufficient strength to prevent undercutting of the coarse aggregate particles. After wet sandblasting, the surface of the concrete shall then be washed thoroughly to remove all loose materials.

3.1.2.4 Waste Disposal

The method used in disposing of waste water employed in cutting, washing, and rinsing of concrete surfaces shall be such that the waste water does not stain, discolor, or affect exposed surfaces of the structures, or damage the environment of the project area. The method of disposal shall be subject to approval.

3.1.2.5 Preparation of Previously Placed Concrete

Concrete surfaces to which other concrete is to be bonded shall be abraded in an approved manner that will expose sound aggregate uniformly without damaging the concrete. Laitance and loose particles shall be removed. Surfaces shall be thoroughly washed and shall be moist but without free water when concrete is placed.

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. A 2 inch layer of compacted, clean concrete sand (fine aggregate) shall be placed on top of the vapor barrier before placing concrete. Concrete placement shall be controlled so as to prevent damage to the vapor barrier, or any covering sand.

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

3.2.1 Batching, Mixing, and Transporting Concrete

Concrete shall either be batched and mixed onsite or shall be furnished from a ready-mixed concrete plant. 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 conform to the following subparagraphs. Concrete shall be batched and mixed onsite, or close to

onsite, and shall conform to the following subparagraphs.

3.2.1.1 General

The batching plant shall be located off site close to the project. The batching plant shall conform to the requirements of NRMCA CPMB 100 and as specified; however, rating plates attached to batch plant equipment are not required.

3.2.1.2 Batching Equipment

The batching controls shall be semiautomatic or automatic, as defined in NRMCA CPMB 100. A semiautomatic batching system shall be provided with interlocks such that the discharge device cannot be actuated until the indicated material is within the applicable tolerance. The batching system shall be equipped with accurate recorder or recorders that meet the requirements of NRMCA CPMB 100. The weight of water and admixtures shall be recorded if batched by weight. Separate bins or compartments shall be provided for each size group of aggregate and type of cementitious material, to prevent intermingling at any time. Aggregates shall be weighed either in separate weigh batchers with individual scales or, provided the smallest size is batched first, cumulatively in one weigh batcher on one scale. Aggregate shall not be weighed in the same batcher with cementitious material. If both portland cement and other cementitious material are used, they may be batched cumulatively, provided that the portland cement is batched first, [except that silica fume shall always be batched separately]. Water may be measured by weight or volume. Water shall not be weighed or measured cumulatively with another ingredient. Filling and discharging valves for the water metering or batching system shall be so interlocked that the discharge valve cannot be opened before the filling valve is fully closed. Piping for water and for admixtures shall be free from leaks and shall be properly valved to prevent backflow or siphoning. Admixtures shall be furnished as a liquid of suitable concentration for easy control of dispensing. An adjustable, accurate, mechanical device for measuring and dispensing each admixture shall be provided. Each admixture dispenser shall be interlocked with the batching and discharging operation of the water so that each admixture is separately batched and individually discharged automatically in a manner to obtain uniform distribution throughout the water as it is added to the batch in the specified mixing period. When use of truck mixers makes this requirement impractical, the admixture dispensers shall be interlocked with the sand batchers] Different admixtures shall not be combined prior to introduction in water and shall not be allowed to intermingle until in contact with the cement. Admixture dispensers shall have suitable devices to detect and indicate flow during dispensing or have a means for visual observation. The plant shall be arranged so as to facilitate the inspection of all operations at all times. Suitable facilities shall be provided for obtaining representative samples of aggregates from each bin or compartment, and for sampling and calibrating the dispensing of cementitious material, water, and admixtures. Filling ports for cementitious materials bins or silos shall be clearly marked with a permanent sign stating the contents.

3.2.1.3 Scales

The weighing equipment shall conform to the applicable requirements of CPMB Concrete Plant Standard, and of NIST HB 44, except that the accuracy shall be plus or minus 0.2 percent of scale capacity. The Contractor shall provide standard test weights and any other auxiliary equipment required

for checking the operating performance of each scale or other measuring devices. The tests shall be made at the specified frequency in the presence of a Government inspector. The weighing equipment shall be arranged so that the plant operator can conveniently observe all dials or indicators.

3.2.1.4 Batching Tolerances

(A) Tolerances with Weighing Equipment

MATERIAL	PERCENT OF REQUIRED WEIGHT
Cementitious materials	0 to plus 2
Aggregate	plus or minus 2
Water	plus or minus 1
Chemical admixture	0 to plus 6

(B) Tolerances with Volumetric Equipment

For volumetric batching equipment used for water and admixtures, the following tolerances shall apply to the required volume of material being batched:

MATERIAL	PERCENT OF REQUIRED MATERIAL
Water:	plus or minus 1 percent
Chemical admixtures:	0 to plus 6 percent

3.2.1.5 Moisture Control

The plant shall be capable of ready adjustment to compensate for the varying moisture content of the aggregates and to change the weights of the materials being batched.

3.2.1.6 Concrete Mixers

Mixers shall be stationary mixers [or truck mixers]. Mixers shall be capable of combining the materials into a uniform mixture and of discharging this mixture without segregation. The mixers shall not be charged in excess of the capacity recommended by the manufacturer. The mixers shall be operated at the drum or mixing blade speed designated by the manufacturer. The mixers shall be maintained in satisfactory operating condition, and the mixer drums shall be kept free of hardened concrete. Should any mixer at any time produce unsatisfactory results, its use shall be promptly discontinued until it is repaired.

3.2.1.7 Stationary Mixers

Concrete plant mixers shall be drum-type mixers of tilting, nontilting, horizontal-shaft, or vertical-shaft type, or shall be pug mill type and shall be provided with an acceptable device to lock the discharge mechanism until the required mixing time has elapsed. The mixing time and uniformity shall conform to all the requirements in ASTM C 94/C 94M applicable to central-mixed concrete.

3.2.1.8 Truck Mixers

Truck mixers, the mixing of concrete therein, and concrete uniformity shall conform to the requirements of ASTM C 94/C 94M. A truck mixer may be used either for complete mixing (transit-mixed) or to finish the partial mixing done in a stationary mixer (shrink-mixed). Each truck shall be equipped with two counters from which it is possible to determine the number of revolutions at mixing speed and the number of revolutions at agitating speed. [Or, if approved in lieu of this, the number of revolutions shall be marked on the batch tickets.] Water shall not be added at the placing site unless specifically approved; and in no case shall it exceed the specified w/c. Any such water shall be injected at the base of the mixer, not at the discharge end.

3.3 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.]

3.4 LIGHTWEIGHT AGGREGATE CONCRETE

In addition to the requirements specified for normal weight concrete, lightweight aggregate concrete shall conform to the following. The batching and mixing cycle shall be as directed based on written recommendations from the aggregate supplier which the Contractor shall furnish. Unless otherwise directed, the mixer shall be charged with approximately 2/3 of the total mixing water and all of the aggregate. This shall be mixed for at least 1-1/2 minutes in a stationary mixer or 15 revolutions at mixing speed in a truck mixer. The remaining ingredients shall then be added and mixing continued as specified for normal weight concrete. Lightweight aggregate concrete shall not be vibrated to the extent that large particles of aggregate float to the surface. During finishing, lightweight aggregate concrete shall not be worked to the extent that mortar is driven down and lightweight coarse aggregate appears at the surface. Lightweight aggregate concrete to be pumped shall have a cement content of at least 564 lb. per cu. yd. [A field trial run of lightweight aggregate concrete placement and finishing shall be made in accordance with ACI 213R.]

3.5 TRANSPORTING CONCRETE TO PROJECT SITE

Concrete shall be transported to the placing site in [truck mixers,] [agitators,] [nonagitating transporting equipment conforming to NRMCA TMMB 100] or by approved [pumping equipment] [conveyors]. Nonagitating equipment, other than pumps, shall not be used for transporting lightweight aggregate concrete.

3.6 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.

3.6.1 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.

3.6.2 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.

3.6.3 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. Nonagitating equipment shall be used only for transporting plant-mixed concrete over a smooth road and when the hauling time is less than 15 minutes. Bodies of nonagitating equipment shall be smooth, watertight, metal containers specifically designed to transport concrete, shaped with rounded corners to minimize segregation, and equipped with gates that will permit positive control of the discharge of the concrete.

3.6.4 Chutes

When concrete can be placed directly from a truck mixer, agitator, or nonagitating equipment, 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.

3.6.5 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.

3.6.6 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.

3.7 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.

3.7.1 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. Concrete shall not be placed in slabs over columns and walls until concrete in columns and walls has been in-place at least two hours or until the concrete begins to lose its plasticity. Concrete for beams, girders, brackets, column capitals, haunches, and drop panels shall be placed at the same time as concrete for adjoining slabs.

3.7.2 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. Excessive vibration of lightweight concrete resulting in segration or flotation of coarse aggregate shall be prevented. Frequency and amplitude of vibrators shall be determined in accordance with COE CRD-C 521. Grate tampers ("jitterbugs") shall not be used.

3.7.3 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.

3.7.4 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

3.7.5 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.

3.7.6 Placing Concrete Underwater

Concrete shall be deposited in water by a tremie or concrete pump. The methods and equipment used shall be subject to approval. Concrete buckets shall not be used for underwater placement of concrete except to deliver concrete to the tremie. The tremie shall be watertight and sufficiently large to permit a free flow of concrete. The concrete shall be deposited so that it enters the mass of the previously placed concrete from within, displacing water with a minimum disturbance to the surface of the concrete. The discharge end of the pump line or tremie shaft shall be kept continuously submerged in the concrete. The underwater seal at start of placing shall not produce undue turbulence in the water. The tremie shaft shall be kept full of concrete to a point well above the water surface. Placement shall proceed without interruption until the concrete has been brought to the required height. The tremie shall not be moved horizontally during a placing operation, and a sufficient number of tremies shall be provided so that the maximum horizontal flow of concrete will be limited to 15 feet. Concrete shall not be deposited in running water or in water with a temperature below 35 degrees F.

3.7.7 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. Reinforcing bars may be temporarily crowded to one side during concrete placement provided they are returned to exact required location before concrete placement and consolidation are completed.

3.7.8 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.

3.8 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. In general, such joints shall be located near the middle of the spans of supported slabs, beams, and girders unless a beam intersects a girder at this point, in which case the joint in the girder shall be offset a distance equal to twice the width of the beam. Joints in walls and columns shall be at the underside of floors, slabs, beams, or girders and at the tops of footings or floor slabs, unless otherwise approved. 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 07900 JOINT SEALING.

3.8.1 Construction Joints

For concrete other than slabs on grade, construction joints shall be located so that the unit of operation does not exceed 15 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. Where horizontal construction joints in walls or columns are required, a strip of 1 inchsquare-edge lumber, bevelled and oiled to facilitate removal, shall be tacked to the inside of the forms at the construction joint. Concrete shall be placed to a point 1 inch above the underside of the strip. The strip shall be removed 1 hour after the concrete has been placed, and any irregularities in the joint line shall be leveled off with a wood float, and all laitance shall be removed. Prior to placing additional concrete, horizontal construction joints shall be prepared as specified in paragraph Previously Placed Concrete.

3.8.2 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 [use of rigid inserts impressed in the concrete during placing operations] [use of snap-out plastic joint forming inserts] [or] [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.

3.8.3 Expansion Joints

Installation of expansion joints and sealing of these joints shall conform to the requirements of Section 03150 EXPANSION JOINTS, CONTRACTION JOINTS, AND WATERSTOPS and Section 07920 JOINT SEALING.

3.8.4 Waterstops

Waterstops shall be installed in conformance with the locations and details shown on the drawings using materials and procedures specified in Section 03150 EXPANSION JOINTS, CONTRACTION JOINTS, AND WATERSTOPS.

3.8.5 Dowels and Tie Bars

Dowels and tie bars shall be installed at the locations shown on the drawings and to the details shown, using materials and procedures specified in Section 03200 CONCRETE REINFORCEMENT and herein. Conventional smooth "paving" dowels shall be installed in slabs using approved methods to hold the dowel in place during concreting within a maximum alignment tolerance of 1/8 inch in 12 inches. "Structural" type deformed bar dowels, or tie bars, shall be installed to meet the specified tolerances. Care shall be taken during placing adjacent to and around dowels and tie bars to ensure there is no displacement of the dowel or tie bar and that the concrete completely embeds the dowel or tie bar and is thoroughly consolidated.

3.9 REPAIRS

3.9.1 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.

3.9.2 Repair of Major Defects

Major defects will be considered to be those more than 1/2 inch deep or, for Class A and B finishes, more than 1/2 inch in diameter and, for Class C and 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.

3.9.2.1 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.

3.9.2.2 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.

3.10 EXTERIOR SLAB AND RELATED ITEMS

3.10.1 Pavements

Pavements shall be constructed where shown on the drawings. After forms are set and underlying material prepared as specified, the concrete shall be placed uniformly throughout the area and thoroughly vibrated. As soon as placed and vibrated, the concrete shall be struck off and screeded to the crown and cross section and to such elevation above grade that when consolidated and finished, the surface of the pavement will be at the required elevation. The entire surface shall be tamped with the strike off, or consolidated with a vibrating screed, and this operation continued until the required compaction and reduction of internal and surface voids are accomplished. Care shall be taken to prevent bringing excess paste to the surface. Immediately following the final consolidation of the surface, the pavement shall be floated longitudinally from bridges resting on the side forms and spanning but not touching the concrete. If necessary, additional concrete shall be placed and screeded, and the float operated until a satisfactory surface has been produced. The floating operation shall be advanced not more than half the length of the float and then continued over the new and previously floated surfaces. After finishing is completed but while the concrete is still plastic, minor irregularities and score marks in the pavement surface shall be eliminated by means of long-handled cutting straightedges. Straightedges shall be 12 feet in length and shall be operated from the sides of the pavement and from bridges. A straightedge operated from the side of the pavement shall be equipped with a handle 3 feet longer than one-half the width of the pavement. The surface shall then be tested for trueness with a 12 foot straightedge held in successive positions parallel and at right angles to the center line of the pavement, and the whole area covered as necessary to detect variations. The straightedge shall be advanced along the pavement in successive stages of not more than one-half the length of the straightedge. Depressions shall be immediately filled with freshly mixed concrete, struck off, consolidated, and refinished. Projections above the required elevation shall also be struck off and refinished. The straightedge testing and finishing shall continue until the entire surface of the concrete is true. Before the surface sheen has disappeared and well

before the concrete becomes nonplastic, the surface of the pavement shall be given a nonslip sandy surface texture by [belting with approved "belt" and procedures] [use of a burlap drag. A strip of clean, wet burlap from 3 to 5 feet wide and 2 feet longer than the pavement width shall be carefully pulled across the surface]. Edges and joints shall be rounded with an edger having a radius of 1/8 inch. Curing shall be as specified.

3.10.2 Sidewalks

Concrete shall be 4 inches minimum thickness. Contraction joints shall be provided at 5 feet spaces unless otherwise indicated. Contraction joints shall be cut 1 inch deep with a jointing tool after the surface has been finished. Transverse expansion joints 1/2 inch thick shall be provided at changes in direction and where sidewalk abuts curbs, steps, rigid pavement, or other similar structures. Sidewalks shall be given a lightly broomed finish. A transverse slope of 1/4 inch per foot shall be provided, unless otherwise indicated. Variations in cross section shall be limited to 1/4 inch in 5 feet.

3.10.3 Curbs and Gutters

Concrete shall be formed, placed, and finished by hand using a properly shaped "mule" or constructed using a slipform machine specially designed for this work. Contraction joints shall be cut 3 inches deep with a jointing tool after the surface has been finished. Expansion joints (1/2 inch wide) shall be provided at 100 feetmaximum spacing unless otherwise indicated. Exposed surfaces shall be finished using a stiff bristled brush.

3.10.4 Pits and Trenches

Pits and trenches shall be constructed as indicated on the drawings. Bottoms and walls shall be placed monolithically or waterstops and keys, shall be provided as approved.

3.11 CURING AND PROTECTION

3.11.1 General

Concrete shall be cured by an approved method for the period of time given below:

Concrete with Type III cement	3 days
All other 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. Concrete containing silica fume shall be initially cured by fog misting during finishing, followed immediately by continuous moist curing. Except for plastic coated burlap, impervious sheeting alone shall not be used for curing.

3.11.2 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.

3.11.3 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 Government][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.

3.12 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 approximately 1/24 the width of the plate, 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.

3.12.1 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.

3.12.2 Nonshrink Grout

Nonshrink grout shall be a ready-mixed 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.

3.12.2.1 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.

3.12.2.2 Treatment of Exposed Surfaces

For metal-oxidizing nonshrink grout, exposed surfaces shall be cut back 1 inch and immediately covered with a parge coat of mortar consisting of 1 part portland cement and 2-1/2 parts fine aggregate by weight, with sufficient water to make a plastic mixture. The parge coat shall have a smooth finish. For other mortars or grouts, exposed surfaces shall have a smooth-dense finish and be left untreated. Curing shall comply with paragraph CURING AND PROTECTION.

3.13 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 quarter thereafter for conformance with ASTM C 1077.

3.13.1 Grading and Corrective Action

3.13.1.1 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.

3.13.1.2 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.

3.13.2 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.

3.13.3 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.

3.13.4 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.

3.13.5 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. [A set of test specimens for concrete with a 90-day strength per the same paragraph shall consist of six specimens, two tested at 7 days, two at 28 days, and two at 90 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.

3.13.6 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.

3.13.7 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.

3.13.8 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.

3.13.9 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.

3.13.10 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.

3.13.11 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.

3.13.12 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.

-- End of Section --

SECTION 03410

PLANT-PRECAST STRUCTURAL CONCRETE
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 ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO SSHB-I-14	Highway Bridges-Division I-Section 14: Bearings

ACI INTERNATIONAL (ACI)

ACI 304R	(1989) Measuring, Mixing, Transporting, and Placing Concrete
ACI 305R	(1991) Hot Weather Concreting
ACI 306.1	(1990) Cold Weather Concreting
ACI 309R	(1996) Consolidation of Concrete
ACI 318	(1999) Building Code Requirements for Structural Concrete

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A135.4	(1995) Basic Hardboard

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 27/A 27M	(1995) Steel Castings, Carbon, for General Application
ASTM A 36/A 36M	(1997a) Carbon Structural Steel
ASTM A 47M	(1990) Ferritic Malleable Iron Castings (Metric)
ASTM A 47	(1990) Ferritic Malleable Iron Castings
ASTM A 123/A 123M	(1997a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(1995) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 185	(1997) Steel Welded Wire Fabric, Plain, for Concrete Reinforcement

ASTM A 307	(1994) Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
ASTM A 325M	(1993) High-Strength Bolts for Structural Steel Joints (Metric)
ASTM A 325	(1997) Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A 497	(1997) Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement
ASTM A 563M	(1996) Carbon and Alloy Steel Nuts (Metric)
ASTM A 563	(1996) Carbon and Alloy Steel Nuts
ASTM A 615/A 615M	(1996a) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 616/A 616M	(1996; Rev. A) Rail-Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A 617/A 617M	(1996; Rev. A) Axle-Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A 706/A 706M	(1996; Rev. B) Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A 780	(1993; Rev. A) Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM C 33	(1997) Concrete Aggregates
ASTM C 94	(1997) Ready-Mixed Concrete
ASTM C 150	(1997) Portland Cement
ASTM C 260	(1995) Air-Entraining Admixtures for Concrete
ASTM C 330	(1989) Lightweight Aggregates for Structural Concrete
ASTM C 494	(1992) Chemical Admixtures for Concrete
ASTM C 595M	(1997) Blended Hydraulic Cements (Metric)
ASTM C 595	(1994a) Blended Hydraulic Cements
ASTM C 618	(1997) Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
ASTM C 989	(1997) Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
ASTM C 1107	(1997) Packaged Dry, Hydraulic-Cement

	Grout (Nonshrink)
ASTM C 1240	(1999) Silica Fume for Use as a Mineral Admixture in Hydraulic-Cement Concrete, Mortar, and Grout
ASTM F 436M	(1993) Hardened Steel Washers (Metric)
ASTM F 436	(1993) Hardened Steel Washers
ASTM F 844	(1990) Washers, Steel, Plain (Flat), Unhardened for General Use

AMERICAN WELDING SOCIETY (AWS)

AWS D1.4	(1998) Structural Welding Code - Reinforcing Steel

PRECAST/PRESTRESSED CONCRETE INSTITUTE (PCI)

PCI MNL-116	(1985) Quality Control for Plants and Production of Precast Prestressed Concrete Products
PCI MNL-120	(1992) Design Handbook - Precast and Prestressed Concrete
PCI MNL-124	(1989) Fire Resistance of Precast Prestressed Concrete

UNDERWRITERS LABORATORIES (UL)

UL FRD	(1997) Fire Resistance Directory

1.2 PRECAST MEMBERS

The work includes the provision of precast non-prestressed concrete herein referred to as precast members. Precast members shall be the product of a manufacturer specializing in the production of precast concrete members. In the ACI publications, the advisory provisions shall be considered to be mandatory, as though the word "shall" has been substituted for "should" wherever it appears; reference to the "Building Official," the "Structural Engineer" and the "Architect/Engineer" shall be interpreted to mean the Contracting Officer.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330 SUBMITTAL DESCRIPTIONS:

SD-02 Shop Drawings

Drawings of precast members; GA

SD-03 Product Data

Anchorage and lifting inserts and devices; GA

Bearing pads; GA

SD-05 Design Data

Precast concrete members design calculations; GA

Concrete mix design; GA

SD-06 Test Reports

Contractor-furnished mix design; GA

Submit copies of test reports showing that the mix has been successfully tested to produce concrete with the properties specified and will be suitable for the job conditions. Obtain approval before concrete placement.

SD-07 Certificates

Fabrication; GA

Submit quality control procedures established in accordance with PCI MNL-116 by the precast manufacturer.

SD-11 Closeout Submittals

Concrete batch ticket information; GA

1.4 QUALITY CONTROL

1.4.1 Precast Concrete Member Design

ACI 318 and the PCI MNL-120. Design precast members (including connections) for the design load conditions and spans indicated, and for additional loads imposed by openings and supports of the work of other trades. Design precast members for handling without cracking in accordance with the PCI MNL-120.

1.4.2 PCI Quality Certifications

PCI MNL-116. At the precast manufacturer's option, in lieu of core samples, ACI 318, full scale load tests may be performed. Perform on randomly selected members, as directed by the Contracting Officer.

1.4.2.1 Product Quality Control

PCI MNL-116 for PCI enrolled plants. Where panels are manufactured by specialists in plants not currently enrolled in the PCI "Quality Control Program," provide a product quality control system in accordance with PCI MNL-116 and perform concrete and aggregate quality control testing using an approved, independent commercial testing laboratory. Submit test results to the Contracting Officer.

or

1.4.2.2 Product Quality Control

Plants shall be certified by the PCI Plant Certification Program for Category C1 work.

1.5 DELIVERY AND STORAGE

Lift and support precast members at the lifting and supporting points indicated on the shop drawings. Store precast members off the ground. Separate stacked precast members by battens across the full width of each bearing point. Protect from weather, marring, damage, and overload.

1.6 FACTORY INSPECTION

At the option of the Contracting Officer, precast units shall be inspected by the QC Representative prior to being transported to the job site. The Contractor shall give notice 14 days prior to the time the units will be available for plant inspection. Neither the exercise nor waiver of inspection at the plant will affect the Government's right to enforce contractual provisions after units are transported or erected.

1.7 QUALITY ASSURANCE

1.7.1 Drawing Information

Submit drawings indicating complete information for the fabrication, handling, and erection of the precast member. Drawings shall not be reproductions of contract drawings. Design calculations and drawings of precast members (including connections) shall be prepared and sealed by a registered professional engineer, and submitted for approval prior to fabrication. The drawings shall indicate, as a minimum, the following information:

a. Marking of members for erection

b. Connections for work of other trades

c. Connections between members, and connections between members and other construction

d. Location and size of openings

e. Headers for openings

f. Joints between members, and joints between members and other construction

g. Reinforcing details

h. Material properties of steel and concrete used

i. Lifting and erection inserts

j. Dimensions and surface finishes of each member

k. Erection sequence and handling requirements

l. All loads used in design (such as live, dead, handling, and erection)

m. Bracing/shoring required

n. Areas to receive toppings, topping thickness.

1.7.2 Design Calculations

Submit calculations reflecting design conforming to requirements of paragraph entitled "Precast Concrete Member Design." Design calculations and drawings of precast members (including connections) shall be prepared and sealed by a registered professional engineer, and submitted for approval prior to fabrication.

1.7.3 Concrete Mix Design

Thirty days minimum prior to concrete placement, submit a mix design for each strength and type of concrete. Include a complete list of materials including type; brand; source and amount of cement, pozzolan, silicate concrete, and admixtures; and applicable reference specifications.

1.7.4 Certificates: Record Requirement

ASTM C 94. Submit mandatory batch ticket information for each load of ready-mixed concrete.

PART 2 PRODUCTS

2.1 CONTRACTOR-FURNISHED MIX DESIGN

ACI 318. The minimum compressive strength of concrete at 28 days shall be 5000 psi, unless otherwise indicated. Add air-entraining admixtures at the mixer to produce between 4 and 6 percent air by volume.

2.2 MATERIALS

2.2.1 Cement

ASTM C 150, Type I, II, or III; or ASTM C 595 Type IP(MS) or IS(MS) blended cement, except as modified herein. The blended cement shall consist of a mixture of ASTM C 150 cement and ASTM C 618pozzolan or fly ash. The pozzolan/fly ash content shall not exceed 25 percent by weight of the total cementitious material. For exposed concrete, use one manufacturer for each type of cement, fly ash, and pozzolan.

2.2.1.1 Fly Ash and Pozzolan

ASTM C 618, Type N, F, or C, except that the maximum allowable loss on ignition shall be 6 percent for Type N and F.

2.2.2 Water

Water shall be fresh, clean, and potable.

2.2.3 Aggregates

2.2.3.1 Aggregates Selection

ASTM C 33, Size 67, except as modified herein. Obtain aggregates for exposed concrete surfaces from one source. Aggregates shall not contain any substance which may be deleteriously reactive with the alkalies in the cement.

2.2.4 Grout

2.2.4.1 Nonshrink Grout

ASTM C 1107.

2.2.4.2 Cementitious Grout

Shall be a mixture of portland cement, sand, and water. Proportion one part cement to approximately 2.5 parts sand, with the amount of water based on placement method. Provide air entrainment for grout exposed to the weather.

2.2.5 Admixtures

2.2.5.1 Air-Entraining

ASTM C 260.

2.2.6 Reinforcement

2.2.6.1 Reinforcing Bars

ASTM A 615/A 615M, Grade 60.

2.2.6.2 Welded Wire Fabric

ASTM A 185.

2.2.7 Metal Accessories

Provide ASTM A 123/A 123M galvanized.

2.2.7.1 Inserts

ASTM A 47, Grade 32510 or 35018, or ASTM A 27/A 27M Grade U-60-30.

2.2.7.2 Structural Steel

ASTM A 36/A 36M.

2.2.7.3 Bolts

ASTM A 307; ASTM A 325.

2.2.7.4 Nuts

ASTM A 563.

2.2.7.5 Washers

ASTM F 844 washers for ASTM A 307 bolts, and ASTM F 436 washers for ASTM A 325 bolts.

2.2.8 Bearing Pads

2.2.8.1 Elastomeric

AASHTO SSHB-I-14, for plain neoprene bearings.

2.2.8.2 Hardboard (Interior Only)

ANSI A135.4, class as specified by the precast manufacturer.

2.3 FABRICATION

PCI MNL-116 unless specified otherwise.

2.3.1 Forms

Brace forms to prevent deformation. Forms shall produce a smooth, dense surface. Chamfer exposed edges of columns and beams 3/4 inch, unless otherwise indicated. Provide threaded or snap-off type form ties.

2.3.2 Reinforcement Placement

ACI 318 for placement and splicing. Reinforcement may be preassembled before placement in forms. Provide exposed connecting bars, or other approved connection methods, between precast and cast-in-place construction. Remove any excess mortar that adheres to the exposed connections.

2.3.3 Concrete

2.3.3.1 Concrete Mixing

ASTM C 94. Mixing operations shall produce batch-to-batch uniformity of strength, consistency, and appearance.

2.3.3.2 Concrete Placing

ACI 304R, ACI 305R for hot weather concreting , ACI 306.1for cold weather concreting, and ACI 309R, unless otherwise specified.

2.3.3.3 Concrete Curing

Commence curing immediately following the initial set and completion of surface finishing. Provide curing procedures to keep the temperature of the concrete between 50 and 190 degrees F. When accelerated curing is used, apply heat at controlled rate and uniformly along the casting beds. Monitor temperatures at various points in a product line in different casts.

2.3.4 Surface Finish

Repairs located in a bearing area shall be approved by the Contracting Officer prior to repairs. Precast members containing hairline cracks which are visible and are less than 0.02 inches in width, may be accepted, except that cracks larger than 0.005 inches in width for surfaces exposed to the weather shall be repaired. Precast members which contain cracks greater than 0.02 inches in width shall be approved by the Contracting Officer, prior to being repaired. Any precast member that is structurally impaired or contains honeycombed section deep enough to expose reinforcing shall be rejected.

2.3.4.1 Unformed Surfaces

Provide a floated finish.

2.3.4.2 Formed Surfaces

PCI MNL-116 (Appendix A - Commentary), Chapter 3, for grades of surface finishes.

a. Unexposed Surfaces: Provide a commercial grade surface finish.

b. Exposed Surfaces: Provide a finish Grade B surface finish. The combined area of acceptable defective areas shall not exceed 0.2 percent of the exposed to view surface area, and the patches shall be indistinguishable from the surrounding surfaces when dry.

PART 3 EXECUTION

3.1 SURFACE REPAIR

Prior to erection, and again after installation, precast members shall be checked for damage, such as cracking, spalling, and honeycombing. As directed by the Contracting Officer, precast members that do not meet the surface finish requirements specified in Part 2 in paragraph entitled "Surface Finish" shall be repaired, or removed and replaced with new precast members.

3.2 ERECTION

Precast members shall be erected after the concrete has attained the specified compressive strength, unless otherwise approved by the precast manufacturer. Erect in accordance with the approved shop drawings. PCI MNL-116 and PCI MNL-120 (Chapter 8), for tolerances. Brace precast members, unless design calculations submitted with the shop drawings indicate bracing is not required. Follow the manufacturer's recommendations for maximum construction loads. Place precast members level, plumb, square, and true within tolerances. Align member ends.

3.3 BEARING SURFACES

Shall be flat, free of irregularities, and properly sized. Size bearing surfaces to provide for the indicated clearances between the precast member and adjacent precast members or adjoining field placed surfaces. Correct bearing surface irregularities with nonshrink grout. Provide bearing pads where indicated or required. Do not use hardboard bearing pads in exterior locations. Place precast members at right angles to the bearing surface, unless indicated otherwise, and draw-up tight without forcing or distortion, with sides plumb.

3.4 ANCHORAGE

Provide anchorage for fastening work in place. Conceal fasteners where practicable. Make threaded connections up tight and nick threads to prevent loosening.

3.5 WELDING

AWS D1.4 for welding connections and reinforcing splices. Protect the concrete and other reinforcing from heat during welding. Weld continuously along the entire area of contact. Grind smooth visible welds in the finished installation.

3.6 OPENINGS

Holes or cuts requiring reinforcing to be cut, which are not indicated on

the approved shop drawing, shall only be made with the approval of the Contracting Officer and the precast manufacturer. Drill holes less than 12 inches in diameter with a diamond tipped core drill.

3.7 GALVANIZING REPAIR

Repair damage to galvanized coatings using ASTM A 780 zinc rich paint for galvanized surfaces damaged by handling, transporting, cutting, welding, bolting, or acid washing. Do not heat surfaces to which repair paint has been applied.

3.8 GROUTING

Clean and fill ,such as existing structures and new manholes, indicated keyways between precast members, and other indicated areas, solidly with nonshrink grout or cementitious grout. Provide reinforcing where indicated. Remove excess grout before hardening.

3.9 SEALANTS

Provide as indicated on the drawings.

-- End of Section --

SECTION 05090

WELDING, STRUCTURAL AND ACID PIPING
09/98

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.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC-04	(1989) Specification for Structural Steel Buildings - Allowable Stress Design, Plastic Design

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B31.3	Chemical Plant and Petroleum Refinery Piping Code

AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

ASNT-01	(1996) Recommended Practice SNT-TC-1A

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4	(1993) Standard Symbols for Welding, Brazing and Nondestructive Examination
AWS A3.0	(1994) Standard Welding Terms and Definitions
AWS D1.1	(1996) Structural Welding Code - Steel
AWS Z49.1	(1994) Safety in Welding and 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-04 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, 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.

Nitrocellulose (NC) service piping systems fabricated or repaired by the construction personnel at RFAAP shall be performed in accordance with RFAAP Drawing 42406 entitled "Welding and Fabrication Requirements - Class NC"; Alliant Engineering Standard 14CS-15500 entitled "Piping Fabrication, Erection and Testing"; and American Society for Mechanical Engineers/American National Standards Institute (ASME/ANSI) ANSI B31.3 entitled "Chemical Plant and Petroleum Refinery Piping Code."

Alliant Corporate and RFAAP Safety and Loss Prevention have directed that these standards apply to all present and future piping work performed at RFAAP. They define the requirements for design, fabrication, materials, examination, inspection, testing, and documentation of NC piping work. Additionaly, these standards require that the personnel and procedures for welding and nondestructive examination (NDE) be qualified and certified by the requirements of the ANSI B31.3 code.

In compliance with the aforementioned mandates, RFAAP has implemented a Quality Control Program for NC service piping work performed at RFAAP. The NDE Committee (Charter No. 29) shall prepare, maintain, and approve a quality control procedure, that describes how affected departments are to initiate NC piping work and assigns authority and responsibility for action involving design, materials, fabrication, welding, inspection, examination, correction of nonconformances, testing, documentation, and record keeping. Departments assigned direct responsibility under this program, including Facilities Engineering, Maintenance, Materials Management, Quality Control, and production departments, shall comply with this program as described in the quality control procedure.

1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL DESCRIPTIONS:

SD-08 Statements

Welding Procedure Qualifications; FIO.

Welder, Welding Operator, and Tacker Qualification; FIO.

Inspector Qualification; FIO.

Copies of the welding procedure specifications; the procedure qualification test records; and the welder, welding operator, or tacker qualification test records.

SD-18 Records

Quality Control; FIO.

A quality assurance plan and records of tests and inspections.

1.5 WELDING PROCEDURE QUALIFICATIONS

Except for prequalified (per AWS D1.1) 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 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. 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, 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 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, 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. 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 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 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

Inspection and nondestructive testing personnel shall be qualified in accordance with the requirements of ASNT-01 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-01, 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.

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 and AISC-04. When AWS D1.1 and the AISC-04 specification conflict, the requirements of AWS D1.1 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.

3.1.3 Welding Process

The welding of the root bead shall be done by the gas tungsten-arc welding process using manual equipment; consumable filler of stainless steel shall be added manually. The remaining beads shall be desposited by the TIG and

SMAW using an electrode of stainless steel.

3.1.4 Base Metal

The base metal shall conform to the specifications listed in Section IX ASME "Welding Qualifications" in Materials Group "P" Number 8.

3.1.5 Base Metal Thickness

Welding of stainless steel from 3/16" through 1-13/16" thickness.

3.1.6 Filler Metal

A. Filler metal for gas tungsten arc welding shall conform to ER316 of SA371.

B. Filler metal as per approved welding procedures.

3.1.7 Gas for Shielding Arc Welding

Welding grade Argon Gas shall be used for gas shielding for the gas tungsten-arc process used on the first pass. Torch gas flow rate shall be 20 to 25 C.F.H. and backing purge shall be 5 to 7 C.F.H.

3.1.8 Position

The welding shall be done in all positions.

3.1.9 Backing Strip

The welded joints shall not utilize a backing strip.

3.1.10 Preheating and Temperature Control

No welding shall be done on materials to be joined when their temperature is below 40 degrees F until the material is heated to 70 degrees F.

3.1.11 Postheating

Stress relief is not required by this specification. See Section III of ASME.

3.1.12 Preparation of Base Metal

The edges or surfaces of the parts to be joined by welding shall be prepared by machining as shown on the attached sketches and must be cleaned of oil, or grease and excessive amounts of moisture, scale, or other foreign material.

3.1.13 Nature of the Electric Current

Direct current straight polarity (electrode negative) for the gas tungsten-arc process shall be used on the first and second passes. Direct current reverse polarity (electrode positive) for gas metal-arc process shall be used on the remaining beads.

3.1.14 Welding Technique

The welding techniques, such as filler wire sizes, and mean voltages and

currents for each electrode shall be shown on welding procedure.

3.1.15 Appearance of Welding Layers

The welding current and manner of depositing the weld metal shall be such that there shall be practically no undercutting of the sidewalls of the welding groove or the adjoining base metal.

3.1.16 Cleaning

All slag remaining on any weld bead shall be removed before depositing the next successive bead.

3.1.17 Defects

Any cracks or holes that appear on the surface of the welding beads shall be removed by chipping or grinding before depositing the next successive bead.

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 and radiographic, ultrasonic, and dye penetrant 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, 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 and the contract drawings. Nondestructive testing shall be by visual inspection and radiographic, ultrasonic, magnetic particle, or dye penetrant methods. The minimum extent of nondestructive testing shall be random 10 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 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.

-- End of Section --

SECTION 05093A

WELDING PRESSURE PIPING AND ACID GRAVITY PIPING
09/98

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.

AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

ASNT RP SNT-TC-1A	(1996) Recommended Practice SNT-TC-1A
ASNT Q&A Bk A	(1996) Question and Answer Book A: Radiographic Test Method; Levels I, II, III (Supplement to Recommended Practice SNT-TC-1A)
ASNT RP SNT-TC-1A Bk B	(1994) Question and Answers Levels I, II, and III Magnetic Particle Method Book B (Supplement to RP SNT-TC-1A)
ASNT Q&A Bk C	(1994) Question and Answer Book C: Ultrasonic Testing Method; Levels I, II, III (Supplement to RP SNT-TC-1A
ASNT Q&A Bk D	(1996) Question and Answer Book D: Liquid Penetrant Testing Method; Levels I, II, III (Supplement to RP SNT-TC-1A)

ASME INTERNATIONAL (ASME)

ASME B31.1	(1998) Power Piping
ASME B31.3	(1999) Process Piping
ASME BPVC SEC I	(1998) Boiler and Pressure Vessel Code; Section I, Power Boilers
ASME BPVC SEC II-C	(1998) Boiler and Pressure Vessel Code; Section II, Materials, Part C - Specifications for Welding Rods, Electrodes and Filler Metals
ASME BPVC SEC V	(1998) Boiler and Pressure Vessel Code; Section V, Nondestructive Examination

ASME BPVC SEC IX	(1998) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4	(1998) Standard Symbols for Welding, Brazing and Nondestructive Examination
AWS A3.0	(1994) Standard Welding Terms and Definitions
AWS B2.1	(1998) Welding Procedure and Performance Qualification
AWS QC1	(1996) AWS Certification of Welding Inspectors
AWS Z49.1	(1999) Safety in Welding and Cutting and Allied Processes

1.2 DEFINITIONS

Definitions shall be in accordance with AWS A3.0. Note that in Attachment I, all references to Hercules implies Alliant-Tech Systems (ATK).

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

Pressure Piping and Acid Gravity Piping; G, SWAO

Detail drawings showing location, length, and type of welds; and indicating postweld heat treatment and NDE as required.

SD-03 Product Data

Qualifications; G, SWAO

Welding procedure qualification.

Welding Operations; G, SWAO

Detailed procedures which define methods of compliance to contract drawings and specifications. Inspection and material procurement records. System and material testing and certification records. Written records and drawings indicating location of welds made by each welder or welding operator.

SD-07 Certificates

Qualifications; G, SWAO

Welder and welding operator performance qualification certificates. Welding inspectors and NDE personnel certificates. Qualifications of testing laboratory or the Contractor's quality assurance organization.

1.4 GENERAL REQUIREMENTS

This section covers the welding of pressure piping systems. Deviations from applicable codes, approved procedures, and approved detail drawings will not be permitted without prior written approval. Materials or components with welds made offsite will not be accepted if the welding does not conform to the requirements of this specification, unless otherwise specified. Procedures shall be developed by the Contractor for welding all metals included in the work. Welding shall not be started until welding procedures, welders, and welding operators have been qualified. Qualification testing shall be performed by an approved testing laboratory, or by the Contractor if approved by the Contracting Officer. Costs of such testing shall be borne by the Contractor. The Contracting Officer shall be notified at least 24 hours in advance of the time and place of the tests. When practicable, the qualification tests shall be performed at or near the worksite. The Contractor shall maintain current records of the test results obtained in the welding procedure, welding operator, welder performance qualifications, and nondestructive examination (NDE) procedures readily available at the site for examination by the Contracting Officer. The procedures for making transition welds between different materials or between plates or pipes of different wall thicknesses shall be qualified. ASME B31.1 ASME B31.3 requirements for branch connections may be used in lieu of detailed designs. Unless otherwise specified, the choice of welding process shall be the responsibility of the Contractor.

Welding and Fabrication Requirements Class Nitrocellulose (NC) piping - fabrication, erection, and testing requirement, i.e., acid waste process and gravity piping, shall be in accordance with Attachment I.

1.5 PERFORMANCE

The Contractor shall be responsible for the quality of all joint preparation, welding, and examination. All materials used in the welding operations shall be clearly identified and recorded. The inspection and testing defined in this specification are minimum requirements. Additional inspection and testing shall be the responsibility of the Contractor when he deems it necessary to achieve the quality required.

1.6 QUALIFICATIONS

Welding procedures, welders, and welding operators previously qualified by test may be accepted for the work without requalification, provided that all of the following conditions are fulfilled:

a. Copies of the welding procedures, the procedure qualification test records, and the welder and welding operator performance qualification test records are submitted and approved in accordance with paragraph SUBMITTALS.

b. Testing was performed by an approved testing laboratory or technical consultant or by the Contractor's approved quality assurance organization.

c. The welding procedures, welders, and welding operators were qualified in accordance with ASME BPVC SEC IX, or AWS B2.1, AR-2 level; and base materials, filler materials, electrodes, equipment, and processes conformed to the applicable requirements of this specification.

d. The requirements of paragraph "Renewal of Qualification" below are met and records showing name of employer and period of employment using the process for which qualified are submitted as evidence of conformance.

1.6.1 Welding Procedures Qualification

The Contractor shall record in detail and shall qualify the Welding Procedure Specifications for every proposed welding procedure. Qualification for each welding procedure shall conform to the requirements of ASME B31.1 and ASME B31.3 and to this specification. The welding procedures shall specify end preparation for butt welds including cleaning, alignment, and root openings. Preheat, interpass temperature control, and postheat treatment of welds shall be as required by approved welding procedures, unless otherwise indicated or specified. The type of backing rings or consumable inserts, if used, shall be described and if they are to be removed, the removal process shall be described. Copies of the welding procedure specifications and procedure qualification test results for each type of welding required shall be submitted in accordance with paragraph SUBMITTALS. Approval of any procedure does not relieve the Contractor of the sole responsibility for producing acceptable welds. Welding procedures shall be identified individually and shall be referenced on the detail drawings or keyed to the contract drawings.

1.6.2 Welder and Welding Operator Performance

Each welder and welding operator assigned to work shall be qualified in accordance with ASME B31.1 and ASME B31.3.

1.6.2.1 Certification

Before assigning welders or welding operators to the work, the Contractor shall provide the Contracting Officer with their names together with certification that each individual is performance-qualified as specified. The certification shall state the type of welding and positions for which each is qualified, the code and procedure under which each is qualified, date qualified, and the firm and individual certifying the qualification tests.

1.6.2.2 Identification

Each particular weld shall be identified with the personal number, letter, or symbol assigned to each welder or welding operator. To identify welds, written records indicating the location of welds made by each welder or welding operator shall be submitted, and each welder or welding operator shall apply the personal mark adjacent to the welds using a rubber stamp or felt-tipped marker with permanent, weatherproof ink or other methods approved by the Contracting Officer that do not deform the metal. For seam welds, identification marks shall be placed adjacent to the welds at 3 foot intervals. Identification by die stamps or electric etchers will not be allowed.

1.6.2.3 Renewal of Qualification

Requalification of a welder or welding operator shall be required under any of the following conditions:

a. When a welder or welding operator has not used the specific welding process for a period of 3 months; the period may be extended to 6 months if the welder or welding operator has been employed on some other welding process.

b. When a welder or welding operator has not welded with any process during a period of 3 months, all the personal qualifications shall be considered expired, including any extended by virtue of a., above.

c. There is specific reason to question the person's ability to make welds that will meet the requirements of the specifications.

d. 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 preceding 12 months.

e. Renewal of qualification for a specific welding process under conditions a., b., and d., above, needs to be made on only a single test joint or pipe of any thickness, position, or material to reestablish the welder's or welding operator's qualification for any thickness, position, or material covered under previous qualification.

1.6.3 Inspection and NDE Personnel

All inspection and NDE personnel shall be qualified in accordance with the following requirements.

1.6.3.1 Inspector Certification

Welding inspectors shall be qualified in accordance with AWS QC1.

1.6.3.2 NDE Personnel

NDE personnel shall be certified, and a written procedure for the control and administration of NDE personnel training, examination, and certification shall be established. The procedures shall be based on appropriate specific and general guidelines of training and experience recommended by ASNT RP SNT-TC-1A, ASNT Q&A Bk A ASNT RP SNT-TC-1A Bk B ASNT Q&A Bk C and ASNT Q&A Bk D.

1.7 DELIVERY, STORAGE, AND HANDLING

All filler metals, electrodes, fluxes, and other welding materials shall be delivered to the site in manufacturers' original packages and stored in a dry space until used. Packages shall be properly labeled and designed to give maximum protection from moisture and to insure safe handling.

1.7.1 Material Control

Materials shall be stored in a controlled access and clean, dry area that is weathertight and is maintained at a temperature recommended by the manufacturer. The materials shall not be in contact with the floor and shall be stored on wooden pallets or cribbing.

1.7.1.1 Damaged Containers

Low-hydrogen steel electrodes shall be stored in their sealed shipping container. If the seal is damaged during shipment or storage, and the damage is not immediately detected, the covered electrodes in that container shall be rebaked in accordance with the manufacturer's instructions prior to issuance or shall be discarded. If a container is damaged in storage and the damage is witnessed, the electrodes from that container shall be immediately placed in a storage oven. The storage oven temperature shall be as recommended by the manufacturer or the welding material specification.

1.7.1.2 Partial Issues

When a container of covered electrodes is opened and only a portion of the content is issued, the remaining portion shall, within 1/2 hour, be placed in a storage oven.

1.7.2 Damaged Materials

Materials which are damaged shall be discarded. Covered electrodes which are oil or water-soaked, dirty, or on which the flux has separated from the wire shall be discarded.

1.8 SYMBOLS

Symbols shall be in accordance with AWS A2.4.

1.9 SAFETY

Safety precautions shall conform to AWS Z49.1.

PART 2 PRODUCTS

2.1 WELDING MATERIALS

Welding materials shall comply with ASME BPVC SEC II-C. Welding equipment, electrodes, welding wire, and fluxes shall be capable of producing satisfactory welds when used by a qualified welder or welding operator using qualified welding procedures.

PART 3 EXECUTION

3.1 WELDING OPERATIONS

Welding shall be performed in accordance with qualified procedures using qualified welders and welding operators. Welding shall not be done when the quality of the completed weld could be impaired by the prevailing working or weather conditions. The Contracting Officer shall determine when weather or working conditions are unsuitable for welding. Welding of hangers, supports, and plates to structural members shall conform to Section 05055 WELDING, STRUCTURAL.

3.1.1 Base Metal Preparation

Oxy-fuel cutting shall not be used on austenitic stainless steel or nonferrous materials.

3.1.2 Weld Joint Fit-Up

Parts that are to be joined by welding shall be fitted, aligned, and retained in position during the welding operation by the use of bars, jacks, clamps, or other mechanical fixtures. Welded temporary attachments shall not be used except when it is impractical to use mechanical fixtures. When temporary attachments are used, they shall be the same material as the base metal, and shall be completely removed by grinding or thermal cutting after the welding operation is completed. If thermal cutting is used, the attachment shall be cut to not less than 1/4 inch from the member and the balance removed by grinding. After the temporary attachment has been removed, the area shall be visually examined.

3.1.3 Preheat and Interpass Temperatures

Preheat temperatures shall meet the requirements specified by ASME B31.1 and ASME B31.3. However, in no case shall the preheat be below 50 degrees F for ferritic steel or austenitic stainless steel, or 32 degrees F for nonferrous alloys. The maximum interpass temperatures shall not exceed 300 degrees F for austenitic stainless steels, nickel alloys, and copper alloys; and 500 degrees F for carbon steels. Preheat techniques shall be such as to ensure that the full thickness of the weld joint preparation and/or adjacent base material, at least 3 inches in all directions, is at the specified temperature. Preheating by induction or resistance methods is preferred. When flame heating is used, only a neutral flame shall be employed. Oxy-fuel heating shall not be used on austenitic stainless steel or nickel-alloy materials; however, air-fuel heating is acceptable if controlled to insure that the surface temperature does not exceed 150 degrees F. Interpass temperatures shall be checked on the surface of the

component within 1 inch of the weld groove and at the starting location of the next weld pass, and for a distance of about 6 inches ahead of the weld, but not on the area to be welded.

3.1.4 Production Welding Instructions

a. Welding shall not be done when the ambient temperature is lower than 0 degree F.

b. Welding is not permitted on surfaces that are wet or covered with ice, when snow or rain is falling on the surfaces to be welded, or during periods of high winds, unless the welders and the work are properly protected.

c. Gases for purging and shielding shall be welding grade and shall have a dew point of minus 40 degrees F or lower.

d. Back purges are required for austenitic stainless steels and nonferrous alloys welded from one side and shall be set up such that the flow of gas from the inlet to the outlet orifice passes across the area to be welded. The oxygen content of the gas exiting from the purge vent shall be less than 2 percent prior to welding.

e. The purge on groove welds shall be maintained for at least three layers or 3/16 inch.

f. Removable purge dam materials shall be made of expandable or flexible plugs, such as plexiglass, plywood (which shall be dry when used), etc. Wood dams shall be kiln-dried quality. Nonremovable purge dams and purge dam adhesives shall be made of water soluble materials. Purge dams shall not be made of polyvinyl alcohol.

g. Any welding process which requires the use of external gas shielding shall not be done in a draft or wind unless the weld area is protected by a shelter. This shelter shall be of material and shape appropriate to reduce wind velocity in the vicinity of the weld to a maximum of 5 mph (440 fpm).

h. Welding of low-alloy and hardenable high-alloy steels may be interrupted provided a minimum of at least 3/8 inch thickness of weld deposit or 25 percent of the weld groove is filled, whichever is greater, and the preheat temperature is maintained during the time that welding is interrupted. If the temperature falls below the minimum preheat temperature before all welding has been completed on a joint, or, where required, before post weld heat treatment, a liquid penetrant or magnetic particle examination shall be performed to insure sound deposited metal before reheating. Welding of other materials may be interrupted without restriction provided a visual inspection is performed before welding is resumed.

i. Tack welds to be incorporated in the final welds shall have their

ends tapered by grinding or welding technique. Tack welds that are cracked or defective shall be removed and the groove shall be retacked prior to welding. Temporary tack welds shall be removed, the surface ground smooth, and visually inspected. For low-alloy and hardenable high-alloy steels, the area shall be magnetic particle examination inspected.

j. When joining ferritic steel pressure piping components to austenitic stainless steel pressure piping components and postweld heat treatment is required, the following requirements apply:

(1) The weld-end preps of ferritic steel components, which are to be welded to austenitic stainless steel, shall be buttered with one of the following weld filler metals and shall conform to the specified requirements:

ASME BPVC SEC II-C, SFA 5.14, Classification ERNiCr-3.

ASME BPVC SEC II-C, SFA 5.11, Classification ENiCrFe-2.

(2) The ferritic steel weld-end prep shall be buttered, receive a postweld heat treatment as required by ASME B31.1 and ASME B31.3 and then be machined with the applicable weld-end preparation. After machining, the buttered layer shall be a minimum of 1/4 inch thick.

(3) Pressure piping transition joints shall be completed using ERNiCr-3 or ENiCrFe-2 weld filler metals. No further postweld heat treatment shall be performed.

k. When joining ferritic steel pressure piping components to austenitic stainless steel pressure piping components and postweld heat treatment is not required, prepare and weld the joint using either ERNiCr-3 or ENiCrFe-2 filler metals. For service temperatures of 200 degrees F or less, stainless filler metal 309 ASME BPVC SEC II-C, SFA 5.4 or 5.9 is permissible in lieu of the nickel-based alloys.

l. Grinding of completed welds is to be performed only to the extent required for NDE, including any inservice examination, and to provide weld reinforcement within the requirements of ASME B31.1 and ASME B31.3. If the surface of the weld requires grinding, reducing the weld or base material below the minimum required thickness shall be avoided. Minimum weld external reinforcement shall be flush between external surfaces.

3.1.5 Postweld Heat Treatment

Postweld heat treatment shall be performed in accordance with ASME B31.1 and ASME B31.3. Temperatures for local postweld heat treatment shall be measured continuously by thermocouples in contact with the weldment.

Postweld heat treatment of low-alloy steels, when required, shall be performed immediately upon completion of welding and prior to the

temperature of the weld falling below the preheat temperature. However, postweld heat treatment may be postponed after the completion of the weld, if, immediately after the weld is completed, it is maintained at a minimum temperature of 300 degrees F or the preheat temperature, whichever is greater, for 2 hours per inch of weld thickness.

For low-alloy steels, the cooling rates shall be such that temper embrittlement is avoided.

3.2 EXAMINATIONS, INSPECTIONS, AND TESTS

Visual and NDE shall be performed by the Contractor to detect surface and internal discontinuities in completed welds. The services of a qualified commercial inspection or testing laboratory or technical consultant, approved by the Contracting Officer, shall be employed by the Contractor. All tack welds, weld passes, and completed welds shall be visually inspected. In addition, liquid penetrant examination shall be performed on root passes. Visual, magnetic particle or Ultrasonic examination shall be required as indicated in ATTACHMENT I. When inspection and testing indicates defects in a weld joint, the weld shall be repaired by a qualified welder in accordance with paragraph CORRECTIONS AND REPAIRS.

3.2.1 Random NDE Testing

Random radiographic and liquid penetrant examination is required, the Contractor shall test a minimum of 5 percent of the total length or number of piping welds. The welds inspected shall be selected randomly, but the selection shall include an examination of welds made by each welding operator or welder. If the random testing reveals that any welds fail to meet minimum quality requirements, an additional 10 percent of the welds in that same group shall be inspected. If all of the additional welds inspected meet the quality requirements, the entire group of welds represented shall be accepted and the defective welds shall be repaired. If any of the additional welds inspected also fail to meet the quality requirements, that entire group of welds shall be rejected. The rejected welds shall be removed and rewelded, or the rejected welds shall be 100 percent inspected and all defective weld areas removed and rewelded.

3.2.2 Visual Inspection

Weld joints shall be inspected visually as follows:

a. Before welding - for compliance with requirements for joint preparation, placement of backing rings or consumable inserts, alignment and fit-up, and cleanliness.

b. During welding - for cracks and conformance to the qualified welding procedure.

c. After welding - for cracks, contour and finish, bead reinforcement, undercutting, overlap, and size of fillet welds.

3.2.3 NDE Testing

NDE shall be in accordance with written procedures. Procedures for radiographic liquid penetrant tests and methods shall conform to ASME BPVC SEC V. The approved procedure shall be demonstrated to the satisfaction of the Contracting Officer. In addition to the information required in ASME BPVC SEC V, the written procedures shall include the timing of the NDE in relation to the welding operations and safety precautions.

3.2.4 Inspection and Tests by the Government

The Government will perform inspection and supplemental nondestructive or destructive tests as deemed necessary. The cost of supplemental NDE will be borne by the Government. The correction and repair of defects and the reexamination of weld repairs shall be performed by the Contractor at no additional cost to the Government. Inspection and tests will be performed as required for visual inspection and NDE, except that destructive tests may be required also. When destructive tests are ordered by the Contracting Officer and performed by the Contractor and the specimens or other supplemental examinations indicate that the materials and workmanship do not conform to the contract requirements, the cost of the tests, corrections, and repairs shall be borne by the Contractor. When the specimens or other supplemental examinations of destructive tests indicate that materials or workmanship do conform to the specification requirements, the cost of the tests and repairs will be borne by the Government. When destructive tests are made, repairs shall be made by qualified welders or welding operators using welding procedures which will develop the full strength of the members cut. Welding shall be subject to inspection and tests in the mill, shop, and field. When materials or workmanship do not conform to the specification requirements, the work may be rejected at any time before final acceptance of the system containing the weldment.

3.3 ACCEPTANCE STANDARDS

3.3.1 Visual

The following indications are unacceptable:

a. Cracks.

b. Undercut on surface which is greater than 1/32 inchdeep.

c. Weld reinforcement greater than 3/16 inch.

d. Lack of fusion on surface.

e. Incomplete penetration (applies only when inside surface is readily accessible).

f. Concavity in groove welds.

3.3.2 Liquid Penetrant Examination

The following relevant indications are unacceptable:

a. Any cracks or linear indications.

b. Four or more rounded indications in a line separated by 1/16 inch or less edge-to-edge.

3.3.3 Radiography

Welds that are shown by radiography to have any of the following discontinuities are unacceptable:

a. Porosity in excess of that shown as acceptable in ASME BPVC SEC I, Appendix A-250.

b. Any type of crack or zone of incomplete fusion or penetration.

c. Any other elongated indication which has a length greater than:

(1) 1/4 inch for t up to 3/4 inchinclusive, where t is the thickness of the thinner portion of the weld.

(2) 1/3 t for t from 3/4 inch to 2-1/4 inch, inclusive.

(3) 3/4 inch for t over 2-1/4 inch.

d. Any group of indications in line that have an aggregate length greater than t in a length of 12t, except where the distance between the successive indications exceeds 6L where L is the longest indication in the group.

Where t pertains to the thickness of the weld being examined; if a weld joins two members having different thickness at the weld, t is the thinner of these two thicknesses.

3.3.4 Ultrasonic Examination

Linear-type discontinuities are unacceptable if the amplitude exceeds the reference level and discontinuities have lengths which exceed the following:

a. 1/4 inch for t up to 3/4 inch.

b. 1/3 inch for t from3/4 to 2-1/4 inch.

c. 3/4 inch for t over 2-1/4 inch.

Where t is the thickness of the weld being examined; if the weld joins two members having different thicknesses at the weld, t is the thinner of these two thicknesses. Where discontinuities are interpreted to be cracks, lack of fusion, and incomplete penetration, they are unacceptable regardless of length.

3.4 CORRECTIONS AND REPAIRS

Defects shall be removed and repaired as specified in ASME B31.1 and ASME B31.3 unless otherwise specified. Disqualifying defects discovered between weld 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 eliminating sharp notches, crevices, or corners. After defect removal is complete and before rewelding, the area shall be examined by the same test method which first revealed the defect to ensure that the defect has been eliminated. After rewelding, the repaired area shall be reexamined by the same test method originally used for that area. Any indication of a defect shall be regarded as a defect unless reevaluation by NDE or by surface conditioning shows that no disqualifying defects are present. The use of any foreign material to mask, fill in, seal, or disguise welding defects will not be permitted.

-- End of Section --

ATTACHMENT I

Class Nitrocellulose (NC) and Acid Gravity Piping (Hercules N0.3947s and 14C5-15500 - PIPING Fabrication, Erection, and Testing Requirements)

CLASS NITROCELLULOSE (NC) PIPING - FABRICATION, ERECTION, AND TESTING REQUIREMENTS

Note: Except where otherwise specified, all references to paragraph numbers (eg 6.2.3) refer to paragraphs of this drawing

1.0 General Requirements for Ferrous and Non-Ferrous Construction and Repairs

1.1 Requirements listed herein are minimum standards and shall not have preference over any specification as stated on Hercules Incorporated approved drawings.

1.2 All Design, Materials, Fabrication, Assembly and Erection, Examination, Inspection, and Testing shall meet the minimum requirements of the latest applicable edition of the American Society of Mechanical Engineers (ASME/ANSI) B31.3 Chemical Plant and Petroleum Refining Piping Code (hereafter referred to as the B31.3 Code), and its mandatory references.

1.2.1 Minimum Design Category

1.2.1.1 The minimum design category for NC fluid service at less than 4% acid content and meeting the temperature/pressure/nonflammable limitations criteria as stated in the definition of "Category D fluid service", paragraph 300.2 of the B31.3 Code, shall be Category D. Additionally, more stringent Hercules Incorporated workmanship, examination and inspection requirements that apply are stated below.

1.2.1.2 The minimum design category for fluid service at 4% acid content or greater and/or experiencing pressures or temperatures above that for Category "D", or defined as being flammable, as defined by paragraph 300.2 of the B31.3 Code, is the implicit "Normal Service Condition", which requires examination in accordance with paragraph 341.4.1 of the B31.3 code, including random 5% Radiography (see also table 341.3.2A of B31.3 Code). Additionally, more stringent Hercules Incorporated workmanship, examination and inspection requirements that apply as stated below.

1.2.2 Owner

1.2.2.1 All references to the term "Owner" as defined in paragraph 300.b.1 and used throughout B31.3 Code shall be understood as referring to Hercules Incorporated. Hercules Incorporated is the authorized Contract Operator of the Government-Owned Radford Army Ammunition Plant.

1.2.3 Fabrication

1.2.3.1 All references to the term "Fabricator" shall be understood as also including the "Manufacturer" or "Erector" as used throughout B31.3 Code and this drawing, unless specifically excluded. It shall also be understood that the Fabricator, Erector, and Manufacturer may be a vendor(s) or firm(s) subcontracted by Hercules Incorporated to perform their respective work, U.S. Army Corps of Engineers contractor(s), or they may be Hercules Incorporated, RAAP employees.

2.0 Design

2.1 All NC piping must meet the minimum design requirements of B31.3 Code as stated above in paragraphs 1.0, 1.1, 1.2, 1.2.1, along with any requirements called forth in the approved applicable Hercules Incorporated drawings and specifications. All references to "Designer" shall be understood as referring to the Designer as defined in 300.b.(2) of B31.3. The Designer(s) may be either a subcontracted engineering firm, U. S. Army Corps of Engineers or their designated design agency, or may be Hercules Incorporated engineering personnel.

2.2 As called forth in Chapter II "Design" of the B31.3 Code, the Designer(s) must take into account the effects of pressure, temperature, and the various forces acting on the piping system along with consideration for ambient and mechanical influences, and other loadings. Additionally, the designer must take into account the various quality factors, allowable stress, and efficiency factors for the approved materials, joining and fastening methods. The Designer must prepare and submit the necessary drawings for fabrication, erection, and assembly along with bills of materials, and any required B31.3 Code calculations to Hercules Incorporated for approval, prior to any procurement of materials or starting of work.

3.0 Materials

3.1 All materials shall be provided by the Fabricator in strict accordance with the materials allowed by the B31.3 Code and the specific materials as required by the applicable Hercules Incorporated drawings and specifications.

3.2 The Fabricator shall receive, account for, and protect from loss or damage, all materials provided by Hercules Incorporated.

3.3 Substitution (including thicker wall materials) is not permitted without written authority from Hercules Incorporated.

3.4 All pressure piping parts, components, fittings, fasteners, valves, and appurtenances must be marked per their applicable specifications. Traceability by unique markings and supporting Certified Material Test Reports (MTR) or Certificates of Compliance (COC) shall be provided as required by Hercules Incorporated specifications.

4.0 Quality Assurance

4.1 Quality Control Program

4.1.1 The Fabricator must submit either a Quality Control Plan or Quality Control Manual to Hercules Incorporated for approval, that outlines how the Fabricator's own Quality Control Function (including both the program and personnel) will perform and document the required examinations and tests that assure that the requirements of this drawing are met. Additionally, the Fabricator as the Employer must submit relevant qualifications and experience information on their designated QC Examination Personnel as described in paragraph 342.1 of B31.3 Code.

5.0 Fabrication, Assembly, and Erection

5.1 All fabrication, assembly and erection as defined in B31.3 Code must be performed in strict compliance with the Hercules Incorporated approved fabrication drawings, specifications and procedures, for the particular scope of work.

5.1.1 Where particular methods, practices, or procedures are not specified by B31.3 Code or Hercules Incorporated specifications, the workmanship performed on piping is to be fabricated and erected by qualified craftsmen in a neat and workmanlike manner consistent with acceptable trade practices.

5.2 Welding

5.2.1 All welding (include tack welding) must be performed by Welding Procedure Specification (WPS's) qualified by one or more Procedure Qualification Records (PQR's) in accordance with B31.3 Chapter V and Section IX "Welding and Brazing" of the ASME Boiler and Pressure Vessel Code, latest edition.

5.2.2 All persons performing welding (including Tack Welds) must be qualified and certified by the Fabricator for the applicable WPS's used in accordance with the above same ASME Code, Section IX.

5.2.3 The Fabricator must provide copies of all applicable WPS's, PQR's and each Welder or Welding Operator Personnel Qualification Records (WPQ's) to Hercules Incorporated for acceptance, prior to any welding. Additionally, each Fabricator must submit documented evidence of current qualification, or renewal of qualification for each welder/welding operator as described in paragraph QW-322 of Section IX of the ASME Code.

5.2.4 Each Welder or Welding Operator must be assigned a unique identification symbol. Marking of this symbol to identify each weld made shall at a minimum be as outlined in paragraph 328.1(b) of B31.3 Code, and as required by Hercules Incorporated.

5.2.5 Welding Electrodes and Fillers Materials shall conform to American Welding Society (AWS) specifications, as allowed by B31.3 Code. Only those fillers and electrodes as identified on the approved WPS's may be used by the Fabricator. Substitution of filler or electrode, even within an "F" number or "A" number group as defined under paragraphs QW-430 and QW-440 of Section IX of the ASME Code is prohibited unless the WPS is properly qualified for the substitution, the WPS is properly revised by the Fabricator, and approved by Hercules Incorporated.

5.2.6 Storage of All Electrodes and Fillers must at a minimum be as recommended by their manufacturers. Electrodes must be purchased in sealed containers. All electrodes and fillers must be kept clean and dry. Exposed electrodes must be kept dry once the container seals are broken. Portable Storage ovens shall be at the job site heated to the proper temperature recommended by their manufacturer. At the end of the work day, remaining electrodes shall be removed from portable ovens and returned to their control storage ovens, which must be kept at their recommended temperatures.

5.2.7 Base Metal Preparation of the edges of the surfaces to be joined by welding shall be prepared by machining, flame cutting, plasma cutting or grinding. Surface oxides shall be removed after thermal cutting. The welding grooves shall be smooth, free of notches or harmful irregularities, clean of all oil, grease, cutting fluids or oxides, and shall meet the dimensional requirements of the approved fabrication drawings.

5.2.8 Weld Joint alignment, fit-up, preheating and interpass temperature maintenance shall be in accordance with the approved fabrication drawings and applicable WPS's. All weld preheating/interpass temperature must be in accordance with B31.3 Code paragraph 330 and Hercules Incorporated Specifications as approved on the applicable WPS's.

5.2.9 All Postweld Heat Treatment (PWHT) where required shall be by approved written procedure meeting B31.3 Code paragraphs 331. and Hercules Incorporated Specification, and must be on welds performed to WPS's qualified for PWHT.

6.0 Inspection, Examination and Testing

6.1 General

6.1.1 All references to "Inspection(s)" shall be understood by the Fabricator as referencing to inspections made by the Hercules Incorporated designated "Inspector" as defined in B31.3 Code, Chapter VI.

6.1.2 All references to "Examination(s)" shall be understood by the Fabricator as being those Quality Control Functions performed by the Fabricator's own QC Examiners, as defined in B31.3 Code Chapter VI. The Fabricator's QC Examination personnel must be free from production pressure, be given the responsibility and authority to examine as stated under Paragraph(s) 341. of B31.3 Code, and be free to take corrective action for any non-conformance arising from non-compliance to the approved drawings, specifications, procedures, and B31.3 Code. Additionally, the QC Examiners are responsible to bring all non-conformances to the attention of the Inspector for approval, prior to taking corrective action (including repairs).

6.2 The Inspector shall have access to any place where work concerning piping installation is being performed. (This includes manufacture, fabrication, heat treatment, assembly, erection, examination and testing of the piping). The Inspector shall have the right to audit the Fabricator's adherence to their Quality Control Program (see 4.0, Quality Assurance), and to inspect the piping using any examination method specified by the engineering design, review all certifications, records, and test reports to the satisfaction of Hercules Incorporated requirements.

6.3 Examination of NC piping meeting Category "D" Fluid Service for acid content less than 4%, where it's design gage pressure does not exceed 150 psi, and its design temperature is from (-20°F through 366°F), shall be performed at a minimum in accordance with paragraph 341.4.2 and 344.2 of the B31.3 Code. Examination for NC piping meeting the implicit category "Normal Service Condition" for acid content at 4% or greater, and/or where either or both the design pressures exceed 150 psi and the design temperatures are outside the (-20°F through 366°F range) at any acid content, shall comply with the requirements of paragraphs 341.4.1 and 344.2 of the B31.3 code. Additionally the following more stringent Hercules Incorporated examination requirements apply to either of the above fluid service categories

NOTE: ("*" denotes more stringent Hercules Incorporated requirements)

(*) 6.3.1 At least 5% of all fabrication for each welder's, bonder's, and operator's work performed by the Fabricator must pass a Liquid Penetrant Examination (PT) performed to approved written procedure(s) in accordance with paragraphs 341.3.4 and 344.4.1 of the B31.3 Code, and by personnel qualified and certified in accordance with paragraph 342 of B31.3 Code.

a. The 5% includes both the external and internal (where accessible) faces of each completed weld in accordance with the rules of Progressive Examination, as defined in paragraph 341.3.4 of B31.3 Code.

b. The Acceptance Criteria for the Liquid Penetrant Examination shall be as stated in Appendix 8 of Section VIII, Div-1 of the ASME B&PV Code (latest edition).

6.3.2 Visual Examination by the Fabricator shall be performed by approved written procedure as stated in paragraph 341.4.2 of B31.3 Code such that:

a. Sufficient materials and components are selected at random, to satisfy the examiner that they conform to specification, and are free from damage.

(*) b. At least 5% of fabrication, for each welder's, bonder's, and operator's, work shall be represented.

(*) c. 100% of fabrication for longitudinal welds as performed by the Fabricator, and welds other than circumferential shall be represented. Standard pressure piping components and fittings (manufactured to ASTM, ANSI, or MSS Standards) purchased under listed specification in B31.3 Code and have been manufactured using automated machine welding processes are not required to be examined by (PT) or given a minimum percentage of visual examination other than as stated in 6.3.2.(a), unless defects are suspected or evidenced during fabrication.

(*) d. Acceptance Criteria as per Table 341.3.2A of the B31.3 Code for Category "D" NC piping by Visual Examination is applicable except as follows: One or more of the following defects as detected by visual examination and/or during hydrostatic testing shall be cause for rejection.

(1) Welding performed by unqualified persons.

(2) Cracks or pinholes.

(3) Evidence of Peening.

(4) Oxidation around welds.

(5) Welds not uniform in appearance.

(6) Lack of fusion or incomplete penetration (none allowed).

(7) Weld penetration (internal protrusion or reinforcement) in excess for that allowed in Table 341.3.2A of the B31.3 Code for "Normal Service Conditions". The weld bead contour shall be smooth and have a slight convex contour.

(8) Presence of porosity, slag inclusion or overlaps.

(9) Undercutting adjacent to completed weld or evidence of undercutting by grinding.

(10) Misalignment exceeding the requirements of paragraph 5.2.8.

(11) Leaks detected during hydrostatic tests and sensitive leak tests.

e. The applicable acceptance criteria for "Normal Service" NC piping is as per Table 341.3.2A of the B31.3 Code for "Normal Service Conditions" by visual examination, and 5% Random Radiography Testing. The same examination characteristics as in 6.3.2(d) items (1 thru 11) are also rejectable for failure to meet them, but additionally for "Normal Service Conditions", failure to meet the radiographic examination requirements is also rejectable.

6.3.3 Defective Welds may be repaired subject to the authority of the Hercules Authorized Representative. Defect removal to acceptable levels, as verified by approved NDE methods, must precede any allowed repairs. All repairs must be documented, as per the approved Quality Program in Paragraph 4.0 Quality Assurance of this drawing.

6.3.4 Examination to Resolve Uncertainty Any applicable, recognized NDE method as listed in Section V of the ASME B&PV Code may be used to resolve doubtful indications. Acceptance criteria shall be those as listed for the required examination(s).

6.4 Tests

6.4.1 Hydrostatic testing shall be performed on a pressure piping system by a procedure prepared and submitted by the Fabricator and approved by the Hercules Representative. All items which could be damaged during the pressure test must be isolated. Only calibrated pressure gauges with a dial or digital readout graduated over a range of about double the intended maximum test pressure shall be used.

6.4.2 Compensation for the static head of water must be made by the Fabricator when locating the test gages. The hydrostatic pressures, temperatures, and times shall be as per the B31.3 Code and Hercules Incorporated drawing or specification.

7.0 Documentation and Records

7.1 The Fabricator is responsible to provide the Hercules Incorporated Inspector copies of all required MTR's, COC's along with in process examination records, repair records, corrective action of non-conformances, reports of liquid penetrant examination, hydrostatic test and any other tests or examinations performed by the Fabricator for acceptance of the piping system.

7.2 Finally, the Fabricator must submit a signed summary certification stating that all materials supplied, and all workmanship, examinations, and tests for the entire scope of the project have been performed in accordance with B31.3 Code and the applicable Hercules Design requirements.

MASTER CONSTRUCTION SPECIFICATION

SECTION 15500 -- PIPING FABRICATION, ERECTION, AND TESTING

1.0 GENERAL

1.1 Description. This specification, along with the work requirements outlined in paragraph 1.1.1, covers the furnishing of all material, construction equipment, accessories, tools, services, transportation, labor, and supervision required for the fabrication, erection, and testing of piping systems.

1.1.1 Work Requirements

a. Hercules data, including piping drawings and isometrics, bills of material, Line Type Specifications, and Line Designation Tables shall be used in conjunction with this specification. Should a conflict exist between this specification and any of the Hercules data or piping codes, the fabricator shall bring the conflict to the Hercules Construction Manager for resolution.

b. Changes or modifications of this specification shall be made only by mutual agreement between Hercules and the contractor.

c. Failure to comply with this specification shall be cause for rejection of all affected material or fabricated assemblies at the option of Hercules.

1.2 Quality Assurance

1.2.1 Codes and Standards

a. Unless noted otherwise, fabrication, erection, and testing shall be in accordance with ANSI/ASME B31.3, Chemical Plant and Petroleum Refinery Piping, latest edition, and other standards referred to in this specification.

NOTE: Article 9, Visual Examination -- Section V, ASME Code may be attached for field reference. Consult piping specialist.

b. This specification may be used where other sections of ANSI/ASME B31 and/or Section I of the ASME Pressure Vessel Code apply. The limits of such piping shall be indicated on the piping drawings.

c. "Latest edition" indicates the edition and addendums in effect at the time the contract or purchase order is issued.

d. Hercules Standards

1. 6DE-0A1; Criteria and Specification for Pressure Testing Piping Systems.

2. 6DE-3S1; Flanged Closures, Bolting.

3. 6DE-4E1; Pipe Thread Lubricants.

4. 6ES-5A1; Allowable Pipe Spans.

5. 6CS-6B2; Field Pressure Testing of Piping Systems.

1.3 Field Storage and Handling

1.3.1 Flange faces shall be protected from damage during storage by suitable wood, plastic, or metal covers securely bolted to the flanges. Also protect faces of flanges against corrosion, either with a durable and easily removed coating, or commercial plastic tape applied before bolting of covers to the flanges.

1.3.2 Valves and fittings in outdoor storage must be placed on planks for protection from mud, dirt, and sand. Place valves such that water will not accumulate in valve body. Fit a pipe plug in the open end of installed valves having open threaded ends to prevent corrosion of threads. Protect pipe and fittings with threaded ends from corrosion and damage to threads, both prior to and during construction.

1.3.3 All precautions shall be taken to assure internal cleanliness of fabricated piping. Flange protectors or end closures shall not be removed until time of installation. Before installing piping, it shall be examined to see that all dirt and foreign matter have been removed from inside the pipe. Wherever practical, hydrostatic test water shall be drained to promote flushing for further cleaning.

2.0 MATERIALS

2.1 Piping materials shall be in accordance with the Hercules Line Type Specifications approved for the project, and as indicated on the drawing bills of material.

2.2 The contractor shall receive, account for, and protect from loss or damage all materials provided by Hercules.

2.3 In cases where the fabricator is to furnish material, he shall furnish all pipe, flanges, fittings, and other components welded directly to the spool. The fabricator shall not furnish field assembly items (e.g., valves, gaskets, bolts).

2.4 Substitutions, including thicker wall materials, are not permitted without authorization from Hercules.

3.0 EXECUTION

3.1 General

3.1.1 Workmanship. Piping shall be fabricated and erected by qualified craftsmen in a neat and workmanlike manner consistent with acceptable trade practices.

3.1.2 Fabrication. Fabrication shall be in accordance with ANSI/ASME B31.3, Chapter V, latest edition.

a. Field fabricated, noncommercial reducers shall <u>not</u> be used.

b. Miter elbows are to be used only when specified on the drawings.

c. Valves shall be installed according to manufacturers' recommendations and as shown on the drawings. Do <u>not</u> install valves with the stem lower than horizontal or with the stem projecting into a passageway.

d. Vent and drain connections shall be provided to facilitate hydrotesting, whether shown on drawings or not, if no other method of venting at a high point or draining at a low point is available. Vents and drains shall be 1/2-inch size minimum. Drain connections shall be 3/4-inch minimum for pipes above 1 inch. Valves are not required.

e. All restrictions which would interfere with filling, draining, or flushing (such as orifice plates, rotameter floats, and flow nozzles) shall not be installed until after completion of the pressure test and line flushing operations.

f. All piping joints shall be left exposed until after completion of pressure testing.

3.1.3 Pipe Sleeves

a. Lines through building walls, floors, and roofs shall be through pipe sleeves large enough to pass a flange, and large enough for insulation and unrestricted pipe expansion and contraction, but no larger.

b. Sleeves shall be standard weight galvanized steel pipe or approved manufacturer's sleeve, furnished and installed by the mechanical contractor.

c. A weather shield shall be provided at all openings through roofs and exterior walls. Sleeves in masonry or concrete walls shall be grouted around the outside to provide an air-tight closure. After the pipe has been installed through the sleeve, the space between the sleeve and the pipe shall be filled with "Quelpyre Mastic 703-B" or approved equal, to protect the penetrations against fire.

3.1.4 Piping around equipment shall be arranged as shown on the drawings. If not shown, piping shall be arranged to permit access to equipment and to permit removal for maintenance and inspection.

3.1.5 Clearance and accessibility shall be maintained as shown on piping drawings.

3.1.6 Piping shall be installed in a manner that the resultant forces on the equipment will be kept to a minimum. Particular care shall be taken at pumps, turbines, compressors, and other mechanical equipment where piping forces can cause misalignment. Flange misalignment beyond the acceptable tolerance per ANSI B31.3, paragraph 335.1.1(c), shall be corrected by cutting and rewelding, or by such bending (hot or cold) as is practical, and not by excessive forcing of the bolting.

3.1.7 Pipe Hangers and Supports

a. The contractor shall install and align pipe supports, hangers, guides, anchors, brackets, hardware, steel work, and attachments as shown on the drawings. Pipe expansion and contraction must be compensated for as shown on the drawings.

b. When permanent pipe supports cannot be installed during erection, or are not necessary, adequate temporary supports shall be provided so that piping is not strained or deformed during the erection process. Special consideration shall be given to piping systems containing fragile materials, and to systems being hydrotested that are not designed to carry the weight of pipe full of water.

c. Where hangers, supports, and fasteners are not specified on the drawings they shall be of a type suited for the service involved and installation method recommended. They shall be designed to support piping filled with water with a safety factor of 5, based on ultimate strength. The support system shall allow for expansion and contraction of the piping, and piping shall not sag.

d. Allowable pipe spans shall be per Hercules Standard 6ES-5A1. Allowable spans for copper tubing shall be as follows:

O.D. Tubing Size	Max Span (ft)
5/8 - 3/4	6
7/8 - 1-1/8	8
1-3/8 - 2-1/8	10

e. Installation of hangers and supports shall be made of structural steel, masonry, or poured concrete. Hangers and supports shall not be installed to precast concrete, metal decks, steel bracing or bridging, conduit, or other piping.

f. Pipe shoes which are field welded to pipe shall be centered over pipe supports in the cold position.

3.1.8 Screwed Joints. Threads shall conform to the American Standard for Taper Pipe Threads, ANSI B1.20.1, and shall be concentric with the outside barrel of the pipe. Ream pipe ends to remove burrs. Threaded joint sealer shall conform to Hercules Standard 6DE-4E1 and shall be applied sparingly on pipe threads. Screw joints tightly together to make them leak-proof. Springing of a pipe to close a joint is not permitted. Protect threads against damage by a subsequent fabricating operation.

3.1.9 Flanged Joints. Bolt holes shall straddle the horizontal and vertical centerlines. Pull all bolts up evenly to ensure leak-proof and stress-free connections.

a. Slip-on flanges shall be welded inside and outside. There shall be a distance of approximately 1/16 - 1/8 inch between the edge of the fillet weld and the face of the flange.

3.1.10 Soldered Copper Joints. Surfaces to be joined by soldering shall be cleaned bright by manual or mechanical means. The joints shall be properly fluxed with noncorrosive type flux and made up with solder manufactured to approved standards.

3.1.11 Bolt thread lubricant shall be used on threads of all flanged bolting. Refer to Hercules Standard 6DE-3S1.

3.1.12 Tolerances on linear dimensions such as face-to-face, face or end-to-end, face or end-to-center, and center-to-center for shop fabricated pipe are as follows:

a. ± 1/8" for sizes 10" and under.

b. ± 3/16" for sizes 12" through 24".

c. ± 1/4" for sizes 26" through 36".

3.2 Welding

3.2.1 Qualification. Qualification of the welding procedures to be used, and of the performance of welders and welding operators, is required and shall comply with the requirements of the ASME Boiler and Pressure Vessel Code, Section IX. Contractor's welding procedures must be submitted for review and approval prior to the start of work. The contractor is responsible for the welding done by personnel of its organization, and shall conduct the required qualification tests to qualify the welding procedures and the welder or welding operators. Test joints for both procedure qualification and performance qualification shall be made as groove welds in pipe in one or more of the specified basic qualification test positions. The contractor shall maintain a record, certified by him, and available to Hercules, of the procedures used and the welders or welding operators employed by him, showing the date and result of procedure and performance qualifications, and the identification symbol assigned to each performance qualification. The qualification of procedure and the qualification of welders and welding operators must be acceptable to the Hercules authorized representative. Do not start welding until qualifications have been accepted by the Hercules representative.

a. Furnish each welder with a steel marking stencil. Each welder must identify each of his own welds with his stencil. Provide welders working close to flammable materials with fire extinguishers. Observe fire prevention precautions and avoid fire hazards and heat damage to adjacent structures. No flame-producing devices, welding, or other hot work is allowed in restricted areas without permission from plant personnel (Hot Work permit).

3.2.2 Welding Electrodes and Filler Material. Electrodes and filler material shall conform to AWS specifications for filler materials and electrodes.

3.2.3 Storage of Electrodes. Care must be exercised in handling electrodes. Electrodes shall be purchased in sealed containers. Special care shall be taken to ensure that exposed electrodes are kept dry in accordance with vendor recommendations after the container seal has been broken. Portable storage ovens shall be at the job site heated to the proper temperature recommended by the vendor. At the end of each work day, electrodes should be removed from the portable oven and returned to the central storage oven.

3.2.4 Preparation of the Base Metal

a. End Preparation. The edges of surfaces of the parts to be joined by welding shall be prepared by machining, flame cutting, and plasma cutting or grinding. If machining is impractical, grind, flame or plasma cut the pipe ends. Surface oxides shall be removed after thermal cutting. The welding grooves shall be reasonably smooth, free of notches or harmful irregularities, and must be cleaned of all oil, grease, cutting fluids, or oxides. The internal and external surfaces of parts to be joined must be free of all paint, oil, rust, scale, or other foreign matter, and should be cleaned to a bright metal surface by solvent washing and/or filing, power brushing, or power grinding.

1. End shape and dimensions shall conform to the requirements of ANSI B16.25, Butt Welding Ends, and B16.9, Wrought Steel Butt Welding Fittings, unless otherwise specified.

2. Weld groove contour shall conform to AWS recommended guidelines or as specified in the welding procedure. Root gap and land geometry shall be such that 100% full penetration is achieved.

b. Alignment. Align ends of pipe joint within the existing commercial tolerances on pipe diameters, wall thickness, and out of roundness. This alignment must be maintained during welding. Where ends of unequal internal diameters are butted and the internal misalignment exceeds 1/16 inch, taper (3:1) the item with the smaller internal diameter to equal the other. The outer diameter of sections to be welded shall be aligned within 1/16 inch. Trim length shall equal wall thickness. Trim by counterboring with bottom angle at 30° maximum from the horizontal. (Refer to ANSI B31.3, Chapter V.) Trimming shall not result in a finished wall thickness of less than the minimum required by the design conditions.

c. Clamps. Welded clips, tack welds or other appropriate means shall be used to properly align the joint for welding. After completion of the weld, all attachments shall be removed and the affected area ground and visually inspected for defects. Defects shall be repaired using a qualified welding procedure and ground smooth. Care must be taken not to reduce the pipe wall thickness when grinding down weld repairs. No backing rings shall be used.

3.2.5 Preheating requirements for all piping shall be in accordance with ANSI B31.3, paragraph 330.

3.2.6 Welding Inspection and Testing

a. All pipe welds shall have visual examination in accordance with ANSI B31.3, paragraph 344.2.

b. Lines in Category N fluid service (flammable, toxic, or with design pressure greater than 150 psig or design temperature greater than 366°F) shall have random radiograph of 5% of circumferential butt welds in accordance with ANSI B31.3, paragraph 341.4.1(b). Radiograph acceptance criteria shall be the same as for 100% radiography.

c. Category D Fluid Service (nonflammable, nontoxic, 150 psi or less design pressure and -20°F to 366°F design temperature), required examination: Visual only in accordance with ANSI B31.3, paragraph 341.4.2, and ASME, Article 9, Section V.

d. The Hercules Line Designation Table indicates the fluid service category for each line.

e. The contractor shall provide continual access for inspection of the work to the Hercules representative. No weld shall be covered, and no insulation shall be applied before the inspection has been carried out to the satisfaction of Hercules. Hercules reserves the right to reject welds upon visual inspection, hydrostatic pressure tests, or evidence of defects detected through radiography. One or more of the following defects shall be cause for rejection of a weld:

1. Failure to meet radiographic examination requirements.

2. Welding performed by unqualified persons.

3. Welds not reasonably uniform in appearance.

4. Evidence of peening.

5. Cracks or pinholes.

6. Oxidation around welds.

7. Lack of fusion and/or incomplete penetration.

8. Weld penetration in excess of 1/32 inch. Inside weld bead contour shall be smooth and have a slight convex contour.

9. The presence of porosity, slag inclusions, or overlaps.

10. Undercutting adjacent to completed weld or evidence of undercutting by grinding.

11. Misalignment exceeding the requirements of paragraph 3.2.4, of this Specification.

12. Leaks detected during hydrostatic tests and sensitive leak tests.

f. Defective welds may be repaired on the authority of the Hercules authorized representative, but any weld that shows evidence of having been repaired without authorization may be rejected. Repairs may be made to pinholes and undercutting or the final bead without authorization, but such repairs must meet the final approval of the Hercules representative. Before repairs are made, remove defects by chipping, grinding or arc-air gouging and grinding. Remove slag and scale by way of chipping and brushing. Preheat any such area before rewelding, when required by the welding procedure.

3.3 Tubing

3.3.1 Care should be taken to install tubing in a neat, orderly fashion, grouping runs where possible. Tubing shall have no flattening, crimping, or other type of deformation.

3.3.2 When running tubing from point-to-point, changes of direction or expansion loops shall be provided in order to prevent tension stresses and allow for temperature expansion.

3.3.3 Tubing should be ganged vertically, rather than horizontally, to avoid collection of dirt and corrosive conditions.

3.3.4 Care shall be taken not to install tubing at elevations subject to being used as foot, arm, or body rests.

3.3.5 Tubing shall not support the weight of valves, filters, regulators, etc. These components should have separate mounting brackets.

3.3.6 No hand bending of tubing is permitted. 1/4 inch O.D. through 1/2 inch O.D. bends shall be formed with a mechanical hand tube bender or a crank-operated manual bender. Five-eights inch O.D. and larger bends shall be formed with a crank-operated manual or hydraulic tube bender.

3.3.7 Minimum Bend Radius for Tubing

Tubing O.D (in)	Mech. Bender without Mandrel (in)
1/8	1/2
1/4	1
3/8	1-1/4 to 2
1/2	1-1/2 to 2
5/8	1-1/2 to 2-1/2
3/4	1-3/4 to 3
7/8	2 to 3-1/2

3.3.8 Tube bending shall be performed before connecting fittings.

3.3.9 Tubing fittings shall be made up with tubing wrenches designed for this purpose. Wrenches of this type equalize the torque over five corners and prevent slipping and distortion of the hexagon nut.

3.3.10 Fittings should be staggered and offset when making multiple runs to provide easier installation and fitting accessibility.

3.4 Cold Bending and Flanging

3.4.1 Only the following pipe shall be used for cold bending and flanging:

a. Carbon Steel: ASTM A587.

b. Stainless Steel. ASTM A312, (Types 304, 304L, 316, 316L), full finished quality, suitable for cold bending and flanging.

3.4.2 Only qualified personnel, trained to Hercules procedures, shall be permitted to operate bending and flanging machine.

3.4.3 Pipe ends for bending and flanging shall be square and true, with cuts made by mechanical device. Cuts made by acetylene torch or plasma arc machine are not permitted.

3.4.4 End ridges must be removed by drum grinder or coarse file prior to bending or flanging.

3.4.5 Bend heel wall thickness, flange lap thickness and diameter shall be checked at random to assure conformance to ANSI B31.3 Section 306.2 and 306.4.2. In no case shall bend wall thickness be reduced by more than 20% of nominal wall thickness.

3.4.6 Prior to installation of piping, all internal lubrication material must be removed from bends. This should be done as soon as possible to avoid the hardening and drying out of lubricant.

3.5 Polyvinyl Chloride Pipe Joints. Solvent cement-type joint shall be used. Pipe ends shall be cut square and then chamfered 10° to 15°. Lightly sand area and wipe clean. Check "dry fit" of pipe, and then apply primer to socket and pipe surface. Apply solvent cement while both surfaces are still wet with primer. While both surfaces are wet with solvent cement, insert pipe end into socket with 1/4 turn twisting motion insuring that pipe end goes to the bottom of socket, completing within one minute. Hold joint together for 30 seconds until both ends are firmly gripped. Allow set time according to the following table before distrubing joints.

Time (min)	Temperature (°F)
30	60 to 100
60	40 to 60
120	20 to 40
240	0 to 20

Primer and solvent cement shall be supplies by piping manufacturer and applied according to manufacturer recommendations.

3.6 Fiberglass Reinforced Plastic Pipe Joints

3.6.1 Socket Type Joints. These joints join with adhesive per manufacturer's recommendations. Pipe ends shall be cut square, and joint area shall be lightly sanded and wiped clean. Apply adhesive to socket and pipe surface and insert pipe end into the socket slowly and without twisting. Fabricated assemblies should be handled carefully to prevent movement of the joint before complete curing.

Curing at temperatures below 60°F is not recommended. External heat may be applied to aid curing. Do not exceed 200°F.

3.6.2 Flanged Joints. These joints provide washers under all bolt heads and nuts. Provide a spacer outside the raised face when mating a fiberglass flange to a raised face flange.

3.6.3 Bonding. Qualification of the bonding procedures to be used, and of the performance of bonders and bonding operators, is required and shall comply with the requirements in ASME/ANSI B31.3, paragraph A328.

3.7 Hydrostatic Testing. Hydrostatic testing shall be performed in accordance with Hercules Standards 6CS-6B2 and 6DE-0A1. All items that could be damaged during pressure testing (e.g., vessels, heat exchangers, pumps, compressors, relief valves, rupture disks, diaphragm instruments, orifice plates, filters, strainers, expansion joints), shall be isolated from test pressures or removed.

SECTION 05120A

STRUCTURAL STEEL
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.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC FCD	(1995a) Quality Certification Program Description
AISC ASD Manual	(1989) Manual of Steel Construction Allowable Stress Design
AISC ASD/LRFD Vol II	(1992) Manual of Steel Construction Vol II: Connections
AISC Design Guide No. 10	(1989) Erection Bracing of Low-Rise Structural Steel Frames
AISC LRFD Vol I	(1995) Manual of Steel Construction Load & Resistance Factor Design, Vol I: Structural Members, Specifications & Codes
AISC LRFD Vol II	(1995) Manual of Steel Construction Load & Resistance Factor Design, Vol II: Structural Members, Specifications & Codes
AISC Pub No. S303	(1992) Code of Standard Practice for Steel Buildings and Bridges

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 6/A 6M	(1998a) General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
ASTM A 36/A 36M	(1997a) Carbon Structural Steel
ASTM A 53	(1999) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 242/A 242M	(1998) High-Strength Low-Alloy Structural Steel
ASTM A 307	(1997) Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 325	(1997) Structural Bolts, Steel, Heat

	Treated, 120/105 ksi Minimum Tensile Strength
ASTM A 325M	(1997) High-Strength Bolts for Structural Steel Joints (Metric)
ASTM A 490	(1997) Heat-Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength
ASTM A 490M	(1993) High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints (Metric)
ASTM A 500	(1999) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 501	(1999) Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM A 502	(1993) Steel Structural Rivets
ASTM A 514/A 514M	(1994a) High-Yield-Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding
ASTM A 529/A 529M	(1996) High-Strength Carbon-Manganese Steel of Structural Quality
ASTM A 563	(1997) Carbon and Alloy Steel Nuts
ASTM A 563M	(1997) Carbon and Alloy Steel Nuts (Metric)
ASTM A 572/A 572M	(1999) High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A 588/A 588M	(1997) High-Strength Low-Alloy Structural Steel with 50 ksi (345 MPa) Minimum Yield Point to 4 in. (100 mm) Thick
ASTM A 618	(1999) Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural Tubing
ASTM A 709/A 709M	(1997a) Carbon and High-Strength Low-Alloy Structural Steel Shapes, Plates, and Bars and Quenched-and-Tempered Alloy Structural Steel Plates for Bridges
ASTM A 852/A 852M	(1997) Quenched and Tempered Low-Alloy Structural Steel Plate with 70 ksi (485 MPa) Minimum Yield Strength to 4 in. (100 mm) Thick
ASTM A 992/A 992M	(1998e1) Steel for Structural Shapes For Use in Building Framing
ASTM F 436	(1993) Hardened Steel Washers
ASTM F 436M	(1993) Hardened Steel Washers (Metric)

ASTM F 844	(1998) Washers, Steel, Plain (Flat), Unhardened for General Use
ASTM F 959	(1999) Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners

ASME INTERNATIONAL (ASME)

ASME B18.21.1	(1994) Lock Washers (Inch Series)
ASME B46.1	(1995) Surface Texture (Surface Roughness, Waviness, and Lay)

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4	(1998) Standard Symbols for Welding, Brazing and Nondestructive Examination
AWS D1.1	(1998) Structural Welding Code - Steel

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 25	(1991) Red Iron Oxide, Zinc Oxide, Raw Linseed Oil and Alkyd Primer (without Lead and Chromate Pigments)

1.2 GENERAL REQUIREMENTS

Structural steel fabrication and erection shall be performed by an organization experienced in structural steel work of equivalent magnitude. The Contractor shall be responsible for correctness of detailing, fabrication, and for the correct fitting of structural members. Connections, for any part of the structure not shown on the contract drawings, shall be considered simple shear connections and shall be designed and detailed in accordance with pertinent provisions of AISC ASD Manual and AISC LRFD Vol II. Substitution of sections or modification of connection details will not be accepted unless approved by the Contracting Officer. AISC ASD Manual and AISC ASD/LRFD Vol II AISC LRFD Vol I and AISC LRFD Vol II shall govern the work. Welding shall be in accordance with AWS D1.1; except that welding for critical applications shall be in accordance with Section 05090 WELDING, STRUCTURAL or paragraph WELDING. High-strength bolting shall be in accordance with AISC ASD Manual.

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

Structural Steel System; G, SWVAO
Structural Connections; G

Shop and erection details including members (with their

connections) not shown on the contract drawings. Welds shall be indicated by standard welding symbols in accordance with AWS A2.4.

SD-03 Product Data

Erection; G

Prior to erection, erection plan of the structural steel framing describing all necessary temporary supports, including the sequence of installation and removal.

Welding; G

WPS not prequalified.

WPS prequalified.

SD-04 Samples

High Strength Bolts and Nuts; G
Carbon Steel Bolts and Nuts; G
Nuts Dimensional Style; G
Washers; G

Random samples of bolts, nuts, and washers as delivered to the job site if requested, taken in the presence of the Contracting Officer and provided to the Contracting Officer for testing to establish compliance with specified requirements.

SD-07 Certificates

Mill Test Reports; G

Certified copies of mill test reports for structural steel, structural bolts, nuts, washers and other related structural steel items, including attesting that the structural steel furnished contains no less than 25 percent recycled scrap steel and meets the requirements specified, prior to the installation.

Welder Qualifications; G

Certified copies of welder qualifications test records showing qualification in accordance with AWS D1.1.

Welding Inspector; G

Welding Inspector qualifications.

Fabrication; G

A copy of the AISC certificate indicating that the fabrication plant meets the specified structural steelwork category.

1.4 STORAGE

Material shall be stored out of contact with the ground in such manner and location as will minimize deterioration.

1.5 WELDING INSPECTOR

Welding Inspector qualifications shall be in accordance with AWS D1.1

PART 2 PRODUCTS

2.1 STRUCTURAL STEEL

2.1.1 Carbon Grade Steel

Carbon grade steel shall conform to ASTM A 36/A 36M.

2.1.2 High-Strength Low-Alloy Steel

High-strength low-alloy steel shall conform to ASTM A 572/A 572M, Grade A.

2.1.3 Corrosion-Resistant High-Strength Low-Alloy Steel

Corrosion-resistant steel shall conform to ASTM A 242/A 242M ASTM A 588/A 588M.

2.1.4 Quenched and Tempered Alloy Steel

Tempered alloy steel shall conform to ASTM A 514/A 514M.

2.1.5 Carbon and High-Strength Low-Alloy Steel

Carbon and high-strength low-alloy steel shall conform to ASTM A 709/A 709M.

2.1.6 Quenched and Tempered Low-Alloy Steel

Quenched and tempered low-alloy steel shall conform to ASTM A 852/A 852M, 70 ksi.

2.1.7 Structural Shapes for Use in Building Framing

Wide flange shapes in accordance with ASTM A 992/A 992M shall be used where indicated on the drawings.

2.2 STRUCTURAL TUBING

Structural tubing shall conform to ASTM A 500, Grade A ASTM A 501 ASTM A 618, Grade A.

2.3 STEEL PIPE

Steel pipe shall conform to ASTM A 53, Type E, Grade B.

2.4 RIVETS

Rivets shall conform to ASTM A 502, Grade A.

2.5 HIGH STRENGTH BOLTS AND NUTS

High strength bolts shall conform to ASTM A 325, Type 1 with carbon steel nuts conforming to ASTM A 563, Grade C ASTM A 325, Type 3 with carbon steel nuts conforming to ASTM A 563, Grade C3 ASTM A 490, Type 2 with carbon steel nuts conforming to ASTM A 563, Grade DH ASTM A 490, Type 3 with carbon steel nuts conforming to ASTM A 563, Grade DH3.

2.6 CARBON STEEL BOLTS AND NUTS

Carbon steel bolts shall conform to ASTM A 307, Grade A with carbon steel nuts conforming to ASTM A 563, Grade A.

2.7 NUTS DIMENSIONAL STYLE

Carbon steel nuts shall be Hex Heavy Hex style when used with ASTM A 307 bolts or Heavy Hex style when used with ASTM A 325 or ASTM A 490 bolts.

2.8 WASHERS

Plain washers shall conform to ASTM F 844. Other types, when required, shall conform to ASME B18.21.1 ASTM F 436 ASTM F 959.

2.9 PAINT

Paint shall conform to SSPC Paint 25.

PART 3 EXECUTION

3.1 FABRICATION

Fabrication shall be in accordance with the applicable provisions of AISC ASD Manual. Fabrication and assembly shall be done in the shop to the greatest extent possible. The fabricating plant shall be certified under the AISC FCD for Category 1 structural steelwork. Compression joints depending on contact bearing shall have a surface roughness not in excess of 500 micro inches as determined by ASME B46.1, and ends shall be square within the tolerances for milled ends specified in ASTM A 6/A 6M. 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 ERECTION

a: Erection of structural steel, except as indicated in item b. below, shall be in accordance with the applicable provisions of AISC ASD Manual AISC LRFD Vol I endorsement F of AISC FCD. Erection plan shall be reviewed, stamped and sealed by a structural engineer licensed by the state in which the project is located.

b. For low-rise structural steel buildings (60 feet tall or less and a maximum of 2 stories), the erection plan shall conform to AISC Pub No. S303 and the structure shall be erected in accordance with AISC Design Guide No. 10.

3.2.1 Structural Connections

Anchor bolts and other connections between the structural steel and foundations shall be provided and shall be properly located and built into connecting work. Field welded structural connections shall be completed before load is applied.

3.2.2 Base Plates and Bearing Plates

Column base plates for columns and bearing plates for beams, girders, and similar members shall be provided. Base plates and bearing plates shall be provided with full bearing after the supported members have been plumbed and properly positioned, but prior to placing superimposed loads. Separate setting plates under column base plates will not be permitted. 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 03307 CONCRETE.

3.2.3 Field Priming

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.

3.3 WELDING

The contractor shall develop and submit the Welding Procedure Specifications (WPS) for all welding, including wleding done using prequalified procedures. Prequaliried procedures may be submitted for information only; however, procedures that are not prequalified shall be submitted for approval.

3.4 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 01452 SPECIAL INSPECTION FOR SEISMIC-RESISTING SYSTEMS.

-- End of Section --

SECTION 05300A

STEEL DECKING
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 INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC ASD Spec S335	(1989) Specification for Structural Steel Buildings - Allowable Stress Design, Plastic Design

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI Cold-Formed Mnl	(1996) Cold-Formed Steel Design Manual

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 108	(1999) Steel Bars, Carbon, Cold-Finished, Standard Quality
ASTM A 570/A 570M	(1998) Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality
ASTM A 611	(1997) Structural Steel (SS), Sheet, Carbon, Cold-Rolled
ASTM A 653/A 653M	(2000) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 780	(2000) Repair of Damaged and Uncoated Areas of Hot-Dipped Galvanized Coatings
ASTM A 792/A 792M	(1999) Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
ASTM C 423	(1999a) Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
ASTM E 795	(2000) Mounting Test Specimens During Sound Absorption Tests

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1	(2000) Structural Welding Code - Steel
AWS D1.3	(1998) Structural Welding Code - Sheet Steel

STEEL DECK INSTITUTE (SDI)

SDI Diaphram Mnl	(1991) Diaphragm Design Manual
SDI Pub No 29	(1995) Design Manual for Composite Decks, Form Decks, Roof Decks, and Cellular Metal Floor Deck with Electrical Distribution

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 20	(1991) Zinc-Rich Primers (Type I - "Inorganic" and Type II - "Organic")

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

Deck Units; FIO, TSCS
Accessories; FIO, TSCS
Attachments; FIO, TSCS
Holes and Openings; FIO, TSCS

Drawings shall include type, configuration, structural properties, location, and necessary details of deck units, accessories, and supporting members; size and location of holes to be cut and reinforcement to be provided; location and sequence of welded connections; and the manufacturer's erection instructions.

SD-05 Design Data

Deck Units; FIO, TSCS

Design computations for the structural properties of the deck units or SDI certification that the units are designed in accordance with SDI specifications.

SD-07 Certificates

Deck Units; FIO, TSCS
Attachments; FIO, TSCS

Manufacturer's certificates attesting that the decking material meets the specified requirements. Manufacturer's certificate attesting that the operators are authorized to use the low-velocity piston tool.

Prior to welding operations, copies of qualified procedures and lists of names and identification symbols of qualified welders and welding operators.

1.3 DELIVERY, STORAGE, AND HANDLING

Deck units shall be delivered to the site in a dry and undamaged condition, stored off the ground with one end elevated, and stored under a weathertight covering permitting good air circulation. Finish of deck units shall be maintained at all times by using touch-up paint whenever necessary to prevent the formation of rust.

PART 2 PRODUCTS

2.1 DECK UNITS

Deck units shall conform to SDI Pub No 29. 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 Cold-Formed Mnl, 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.

2.1.1 Roof Deck

Steel deck used in conjunction with insulation and built-up roofing shall conform to ASTM A 792/A 792M, ASTM A 611 or ASTM A 792/A 792M. Roof deck units shall be fabricated of the steel design thickness required by the design drawings and shall be zinc-coated in conformance with ASTM A 653/A 653M, G90 coating class or aluminum-zinc coated in accordance with ASTM A 792/A 792M Coating Designation AZ55.

2.1.2 Acoustical Deck Units

Not Used

2.1.3 Composite Deck

Deck to receive concrete as a filler or for composite deck assembly shall conform to ASTM A 653/A 653M or ASTM A 611. Deck used as the tension reinforcing in composite deck shall be fabricated of the steel design thickness required by the design drawings, and shall be zinc-coated in conformance with ASTM A 653/A 653M, G90 coating class. Deck units used in composite deck shall have adequate embossment to develop mechanical shear bond to provide composite action between the deck and the concrete.

2.1.4 Form Deck

Deck used as a permanent form for concrete shall conform to ASTM A 653/A 653M or ASTM A 611. Deck used as a form for concrete shall be fabricated of the steel design thickness required by the design drawings, and shall be zinc-coated in conformance with ASTM A 653/A 653M, G90 coating class.

2.1.5 Sump Pans

Sump pans shall be provided for roof drains and shall be minimum 0.075 inch thick steel, flat recessed type. 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.

2.1.6 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 ASD Spec S335.

2.2 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.

2.3 ADJUSTING PLATES

Adjusting plates or segments of deck units shall be provided in locations too narrow to accommodate full-size units. As far as practical, the plates shall be the same thickness and configuration as the deck units.

2.4 CLOSURE PLATES

2.4.1 Closure Plates for Roof Deck

Voids above interior walls shall be closed with sheet metal where shown. Open deck cells at parapets, end walls, eaves, and openings through roofs shall be closed with sheet metal. Sheet metal shall be same thickness as deck units.

2.4.2 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, including but not limited to:

2.4.2.1 Cover Plates to Close Panels

Cover plates to close panel edge and end conditions and where panels change direction or abut. Butt joints in composite steel deck may receive a tape joint cover.

2.4.2.2 Column Closures to Close Openings

Column closures to close openings between steel deck and structural steel columns.

2.4.2.3 Sheet Metal

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.

2.5 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 and have minimum design thickness as follows: saddles, 0.0474 inch; welding washers, 0.0598 inch; cant strip, 0.0295 inch; other metal accessories, 0.0358 inch; unless otherwise indicated. Accessories shall include but not be limited to saddles, welding washers, cant strips, butt cover plates, underlapping sleeves, and ridge and valley plates.

PART 3 EXECUTION

3.1 ERECTION

Erection of deck and accessories shall be in accordance with SDI Diaphram Mnl and the approved detail drawings. Damaged deck and accessories including material which is permanently stained or contaminated, with burned holes or deformed shall not be installed. The deck units shall be placed on secure supports, properly adjusted, and aligned at right angles to supports before being permanently secured in place. The deck shall not be filled with concrete, used for storage or as a working platform until the units have been secured in position. Loads shall be distributed by appropriate means to prevent damage during construction and to the completed assembly. The maximum uniform distributed storage load shall not exceed the design live load. There shall be no loads suspended directly from the steel deck.

3.2 ATTACHMENTS

All fasteners shall be installed in accordance with the manufacturer's recommended procedure, except as otherwise specified. The deck units shall be welded with nominal 5/8 inch diameter puddle welds to supports as indicated on the design drawings and in accordance with requirements of SDI Pub No 29. All welding of steel deck shall be in accordance with AWS D1.3 using methods and electrodes as recommended by the manufacturer of the steel deck being used. Welds shall be made only by operators previously qualified by tests prescribed in AWS D1.3 to perform the type of work required. 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 Diaphram Mnl. Shear connectors shall be attached as shown and shall be welded as per AWS D1.1 directly to the steel member.

3.3 HOLES AND OPENINGS

All holes and openings required shall be coordinated with the drawings, specifications, and other trades. Holes and openings shall be drilled or cut, reinforced and framed as indicated on the drawings or described in the specifications and as required for rigidity and load capacity. Holes and openings less than 6 inches across require no reinforcement. 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 angles installed perpendicular to the steel joists and supported by the adjacent steel joists. The size of steel angles that are required to be provided on each side of all roof openings larger than 12 inches in any direction to be 3" x 3" x 1/4" minimum UON. Steel angles shall be installed perpendicular to the deck ribs and shall be fastened to the angles perpendicular to the steel joists. Openings must not interfere

with seismic members such as chords and drag struts.

3.4 PREPARATION OF FIRE-PROOFED SURFACES

Deck surfaces, both composite and noncomposite, which are to receive sprayed-on fireproofing, shall be galvanized and shall be free of all grease, mill oil, paraffin, dirt, salt, and other contaminants which impair adhesion of the fireproofing. Any required cleaning shall be done prior to steel deck installation using a cleaning method that is compatible with the sprayed-on fireproofing.

-- End of Section --

SECTION 05500A

MISCELLANEOUS METAL
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.

ALUMINUM ASSOCIATION (AA)

AA DAF-45	(1997) Designation System for Aluminum Finishes

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A14.3	(1992) Ladders - Fixed - Safety Requirements
ANSI MH28.1	(1982) Design, Testing, Utilization, and Application of Industrial Grade Steel Shelving

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M	(2000) Carbon Structural Steel
ASTM A 53/A 53M	(1999b) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 123/A 123M	(2000) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 283/A 283M	(2000) Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A 467/A 467M	(1998) Machine and Coil Chain
ASTM A 475	(1998) Zinc-Coated Steel Wire Strand
ASTM A 500	(1999) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 653/A 653M	(2000) 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 26/B 26M	(1999) Aluminum-Alloy Sand Castings
ASTM B 221	(2000) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B 221M	(2000) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)
ASTM B 429	(2000) Aluminum-Alloy Extruded Structural Pipe and Tube
ASTM D 2047	(1999) Static Coefficient of Friction of Polish-Coated Floor Surfaces as Measured by the James Machine
ASTM E 814	(2000) Fire Tests of Through-Penetration Fire Stops
ASTM F 1267	(1991; R 1997) Metal, Expanded, Steel

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7	(1998) Minimum Design Loads for Buildings and Other Structures

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1	(2000) Structural Welding Code - Steel

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-344	(Rev B) Lacquer, Clear Gloss, Exterior, Interior

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM MBG 531	(1994) Metal Bar Grating Manual
NAAMM MBG 532	(1994) Heavy Duty Metal Bar Grating Manual

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 10	(1998; Errata 10-98-1) Portable Fire Extinguishers
NFPA 211	(2000) Chimneys, Fireplaces, Vents and Solid Fuel-Burning Appliances

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.

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.

SD-04 Samples

Miscellaneous Metal Items; G.

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. 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. 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 ALUMINUM FINISHES

Unless otherwise specified, aluminum items shall have standard mill finish. The thickness of the coating shall be not less than that specified for protective and decorative type finishes for items used in interior locations or architectural Class I type finish for items used in exterior locations in AA DAF-45. Items to be anodized shall receive a polished satin finish. Aluminum surfaces to be in contact with plaster or concrete during construction shall be protected with a field coat conforming to CID A-A-344.

1.8 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. Exposed metal surfaces shall have a baked enamel finish shop applied prime coat.

2.2 VENTS

Chimneys and vents shall be designed and constructed in accordance with NFPA 211. Stacks shall be designed and constructed to withstand a wind velocity of 150 mile/h in accordance with ASCE 7. Unlined stacks shall be constructed of black-steel plates not less than 3/16 inchthick conforming to ASTM A 36/A 36M. Seams and joints shall be welded, except that an angle flange shall be provided for connection to the boiler, other equipment, and stack support.

2.3 CLEANOUT DOORS

Cleanout doors shall be galvanized, shall be provided with frames, and unless otherwise indicated, shall be sized to match flues. The frames shall have a continuous flange and anchors for securing into masonry. The doors shall be smokeproof, hinged, and shall have fastening devices to hold the door closed.

2.4 DOOR GUARDS

Door guards shall be constructed of woven steel wire or expanded metal

framed with structural steel shapes. Expanded metal guards shall be of 1-1/2 inch No. 10 mesh, welded to 1 by 1 by 1/8 inch angle frame. Woven-wire panel shall be of 10 gauge, 1-1/2 inch mesh secured through weaving to 1 inchchannel frame or around a 3/8 inch round bar frame. Corners of frames shall be mitered and welded. Guards shall be sized as indicated.

2.5 PIPE GUARDS

Pipe guards shall be heavy duty steel pipe conforming to ASTM A 53/A 53M, Type E or S, weight STD, black finish.

2.6 DOWNSPOUT BOOTS

Downspout boots shall be cast iron with receiving bells sized to fit downspouts.

2.7 EXPANSION JOINT COVERS

Expansion joint covers shall be constructed of extruded aluminum with anodized satin finish for walls and ceilings and with standard mill finish for floor covers and exterior covers. Plates, backup angles, expansion filler strip and anchors shall be designed as indicated. Expansion joint system shall provide a 2 hour fire rating and 1 inchmovement.

2.8 FLOOR GRATINGS AND FRAMES NOT OVER HAZARDOUS TANKS

Steel grating shall be designed in accordance with NAAMM-01 for bar-type floor gratings and FS RR-G-1602 for floor gratings other than bar types to meet the indicated load requirements. Edges shall be banded with bars 6 mm (1/4 inch) 1/4 inch less in height than bearing bars for grating sizes above 19 mm (3/4 inch) 3/4 inch. Banding bars shall be flush with the top of bearing grating. Frames shall be of welded steel construction finished to match the grating. Floor gratings and frames shall be galvanized after fabrication.

2.9 FLOOR GRATINGS OVER HAZAROUS TANKS

All grating shall be Duradek T-3300 or T-5000 as manufactured by Morrison Molded Fiberglass Company of Bristol, Virginia or an engineer-approved equal.

2.10 FLOOR PLATES

Floor plates shall be 1/4 inch thick, slip-resistant, carbon steel conforming to ASTM A 283/A 283M having a minimum static coefficient of friction of 0.50 when tested in accordance with ASTM D 2047. Wearing surface shall be aluminum oxide or silicon carbide.

2.11 HANDRAILS

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 20 pounds per foot applied horizontally to top of the rail, whichever is more severe.

2.11.1 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 inch nominal size. Railings shall be hot-dip galvanized and shop painted. Pipe collars shall be steel.

a. Joint posts, rail, and corners shall be fabricated by one of the following methods:

(1) Flush type rail fittings of commercial standard, welded and ground smooth with railing splice locks secured with 3/8 inch hexagonal recessed-head setscrews.

(2) 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.

(3) Railings may be bent at corners in lieu of jointing, provided bends are made in suitable jigs and the pipe is not crushed.

b. Removable sections, toe-boards, and brackets shall be provided as indicated.

2.12 METAL GRID WALKWAYS

Metal grid walkways shall be designed to protect rooftops from pedestrian traffic and shall be [14 gauge minimum galvanized steel] [12 gauge minimum aluminum]. The walkway shall consist of metal planks, 2 by 10 or 12 feet, bolted or welded to support stands. Other sizes may be furnished if approved. In addition to end supports, a midspan support shall be provided when required to limit deflection. End supports shall be located to avoid uplift and to provide continuous runs.

2.13 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.

2.14 SAFETY NOSING

Safety nosings shall be as indicated on Drawing G0015.

2.15 STEEL STAIRS NOT OVER HAZARDOUS TANKS

Steel stairs shall be complete with structural or formed channel stringers, grating treads, landings, columns, handrails, and necessary bolts and other fastenings as indicated. Structural steel shall conform to ASTM A 36. Stairs and accessories shall be galvanized. Gratings for treads and landings shall conform to NAAMM-01. Grating treads shall have slip-resistant nosings.

2.16 STEEL DOOR FRAMES

Steel door frames built from structural shapes shall be neatly mitered and securely welded at the corners with all welds ground smooth. Jambs shall be provided with 2 by 1/4 by 12 inch bent, adjustable metal anchors spaced not over 2 feet 6 inches on centers. Provision shall be made to stiffen the top member for all spans over 3 feet. Continuous door stops shall be

made of 1-1/2 by 5/8 inch bars.

2.17 TRENCH COVERS, FRAMES, AND LINERS

Trench covers shall be designed to meet the indicated load requirements. Trench frames and anchors shall be all welded steel construction designed to match cover. Covers shall be secured to frame, and shall be cast-iron grating. Grating opening widths shall not exceed 1 inch. Trench liners shall be cast iron with integral frame for cover.

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 VENTS

Vents shall be installed in accordance with NFPA 211. A cleanout opening with a tight-fitting, hinged, cast-iron door and frame shall be provided at the base of each smokestack. A top band shall be provided on stacks for attachment of painter's rigging. Roof housing, rain cap, downdraft diverter, fire damper, and other accessories required for a complete installation shall be provided. Sections of prefabricated lined stacks shall be joined with acid-resisting high-temperature cement and steel draw bands. Means to prevent accumulation of water in the smokestack shall be provided.

3.4 DOOR GUARD FRAME

Door guard frame shall be mounted over the glazed opening using 1/4 inch lag bolts on the interior of wood doors or tamperproof through bolts on the interior of metal doors.

3.5 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 03300A CAST-IN-PLACE STRUCTURAL CONCRETE.] [having a compressive strength of 3000 psi.]

3.6 INSTALLATION OF DOWNSPOUT BOOTS

Downspouts shall be secured to building through integral lips with appropriate fasteners.

3.7 ATTACHMENT OF HANDRAILS

Toeboards and brackets shall be installed where indicated. Splices, where required, shall be made at expansion joints. Removable sections shall be

installed as indicated.

3.7.1 Installation of Steel Handrails

Installation shall be in pipe sleeves embedded in concrete and filled with molten lead or sulphur with anchorage covered with standard pipe collar pinned to post. 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.

3.8 INSTALLATION OF METAL GRID WALKWAYS

Walkways shall be installed after final flood coat and aggregate surfacing. Each stand shall be set on a protective pad; the pad may be adhesively attached to the bottom of the stand or set loose under the stand. The area where the supports are to be located shall be swept clear of loose aggregate. Protective pad shall be placed on the roof membrane except on inverted roofs where the protective pad shall be set on the rigid insulation.

3.9 PARTITION POSTS AND OPENINGS

Posts shall be set in shoes bolted to the floor and in caps tap-screwed to clip angles in overhead construction, as indicated. Openings shall be formed using channels similar to the partition frames at ducts, pipes, and other obstructions.

3.10 INSTALLATION OF SAFETY NOSINGS

Nosing shall be completely embedded in concrete before the initial set of the concrete occurs and shall finish flush with the top of the concrete surface.

3.11 DOOR FRAMES

Door frames shall be secured to the floor slab by means of angle clips and expansion bolts. Continuous door stops shall be welded to the frame or tap screwed with countersunk screws at no more than 18 inchcenters, assuring in either case full contact with the frame. Any necessary reinforcements shall be made and the frames shall be drilled and tapped as required for hardware.

3.12 TRENCH FRAMES AND COVERS

Trench frames and covers shall finish flush with the floor.

-- End of Section --

SECTION 06100

ROUGH CARPENTRY
12/93

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 AND PAPER ASSOCIATION (AFPA)

AFPA-01	(1991; Supple; Errata/Addenda Mar 1992 and Jul 1992) National Design Specification for Wood Construction
AFPA WCD No. 1	(1988) Manual for Wood Frame Construction

AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.4	(1988) Basic Hardboard
AHA A194.1	(1985) Cellulosic Fiberboard

AMERICAN INSTITUTE OF TIMBER CONSTRUCTION (AITC)

AITC-01	(1985: 3rd Ed.) Timber Construction Manual
AITC 109	(1990) Preservative Treatment of Structural Glued Laminated Timber
AITC 111	(1979) Recommended Practice for Protection of Structural Glued Laminated Timber During Transit, Storage and Erection
AITC A190.1	(1992) Structural Glued Laminated Timber

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A208.1	(1989) Wood Particleboard

AMERICAN PLYWOOD ASSOCIATION (APA)

APA E30	(1990) Design/Construction Guide, Residential and Commercial
APA E445	(1991; Rev May 1991) Performance Standards and Policies for Structural-Use Panels
APA V450	(1992) Source List - Adhesives for APA Glued Floor System

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 307	(1992a) Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM C 79	(1992) Gypsum Sheathing Board
ASTM C 208	(1972; R 1982) Insulating Board (Cellulosic Fiber), Structural and Decorative
ASTM C 516	(1980; R 1990) Vermiculite Loose Fill Thermal Insulation
ASTM C 518	(1991) Steady-State Heat Flux Measurements and Thermal Transmission Properties By Means of the Heat Flow Meter Apparatus
ASTM C 549	(1981; R 1986) Perlite Loose Fill Insulation
ASTM C 552	(1991) Cellular Glass Thermal Insulation
ASTM C 578	(1992) Rigid, Cellular Polystyrene Thermal Insulation
ASTM C 591	(1985) Unfaced Preformed Rigid Cellular Polyurethane Thermal Insulation
ASTM C 612	(1983) Mineral Fiber Block and Board Thermal Insulation
ASTM C 665	(1991) Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
ASTM C 726	(1988) Mineral Fiber Roof Insulation Board
ASTM C 739	(1991) Cellulosic Fiber (Wood-Base) Loose-Fill Thermal Insulation
ASTM C 764	(1991) Mineral Fiber Loose-Fill Thermal Insulation
ASTM C 1136	(1992) Flexible, Low Permeance Vapor Retarders for Thermal Insulation
ASTM D 2898	(1981; R 1986) Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing
ASTM E 84	(1991a) Surface Burning Characteristics of Building Materials
ASTM E 96	(1993) Water Vapor Transmission of Materials
ASTM E 154	(1988) Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover

AMERICAN WOOD PRESERVERS' ASSOCIATION (AWPA)

AWPA C2	(1992) Lumber, Timbers, Bridge Ties and Mine Ties - Preservative Treatment by Pressure Processes
AWPA C9	(1990) Plywood - Preservative Treatment by Pressure Processes
AWPA C20	(1991) Structural Lumber - Fire-Retardant Treatment by Pressure Processes
AWPA C27	(1991) Plywood - Fire-Retardant Treatment by Pressure Processes
AWPA C28	(1991) Standard for Preservative Treatment of Structural Glued Laminated Members and Laminations Before Gluing of Southern Pine, Pacific Coast Douglas Fir, Hemfir and Western Hemlock by Pressure Processes
AWPA M4	(1991) The Care of Preservative-Treated Wood Products
AWPA P5	(1992) Oil-Borne Preservatives

CALIFORNIA REDWOOD ASSOCIATION (CRA)

CRA-01	(1992) Standard Specifications for Grades of California Redwood Lumber

CODE OF FEDERAL REGULATION (CFR)

CFR 16 Part 1209	Interim Safety Standard for Cellulose Insulation

DEPARTMENT OF COMMERCE (DOC)

DOC PS 1	(1983) Construction and Industrial Plywood

FEDERAL SPECIFICATIONS (FS)

FS FF-N-105	(Rev B; Int Am 4;) Nails, Brads, Staples and Spikes: Wire, Cut and Wrought
FS HH-I-558	(Rev C) Insulation, Blankets, Thermal (Mineral Fiber, Industrial Type)
FS HH-I-1972/GEN	(Basic; Am 1; Notice 1) Insulation Board, Thermal, Faced, Polyurethane or Polyisocyanurate
FS UU-B-790	(Rev A; Notice 2) Building Paper, Vegetable Fiber: (Kraft, Waterproofed, Water Repellent and Fire Resistant)

NATIONAL HARDWOOD LUMBER ASSOCIATION (NHLA)

NHLA-01	(Jan 1990) Rules for the Measurement & Inspection of Hardwood & Cypress Lumber

NORTHEASTERN LUMBER MANUFACTURERS ASSOCIATION (NELMA)

NELMA-01	(1991) Standard Grading Rules for Northeastern Lumber

SOUTHERN CYPRESS MANUFACTURERS ASSOCIATION (SCMA)

SCMA-01	(1986) Standard Specifications for Grades of Southern Cypress

SOUTHERN PINE INSPECTION BUREAU (SPIB)

SPIB-01	(1991; Supple 1 thru 4) Standard Grading Rules for Southern Pine Lumber

TRUSS PLATE INSTITUTE (TPI)

TPI QST-88	(1988) Quality Standard for Metal Plate Connected Wood Trusses Addendum to TPI-85
TPI 85	(1985; Errata; Supple; Addendum QST-88) Design Specification for Metal Plate Connected Wood Trusses

WEST COAST LUMBER INSPECTION BUREAU (WCLIB)

WCLIB Std 17	(1991) Standard Grading Rules for West Coast Lumber

WESTERN WOOD PRODUCTS ASSOCIATION (WWPA)

WWPA-01	(1991; Supple No. 1) Western Lumber Grading Rules 91

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL DESCRIPTIONS:

SD-13 Certificates

Grading and Marking; FIO.

Manufacturer's certificates attesting that lumber and material not normally grade marked or exempt from being grade marked meets the specified requirements.

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 LUMBER

2.1.1 Grading and Marking

2.1.1.1 Plywood and other Sheathing Products

Materials shall bear the grademark, stamp or other identifying marks indicating grades of material and rules or standards under which produced. Such identifying marks 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. The inspection agency for lumber shall be certified by the Board of Review, American Lumber Standards Committee, to grade species used.

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. Size references, unless otherwise specified, are nominal sizes, and actual sizes shall be within manufacturing tolerances allowed by the standard under which the product is produced.

2.1.3 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:

4 inches or less, nominal thickness, 19 percent maximum.
5 inches or more, nominal thickness, 23 percent maximum.

2.1.4 Treatment

2.1.4.1 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.

2.1.4.2 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.

2.1.5 Structural Wood Members

Species and grades shall be as listed in AFPA-01 shall have allowable design values of 1050 psi in bending; 700 psi in tension parallel to the grain; 300 psi in compression perpendicular to the grain; 300 psi in compression parallel to the grain; 60 psi in horizontal shear; and a modulus of elasticity of 1,200,000 psi. Design of members and fastenings

shall conform to AITC-01. Other stress graded or dimensioned items such as blocking, carriages, and studs shall be standard or No. 2 grade except that studs may be Stud 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 Bolts: Lag, Toggle, and Miscellaneous Bolts and Screws

Type, size, and finish best suited for intended use.

2.2.2 Nails and Staples

FS FF-N-105, size and type best suited for purpose. 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 shall be galvanized.

PART 3 EXECUTION

3.1 INSTALLATION OF MISCELLANEOUS WOOD MEMBERS

3.1.1 Nailers and Nailing Strips

Nailers and nailing strips shall be provided as necessary for the attachment of finish materials. Nailers used in conjunction with roof deck installation shall be installed flush with the roof deck system. 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. Strips shall be run in lengths as long as practicable, butt jointed, cut into wood framing members when necessary, and rigidly secured in place.

-- End of Section --

SECTION 07132

BITUMINOUS WATERPROOFING
09/98

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.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 208	(1995) Cellulosic Fiber Insulating Board
ASTM D 41	(1994) Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D 173	(1997) Bitumen-Saturated Cotton Fabrics Used in Roofing and Waterproofing
ASTM D 449	(1989; R 1994) Asphalt Used in Dampproofing and Waterproofing
ASTM D 1327	(1997) Bitumen-Saturated Woven Burlap Fabrics Used in Roofing and Waterproofing
ASTM D 1668	(1995) Glass Fabrics (Woven and Treated) for Roofing and Waterproofing
ASTM D 4586	(1993) Asphalt Roof Cement, Asbestos Free

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL DESCRIPTIONS:

SD-01 Data

Reinforcing Fabric; FIO.

Manufacturer's data including technical information which indicates full compliance with this section.

SD-06 Instructions

Application; FIO.

Manufacturer's installation instructions, before delivery of materials to the site. Instructions shall specify acceptable range of asphalt application temperatures and the maximum temperature for holding asphalt in a heated condition.

SD-13 Certificates

Materials; FIO.

Certificates from manufacturer attesting that asphalt manufactured and shipped to jobsite meets the specified requirements.

1.3 QUALIFICATIONS

Work shall be performed by skilled laborers thoroughly experienced in the type of bituminous waterproofing work specified to meet the requirements of the contract.

1.4 DELIVERY, STORAGE AND HANDLING

Waterproofing materials shall be delivered to the project site in the original sealed containers bearing the name of the manufacturer, contents and brand name. Asphalt shall be protected from freezing in a weathertight enclosure. Reinforcement fabrics shall be protected from moisture damage and moisture absorption in a weathertight enclosure or shall be stored off the ground on pallets, and covered on top and all sides with breathable-type canvas tarpaulins. Plastic sheets cause condensation buildup and therefore shall not be used to cover waterproofing materials. Damaged or deteriorated materials shall be removed from project site.

PART 2 PRODUCTS

2.1 ASPHALT WATERPROOFING

2.1.1 Primer

Primer for hot-applied asphalt waterproofing shall conform to ASTM D 41, asbestos-free, non-fibrated, manufactured with highly ductile soft asphalts and selected hydrocarbons.

2.1.2 Above-Grade Hot-Applied Asphalt

For above-grade applications where asphalt will not be exposed to temperatures exceeding 122 degrees F, hot-applied asphalt for membrane waterproofing system shall conform to ASTM D 449, Type II. For above-grade applications where asphalt will be exposed to sunlight and temperatures exceeding 122 degrees F, hot-applied asphalt shall conform to ASTM D 449, Type III.

2.1.3 Below-Grade Hot-Applied Asphalt

Hot-applied asphalt for below-grade applications shall conform to ASTM D 449, Type I, asbestos-free, manufactured from crude petroleum, suitable for use with membrane waterproofing systems.

2.1.4 Reinforcement Fabrics

2.1.4.1 Cotton Fabrics

Cotton fabrics shall be woven entirely of cotton conforming with ASTM D 173, thoroughly and uniformly saturated with asphalt.

2.1.4.2 Woven Burlap Fabrics

Woven burlap fabrics shall be composed of 100 percent jute fiber and two cotton threads at each selvage conforming with ASTM D 1327, thoroughly and uniformly saturated with asphalt. The fabric mesh shall not be completely closed or sealed by the process of saturation. Sufficient porosity shall be maintained to allow successive moppings of the plying asphalt to seep through. The surface shall not be coated or covered with talc or any other substances that will interfere with the adhesion between fabric and plying asphalt. The fabric surface shall be uniformly smooth and free of irregularities, folds and knots. The finished woven burlap fabrics shall be free of ragged edges, untrue edges, breaks or cracks, and other visible external defects.

2.1.4.3 Glass Fabrics

Glass fabrics shall conform to ASTM D 1668 Type I, asphalt-treated woven glass waterproofing fabrics coated with asphalt.

2.1.5 Flashing Cement

Flashing cement shall conform to ASTM D 4586, Type I, trowel grade, asbestos free, manufactured from asphalts characterized as adhesive, healing and ductile.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Surfaces scheduled for bituminous waterproofing shall be prepared in accordance with waterproofing manufacturer's recommendations. Surface preparation shall be approved prior to waterproofing application.

3.1.1 Protection of Surrounding Areas

Before starting the waterproofing work, the surrounding areas and surfaces shall be protected from spillage and migration of asphalt onto other work. Drains and conductors shall be protected from clogging with asphalt.

3.1.2 Masonry Surfaces

Surfaces shall be free of oil, grease, dirt, laitance, loose material, frost, debris and other contaminants. Mortar joints shall be flush and free of extraneous mortar and chipped or broken masonry.

3.1.3 Concrete Surfaces

Surfaces shall be properly cured, free of form release agents, oil, grease, dirt, laitance, loose material, frost, debris and other contaminants. Form ties shall be cut flush with surface. Sharp protrusions and form match lines shall be removed. Holes, voids, spalled areas and cracks which can damage waterproofing materials shall be repaired. Rough surfaces shall be parged with a well-adhering coat of cement mortar.

3.1.4 Metal Surfaces

Surfaces shall be dry and be free of rust, scale, loose paint, oil, grease, dirt, frost and debris.

3.2 HOT-APPLIED ASPHALT WATERPROOFING

Asphalt waterproofing shall be applied when the ambient temperature is 40 degrees F or above. Heating kettles and tanks shall be provided with automatic thermostatic control capable of maintaining asphalt temperature. Controls shall be calibrated and maintained in working order for duration of work. At time of application, asphalt shall not be heated above the equiviscous temperature (EVT) recommended by manufacturer. Immediately before use, temperature shall be measured with a portable thermometer at the point of application. EVT and flashpoint temperatures of asphalt in kettle shall be conspicuously posted on kettle. Asphalt with a temperature not conforming to the manufacturer's recommendations shall be returned to the kettle. Asphalt overheated by more than 50 degrees F for more than 1 hour shall be removed from site.

3.2.1 Below-Grade Wall Waterproofing

Waterproofing for foundation walls shall consist of a 1-ply hot-applied asphalt membrane system. Fabrics shall be installed using the "shingle" method. Joints shall be caulked prior to primer applications. Primer shall be applied at a rate of 1/2 gallon per 100 square feet. Fabrics shall be overlapped at ends and staggered a minimum 10 inch for 1-ply system. End-to-end taping is not acceptable. Each fabric shall be firmly embedded into a solid uniform coating of hot asphalt at a rate of 20 pounds per 100 square feet by pressing with broom. Fabrics shall not touch fabrics. Hot asphalt shall penetrate each fabric to provide the required adhesion. Asphalt between fabrics shall not be excessive to prevent slippage. Waterproofing system consisting of two or more fabrics shall be provided with fabric reinforcement at corners, angles, over construction joints, and in locations where waterproofing fabrics are subject to unusual stress.

3.3 CLEAN-UP

Surfaces of other work which are stained with waterproofing materials shall be cleaned with a cleaner recommended by waterproofing manufacturer.

3.4 PROTECTION OF COMPLETED WORK

3.4.1 Floor Waterproofing

The completed waterproofing work shall be protected from damage during and after construction. Protective covering shall be placed immediately before proceeding with the work which will conceal the waterproofing.

3.4.2 Wall Waterproofing

Waterproofing against which backfill is to be placed shall be protected with a single layer of insulation board. Insulation boards shall be pressed into the final mopping while the asphalt is still hot, with edges of boards placed into moderate contact and joints staggered. For two-layer installation, joints in second layer shall be staggered over joints in first layer. Where surfaced insulation board is used, the surfaced side shall face outward. Boards shall be carefully and neatly fitted around projections, and shall cover the entire surface of the waterproofing materials. Waterproofing system not covered with protection boards shall be protected to prevent damage from subsequent building operations. Installed boards shall not remain exposed at the end of a work day.

-- End of Section --

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THERMAL & MOISTURE PROTECTION

SECTION 07920

JOINT SEALING

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SECTION 07920

JOINT SEALING

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 SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 920 (1987) Elastomeric Joint Sealants

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. Submittals to verify compatibility requirements of Para. IV of Attachment 1 to Section 01005 SPECIAL WORK RESTRICTIONS AND REQUIREMENTS for all exposed material in secondary containment, dikes, and pump pads, parshall flume and MH's. The following shall be submitted in accordance with Section 01300 SUBMITTAL DESCRIPTIONS:

SD-01 Data

Backing; FIO.

Bond-Breaker; FIO.

Sealant; GA

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-13 Certificates

Sealant; GA

Certificates of compliance stating that the materials conform to the specified requirements.

1.3 ENVIRONMENTAL REQUIREMENTS

The ambient temperature shall be within the limits of 40 to 90 degrees F when the sealants are applied.

1.4 DELIVERY AND STORAGE

Materials shall be delivered to the job in the manufacturer's original unopened containers. The container label or accompanying data sheet shall include the following information as applicable: manufacturer, name of material, formula or specification number, lot number, color, date of manufacture, mixing instructions, shelf life, and curing time at the standard conditions for laboratory tests. Materials shall be handled and stored to prevent inclusion of foreign materials. Materials shall be stored at temperatures between 40 and 90 degrees F unless otherwise specified by the manufacturer.

PART 2 PRODUCTS

2.1 Backing

Materials to seal joints in precast panels are specified on drawings. Polyurethane or polyethylene foam rod is the required back-up material. Caulking/sealant to be applied around exterior doors and windows. Material described in Paragraph 2.3 Caulking.

2.2 PRIMER

Primer shall be non-staining type as recommended by sealant manufacturer for the application.

2.3 CAULKING

Elastomeric sealants shall conform to ASTM C 920 and the following:

a. Polysulfide Sealant B: Polysulfide sealant, Type S, Grade NS, Class 12.5, Use G.

PART 3 EXECUTION

3.1 GENERAL

3.1.1 Surface Preparation

The surfaces of joints to be sealed shall be dry. Oil, grease, dirt, chalk, particles of mortar, dust, loose rust, loose mill scale, and other foreign substances shall be removed from surfaces of joints to be in contact with the sealant. Oil and grease shall be removed with solvent and surfaces shall be wiped dry with clean cloths.

3.1.2 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.

3.1.3 Steel Surfaces

Steel surfaces to be in contact with sealant shall be sandblasted or, if sandblasting would not be practical or would damage adjacent finish work,

the metal shall be scraped and wire brushed to remove loose mill scale. Protective coatings on steel surfaces shall be removed by sandblasting or by a solvent that leaves no residue.

3.1.4 Aluminum Surfaces

Aluminum surfaces to be in contact with sealants shall be cleaned of temporary protective coatings. When masking tape is used for a protective cover, the tape and any residual adhesive shall be removed just prior to applying the sealant. Solvents used to remove protective coating shall be as recommended by the manufacturer of the aluminum work and shall be non-staining.

3.2 APPLICATION

3.2.1 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.

3.2.2 Backing

Backing shall be installed to provide the indicated sealant depth. The installation tool shall be shaped to avoid puncturing the backing.

3.2.3 Bond Breaker

Bond-breaker consisting of 2 coats of curing compound shall be applied to fully cover the bottom of the joint without contamination the sides where sealant adhesion is required.

3.2.4 Primer

Primer shall be used on concrete masonry units, wood, or other porous surfaces in accordance with instructions furnished with the sealant. Primer shall be applied to the joint surfaces to be sealed. Surfaces adjacent to joints shall not be primed.

3.2.5 Sealant

Sealant shall be used before expiration of shelf life. Multi-component sealants shall be mixed according to manufacturer's printed instructions. Sealant in guns shall be applied with a nozzle of proper size to fit the width of joint. Joints shall be sealed as detailed in the drawings. Sealant shall be forced into joints with sufficient pressure to expel air and fill the groove solidly. Sealant shall be installed to the indicated depth without displacing the backing. Unless otherwise indicated, specified, or recommended by the manufacturer, the installed sealant shall be tooled so that the surface is uniformly smooth and free of wrinkles and to assure full adhesion to the sides of the joint. Sealants shall be installed free of air pockets, foreign embedded matter, ridges and sags. Sealer shall be applied over the sealant when and as specified by the sealant manufacturer.

3.3 CLEANING

The surfaces adjoining the sealed joints shall be cleaned of smears and other soiling resulting from the sealant application as work progresses.

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SECTION 09900

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SECTION 09900

PAINTING, GENERAL

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. If there are any conflicts between this section and the RAAP Painting Specification (DUP-488), the RAAP Painting Specification governs.

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)

CID A-A-1500	(1991) 1991-1992 Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices

COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-1500	(Rev A) Sealer, Surface (Latex Block Filler)

FEDERAL SPECIFICATIONS (FS)

FS TT-E-489	(Rev H) Enamel, Alkyd, Gloss, Low VOC Content
FS TT-E-490	Silicon Alkyd
FS TT-E-505	(Rev B) Enamel (Odorless, Alkyd, Interior, High Gloss)
FS TT-E-506	(Rev K; Am 1) Enamel, Alkyd, Gloss, Tints and White (for Interior Use)
FS TT-E-508	(Rev C; Am 1) Enamel, Interior Semigloss, Tints and White
FS TT-E-509	(Rev C) Enamel, Odorless, Alkyd, Interior, Semigloss, White and Tints
FS TT-E-545	(Rev C) Primer (Enamel-Undercoat, Alkyd, Odorless, Interior, Flat, Tints and White)
FS TT-F-1098	(Rev D) Filler, Block, Solvent-Thinned, for Porous Surfaces (Concrete Block, Cinder Block, Stucco, Etc.)
FS TT-P-19	(Rev D; Am 1)&\ Paint, Latex (Acrylic Emulsion, Exterior Wood and Masonry)
FS TT-P-29	(Rev K) Paint, Latex&\

FS TT-P-30	(Rev E; Am 1) Paint, Alkyd, Odorless, Interior, Flat, White and Tints
FS TT-P-645	(Rev B) Primer, Paint, Zinc-Molybdate, Alkyd Type
FS TT-P-650	(Rev D) Primer Coating, Latex Base, Interior, White (for Gypsum Wallboard, or Plaster)

FEDERAL STANDARDS (FED-STD)

FED-STD 313	(Rev C) Material Safety Data, Transportation Data and Disposal Data for Hazardous Materials Furnished to Government Activities
FED-STD 595	(Rev B) Colors Used in Government Procurement

MILITARY SPECIFICATIONS (MS)

MS MIL-S-12935	(Rev D) Sealer, Surface; for Knots

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC Paint 5	(1991) Zinc Dust, Zinc Oxide and Phenolic Varnish Paint
SSPC Paint 21	(1991) White or Colored Silicone Alkyd Paint
SSPC SP 1	(1982) Solvent Cleaning
SSPC SP 2	(1989) Hand Tool Cleaning&\
SSPC SP 3	(1989) Power Tool Cleaning
SSPC SP 7	(1991) Brush-Off Blast Cleaning

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL DESCRIPTIONS:

SD-O1 Data

Paint; FIO

The names, quantity represented, and intended use for the proprietary brands of materials proposed to be substituted for the specified materials when the required quantity of a particular batch is 50 gallons or less.

SD-06 Instructions

Mixing and Thinning; FIO. Application; FIO

Manufacturer's current printed product description, material safety data sheets (MSDS) and technical data sheets for .each coating system. MSDS submittals shall meet the requirements of FED-STD 313. Detailed application instructions for textured coatings shall be provided.

SD-09 Reports

Paint; GA.

A statement as to the quantity represented and the intended use, plus the following test report for batches in excess of 10 gallons:

a. A test report showing that the proposed batch to be used meets all specification requirements, or:

b. A test report showing that a previous batch of the same formulation as the batch to be used met all specification requirements, plus, on the proposed batch to be used, a report of test results for properties of weight per gallon, viscosity, fineness of grind, drying time, color, and gloss.

c. An Operating Contractor approved test report must be submitted on any tested batch material showing acid resistance, nitratability, and compatibility with liquids which have potential of coming in contact with paint. The contractor shall submit literature, information, or certificates about the materials proposed for use, sufficient in detail for the Operating Contractor to determine if compatibility and nitratibility testing has been performed and/or approved at RFAAP in the past by the Operating Contractor.

SD-13 Certificates

Lead; GA. Mildewcide and Insecticide; GA. Volatile Organic Compound (VOC) Content; GA.

Certificate stating that paints contain no mercurial mildewcide or insecticide. Certificate stating that paints proposed for use do not contain lead. Certificate stating that paints proposed for use meet the VOC regulations of the local Air Pollution Control Districts having jurisdiction over the geographical area in which the project is located.

SD-14 Samples

Paint; GA.

While the material is at the site or source of supply, and at a time agreeable to the Contractor and the Contracting Officer, a 1 quart sample of each color and batch, except for quantities of 50 gallons or less, shall be

taken by random selection from the sealed containers by the Contractor in the presence of a representative of the Contracting Officer. The contents of the containers to be sampled shall be thoroughly mixed to ensure that the sample is representative. Samples shall be identified by designated name, specification number, manufacturer name and address, batch number, project contract number, intended use, and quantity involved.

1.3 PACKAGING, LABELING, AND STORING

Paints shall be in sealed containers that legibly show the designated 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 of manufacturer. Pigmented paints shall be furnished in containers not larger than 5 gallons. Paints and thinner 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 offlammable vapors and at temperatures between 40 and 95 degrees F. Paints shall be stored on the project site or segregated at the source of supply sufficiently in advance of need to allow 30 days for testing.

1.4 APPROVAL OF MATERIALS

When samples are tested, approval of materials will be based on tests of the samples; otherwise, materials will be approved based on test reports furnished with them. If materials are approved based on test reports furnished, samples will be retained by the Government for testing should the materials appear defective during or after application. In addition to any other remedies under the contract the cost of retesting defective materials will be at the Contractor's expense.

1.5 ENVIRONMENTAL CONDITIONS

Unless otherwise recommended by the paint manufacturer, the ambient temperature shall be between 45 and 95 degrees F when applying coatings other than water-thinned coatings. Water-thinned coatings shall be applied only when ambient temperature is between 50 and 90 degrees F.

1.6 SAFETY AND HEALTH

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 the CONTRACT CLAUSES. 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.

1.6.1 Worker Exposures

Exposure of workers to chemical substances shall not exceed limits as established by ACGIH-02, or as required by a more stringent applicable regulation.

1.6.2 Toxic Compounds

Toxic compounds having ineffective physiological properties, such as odor

or irritation levels, shall not be used unless approved by the Contracting Officer.

1.6.3 Training

Workers having access to an affected work area shall be informed of the contents of the applicable material data safety sheets (MSDS) and shall be informed of potential health and safety hazard and protective controls associated with materials used on the project. An affected work area is one which may receive mists and odors from the painting operations. Workers involved in preparation, painting and clean-up shall be trained in the safe handling and application, and the exposure limit, for each material which the worker will use in the project. Personnel having a need to use respirators and masks shall be instructed in the use and maintenance of such equipment.

1.6.4 Coordination

Work shall be coordinated to minimize exposure of building occupants, other Contractor personnel, and visitors to mists and odors from preparation, painting and clean-up operations.

PART 2 PRODUCTS

2.1 PAINT

The term "paint" as used herein includes enamels, paints, sealers, and other coatings, whether used as prime, intermediate, or finish coat. Paint shall conform to the respective specifications listed for use in the painting schedules at the end of this section, except when the required amount of a material of a particular batch is 50 gallons or less, an approved first-line proprietary paint material with similar intended usage and color to that specified may be used. Additional requirements are as follows:

2.1.1 Colors and Tints

Colors shall be as specified in Section 09915 COLOR SCHEDULE. The color of the undercoats shall vary slightly from the color of the next coat.

2.1.2 Chromium

Paints containing zinc chromate or strontium chromate pigments shall not be used.

2.1.3 Volatile Organic Compound (VOC) Content

Paints shall comply with applicable state and local laws enacted to insure compliance with Federal Clean Air Standards and shall conform to the restrictions of the local air pollution control authority.

PART 3 EXECUTION

3.1 PROTECTION OF AREAS NOT TO BE PAINTED

Items not to be painted which are in contact with or adjacent to painted

surfaces shall be removed or protected prior to surface preparation and painting operations. Items removed prior to painting shall be replaced when painting is completed. Following completion of painting, workmen skilled in the trades involved shall reinstall removed items. Surfaces contaminated by coating materials shall be restored to original condition.

3.2 SURFACE PREPARATION

Surfaces to be painted shall be clean and free of foreign matter before application of paint or surface treatments. Oil and grease shall be removed with clean cloths and cleaning solvents prior to mechanical cleaning. Cleaning solvents shall be of low toxicity with a flashpoint in excess of 100 degrees F. 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 primed with a suitable corrosion inhibitive primer capable of preventing flash rusting and compatible with the coating specified for the adjacent areas.

3.2.1 Concrete Surfaces

Concrete surfaces shall be allowed to dry at least 30 days before painting, except concrete slab on grade which shall be allowed to cure 90 days before painting. Glaze, efflorescence, laitance, dirt, grease, oil, asphalt, surface deposits of free iron and other foreign matter shall be removed prior to painting.

The interior surfaces of the concrete containment (Bldg 3056 & 3058) shall be coated with a 100 to 120 mils DFT base course of DEVCON (or approved equal) Iraseal 200 System and a final 8 to 10 mils DFT layer of Fluorolast SB (or approved equal) per the manufacturer's instructions. Attached to this section are the following attachments:

1. DEVCON Iraseal 200 coating system technical information
2. Fluorolast SB technical information.

3.2.1.1 IRASEAL 200 Polyurea Lining System (OR APPROVED EQUAL)

Caution: This is not a technical specification. This is an outline to provide basic requirements and general information on the relationships of the different coating system elements, which element gets applied to which surface, curing/recoating time restrictions, and special equipment requirements. It is the Contractor's responsibility to refer to the manufacturer' Specification and Procedures for the Repair and Lining of Concrete Surfaces with Iraseal 200 Systems, along with product data bulletins, application procedures, and surface preparation sheets for application data, surface preparation specifics, temperature and humidity specifics, and other details and restrictions.

Materials: Descriptions of Elements or Components (from DEVCON literature):

- IRABOND CR-90, a room temperature curing, two component trowel able primer compounded specifically to deal with problems unique to concrete substrates, which - enhances adhesion of Iraseal to the concrete. This thixotropic material may be toweled or squeegeed out to a thin coating, yet will fill rock pockets and voids over an inch in diameter without sagging or running.

- IRABOND UU-96 Adhesive, an ambient temperature curing second stage adhesive used-over the CR 90 primer, if necessary.
- CS-1000 Concrete Sealer, an epoxy-based 100% solids formulation for sealing, waterproofing, and protecting concrete, and as a primer for other engineered coatings.
- IRASEAL 200, a 2-component, 100% solids, fast-curing polyurea coating.

Installation

- New concrete shall be cured for at least 30 days at a minimum temperature of 70°F.
- Concrete shall be grit-blasted or water-blasted to produce a rough and clean surface, at least as rough as mediun grit sandpaper.
- Apply CR-90 by squeegee/trowel to walls or other vertical surfaces (and large voids on floors or other horizontal surfaces, if any).
  1. Apply UU-96 over CR-90 if necessary (ifCR-90 has been allowed to cure for more than 48 hours at 75°F), 3-4 wet mils, and single pass.
  2. Iraseal 200 must be applied over UU-96 between 50 minutes & 5 hours after application ofUU-96, or another coat of UU 96 is required. Do not exceed 24 hours cure of UU-96 or it must be stripped from surface.
- Apply CS-1000 to floor (or other horizontal surfaces) not treated with CR-90. The manufacturer indicates that it should not be used on vertical surfaces in this application, as 100% contact with all surfaces (i.e., in fisheyes and bugholes) is not guaranteed. Recoat time is 4-48 hours to apply additional CS-1000, or 4-12 hours to topcoat with IRASEAL 200.
- Apply Iraseal 200 to secondary container floors at a thickness range of 100 to 120 mils DFT. Iraseal is spray-applied using *specialized temperature-controlled, plural component spray equipment.* Apply Iraseal 200 to walls and other surfaces at a thickness of 80 -100 mils DF.

3.2.2 Ferrous Surfaces

Ferrous surfaces including those that have been shop-coated, sha11 be solvent-cleaned. Surfaces that contain loose rust, 1oose mill scale, and other foreign substances sha11 be cleaned mechanically with hand tools according to SSPC SP 2, power tools according to SSPC SP 3 or by sandblasting according to SSPC SP 7. Shop-coated ferrous surfaces shall be protected from corrosion by treating and touching up corroded areas immediately upon detection.

3.2.3 Nonferrous Metallic Surfaces

Galvanized and other nonferrous metal surfaces shall be solvent-cleaned in accordance with SSPC SP 1.

3.2.4 Gypsum Board Surfaces

Gypsum board surfaces shall be dry and shall have all loose dirt and dust removed by brushing with a soft brush, rubbing with a 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.

3.2.5 Mastic-Type Surfaces

Mastic-type surfaces shall be prepared by removing foreign material.

3.2.6 Wood Surfaces

Wood surfaces shall be cleaned of foreign matter. Wood surfaces adjacent to surfaces to receive water-thinned paints shall be primed and/or touched up before applying water-thinned paints. Small, dry seasoned knots shall be scraped, cleaned, and given a thin coat of knot sealer, MS MIL-S-12935, before application of the priming coat. Pitch on large, open, unseasoned knots and all other beads or streaks of pitch shall be scraped off, or, if it is still soft, removed with mineral spirits or turpentine, and the resinous area shall be thinly coated with knot sealer. Finishing nails shall be set, and all holes and surface imperfections shall be primed. After priming, holes and imperfections in finish surfaces shall be filled with putty or plastic wood filler, colored to match the finish coat if natural finish is required, allowed to dry, and sanded smooth. Putty or wood filler shall be compatible with subsequent coatings. 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. Moisture content of the wood shall not exceed 12 percent as measured by a moisture meter, unless otherwise authorized.

3.3 MIXING AND THINNING

When thinning is approved as necessary to suit surface, temperature, weather conditions, or application methods, paints may be thinned in accordance with the manufacturer's directions. 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 local limits on volatile organic compounds. Paints of different manufacturers shall not be mixed.

3.3.1 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.

3.4 APPLICATION

Painting practices shall comply with applicable state and local laws enacted to insure compliance with Federal Clean Air Standards. Unless otherwise specified or recommended by the paint manufacturer, paint may be applied by brush, roller, or spray. At the time of application, paint shall show no signs of deterioration. Uniform suspension of pigments shall be maintained during application. 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. Rollers for applying paints and enamels shall be of a type designed for the coating to be applied and the surface to be coated. 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. Paints, except water-thinned types, shall be applied only to surfaces that are completely free of moisture as determined by sight or touch.

3.4.1 Ventilation

Affected areas shall be ventilated during paint application so that workers exposure to chemical substances shall not exceed limits as established by ACGIH-02, or as required by a more stringent applicable regulation. Interior work zones having a volume of 10,000 cubic feet or less shall be ventilated at a minimum of 2 air exchanges per hour. Ventilation in larger work zones shall be maintained by means of mechanical exhaust. Solvent vapors shall be exhausted outdoors, away from air intakes and workers. Return air inlets in the work zone shall be temporarily sealed before start of work until the coatings have dried.

3.4.2 Respirators

Operators and personnel in the vicinity of operating paint sprayers shall wear respirators.

3.4.3 First Coat

The first coat on gypsum wallboard, and other surfaces shall include repeated touching up of suction spots or overall application of primer or sealer to produce uniform color and gloss. Excess sealer shall be wiped off after each application. The first coat on both faces of wood doors shall be applied at essentially the same time. Glazed doors and sashes shall be given the specified coating system within 3 weeks of the time they are glazed, but not before the glazing material has set; paint shall overlay glass about 70 mils all around.

3.4.4 Timing

Surfaces that have been cleaned, pretreated, and otherwise prepared for painting shall be given a coat of the specified first coat as soon as practical after such pretreatment has been completed, but prior to any deterioration of the prepared surface. Sufficient time shall elapse between successive coats to permit proper drying. This period shall be modified as necessary to suit weather conditions. Oil-based paints shall be considered dry for recoating when the paint feels firm, does not deform or feel sticky under moderate pressure of the thumb, and the application of another coat of paint does not cause the undercoat to lift or lose adhesion. Manufacturer's instructions for application, curing and drying time between coats of two-component systems shall be followed.

3.4.5 Ferrous-Metal Primer

Primer for ferrous-metal shall be applied to ferrous surfaces to receive paint other than asphalt varnish prior to deterioration of the prepared surface. 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.

3.5 PIPE COLOR CODE MARKING

Pipes in exposed areas and in accessible pipe spaces shall be provided with color band and titles adjacent to all valves, except those provided at plumbing fixtures, at not more than 40 foot spacing on straight pipe runs, adjacent to change in direction, and on both sides where pipes pass through walls or floors. Color code marking shall be of the color listed in TABLE I (and DUP-488 which governs in case of conflict) and the size listed in TABLE II. The arrows shall be installed adjacent to each band to indicate the direction of flow in the pipe. The legends shall be printed in upper-case black letters as listed in TABLE I. Letter sizes shall be as listed in TABLE II. Marking shall be painted or applied using colored, pressure-sensitive adhesive markers of standard manufacture. Paint shall be as specified for insulated and uninsulated piping.

TABLE I. COLOR CODES FOR MARKING PIPE

Material	Band	Letters and Arrow*	Legend
Cold water (potable) WATER	Green	White	POTABLE
Fire protection water WATER	Red	White	FIRE PR.
Hot water (domestic)	Green	White	H.W.
Hot water recirculating (domestic)	Green	White	H.W.R.
High temp. water supply	Yellow	Black	H.T.W.S.
High temp. water return	Yellow	Black	H.T.W.R.
Boiler feed water	Yellow	Black	B.F.
Low temp. water supply (heating)	Yellow	Black	L.T.W.S.
Low temp. water return (heating)	Yellow	Black	L.T.W.R.
Condenser water supply	Green	White	COND. W.S.
Condenser water return	Green	White	COND. W.R.
Chilled water supply	Green	White	C.H.W.S.
Chilled water return	Green	White	C.H.W.R.
Treated water	Yellow	Black	TR. WATER
Chemical feed	Yellow	Black	CH. FEED
Compressed air	Yellow	Black	COMP. AIR
Natural gas	Blue	White	NAT. GAS
Freon	Blue	White	FREON
Fuel oil	Yellow	Black	FUEL OIL
Steam	Yellow	Black	STM.
Condensate	Yellow	Black	COND.

TABLE II. COLOR CODE MARKING SIZES

Outside Diameter of Pipe Covering (Inches)	Length of Color Band (inches)	Arrow Length x Width (Inches)	Size of Legend Letters and Numerals (Inches)
Less than 1-1/2	8	8 x 2-1/4	1/2
1-1/2 to 2-3/8	8	8 x 2-1/4	3/4
2-1/2 to 7-7/8	12	8 x 2-1/4	1-1/4

8 to 10	24	12 x 4-1/2	2-1/2
Over 10	32	12 x 4-1/2	3-1/2

3.6 MISCELLANEOUS PAINTING

3.6.1 Lettering

Lettering block type, and shall be black enamel. Samples shall be approved before application.

3.7 SURFACES TO BE PAINTED

Surfaces listed in the painting schedules at the end of this section, other than those listed in paragraph SURFACES NOT TO BE PAINTED, shall be painted as scheduled.

Specifications, Section 09900 PAINTING, GENERAL and DUP-488. In the case of conflict, DUP-488 governs.

3.8 SURFACES NOT TO BE PAINTED

Surfaces of hardware, fittings, and other factory finished items shall not be painted.

3.9 CLEANING

Cloths, cotton waste and other debris that might constitute a fire hazard

shall be placed in closed metal containers and removed at the end of each day. Upon completion of the work, staging, scaffolding, and containers shall be removed from the site or destroyed in an approved manner. Paint and other deposits on adjacent surfaces shall be removed and the entire job left clean and acceptable.

3.10 PAINTING SCHEDULES

The following painting schedules identify the surfaces to be painted and prescribe the paint to be used and the number of coats of paint to be applied. Contractor options are indicated by ------or------ between optional systems or coats.

EXTERIOR PAINTING SCHEDULE

Surface	First Coat	Second Coat	Third Coat

Concrete, unless otherwise specified.	FS TT-P-19	FS TT-P-19	None
Concrete: walls and bottoms of secondary containment tanks, manholes, flumes, and any other structures which potentially must be water-tight.	100 TO 120 MILS DFT BASE COURSE OF DEVCON IRASEAL 200 SYSTEM FINAL 8 TO 10 MILS DFT LAYER OF FLUOROLAST SB		
Ferrous metal unless otherwise specified.	Carboline Carbozinc II (green or red) (3 mils DFT)	Amerlock 400 or Dupont 25P or Tnemec's Chem-Build Series 135 (grey) (6-8 mils DFT)	Flourolast LC-8125 (black) (1-3 mils DFT) then LCGY-8125 (grey) (1-3 mils DFT)
Galvanized	Carboline Carbozinc II (green or red) (3 mils DFT)	A merlock 400 or Dupont 25P or Tnemec's Chem-Build Series 135 (grey) (6-8 mils DFT)	Flourolast LC-8125 (black) (1-3 mils DFT) then LCGY-8125 (grey) (1-3 mils DFT)
Aluminum aluminum-alloy, and other non-ferrous metal (non-galvanized)	FS TT-P-645	FS TT-E-489	FS TT-E-489
		----------or----------	
		SSPC Paint 21 Type I	SSPC Paint 21 Type I

INTERIOR PAINTING SCHEDULE

Surface	First Coat	Second Coat	Third Coat
..LAYOUT 8 Gypsum board, and concrete,	FS TT-F-1098	FS TT-P-29	FS TT-P-29

unless otherwise specified.	------or------ CID A-A-1500	----------or---------- FS TT-P-30	FS TT-P-30
Gypsum board: in food preparation, and latrine unless otherwise specified.	FS TT-P-650	FS TT-E-505 ----------or---------- FS TT-E-506	None None
Metal in food preparation, latrine and areas other than equipment, machinery.	Ferrous metal: SSPC Paint 5 FS TT-P-645 Aluminum: FS TT-P-645 Galvanized surface: SSPC Paint 5	FS TT-E-545	FS TT-E-505 --------or------- FS TT-E-506
Ferrous metal unless otherwise specified	SSPC Paint 5	FS TT-E-490	FS TT-E-490
Wood: unless otherwise specified.	FS TT-E-545	FS TT-P-30	None
Metal: Convector enclosures, electrical conduit runs, metallic tubing, uninsulated ducts and pipes, pipe hangers, louvers, grilles, and air outlets in areas having painted adjacent surfaces.	Ferrous metal: SSPC Paint 5 FS TT-P-645 Aluminum: FS TT-P-645 Galvanized surface: SSPC Paint 5	FS TT-E-545 FS TT-P-30 FS TT-E-489	FS TT-E-506 ------or------- FS TT-E-505 FS TT-E-508 ------or------- FS TT-E-509 FS TT-P-30 FS TT-E-489

-- End of Section --

Iraseal 200

Product Data Bulletin

The Iraseal 200 system is a 2-component, 100% solids, fast-curing polyurea coating designed to provide excellent hydrolytic stability in long term immersion conditions. Iraseal 200 is extremely resistant to moderate concentrations of both acid and alkaline solutions. Chemical resistance to slurries and water solutions is excellent at ambient temperatures. This resilient compound has excellent resistance to abrasion, Ultra Violet, weathering, outstanding physical strength and properties which enable it to perform successfully in a variety of service conditions.

Iraseal 200 is spray-applied utilizing specialized plural component spray equipment. It can be applied at practically any desired thickness in multiple coats even on overhead or vertical surfaces. Its quick cure capabilities allow the application of successive coats without sags or runs. It can be built up to a thickness of one-half inch in a matter of minutes. With the elimination of material mixing and waste, large surface areas can be coated quickly and economically.

The high elongation and flexibility of Iraseal 200 make it an ideal coating for concrete and other substrates that are prone to cracking and movement. Iraseal 200 will bond effectively to all common substrates, in many cases, it can be applied directly to the substrate without the use of primers or sealers. On clay, sand or soil surfaces, it should be applied directly on to a geotextile or a fiberglass scrim.

A 125 mil coating of Iraseal 200 can be put in light duty service after 24 hours cure.

TYPICAL PROPERTIES, LIQUID COMPONENTS

Properties	Mixed Components
Color	Grey
Volume Solids	100%
Weight Solids	l00%
Flash Point, T.O.C.	350+°F
Sprayed Gel Time	3 seconds
Sprayed Tack Time	6 seconds
Mix Ratio	1:1

TYPICAL PROPERTIES, CURED IRASEAL 200

Tensile Strength (ASTM D638)	3000 psi
Tear Strength (ASTM D1004)	450 pli
Puncture Resistance (ASTM D4833)	625 pli
Secant Modulus (ASTM D638)	600 psi
Elongation (ASTM D638)	450%
Hardness (ASTM D2240-68 Shore A)	90-95A
Abrasion Resistance (H-18 Wheels 1000 gm/wheel)	-344 mg loss/1000 revs
Operating Temperature Range (Continuous Service)	Dry -15° to 180°F Wet up to 140°F
Theoretical Coverage Rate	16 sq.ft./gal @ 100 mil DFT

SURFACE PREPARATION

All surfaces to be coated should be clean and completely dry. Steel, aluminum, galvanized metals, wood, brick, concrete, fiberglass, felt, and rubber are acceptable surfaces. If an application arises where Iraseal 200 would be applied over a substrate not mentioned here, consult the technical department at Engineered Coatings for a recommendation. The proper Irabond System should be used with each substrate. Refer to the "Application Procedures Bulletin". Metal surfaces should be grit-blasted with 20/40 or coarser grit as per SSPC-SP5 "White Metal Blast Cleaning". A 2-4 mil surface profile is desirable. Concrete should be sand or grit-blasted. Refer to the "Surface Preparation" specification for complete instructions.

APPLICATION METHOD

Please refer to Application Procedures Bulletin PRIOR to using for complete instructions.

Iraseal 200 requires specialized plural component spray equipment, please consult ITW Devcon Engineered Coatings for proper equipment and procedures information.

CURE RATES

The cure rate of Iraseal 200 is dependent upon temperature and thickness. Please refer to application procedures bulletin for complete details.

PRECAUTIONS

Adequate ventilation must be provided and protective clothing and breathing equipment must be used during application. For complete safety and handling information, please refer to Material Safety Data Sheets **PRIOR** to using this product.

For technical assistance please call 1-800-933-8266.

Non-warranty: Because we cannot anticipate the conditions under which this information or our products may be used, we can accept no liability for the results obtained. The information in this bulletin should not be construed as an expressed or implied warrant of merchantability or fitness for a particular purpose. We suggest that potential users conduct their own tests to determine the suitability of this product for a particular purpose.

ORDERING INFORMATION

Product	Size	Stock No.
Iraseal Part A	50 gal.	93101A
Iraseal 100 Part B	50 gal.	93200B

11/21/00

SURFACE PREPARATION: THE KEY TO SUCCESSFUL REPAIRS

The successful application of Devcon repair products and protective coatings depends on proper surface preparation. Dust, dirt, oil, grease, rust, and dampness can all adversely affect the adhesion of epoxies causing the entire repair to chip, crack, or break away under stress. A clean, dry, slightly roughened surface will ensure maximum adhesion of Devcon products.

General Surface Preparation

In general, the following steps will help you properly prepare a surface prior to applying Devcon products:

1) Make sure the surface is completely dry. Moisture will adversely affect the strength of the bond to the surface.
2) Remove all surface contamination (paint, rust, and grime) by abrasive blasting, sanding, or other mechanical means.
3) Degrease with Devcon Cleaner Blend 300.
4) Abrade the surface to roughen it and create a surface profile.
5) Use the appropriate Devcon primer.

For more detailed surface preparation information, refer to the appropriate substrate category below.

Rubber

To properly prepare a rubber surface:

1) Abrade the surface using a rubber rasp or a grinder with a wire wheel to produce a good surface profile. (Oils and contaminants imbedded in the rubber surface are typically released in this process.)
2) Remove all oil and grease from the rubber surface with Devcon Cleaner Blend 300 and an abrasive pad.
3) Wipe the surface with a clean, lint-free cloth continuously until black residue is no longer picked up by the white cloth.
4) Prime the surface as follows:

   Rubber to metal: Coat all metal surfaces (including stainless steel and aluminum) with two coats of Devcon FL-10 Primer. The primer will significantly improve adhesion of Devcon products to metal.

   Rubber to metal (for immersion service): Coat any metal that will be immersed in an aqueous solution with Devcon FL-10 Primer and Devcon FL-20 Primer. First apply the FL-10 Primer and let dry for 60 minutes. Next, coat with the FL-20 Primer. Let dry for 30 minutes before applying the Devcon product.

   Rubber to rubber: Coat all gum rubbers, neoprene, or cured urethanes with a thin coat of Devcon FL-20 Primer.

   Rubber to concrete: Coat concrete with Devcon FL-20 Primer. Multiple coats may be necessary because concrete is very porous. Let the primer dry for 30 minutes between coats.

   Rubber to wood or fiberglass: Coat these surfaces with Devcon FL-20 Primer. Soft woods will require a second coat due to their absorption characteristics.

If you are bonding rubber to other surfaces, contact us for a recommendation on primers and surface preparation procedures.

Devcon Technical Service:

1-800-933-8266

Remove all contamination from metal surfaces by abrasive blasting, sanding, or other mechanical means.

Abrade the surface to roughen it and create a surface profile.

Metal

To properly prepare a metal surface:

1) If the surface is oily or greasy, degrease it with Devcon Cleaner Blend 300.
2) Abrasive-blast the surface with 25-40 grit (or coarser) to produce a good surface profile. If you cannot abrasive-blast the surface, use a 60 grit or coarser sandpaper to achieve a similar result.
3) Immediately coat the metal surface with Devcon FL-10 Primer to prevent it from rusting.
4) Make repairs as soon as possible after blasting the substrate to avoid oxidation or flash rusting.

Aluminum Surfaces

Oxidation on aluminum surfaces reduces epoxy adhesion. This oxidation film must be removed before repairing aluminum with Devcon Metal Repair Epoxies.

To properly prepare an aluminum surface:

1) Remove oxidation by mechanical means such as grit-blasting or by chemical means such as acid etching.
2) Follow the General Surface Preparation guidelines.

Concrete

To properly prepare a concrete surface:

1) Degrease the surface with Devcon Cleaner Blend 300 or any water-based emulsifying cleaner and rinse thoroughly. Multiple cleanings may be necessary. Power washers or steam cleaners are very effective and can reduce the number of passes needed to clean the surface. Let the surface dry thoroughly before proceeding.
2) Remove any cap-curing agents that were applied to the concrete when it was poured. These agents form a dense, impenetrable finish, making it almost impossible for coatings to adhere to them.
3) Shot blast (Blastrac) the concrete to create a porous surface profile. This will improve surface "wetting" and coating or repair product adhesion.
4) If you cannot shot blast the concrete, use Devcon B-4 Etcher to acid etch the surface. This will "open up" the pores of the concrete for improved adhesion. (This step must be performed after the floor has been degreased and does not replace degreasing.) Be sure to rinse the floor thoroughly several times to neutralize the acid in the B-4 Etcher before applying primer or topcoat.

If the surface is oily or greasy, degrease it with Devcon Cleaner Blend 300.

Devcon applications experts will conduct in-plant application seminars to train your maintenance personnel on the proper use of Devcon products.

Wet Surfaces

In general, Devcon repair products and protective coatings will not adhere to wet surfaces.

To properly repair a wet surface:

1) Review the General Surface Preparation guidelines.
2) Thoroughly dry the surface. (If you are using Devcon Underwater Repair Putty (UW), refer to Underwater Surfaces section.)
3) Stop all leaks or seepage as follows:
   - Shut off the flow or pressure;
   - Fit a wooden peg or a sheet metal screw into the hole; or
   - Stuff wax, cork, plumber's caulk, Mortite, or a cloth into the opening.

   If the leak is caused by corrosion, the sidewall might be weak. Open the orifice until sound metal is exposed and the wall is thick enough to be plugged.
4) Remove surface condensation (sweating) or dampness with a heat gun or similar device.

Underwater Surfaces

To properly prepare an underwater surface:

1) Remove all dirt, barnacles, flaking paint, or algae/seaweed from the surface.
2) Wipe the surface with a clean cloth to remove any film. Although you cannot degrease underwater, wiping and turning a clean cloth will often remove any film from the surface.
3) Abrade the surface if possible. (Use a file or other mechanical means.)
4) Remove oxidation by mechanical means such as high-pressure water or grit-blasting, or by chemical means such as acid etching.

Specifications for Applying Fluorolast SB Protective Coatings over CONCRETE

A. Precaution

Read the MSDS on this product. Fluorolast SB and SBSS ("SB") contain potentially harmful solvents. Adequate safety and health precautions should be taken during handling, application, and drying of this product. The material should be applied under local, state, and federal regulations as well as in accordance with OSHA and ANSI bulletins on safety requirements. Use caution when handling this or any other solvent-based coating.

B. Suitability to Application

These two-component, high performance, fluoropolymer products are suitable for use as industrial strength protective sealants. They will adhere to most any substrate and are ideal as a chemically resistant barrier for a variety of substrates against corrosion.

These Viton terpolymer-based coatings have extraordinary performance characteristics in some of the harshest environments. Depending on conditions, they are able to withstand temperature extremes of from less than -20° to those in excess of 400° F. In addition, they will offer superior protection against hundreds of corrosive chemicals of the kind found in industrial environments (see Chemical Resistance Chart and Technical Data Sheet).

C. Equipment

Refer to the MSDS sheet regarding special personal protection equipment information. All Fluorolast SB formulas can be applied with a brush, squeegee, or roller for the simplest application of the coating. Spraying of SB formulas can also be done but <u>only</u> with <u>airless</u> spray equipment. Low solids SB (i.e. 8120, 8125) will spray easily with most any commercial strength pump, a 3/8" diameter hose, and nozzle tip. To spray higher solids SB, use an industrial-strength 50-to-1 pump with the pressure set to 85 lbs. as minimum (to start) and make adjustments as needed. Hose diameter of ½" works best. Nozzle tip sizes can be 423, 421, or 419. Higher atomization levels using these tips may be achieved by using more pressure and/or some dilution of the coating with a similar (ketone-based) solvent.

D. Primers, Sealers, and other Undercoatings

In order to seal the concrete and provide a surface most conducive to adhesion of the Fluorolast coating, use a quality epoxy primer that has been specified by its manufacturer for use on the type of concrete involved. A properly applied primer/sealer should be able to penetrate the porosity of the concrete, and serve as an anchor coat for bonding of the Fluorolast SB topcoat. The primer/sealer used should be a solvent-borne type (depending on conditions of the concrete and/or intended service) and not totally resistant to the solvent in the Fluorolast SB.

Fluorolast SB may be applied over a wide variety of base coatings including both polyurea and polyurethane type products to provide chemical resistance far beyond the capabilities of those thick-filmed protective products. Contact Fluorolast for details pertaining to the specifics of conditions and type of service environment involved.

E. Surface Preparation

If top coating a previously applied primer or sealer, follow the manufacturer's instructions for surface preparation and application procedure. Similarly, start with a clean, dry substrate that is free of contaminants. The temperature of the substrate should neither be too warm (to allow adequate "wetting out" of the Fluorolast SB coating) or too cold (hindering solvent evaporation) during application.

F. First Application

After the primer has dried sufficiently (to at *least* a slight tacky finish), you are ready to begin application of the SB. First, pour the full contents of the catalyst into the container of the Fluorolast SB. Stir so that it goes into complete solution with the coating. This will also disperse the solids evenly into solution. Using power equipment, this only takes about 20 seconds. Dwell time of 3 minutes before use.

For best results, air and surface temperatures during application should be at least 60°F and less than 150°F and at least 5°F above the dew point in order to allow adequate "wetting out" of Fluorolast SB coatings during application. Please keep in mind that warmer or hotter air and substrate temperatures will cause the coating to dry and set more quickly while cool or cold temperatures will affect the coating in the opposite way.

Commence the SB coating procedure. Be careful to avoid the creation of bubbles, pinholes, fisheyes, etc. by over-agitating (via brush strokes, roller thrusts) the coating during application.

Depending on the usual factors (e.g. Air and substrate temperature, humidity, etc.,) the "BK" line of Fluorolast SB coatings applied @ 12-15 mils <u>wet</u> thickness will normally dry in less than 30 minutes to permit recoating within 60 minutes. The <u>higher</u> solids "AK" line (40% solids and higher) coatings may be applied at 15-20 mils wet thickness per application to permit recoating in about 90 minutes time. *

Application procedures may vary due to the level of viscosity. As with other coatings, viscosity is directly proportional to solids content. With regard to (wet or dry) thickness per application; the coatings should be applied with conformance with the above guidelines.

The lighter solids "BK" coatings are specially designed for application onto *vertical* substrates. To reduce the occurrence of runs and sagging, the recommended coatings should be applied at 15 mils or less wet film thickness per coat. The high solids and heavy "AK" Fluorolast SB coatings are designed for application onto *horizontal* or flat concrete substrates (floors) only.

*NOTE: The temperature of the concrete substrate will affect these above guidelines accordingly and may shorten or lengthen drying period significantly (e.g. Warmer temps may permit heavier wet thickness per application; cooler temperatures may require less).

G. Subsequent Applications and Drying Time

It is vitally important that there is adequate drying time between coating applications (in conjunction with other conditions) to allow the solvent in the coating solution to evaporate out of the film and avoid "solvent entrapment". As previously mentioned, this can be as little as 30 minutes. The presence of higher temperatures and lower humidity will reduce the SB coatings' drying time accordingly. However, the opposite conditions will have the reverse affect.

In order to apply additional coating applications, wait until each coat has dried as per the above directions. Walking on the uncured film to apply additional coats will not be harmful as long as protective covers (e.g. Tyvec) are used over the technician's shoes. This will prevent dirt and other contamination from getting on and being trapped in the protective film. Also, if spraying, be sure the hose has been wiped clean prior to its contact with the area being coated.

H. Achieving Desired DFT

Using the Technical Data Sheet that details the dft of each Fluorolast coating formula as a guide, put on as many coating applications as necessary to reach the final dft of protective coating thickness desired. Keep in mind that drying time may increase with each of these additional applications for the reasons already described. Electronic thickness gauges are available on the market for measuring coating film thickness.

I. Cure time

Under normal circumstances, Fluorolast SB coatings will cure ambiently within 5 to 10 days from the end of application. As with other coatings, ambient cure time projections are dependent upon variable conditions such as atmospheric temperature, relative humidity, wind speed, service environment, and direct sunlight. Warm or hot temperatures can reduce cure time accordingly in some instances. However, when in doubt it is better to allow more (rather than too little) time for the coating to cure and achieve the maximum strength and effectiveness it was designed for.

J. Clean Up

Use of acetone or other ketone-type solvents will dissolve and remove unwanted dried coating from surfaces and equipment. Proper disposal of any remaining unused catalyzed coating, brushes, solvents, etc. should be observed and followed according to established code.

K. Maintenance of Fluorolast SB Coatings

Care should be taken not to perform activities on the coating before it has been fully cured. Similarly, if solvents or other chemicals are to be used in the coated area, be sure they are compatible with the chemical resistance of the Fluorolast coating as originally intended.

Fluorolast coatings are formulated to stand up to incidental foot and some vehicle traffic (rubber tires). Use special caution if it is necessary to bring heavy equipment onto the coated area so as not to cause damage to the coating.

Where gravel or other sharp objects may become embedded in the tires of vehicles that will be operating on the coated surface, it is highly recommended that a "sacrificial" rubber mat or sheet of sufficient thickness (i.e. old conveyor belts) be placed over the traffic area to protect the coating from being punctured.

Fully cured Fluorolast coatings are designed to withstand normal operating conditions as discussed with your Fluorolast representative prior to application. If conditions other than those discussed do arise, please contact Fluorolast for technical assistance in addressing them.

L. Repairing Damaged Fluorolast SB – Small areas

In case of damage after the Fluorolast coating has been installed, the coating may be easily repaired via the following procedure.

Using a sharp blade, cut out and remove the damaged section. Use a clean, (water) damp cloth to wipe dirt and dust from the damaged area sufficiently. If the area has been chemically contaminated, use a suitable solvent wipe in place of water to clean the surface. In either case, spare no effort to clean the surface of the bare substrate and the fringes of the coating surrounding it. Allow the area to dry completely.

Next, apply coats of Fluorolast SB (allowing each to dry before applying the next as per Section 'H') onto the damaged area. Allow the coating to dry and cure. SB will bond to itself securely and result in a seamless adhesion over the repaired area.

M. Repairing Damaged Fluorolast SB – Large areas

If a larger area of Fluorolast coating is damaged, please contact Fluorolast and describe the conditions and situation. Major repairs should be discussed with a Fluorolast representative first.

N. Coating Storage, Shelf Life & Pot Life

When stored properly in a moderate temperature environment, the UN-catalyzed Fluorolast SB coatings have an indefinite shelf life. With the introduction of catalyst into the coating and at moderate temperatures (75-80°F), typical pot life is about 2-3 hours – with normal coating agitation. Higher temperature conditions will reduce pot life accordingly (i.e. at 95°F, pot life may be reduced by half).

The addition of the catalyst along with normal evaporation of solvent out of the coating may gradually increase the viscosity of SB coatings as, the elastomers react to the cure system. The catalyzed coating may be thinned as needed by adding up to 10% of a ketone solvent. However, this could adversely affect the cross-link process of the catalyst if done after the first hour or so.

The presence of high temperatures or having the lid removed without agitation of the coating will increase the rate of both the evaporation and curing process which, could reduce pot life accordingly.

O. Contacting the Company

Fluorolast is available to offer assistance when you encounter questions involving the application and use of its protective coatings. Please refer your questions and requests for information to us by phone during regular business hours at (800) 785-3601. You may also contact us by fax at (330) 339-1515 or send e-mail to fluorolast@lauren.com. Visit us on the Internet at **www.fluorolast.com.**

Warranty Disclaimer: The manufacturer does not make any representations, nor does it assume any responsibility, as to any other materials or products to which this manufacturer's product will be used or applied, whether in combination with other materials or not; and, therefore the manufacturer disclaims all warranties, express or implied, concerning any particular use of this product, whether used in accordance with directions or not, or for any processes or uses of the product whether disclosed or not. It is the sole responsibility of the user of this product to test for and determine the suitability of his product for any use of the product with any material or combination of materials.

HERCULES INCORPORATED
RADFORD ARMY AMMUNITION PLANT
RADFORD, VIRGINIA

PAINTING SPECIFICATIONS

1.0 SCOPE: The work covered by this specification consists of furnishing all plant, labor, materials, tools, equipment and appliances and performing all operations in connection with the preparation and painting of surfaces of specified buildings and facilities at Radford Army Ammunition Plant, Radford, Virginia. All work shall be done in accordance with the specifications set forth herein, applicable drawings and schedules and subject to the terms and conditions of the Subcontract incorporating these specifications by reference.

1.1 Buildings and Facilities and Surfaces to be Painted shall be as specified in the Subcontract specifications. The surfaces to be painted shall receive the surface preparation, paint and number of coats prescribed in the PAINTING SCHEDULE hereinafter, unless otherwise provided in the Subcontract specifications.

1.2 Surfaces Not to be Painted shall be as specified in the Subcontract specifications.

1.3 Definition of Surfaces to be Painted: The following terms used in the Subcontract specifications shall be defined as follows:

1.3.1 Wood Trim shall include all exposed sheathing, rafters, barge and fascia boards and other exposed wood not otherwise mentioned.

1.3.2 Doors and Windows shall include the doors, windows, screens, frames and casing.

1.3.3 Underside of Porch Roofs and Canopies: Painting the underside of porch roofs shall extend from the outside edges to the first structural member or rafter or 12", whichever is greater.

1.3.4 Steps and Stairs: Only the top and bottom tread and riser shall be painted.

1.4 Work Not Included: This specification does not cover painting of water storage tanks. Water storage tanks shall be painted in accordance with applicable American Water Works Association specifications as covered by Subcontractor specifications developed for the particular job.

2.0 APPLICABLE PUBLICATIONS: The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent indicated by the references thereto:

2.1 Federal Specifications (Fed. Spec.):

TT-E-487E & Am 1	Enamel: Floor and Deck
TT-E-489G	Enamel, Alkyd, Gloss (For Exterior and Interior Surfaces)
TT-E-496B & Am 2	Enamel: Heat Resisting (400°F.), Black
TT-E-505A & Am 3	Enamel, Odorless, Alkyd, Interior, High Gloss, White and Light Tints
TT-E-506K	Enamel, Alkyd, Gloss, Tints and White, (For Interior Use)
TT-E-508C	Enamel, Interior, Semi-gloss, Tints and White
TT-E-509B & Am 2	Enamel, Odorless, Alkyd, Interior, Semi-gloss, White and Tints
TT-E-543A & Am 1	Enamel, Interior, Undercoat, Tints and White
TT-E-545B & Am 1	Enamel, Odorless, Alkyd, Interior-Undercoat, Flat, Tints and White
TT-F-1098D	Filler, Block, Solvent-Thinned, for Porous Surfaces, (Concrete Block, Cinder Block, Stucco, etc.)
TT-P-19D & Am 2	Paint, Acrylic Emulsion: Exterior
TT-P-28F	Paint, Aluminum, Heat Resisting (1200°F.)
TT-P-29J & Am 1	Paint, Latex Base, Interior, Flat, White and Tints
TT-P-31D	Paint, Oil: Iron-Oxide, Ready-Mixed, Red and Brown

TT-P-37C & Am 4	Paint, Alkyd Resin: Exterior Trim, Deep Colors
TT-P-38D & Am 1	Paint, Aluminum, Ready-Mixed
TT-P-55B & Am 2	Paint, Polyvinyl Acetate Emulsion, Exterior
TT-P-1551B & Am 2	Paint, Latex-base, Gloss and Semi-gloss, Tints and White (Interior)
TT-P-91D & Am 2	Paint, Rubber-Base, For Interior Use (Concrete and Masonry Floors)
TT-P-102E & Am 1	Paint, Oil: Alkyd (modified) Exterior White and Tints
TT-P-641G & Am 1	Primer Coating: Zinc Dust-Zinc Oxide (For Galvanized Surfaces)
TT-P-645A	Primer, Paint, Zinc-Chromate, Alkyd Type

2.2 Federal Standards (Fed. Std.):

No. 595a & Change Notices 2, 3, 4, 5, 7, 8, 9, and Errata	Colors

Military Specifications (Mil. Spec.):

MIL-S-12935D	Sealer, Surface; For Knots
MIL-P-15328C & Am 1	Primer (Wash), Pretreatment, Blue (Formula No. 117-B for Metals)
MIL-P-26915B	Primer Coating, Zinc Dust Pigmented, for Steel Surfaces
MIL-P-28582	Primer Coating, Exterior, Lead-Pigment-Free (Undercoat for Wood, Ready-Mixed, White and Tints)
MIL-P-52324	Paint, Oil, Alkyd, Exterior, White and Light Tints
DOD-P-15328D	Pretreatment, Vinyl-Type Wash Coat (Formula No. 117 for Metals)

2.4 American Society for Testing and Materials (ASTM) Publication:

C 150-86	Portland Cement

2.5 Military Standard (Mil. Std.):

MIL-STD-101B 3 Dec. 1970	Color Code for Pipelines and for Compressed Gas Cylinders

2.6 Steel Structures Painting Council (SSPC) Specifications:

SSPC-PA 1-82	Paint Application Specifications: No. 1 Shop, Field and Maintenance Painting
SSPC-SP 1-82	Solvent Cleaning
SSPC-SP 2-82	Hand Tool Cleaning
SSPC-SP 3-82	Power Tool Cleaning
SSPC-SP 7-85	Brush-Off Blast Cleaning
SSPC-SP 6-85	No. 6 Commercial Blast Cleaning
SSPC-Paint 5	(1982) Zinc Dust, Zinc Oxide and Phenolic Varnish Paint
SSPC-Paint 9	(1982) White (or Colored) vinyl Paint
SSPC-Paint 11	(1982) Red Iron Oxide, Zinc Chromate, Raw Linseed Oil and Alkyd Paint
SSPC-Paint 25	(1982) Red Iron Oxide, Zinc Oxide, Raw Linseed Oil and Alkyd Primer (Without Lead and Chromate Pigments)

3.0 GENERAL: The term "paint" as used herein, includes emulsions, enamels, paints, stains, varnishes, sealers, cement-emulsion filler and other coatings, whether used as prime, intermediate or finish coats. All paint materials shall be delivered to the job in original unbroken containers with the manufacturer's labels and/or tags intact. Paints shall be furnished in containers not larger than five (5) gallons.

4.0 MATERIALS: All materials shall be subject to the approval of Hercules. The specifications set forth in Paragraph 2 establish minimum standards; the materials shall be essentially the standard products of the manufacturer and shall be equal to or exceed the respective Federal, Military or other indicated specifications. Where proprietary paints are specified, no substitute product shall be used unless specially authorized in writing or specified by Hercules. Materials shall conform to the specifications shown in the PAINTING SCHEDULE herein and to the requirements hereinafter specified.

4.1 All paints shall comply with the following hazardous material restrictions. Certificate of compliance shall be furnished in accordance with paragraph, SAMPLES AND CERTIFICATION.

4.1.1 Lead: All paint shall be lead-free.

4.1.2 Mercury: Mercurial fungicides shall not be used in exterior oil paints.

4.2 Cement-Emulsion Fill Coat: Fill coat shall be either an acrylic-based fill coat or a polyvinyl acetate fill coat and shall consist of the following:

White Portland Cement	-	16.5 pounds
Aggregate	-	33.5 pounds
Mixing Liquid	-	0.75 pounds
Potable Water	-	1.0 gallons maximum
Exterior Emulsion Paint	-	1.0 gallons

The White Portland Cement shall conform to ASTM C 150, Type I. The aggregate shall be washed silica sand with the following gradation:

U.S. Sieve Size	Percent Sand (by Weight) Passing Individual Sieve
20	100
30	95 - 100
50	30 - 65
100	0 - 10
200	0 - 1

The mixing liquid shall be the same resin emulsion as used in formulating the exterior emulsion paint. The acrylic mixing liquid shall contain 46 to 47 percent solids. The polyvinyl acetate liquid shall consist of 92.6 percent by weight or vinyl polymer (55 percent solids), 3.7 percent by weight carbitol acetate, and 3.7 percent by weight potable water. The mixing liquid shall be factory prepared. The exterior emulsion paint shall be exterior acrylic emulsion paint conforming to Fed. Spec. TT-P-19 or exterior polyvinyl acetate emulsion paint conforming to Fed. Spec. TT-P-55, Type II. The various cement-emulsion fill coats and exterior emulsion paints shall not be interchanged.

4.3 Exterior Oil Paint: Exterior oil paint shall conform to the following Federal Military Specifications:

White:	TT-P-102; or MIL-P-52324, Class 1 or 2
Light Tints:	TT-P-102; or MIL-P-52324, Class 2
Red or Brown:	TT-P-31
Other Deep Colors	TT-P-37

4.4 Ferrous-Metal Primer: Ferrous-metal primer shall conform to TT-P-645, SSPC-Paint 5, SSPC-Paint 11, or SSPC-Paint 25.

4.5 Fungicide: Material specified for all coats applied to fabrics and vapor barrier jackets over insulation shall contain a fungicide that will not adversely affect the color, texture, or durability of the coating. The paint shall contain a fungicide incorporated into the paint by the manufacturer and will meet the fungus resistance test specified in Fed. Spec. TT-P-19.

4.6 Roof Paint shall be 3R Premium Aluminum Coating (ARMRA) system as manufactured by Colonial Refining & Chemical Company, Rocky River, Ohio. Primers shall be 3R Roof Primer for porous surfaces and Rust Raider Aluminum Paint for rusted metal surfaces. Roofing cement shall be a type as recommended by the roof coating manufacturer.

4.7 Special materials for NG resistant interior finishes in high explosive (H.E.) buildings:

4.7.1 Adhesive shall be PB No. 30, Industrial, "Pliobond," as distributed by H. B. Ruscoe Company.

4.7.2 Tape shall be cloth, pinked edges, 3" wide, "Flightex 3", as manufactured by Flightex Fabrics, New York, New York (Division Belding Corticelli Fiberglass).

4.7.3 Caulking, Silicon Rubber Adhesive - RTV #732, manufactured by Dow Corning, may be used in areas where taping is not practical, but only as approved by the Hercules Engineer:

4.7.4 H.E. Primer and Finish Paints for new work and repainting shall be NG resistant Chlorinated Rubber.

4.8 Chlorinated Rubber Primer and Finish Paints shall be as specified below. When the old finish is not completely removed in repaint work, the Subcontractor shall verify compatibility between the old and new coating by testing to determine whether the solvents of the new coating will loosen or lift the old coating.

4.8.1 Sampson Paint Company, Richmond, Virginia, "Sentrx" (formerly Perry Austen "Tornesit")

4.8.2 Sherwin-Williams Company, Cleveland, Ohio, Hi-Bild Primer and Enamel, B63 Series

4.8.3 PPG Industries, Pittsburg, Pennsylvania - Chlorinated Rubber Coatings 97-380, multi-prime Barrier Coat 97-684.

4.8.4 Glidden Coatings, Reading, Pennsylvania - Gli-Guard Chlorinated Rubber Hi-Mil No. 5500.

4.8.5 Other NG Resistant paint may be used after submission of request and samples by the Subcontractor for testing and approval by Hercules. Sufficient time must be allowed for testing and approval before material is scheduled to be used.

5.0 SAMPLES AND CERTIFICATION:

5.1 Samples: The Subcontractor shall submit samples of all paints to the Hercules Facilities Engineering Department for approval. Samples shall be submitted in a minimum one-half (1/2) pint, original, unbroken containers with manufacturer's label intact. Samples shall be properly labeled and accompanied by a letter of transmittal stating manufacturer's certification that paint conforms to the proper specifications when applicable and manufacturer's letter or literature stating the contents, type, mixture, thinning and application instructions and intended use. Samples shall be submitted a minimum of ten (10) days prior to their intended use and the materials represented by the samples shall not be used in the work until written approval has been received from Hercules.

5.2 Certificates of Compliance: The Subcontractor shall furnish a certificate of compliance attesting that all paints proposed for use are lead free.

6.0 CLEANING AND PREPARATION OF SURFACES:

6.1 General: Hardware, hardware accessories, machined surfaces, plates, lighting fixtures, sprinkler heads or fire detection elements and similar items in contact with painted surfaces and not to be painted shall be removed and repositioned upon completion, masked, or otherwise protected prior to surface preparation and painting operations. Exposed radiator covers shall be removed to permit the complete painting of the radiator and adjacent surfaces. Such removal shall be done by workmen skilled in the trades involved. Exposed nails and other ferrous metal on or in contact with surfaces to be painted shall be spot-primed with zinc dust, zinc dust-zinc oxide, or zinc chromate primer. Surfaces to be painted shall be clean before applying paint or surface treatments, shall be smooth, dry and free from dirt, loose non-adherent rust, loose mill scale, frost, loose and scaling paint and other foreign substances. Oil and grease shall be removed with clean cloths and cleaning solvents prior to mechanical cleaning. Cleaning solvents shall be of low toxicity and shall have a flash point in excess of 100°F. Edges of old tight paint shall be sanded to a feather edge to provide a smooth surface. Cleaning and painting shall be so programmed that dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces. Subcontractor shall clean and prepare all surfaces to assure proper adhesion of new paint.

6.2 Asbestos-Cement Surfaces: Asbestos-cement surfaces shall be dry and clean prior to application of the first-coat material. Stains shall be removed with solvents. Wire brushing will not be permitted.

6.3 Concrete and Masonry Surfaces: Surfaces shall be allowed to dry at least 30 days before painting. Glaze, efflorescence, laitance, dirt, grease, oil, asphalt, surface deposits of free iron and other foreign matter shall be removed prior to painting. Immediately before coating with cement-emulsion filler, concrete-masonry-unit surfaces to be painted shall be uniformly and thoroughly dampened, with no free surface water visible, by several applications of potable water with a fog spray, allowing time between the sprayings for water to be absorbed. Concrete and other masonry surfaces to be painted with oil base paints shall be free of alkali and shall be thoroughly dry before paint is applied. Previously painted concrete or masonry surfaces shall be prepared by removing loose paint with vigorous wire brushing or brooming; patching cracks and holes, and thoroughly cleaning with a suitable solvent before applying paint. Unless otherwise provided in the Subcontract specifications, previously painted exterior surfaces shall be sandblasted.

6.4 Ferrous Surfaces: Ferrous surfaces that have not been shop coated shall be solvent cleaned. Surfaces that contain loose rust, loose mill scale, old paint and other foreign substances, shall be mechanically cleaned by power tools according to SSPC-SP 3 or by sandblasting according to SSPC-3P7. After cleaning, one coat of ferrous-metal primer shall be applied to all ferrous surfaces to receive paint. Primer shall be compatible with the finish coats. The semitransparent film applied to some pipes and tubing at the mill is not to be considered as to application of finish coats. Shop coated ferrous surfaces shall be protected from corrosion by treating and touching up corroded areas immediately upon detection.

6.5 Galvanized and Non-Ferrous Surfaces: Galvanized, aluminum and aluminum alloy, lead, copper and other non-ferrous surfaces to be painted shall be solvent cleaned and treated with Vinyl-type wash coat.

6.6 Gypsum Board Surfaces: Gypsum board surfaces shall be dry and shall have all loose dirt and dust removed by brushing with a soft brush or rubbing with a dry cloth prior to application of the first coat material.

6.7 Mastic Type Surfaces: Mastic type surfaces shall be prepared by removing foreign material.

6.8 Plaster Surfaces: Plaster shall age at least 30 days before painting. Plaster shall be clean, free from loose matter, surface irregularities, and shall have an instrument measured moisture content not exceeding 8 percent. All cracks and scratches in new and previously painted plaster work shall be cut out and repaired with patching plaster, properly keyed to existing plaster and sanded smooth.

6.9 Wood Surfaces: Wood surfaces to be painted shall be cleaned of foreign matter. Wood surfaces adjacent to surfaces to receive water thinned paints shall be primed and/or touched up prior to the application of water thinned paints. Small, dry, seasoned knots shall be scraped, cleaned, and given a thin coat of knot sealer, Mil. Spec. MIL-S-12935, before application of the priming coat. Pitch on large, open, unseasoned knots and all other beads or streaks of pitch shall be scraped off, or if still soft, removed with mineral spirits or turpentine and the resinous area thinly coated with knot sealer. Surfaces shall be checked to insure that finishing nails have been properly set and all holes and surface imperfections shall be primed. After priming, all holes and imperfections in finish surfaces shall be filled with putty or plastic wood filler, colored to match the finish coat, allowed to dry, and sandpapered smooth. Putty or wood filler used shall be compatible with subsequent coatings. Painting shall proceed when the moisture content of the wood does not exceed 12 percent as measured by a moisture meter, unless otherwise authorized. Previously painted surfaces shall be clean and dry, and shall be prepared by removing all loose and scaling paint by scraping, brushing or sanding and bonded paint sanded to a feather edge, then treated as above.

6.10 Treated lumber when specified by Hercules to be painted shall be wiped clean of all exuded preservative treatment before primer is applied. A primer coat of aluminum paint shall be applied and allowed to dry thoroughly before finish coats are applied. Exudation should be complete prior to application of primer.

6.11 Sealing of Cracks and Joints of Interior Walls and Ceilings in High Explosive (HE) Buildings: All nail heads shall be covered and all cracks and joints in wall and ceilings of HE buildings shall be sealed as follows:

6.11.1 Room temperature shall be brought to a minimum of 70°F prior to beginning work.

6.11.2 All surfaces shall be cleaned as specified in paragraph, SURFACE PREPARATION, and any paint left is to be removed prior to application of the adhesive.

6.11.3 Adhesive shall be mixed according to the manufacturer's instructions.

6.11.4 Apply by brush a minimum of three and one-half inches wide, one coat of adhesive with as thin a coat of possible over cracks and joints and follow immediately by pressing on the cloth tape smoothly and wrinkle free. After the adhesive has become sufficiently set, apply another coat of adhesive thoroughly saturating the cloth tape and sealing the edges.

6.11.5 The following schedule indicates curing time of the adhesive before applying paint.

6.11.6 The approved Silicon Rubber caulking may be used to seal cracks where taping is not practical as approved by Hercules.

Room Temperature	Curing Period (Minimum)
70°F	10 hours
75°F	8 hours
80°F	6 hours
90°F	3 1/2 hours
100°F	2 hours

6.12 Roof Surfaces: All projections (nails, etc.) shall be driven down or removed and replaced. Roofing and flashing which do not contain sufficient nails to firmly secure the roofing material shall be renailed. Holes, cracks and other minor crevices in roof surfaces and flashing shall be filled with roofing mastic applied in accordance with the manufacturer's instructions. Surfaces shall be thoroughly cleaned by vigorous broom sweeping or hand brushing.

6.13 Fabric Covering: New or unpainted fabric covering over insulation on pipes, ducts, tanks and other equipment shall be given a heavy coat of nonpenetrating size to which subsequent paint coats will permanently adhere. The size shall be applied in such manner as to completely seal the surface. A sufficient amount of fungicidal agent shall be added to the size and each coat of paint thereafter to render the fabric mildew-proof.

6.14 Reputtying and Recaulking: In repaint work the Subcontractor shall reputty glazed sash and doors where needed. Windows, doors, and other building components to be painted shall be recaulked using an approved latex or better caulking compound. Oil base caulking will not be acceptable. Reputty work and caulking shall be done on interior and exterior surfaces. Putty and caulking shall not be painted without allowing sufficient time for curing.

6.15 Wooden window screens shall be removed to be painted and to accommodate painting of windows, and reinstalled unless otherwise specified.

6.16 Inspection: Hercules Engineer shall inspect prepared surfaces before coating is applied.

7.0 MIXING AND THINNING:

7.1 General: Packaged paint other than cement emulsion filler may be thinned in accordance with manufacturer's written instructions immediately prior to application where necessary to suit conditions of surface, temperature, weather, and method of application with not more than one pint of suitable thinner per gallon. The use of thinner shall not relieve the Subcontractor from obtaining complete hiding. Paints of different manufacturers shall not be mixed.

7.2 Cement-Emulsion Fill Coat: Cement and aggregate shall be dry mixed so that uniform distribution and intermixing are obtained. Mixing liquid and one-half of the total amount of water shall be premixed and added gradually to the white portland cement and aggregate with constant stirring until a thick, smooth material is obtained. Emulsion paint shall then be added to the foregoing and stirred until uniformity is obtained. The blend shall have a thick, creamy consistency. The remainder of the water shall be added, if necessary, to obtain a material with adequate application characteristics. Blending resin emulsion or emulsion paint with any other component shall be done with caution; too rapid agitation will cause air entrapment and foaming.

7.3 Vinyl-type wash coat: MIL Spec. DOD-P-15328 wash coat shall be mixed by adding one volume of acid component to four volumes of resin component. The acid component shall be added slowly to the resin component with constant stirring. The wash coat shall be used within 8 hours. The material may be reduced with normal butyl alcohol or 99 percent isopropyl alcohol, if thinning is required to maintain a wet spray.

8.0 APPLICATION:

8.1 General: Paint may be applied by brush, roller or spray according to manufacturer's specifications except as hereinafter specified or otherwise prohibited by Hercules in the job specifications. At time of application, paint shall show no signs of deterioration. Uniform suspension of pigments shall be maintained during application. Paint shall be applied so finished surfaces shall be free from runs, drops, ridges, waves, laps, brush marks, and variations in color, texture, and finish. Hiding shall be complete. Each coat shall be applied as a film of uniform thickness. Rollers for applying paints and enamels shall be of a type designed for the coating to be applied and the surface to be coated. Special attention shall be given to insure that all surfaces including edges, corners, crevices, welds, and rivets receive a film thickness equivalent to that of adjacent painted surfaces. Adequate ventilation shall be provided during paint application. Respirators shall be worn by all persons engaged in spray painting. Adjacent areas shall be protected by the use of drop cloths or other approved precautionary measures shall be taken. The first coat on plaster, gypsum wallboard and other surfaces shall include repeated touching up of suction spots or overall application of primer or sealer to produce a uniform color and gloss. The first coat on both faces of wood doors shall be applied at essentially the same time. Steel and wood glazed doors and sashes shall be given both coats of paint within three weeks of the time they are glazed, but not before the glazing material has set; paint shall overlay glass slightly above the sight line. Unless otherwise specified, each undercoat of paint shall be tinted to a definite variation in shade to distinguish it from the following coat.

8.2 Coating Process: Sufficient time shall elapse between successive coats to permit proper drying. This period shall be modified as necessary to suit adverse weather conditions. Oil base or oleoresinous solvent type paints shall be considered dry for recoating when the paint feels firm, does not deform or feel sticky under moderate pressure of the thumb, and the application of another coat of paint does not cause lifting or loss of adhesion of the undercoat. Each coat shall be complete and approved by Hercules Engineer before successive coat is applied.

8.3 Masonry Surfaces: Masonry surfaces may be coated by brush, roller, or spray, except filler coats. Cement emulsion filler shall be vigorously scrubbed into the surface with a stiff-bristle brush having tampico or palmyra bristles not longer than 2-1/2 inches. At least 24 hours shall elapse before applying exterior emulsion paint over cement emulsion filler coat. When the ambient temperature is in excess of 85°F, cement emulsion filler surfaces shall be lightly dampened with a fog spray of potable water immediately prior to application of the subsequent paint coat. Application of solvent thinned filler shall be applied by brush, allowed to set for 3 to 5 minutes or until the filler becomes tacky, and the excess filler material removed with a rubber squeegee. Surface voids shall be filled. Surface irregularities need not be completely filled. The material shall not be applied over caulking compound.

8.4 Metal Surfaces: First coats shall be applied by brush only. The three-coat paint system specified for exterior and interior ferrous surfaces shall be applied so that the dry film thickness of the three coat systems at any point shall be not less than 4.0 mils with the primer having a minimum dry film thickness of 1.5 mils.

8.5 Time Between Surface Preparation and Painting: Surfaces that have been cleaned, pretreated and otherwise prepared for painting shall be given a coat of the specified first coat as soon as practicable after such pretreatment has been completed, but prior to any deterioration of the prepared surface.

8.6 Roof Surfaces: Roof paint shall be applied by brushing and in accordance with the manufacturer's instructions.

9.0 ENVIRONMENTAL CONDITIONS: Unless otherwise recommended by the paint manufacturer, the ambient temperature shall be between 45 and 95°F when applying coatings other than water-thinned. Water-thinned coatings will only be applied when ambient temperature is between 50 and 90°F. Paints, except water-thinned types, shall be applied only to surfaces that are completely free of surface moisture as determined by sight or touch. In no case shall paint be applied to surfaces upon which there is visible frost or ice.

10.0 PROTECTION AND CLEANING:

10.1 The Subcontractor shall use drop cloths or other coverings to protect adjacent surfaces during painting operations. Subcontractor shall be held responsible for any damages incurred during the performance of work.

10.2 The Subcontractor shall remove all paint spots, oil and stains from adjacent surfaces and leave the work in a clean condition acceptable to Hercules.

10.3 The Subcontractor shall not support ladders or scaffolding on piping, equipment or unstable objects.

10.4 The Subcontractor shall furnish approved suitable containers such as all-metal boxes with lids or large metal garbage cans with lids to store any previously opened paint, solvent and brushes. The containers shall be located in an area designated by Hercules.

10.5 Subcontractor shall place in approved metal containers (provided by the Subcontractor) and remove from the plant at the end of each working day, all used cloths, waste solvent, and other waste. Subcontractor shall properly and legally dispose of such waste at an off-plant site, in accordance with all applicable Federal, State, and Local regulations.

10.6 After final coat of paint on windows and casings has dried, Subcontractor shall free all windows and lubricate slides with a suitable wax lubricant. Subcontractor shall see that all windows raise and lower easily before leaving the job.

11.0 MISCELLANEOUS:

11.1 Lettering: Lettering shall be the block type, height as specified, and shall be black enamel. Samples shall be approved before application.

11.2 The Subcontractor shall furnish all stencils required for identification.

11.3 Upon completion of interior and exterior painting, the Subcontractor shall stencil lettering (1/2" high) on surfaces where specified by the Hercules Engineer and denoting the following:

Date Painted: _____
Subcontract No.: _____
Type of Paint: _____

11.4 Relettering or Restenciling of Facility Titles, Numbers and Property Identification: In repainting, the Subcontractor shall record this type information and shall reletter or restencil at the original location(s) and size.

12.0 COLOR CONDITIONING AND COLOR CODING:

12.1 Preface to Color Code: Unless otherwise specified in the Subcontract specifications, the facilities shall be color coded in compliance with these specifications. Color card numbers refer to those shown in Federal Standard No. 595. Exact conformance is not mandatory but shall be subject to approval by Hercules. Except for the color schemes indicated below, all exterior surfaces shall be painted gray, Color Card Number 16187 and all interior surfaces shall be painted white, Color Card Number 17875. Any surface not definitely specified as to color or type of paint shall be a color or type of paint as approved by the Hercules Facilities Engineering Department. The following surfaces shall be painted to conform to the color scheme and color card numbers as indicated:

12.2 Interior surfaces of buildings protected by a Primac Sprinkler System shall be painted "glacier green".

12.3 Exterior:

Item	Color Scheme	Color Card Number
Bumper Block (dock edges) Guards for Guy Wires Guard Posts	Yellow with Black Stripes	13538 & 17038
Sprinkler Switch Box Deluge Rings	Red	11105
Sprinkler Valve House Fire Hose Houses	Red with 4" White Band around Middle Horizontally	11105 & 17875
Manual Fire Alarm Boxes	Red with 38" Red Band Horizontally on Supporting Pole with 4" White Bands Above and Below the Red Bands	11105 & 17875
Fire Hydrants Elevator Gates & Landings	Yellow (See Note 12.5)	13538
Switch Boxes & Circuit Breakers	Aluminum	17178
Safety Shower	Green with White Band	14187 & 17875
Fire Blanket Boxes	Red with 3" White Letters	11105 & 17875

Outside Pipelines Operational Storage Tanks	White	17875

12.4 Interior:

Item	Color Scheme	Color Card Number
Floor Areas	Brownish Red or Gray	10076 & 16376
Baseboard or Equivalent Wall Space, 6" High Maximum	Black	17038
Sprinkler Piping	Red	11105
Tool Boards	White	17875
Machine Body	White	17875
Mounting Boards	White with Red Stripes	17875 & 11105
Stop Buttons or Handle Knobs	Red	11105
Switch Boxes & Circuit Breakers	Blue	15123

12.5 Miscellaneous - General Exterior and Interior:

Item	Color Scheme	Color Card Number
Curbing, Hazardous Location Protruding Parts and Obstacles Steps (Bottom & Top Only - Tread & Riser) Hazardous Moving Objects Block Hoist	Yellow with Black Stripes	13538 & 17038
Ramps	Yellow or Yellow with Black Stripes	13538 & 17038
Handrails (Wood & Metal) (Top Rail Only) Handle Wheel & Operating Levers Overhead Cranes Conveyors - Edges, Sides & Ends Telpher System	Yellow	13538

Fire Extinguisher Safety Starting Levers	Green	14062 & 14187
Guards (Inside Covers) Operating Levers (Requiring Caution)	Orange	12246

12.6 Fire hydrants shall be painted yellow except the tops and Outlet caps shall be color coded to indicate the hydrant capacity as follows:

Hydrant Capacity	Colors for Tops & Caps	Color Card Number
Less than 500 GPM	Red	11105
500 to 1000 GPM	Orange	12246
1000 to 1500 GPM	Green	14187
1500 to 2000 GPM	Blue	15102

Hydrant capacities will be furnished by Hercules.

13.0 COLOR CODING FOR PIPING SYSTEMS:

13.1 General: Piping identification shall be in accordance with Mil. Standard.
101. Piping systems except sprinklers will not be entirely painted with the primary or secondary color; inside pipe will be painted the same color as the background; outside piping will be painted white, Color Card No. 17875. The primary color warnings (bands), secondary color warnings (arrows), and identification signs (letter titles) will be used. Conduit or wiring for the electrical and telephone systems shall be painted as the background with no identification required. Unless otherwise prohibited in the Subcontract specifications, approved pressure sensitive tape, and flexible pipe markers in proper size and colors may be used in lieu of painting the bands and identification. Self-sticking legends in safety colors, banding material, and directional arrows are available from: W. H. Brady Company, 727 W. Glendale Avenue, Milwaukee, Wisconsin, 53209.

13.2 Legend or Titles: Exact identification of piping shall be made by means of titles stenciled on pipes in black. Titles shall be prominently displayed adjacent to color warnings. Where the view is unobstructed, the titles shall be lettered on the two lower quarters of the pipe or covering to prevent obscurity by dust collection or mechanical damage. However, titles shall be clearly visible from operating positions, especially those adjacent to control valves. Titles shall be stenciled or lettered with standard size letters as specified in TABLE I.

TABLE I

O.D. of Pipe or Pipe Covering	Size of Stencil or Lettered Legend
Under 1-1/2"	1/2"
1-1/2" to 3-1/2"	3/4"
3-1/2" to 6"	1-1/4"
6" to 9"	2"
9" to 13"	3"
Over 13"	3-1/2"

13.3 Primary Color Warnings: Primary color warnings shall consist of a SINGLE color applied as a band which completely encircles the pipe.

13.4 Secondary Color Warnings: A colored arrow shall appear adjacent to each primary color warning applied to a piping system and shall indicate the normal direction(s) of flow of the material in the system. A double headed arrow shall be placed on lines subject to reverse flow.

13.5 Application: Color bands shall be applied in conformance with dimensional information shown in Figure 1 (copy attached) of MIL-STD-101.

13.6 Location on Piping System: Immediately adjacent to all operating accessories, such as valves, regulators, flow checks, strainers, cleanouts, vents, where branch lines join the system, where the system passes underground or through walls, and at any other conspicuous place where warnings are required by safety authority.

13.7 Piping Systems: The colors for piping system shall be as specified in TABLE II. The colors to be used for any piping not covered in TABLE II will be supplied by Hercules. In the secondary warning column, arrows on the system marked (1) may be the same color as primary warning or black at the Subcontractor's option.

TABLE II

Piping	Primary Warning	Secondary Warning	Title or Legend
Acetone	Yellow	(1)	Acetone
Acid-Concentrated Mix	Blue	Brown	Con Mix
Acid-Mixed Fortified	Blue	Brown	M. F.
Acid Mixed	Blue	Brown	Mixed
Acid-N.G. Concentrated Mix	Blue	Brown	N.G. Con Mix
Acid-N.G. Mixed	Blue	Brown	N.G. Mixed
Acid-N.G. Spent	Blue	Yellow	N.G. Spent

TABLE II (Continued)

Piping	Primary Warning	Secondary Warning	Title or Legend
Acid-N.C. Mixed	Yellow	Blue	N.C. Mixed
Acid-N.C. Spent	Yellow	Blue	N.C. Spent
Acid-Strong Nitric	Blue	Brown	Strong Nitric
Acid-Weak Nitric	Blue	Brown	Weak Nitric
Acid-Oleum	Blue	Brown	O. V.
Acid-Pyro Spent	Blue	Yellow	Pyro Spent
Acid-Strong Sulphuric	Blue	Gray	Strong H_2SO_4
Air-Compressed	Gray	Green	Air
Alcohol-Ethyl (Strong)	Yellow	(1)	Alcohol-Strong
Alcohol-Reject	Yellow	(1)	Alcohol-Reject
Alcohol-Weak	Yellow	(1)	Alcohol-Weak
Ammonia-Anhydrous Ammonia	Brown	Yellow	Anhydrous
Amonia-Nitrate-Molten	Yellow	Green	Ammonia Nitrate
Benzene	Yellow	Brown	Benzene
Butane	Yellow	(1)	Butane
Caustic-Soda-Strong	Blue	(1)	Caustic-Strong
Caustic-Soda-Spent	Blue	(1)	Caustic-Spent
Chlorine	Brown	(1)	Chlorine
Dibutylaphalate	Yellow	(1)	D. B. F.
Diethylphalate	Yellow	(1)	D. E. P.
Dimethylphalate	Yellow	(1)	D. M. P.
Dioctylphalate	Yellow	(1)	D. O. P.
Ether	Yellow	Blue	Ether
Ether Reject	Yellow	Blue	Ether Reject
Ether Layer	Yellow	Blue	Ether Layer
Glycerin-Cold	-	(1)	Glycerin
Glycerin-Hot	-	(1)	Glycerin
Hydraulic-H. P.	Gray	(1)	H. P. Hydraulic
Hydraulic-L. P.	Gray	(1)	L. P. Hydraulic
Hydraulic-Exhaust	Gray	(1)	Exh. Hydraulic
Hydraulic-Oil	Yellow	Gray	Oil-Hydraulic
Inert Gas	Gray	(1)	I. G.
Inert Gas H. P.	Gray	(1)	H. P. Inert Gas
Inert Gas L. P.	Gray	(1)	L. P. Inert Gas
Mixed Solvent (Flammable)	Yellow	(1)	Mixed Solvent
Nitrocellulose Slurry	Yellow	(1)	Nitrocellulose
Recovered Solvent	Yellow	(1)	Sol. Recovered
Steam-400 p.s.i.	Gray	(1)	400# Steam
Steam-260 p.s.i.	Gray	(1)	260# Steam
Steam-40 p.s.i.	Gray	(1)	40# Steam
Steam-5 p.s.i.	Gray	(1)	5# Steam
Triacetin	-	(1)	Triacetin
Vacuum (Contaminated)	Gray	(1)	Vacuum
Water-Chilled	-	(1)	Chilled Water

TABLE II (Continued)

Piping	Primary Warning	Secondary Warning	Title or Legend
Water-Condensate	Gray	(1)	Condensate
Water-Distilled	Gray	(1)	Distilled Water
Water-Filtered	-	(1)	Filtered Water
Water-Drinking	White	(1)	Drinking Water
Water-Fire	Red	(1)	-
Water-Hot	Gray	(1)	Hot Water
Water-Recovered	See Note 13.8	See Note 13.8	Recovered Water
Water-Waste	See Note 13.8	See Note 13.8	Waste Water
Water-Layer	Yellow	(1)	Water Layer

13.8 Note: Waste and recovered water piping systems which are contaminated with chemicals having color warning classifications shall be painted with color warnings in accordance with those specified for the contaminating chemical. The identifying title shall be as specified for waste and recovered water piping systems and shall include the identifying title specified for the contaminating chemical.

14.0 PAINTING SCHEDULE: The PAINTING SCHEDULE prescribes the surfaces to be painted, required surface preparation, and the number and types of coats of paint. Explanatory information for use with the PAINTING SCHEDULE is as follows:

14.1 Subcontractor's Options: The PAINTING SCHEDULE provides Subcontractor's options as shown in the following examples:

	Surface	1st Coat	2nd Coat		3rd Coat
(1)	Exterior ferrous surfaces, exposed, Unless otherwise specified	Ferrous Metal Primer	Exterior Oil Paint	or	Exterior Oil Paint
			TT-E-489, Class A		TT-E-489, Class A
(2)	Interior hardboard and ..... floors	TT-E-543 or TT-E-545 for wood & primed metal. TT-P-645 for bare metal.	TT-E-508 or TT-E-509		TT-E-508 or TT-E-509

In the first example, the Subcontractor has the option of using either Exterior Oil Paint or TT-E-489, Class A, for both the second and third coats. In the second example, the Subcontractor has the option of using either TT-E-543 or TT-E-545 for the first coat, and either TT-E-508 or TT-E-509 for the second and third coats. TT-P-645 must be used for first coat on bare metal.

14.2 Shop Painted Items: Surfaces of items finish painted by the manufacturer, or specified to be finish painted under other sections of the specifications, are exempted from the requirements for surface preparation and painting. Shop primed items shall receive surface preparation and finish painting as required by this section.

14.3 Surface Preparation: The statement "as previously specified" under column heading "Surface Preparation" of the PAINTING SCHEDULE refers to paragraph CLEANING AND PREPARATION OF SURFACES of these specifications.

14.4 Unless otherwise specified, previously painted surfaces shall receive a prime coat and one finish coat.

PAINTING SPECIFICATIONS
HERCULES INCORPORATED
RADFORD ARMY AMMUNITION PLANT
RADFORD, VIRGINIA

PAINTING SCHEDULE

Surface	Surface Preparation	1st Coat	2nd Coat	3rd Coat
Exterior concrete masonry units	Remove foreign matter loose particles, & efflorescence. Dampen as specified.	TT-F-1098 or Cement-emulsion filler	TP-P-19 or TT-P-55, Type II	TP-P-19 or TT-P-55, Type II
Exterior concrete surfaces if specified.	As previously specified.	TT-P-19	TT-P-19	None
Exterior wood surfaces not otherwise specified.	As previously specified.	MIL-P-28582	Exterior Oil Paint	Exterior Oil Paint
Exterior wood steps, platforms, floors of open porches, and other traveled wood surfaces if specified.	As previously specified.	TT-E-487	TT-E-487	None
Exterior hardboard factory primed.	Remove foreign matter.	Exterior Oil Paint	Exterior Oil Paint	None

Surface	Surface Preparation	1st Coat	2nd Coat	3rd Coat
Exterior ferrous surfaces exposed, unless otherwise specified, except in Acid, NG, TNT, Oleum & Nitrocotton Areas	As previously specified.	Ferrous metal primer	Exterior Oil Paint or TT-E-489 Class A	Exterior Oil Paint or TT-E-489 Class A
Exposed interior & exterior ferrous or galvanized surfaces in Acid, NG, TNT, Oleum & Nitrocotton Areas	As previously specified.	Chlorinated rubber primer	Chlorinated rubber	Chlorinated rubber
Exterior galvanized surfaces, if specified, except in Acid, NG, TNT, Oleum & Nitrocotton Areas	As previously specified.	TT-P-641, Type II or MIL-P-26915, Type I, Class A	Exterior Oil Paint or TT-E-489 Class A	Exterior Oil Paint or TT-E-489 Class A
Exterior roof surfaces	As previously specified.	Roof Primer	Roof Paint	
Exterior corrugated galvanized siding, if specified, except in Acid, NG, TNT, Oleum & Nitrocotton Areas	As previously specified.	TT-P-641, Type II or MIL-P-26915 Type I, Class A	TT-P-38	TT-P-38

Surface	Surface Preparation	1st Coat	2nd Coat	3rd Coat
Exterior aluminum and aluminum alloy surfaces, if specified.	As previously specified.	TT-P-645	TT-E-489, Class A or Exterior Oil Paint	TT-E-489 Class A or Exterior Oil Paint
Exterior ferrous surface of operational storage tanks	Surface preparation shall be SSPC-SP 2-63, Hand Tool Cleaning/SSPC-SP 3-63, Power Tool Cleaning, or SSPC-SP 6-63, Commercial Blast Cleaning as specified in the subcontract specifications. Paint system shall be specified in the subcontract specifications and shall be applied in accordance with SSPC-PA 1-64, Shop, Field and Maintenance Painting.			
Interior concrete floors and floor markings	As previously specified except allow to age 90 days minimum.	TT-P-91	TT-P-91	None
Interior surfaces of high explosive (HE) buildings requiring N.G. resistant finish	Seal cracks & joints.	HE Primer	HE Finish	HE Finish
Interior concrete masonry units, concrete except concrete floors, plaster & gypsum board, asbestos cement board, unless otherwise specified.	As previously specified. Fill surface of concrete masonry units with TT-F-1098 filler.	TT-P-29 or TT-S-179	TT-E-543 or TT-E-545	TT-E-508 or TT-E-509
		In repaint work, spot paint bare areas with 1st coat material; then apply 2nd & 3rd coats specified.		

Surface	Surface Preparation	1st Coat	2nd Coat	3rd Coat
Interior concrete-masonry-unit walls in food-preparation food-serving, shower, latrine, lunchrooms, change houses & laundry areas, unless otherwise specified.	As previously specified. Fill surface of concrete masonry units with TT-F-1098 filler.	TT-P-29 or TT-S-179	TT-E-543 or TT-E-545	TT-E-505 or TT-E-506
		In repaint work, spot paint bare areas with 1st coat material; then apply 2nd & 3rd coats specified.		
Interior hardboard & wood surfaces, trim, doors, & windows except in food-preparation, food-serving, shower, latrine, lunchrooms, change houses & laundry areas, & wood floors	As previously specified for each type surface.	TT-E-543 or TT-545 for wood & primed metal. TT-P-645 for bare metal	TT-E-508 or TT-E-509	TT-E-508 or TT-E-509
Interior wood & metal surfaces in food-preparation, food-serving, shower, latrine, lunchrooms, change houses, & laundry areas, other than equipment & machinery	As previously specified.	TT-E-543 or TT-E-545 for wood & primed metal. TT-P-645 for bare metal.	TT-E-505 or TT-E-506	TT-E-505 or TT-E-506
Ferrous surfaces of mechanical & electrical equipment that has been factory primed	Solvent clean as specified.	TT-E-489, Class A	TT-E-489, Class A	None

Surface	Surface Preparation	1st Coat	2nd Coat	3rd Coat
Interior galvanized surfaces, unless otherwise specified	As previously specified.	TT-P-641 Type II or MIL-P-26915 Type I, Class A	2nd & 3rd coats of paint to match adjacent areas	
Interior wood floors to receive painted finish	As previously specified.	TT-E-487	TT-E-487	None
Convector enclosures, electrical conduit runs, metallic tubing, uninsulated ducts & pipes, pipe hangers, louvers, grilles, & air outlets in areas having painted adjacent surfaces	As previously specified.	TT-E-543 or TT-E-545 for primed metal. TT-P-645 for bare metal.	TT-E-508 or TT-E-509	TT-E-508 or TT-E-509
Exterior & interior metal surfaces subject to high temperature, up to 400°F.	Solvent cleaning wire brushing; no pretreatment.	TT-E-496, Type II	TT-E-496 Type II	None
Exterior or interior metal surfaces subject to temperatures from 400°F to 1200°F	Commercial blast cleaning, SSPC-SP 6; no pretreatment	TT-P-28	TT-P-28	None

Surface	Surface Preparation	1st Coat	2nd Coat	3rd Coat
Exposed to view paper facing of vapor barrier jackets of pre-sized or adhesive finished glass cloth over insulation on pipes, duct & equipment, interior	Remove foreign matter.	Two coats of paint to match adjacent areas.		

SECTION 09915

COLOR SCHEDULE
06/93

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.

FEDERAL STANDARDS (FED-STD)

FED-STD 595	(Rev B) Colors Used in Government Procurement

1.2 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.

PART 2 PRODUCTS

2.1 COLOR REFERENCE

FED-STD 595 numbers are specified for color reference only. Where a product is specified to be a factory finished item, the color shall match the FED-STD 595 color. Federal standard colors are designated by five digit numbers, the first of which specifies luster. Since the luster is specified in Section 09900 PAINTING, GENERAL, luster is not referenced within this specification. The first digit is omitted and replaced with an "x" when referenced.

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.

a. Precast Concrete: Natural Finish.

2.2.2 Exterior Trim

Exterior trim shall be provided to match the colors listed below.

a. Doors and Door Frames: Glidden, White.

b. Windows (mullion, muntin, sash, trim, and sill): Window Frames, Baked Acrylic, White.

c. Downspouts, Gutter, Louvers: By Gutter Manufacturer, White.

d. Handrails: Glidden, Yellow.

e. Signage: Glidden, White.

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.

a. Metal: By Roof Manufacturer, Grey.

2.2.4 Interior Floor Finishes

Flooring materials shall be provided to match the colors listed below.

a. Vinyl Composition Tile: Grey.

b. Ceramic Tile: Grey.

c. Grout: White.

d. Concrete for secondary containments and other structures which should be watertight: Grey.

2.2.5 Interior Base Finishes

Base materials shall be provided to match the colors listed below.

a. Rubber Base: Black.

b. Ceramic Tile: Black.

c. Grout: White.

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.

a. Paint: Glidden, White.

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.

a. Acoustical Tile and Grid: White.

2.2.8 Interior Trim

Interior trim shall be provided to match the colors listed below.

a. Doors: Grey.

b. Door Frames: Grey.

c. Windows (mullion, muntin, sash, trim, and stool): Grey.

d. Window Sills: Grey.

e. Fire Extinguisher Cabinets: Red.

2.2.9 Interior Miscellaneous

Miscellaneous items shall be provided to match the colors listed below.

a. Plastic Laminate: White.

b. Signage Message Color (excluding handicapped signage): Black.

c. Signage Background Color (excluding handicapped signage): White.

d. Lockers: Grey.

e. Wall Switch Handles and Standard Receptacle Bodies: Black.

f. Electrical Device Cover Plates and Panels: Black.

g. Casework: Grey.

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-- End of Section --

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SECTION 10430

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3.1 INSTALLATION
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3.1.2 Protection and Cleaning

-- End of Section Table of Contents --

SECTION 10430

EXTERIOR SIGNAGE

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 Z97.1	(1989) Safety Glazing Materials Used in Buildings

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36	(1991) Structural Steel
ASTM A 123	(1989a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 525	(1991b) General Requirement for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
ASTM A 570	(1991) Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality
ASTM B 26	(1992a) Aluminum-Alloy Sand Castings
ASTM B 209	(1992a) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 221	(1992a) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes
ASTM D 3841	(1988) Glass-Fiber-Reinforced Polyester Plastic Panels

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1	(1992) Structural Welding Code - Steel

ARMY REGULATIONS (AMC-R)

AMC-R 385-100	Safety Manual

FEDERAL STANDARDS (FED-STD)

FED-STD 795	(Basic) Uniform Federal Accessibility Standards

MILITARY SPECIFICATIONS (MS)

MS MIL-M-43719	(Rev B; Am 1) Marking Materials and Markers, Adhesive, Elastomeric, Pigmented

MILITARY STANDARDS (MIL-STD)

101-B	(1970) Color Code for Pipelines and for Compressed Gas Cylinders

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM AMP 505	(1988) Metal Finishes Manual for Architectural and Metal Products; Section: Applied Coatings

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

SAE AMS 3611	(1964; Rev C) Plastic Sheet, Polycarbonate, General Purpose

1.2 GENERAL

Exterior signage shall be of the size and type listed in paragraphs 1.2.1 through 1.2.5, shall conform to the requirements specified herein, and shall be provided at the locations identified in paragraphs 1.2.1 through 1.2.5. Signs shall be complete with lettering, framing as detailed, and related components for a complete installation. Materials and equipment 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.

1.2.1 Identification of Exposed Piping Systems

Exposed piping systems shall be identified in accordance with Military Standard 101-B, AR 385-30 and Radford Army Ammunition Plant Painting Specifications, Section 09900 PAINTING, GENERAL and DUP-488. In the case of conflict, DUP-488 governs.

1.2.2 Identification of Underground Piping System

For identification and location of underground piping, signs shall be erected on metal posts along mains at each lateral to a facility and/or at each valve, and where pipeline passes beneath road, walks, fences, etc. Information on signs to consist of pipe content, building number served (for signs located at valves), size of main, and direction of main. (Example: Filtered Water, Bldg. 9500, 6", East-West.) For uniformity throughout the Radford Army Ammunition Plant complex, the signs should be metal, 20" x 10" overall, 1 1/2" letters, 1" border with white background and mounted on metal stake with bottom of sign 18" above ground. Colors for letters and border should be as follows:

Filtered Water = Blue
Fire Water = Red
Drinking Water = Green
Cold Softened Water = Blue
Sanitary Sewer = Black
Acid Sewer = Black

1.2.3 Identification of Valves and Controls

All valves and other system components shall be identified as to function. Identification by a metal tag affixed to the component is preferred. Every water outlet which is not connected to a drinking water source shall be equipped with a sign stating "CAUTION: This water is unsafe. Do not use for drinking, washing, or cooking."

1.2.4 Building Signs

All buildings shall be identified by account number and building name, with separate signs installed on corner of building approximately six (6) feet above grade and visible from main road through the area (for earth-mounded buildings, signs to be installed on vertical portions of main portal). For uniformity through the Radford Army Ammunition Plant complex, the sign for account number and the sign for building name should be 6" wide by whatever length is necessary to accommodate the text, white background with black embossed border and black 4" high embossed letters (or numbers) on 16-gauge metal with rounded corners and a 3/8" diameter hole in each corner.

1.2.4.1 Fire Hazard Classification Symbol

A fire hazard classification symbol shall be provided on appropriate buildings as per Paragraph 12-21b of AMC-R Safety Manual, AMC-R 385-100.

1.2.5 Road Signs

Safety and direction signs are to be provided per AR 385-30, and along roads per applicable paragraphs of AMC-R Safety Manual, AMC-R 385-100.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL DESCRIPTIONS:

SD-04 Drawings

Exterior signs; FIO.

Drawings including 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 of each sign type shall be included.

SD-06 Instructions

Exterior Signs; FIO.

Manufacturer's descriptive data, catalog cuts, and installation instructions.

1.4 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.

PART 2 PRODUCTS

2.1 ALUMINUM ALLOY PRODUCTS

Aluminum alloy products shall conform to ASTM B 209 for sheet or plate, ASTM B 221 for extrusions and ASTM B 26. Aluminum extrusions shall be provided at least 1/8 inch thick and aluminum plate or sheet at least 16 gauge, 0.0508 inch thick.

2.2 ORGANIC COATING

Surfaces shall be cleaned, primed, and given a semi-gloss baked enamel finish in accordance with NAAMM AMP 505 with total dry film thickness not less than 1.2 mils.

2.3 STEEL PRODUCTS

ASTM A 36 for structural steel, ASTM A 570 for sheet and strip.

2.4 VINYL SHEETING FOR GRAPHICS

MS MIL-M-43719, minimum 0.003 inch film thickness. Film shall include a precoated pressure sensitive adhesive backing, Class 1, or positionable pressure sensitive adhesive backing, Class 3.

2.5 FIBER-REINFORCED POLYESTER (FRP)

ASTM D 3841, Type II, Grade 1, Class 124.

2.6 ACRYLIC SHEET

ANSI Z97.1.

2.7 POLYCARBONATE SHEET

SAE AMS 3611.

2.8 ANCHORS AND FASTENERS

Exposed anchor and fastener materials shall be compatible with metal to which applied and shall match in color and finish.

2.9 SHOP FABRICATION AND MANUFACTURE

2.9.1 Workmanship

Work shall be assembled in the shop, insofar as practicable, 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. Holes for bolts and screws shall be drilled or punched. Drilling and punching shall produce clean, true lines and surfaces. Weld to or on structural steel in accordance with AWS D1.1. Welding shall be continuous along the entire area of contact. Exposed welds shall be ground smooth. Exposed surfaces of work shall have a smooth finish and exposed riveting shall be flush. Fastenings shall be concealed where practicable. Items specified to be galvanized shall be by hot-dip process after fabrication if practicable. Galvanization shall be in accordance with ASTM A 123 and ASTM A 525, as applicable. Joints exposed to the weather shall be formed to exclude water. Drainage and weep holes shall be included as required to prevent condensation buildup.

2.9.2 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.

2.9.3 Shop Painting

Surfaces of miscellaneous metal work, except nonferrous metal, corrosion resisting steel, and zinc-coated work, shall be given one coat of zinc-molybdate primer, or an approved rust-resisting treatment and metallic primer in accordance with manufacturer's standard practice. Do not paint surfaces of items to be embedded in concrete. Upon completion of work, thoroughly recoat all damaged surfaces.

2.10 STAKE/PANEL TYPE SIGNS

2.10.1 Stakes

Stakes to be galvanized steel 1/2" dia. x 4'-0" Lg.

2.11 GRAPHICS FOR PYLON/MONOLITH AND POST/PANEL TYPE SIGNS

2.11.1 Tactile Graphics

Signage that provides emergency information, general circulation directions, or identification of spaces shall be tactile (perceptible to touch) and shall comply with FED-STD 795. Characters, symbols, or pictographs on tactile engraved signs shall be raised or recessed 1/32 inch minimum. Raised letters and numbers shall be sans serif upper case. Raised characters or symbols shall be at least 5/8 inch high, but no higher than a nominal 2 inches. Characters and symbols shall contrast in color with their background.

2.11.2 Graphics

Signage graphics shall conform to the following:

a. Pressure sensitive precision cut vinyl letters with reflecting surface shall be provided UNO in Paragraph 1.2.

2.11.3 Messages

See Paragraph 1.2 for message content. Typeface: Black. Type size as indicated in Paragraph 1.2. Color as indicated in Paragraph 1.2.

2.12 PRESSURE SENSITIVE LETTERS

Precision cut vinyl letters shall be provided. Edges and corners of finished letter forms and graphics shall be true and clean.

2.12.1 Typeface

Bold.

2.12.2 Size

As indicated in Paragraph 1.2.

2.12.3 Color

As indicated in Paragraph 1.2.

PART 3 EXECUTION

3.1 INSTALLATION

Signs shall be installed at locations specified in Paragraph 1.2. All signs shall be installed plumb and true at mounting heights specified, 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 not otherwise specified or indicated shall include slotted inserts, expansion shields, and power-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine carriage bolts for steel; lag bolts and screws for wood.

3.1.2 Protection and Cleaning

The work shall be protected against damage during construction. Hardware shall be adjusted for proper operation. Glass, frames, and other sign surfaces shall be cleaned.

-- End of Section --

SECTION 10440

INTERIOR SIGNAGE
04/89

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.

ALUMINUM ASSOCIATION (AA)

AA DAF-45	(1980) Designation System for Aluminum Finishes
AA PK-1	(1989) Registration Record of Aluminum Association Alloy Designations and Chemical Composition Limits for Aluminum Alloys in the Form of Castings and Ingot
AA SAA-46	(1978) Standards for Anodized Architectural Aluminum

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 605.2	(1992) Voluntary Specification for High Performance Organic Coatings on Architectural Extrusions and Panels

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z97.1	(1984) Safety Glazing Materials Used in Buildings

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 209	(1992a) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 221	(1992a) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes

ARMY REGULATIONS

AMC-R 385-100	AMC-R Safety Manual

FEDERAL SPECIFICATIONS (FS)

FS DD-G-451	(Rev D) Glass, Float or Plate, Sheet, Figured (Flat, for Glazing, Mirrors and Other Uses)

FS L-P-387	(Rev A; Am 1; Int Am 2) Plastic Sheet, Laminated, Thermosetting (for Designation Plates)

FEDERAL STANDARDS (FED-STD)

FED-STD 795	(Basic) Uniform Federal Accessibility Standards

MILITARY SPECIFICATIONS (MS)

MS MIL-M-43719	(Rev B; Am 1) Marking Materials and Markers, Adhesive, Elastomeric, Pigmented

MILITARY STANDARDS (MIL-STD)

101-B	(1970) Color Code for Pipelines and for Compressed Gas Cylinders

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1993) National Electrical Code

1.2 GENERAL

Interior signage shall be of the sizes and types specific in paragraphs 1.2.1 through 1.2.3 shall conform to the requirements specified herein, and shall be provided at the locations specified. Signs shall be complete with lettering, framing as detailed, and related components for a complete installation. Signs 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.

1.2.1 Identification of Exposed Piping Systems

Exposed piping systems shall be identified in accordance with Military Standard 101-B, AR 385-30, and Radford Army Ammunition Plant Painting Specifications, Form DUP-488, dated 12-21-90.

1.2.2 Identification of Valves and Controls

All valves and other system components shall be identified as to function. Identification by a metal tag affixed to the component is preferred. Every water outlet which is not connected to a drinking water source shall be equipped with a sign stating "CAUTION: This water is unsafe. Do not use for drinking, washing, or cooking."

1.2.3 Personnel Limits Signs

Personnel limits signs shall be provided in all appropriate buildings as per Paragraph 16-1c of AMC-R Safety Manual, AMC-R 385-100.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL DESCRIPTIONS:

SD-01 Data

Interior Signage; FIO.

Manufacturer's descriptive data, catalogs cuts and installation instructions.

SD-04 Drawings

Interior Signage; FIO.
Drawings shall include elevations of each type of sign and shall show dimensions, details and methods of mounting or anchoring, shape and thickness of materials, and details of construction. A schedule showing the location of each sign type shall be included.

1.4 DELIVERY AND STORAGE

Materials shall be delivered to the jobsite in manufacturer's original packaging and stored in a clean, dry area.

PART 2 PRODUCTS

2.1 ALUMINUM ALLOY PRODUCTS

Aluminum extrusions shall be at least 1/8 inch thick, and aluminum plate or sheet shall be at least 16 gauge, 0.0508 inch thick. Extrusions shall conform to ASTM B 221; plate and sheet shall conform to ASTM B 209. Where anodic coatings are specified, alloy shall conform to AA PK-1 alloy designation 514.0. Exposed anodized aluminum finishes shall be as shown and shall conform to AA SAA-46.

2.1.1 Anodic Coating

Anodized finish shall conform to AA DAF-45 as follows:

a. Clear (natural) designation AA-M10-C22-A31, Architectural Class II (0.4 mil or thicker).

2.2 VINYL SHEETING FOR GRAPHICS

Vinyl sheeting for graphics shall conform to MS MIL-M-43719, minimum 0.003 inch film thickness. Film shall include a precoated pressure sensitive adhesive backing (Class 3).

2.3 ACRYLIC SHEET

Acrylic sheet for panels and components shall conform to ANSI Z97.1.

2.4 ANCHORS AND FASTENERS

Exposed anchor and fastener materials shall be compatible with metal to which applied and shall have matching color and finish.

2.5 FABRICATION AND MANUFACTURE

2.5.1 Workmanship

Holes for bolts and screws shall be drilled or punched. Drilling and

punching shall produce clean, true lines and surfaces. Exposed surfaces of work shall have a smooth finish and exposed riveting shall be flush. Fastenings shall be concealed where practicable.

2.5.2 Dissimilar Materials

Where dissimilar metals are in contact, the surfaces will be protected to prevent galvanic or corrosive action.

2.6 PLAQUE SIGNS

Plaque signs shall be a modular type signage system. Signs shall be fabricated of Type ES melamine plastic conforming to FS L-P-387, Type NDP self-extinguishing or acrylic conforming to ANSI Z97.1 as shown.

2.6.1 Standard Modular Plaque Signs

Plaque signs shall consist of matte finish laminated to acrylic or plexiglass back, thickness and size as shown. Frames shall be aluminum as shown. Corners of signs shall be squared 1/2 inch radius.

2.6.2 Mounting of Plaque Signs

Surface mounted signs shall be provided with countersunk mounting holes in plaques and mounting screws.

2.7 GRAPHICS

2.7.1 Tactile Graphics

Signage that provides emergency information, general circulation directions, or identification of rooms and spaces shall be tactile (perceptible to touch) and shall comply with FED-STD 795, paragraph 4.30. Characters, symbols, or pictographs on tactile signs shall be recessed or raised 1/32 inch minimum. Tactile letters and numbers shall be sans serif upper case. Tactile characters or symbols shall be at least 5/8 inch high, but no higher than a nominal 2 inches. Characters and symbols shall contrast with their background.

PART 3 EXECUTION

3.1 INSTALLATION

Signs shall be installed at locations specified in paragraph 1.2. Signs shall be installed plumb and true at mounting heights indicated, and by method shown or specified. Signs on doors or other surfaces shall not be installed until finishes on such surfaces have been installed.

3.1.1 Anchorage

Anchorage not otherwise specified or indicated shall include slotted inserts, expansion shields, and power-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine carriage bolts for steel; lag bolts and screws for wood.

3.1.2 Protection and Cleaning

The work shall be protected against damage during construction. Hardware shall be adjusted for proper operation. Glass, frames, and other sign

surfaces shall be cleaned.

-- End of Section --

SECTION 11211A

PUMPS: INDUSTRIAL, CENTRIFUGAL
12/88

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 SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123/A 123M	(1997ael) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(1998) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 307	(1997) Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM D 975	(1998b) Diesel Fuel Oils

ASME INTERNATIONAL (ASME)

ASME B1.1	(1989) Unified Inch Screw Threads (UN and UNR Thread Form)
ASME B16.1	(1998) Cast Iron Pipe Flanges and Flanged Fittings
ASME B16.5	(1996; B16.5a) Pipe Flanges and Flanged Fittings NPS 1/2 thru NPS 24
ASME B40.1	(1991) Gauges - Pressure Indicating Dial Type - Elastic Element

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

47 CFR 15	Radio Frequency Devices

HYDRAULIC INSTITUTE (HI)

HI 1.1-1.5	(1994) Standards for Centrifugal Pumps

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(1998) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 20	(1996; Errata Oct 1996; TIA 96-1) Installation of Centrifugal Fire Pumps
NFPA 30	(1996; Errata; TIA 96-2) Flammable and Combustible Liquids Code
NFPA 37	(1998) Installation and Use of Stationary Combustion Engines and Gas Turbines
NFPA 70	(1999) National Electrical Code

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 21	(1991) White or Colored Silicone Alkyd Paint
SSPC Paint 25	(1991) Red Iron Oxide, Zinc Oxide, Raw Linseed Oil and Alkyd Primer (Without Lead and Chromate Pigments)

UNDERWRITERS LABORATORIES (UL)

UL 448	(1994; Rev thru May 1999) Pumps for Fire-Protection Service

1.2 GENERAL REQUIREMENTS

1.2.1 Standard Products

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate equipment that has been in satisfactory waterworks operation 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 jobsite. Pumps motors of the same types shall each be the product of one manufacturer.

1.2.2 Description

The pumps shall be horizontal centrifugal water pumps of the types indicated and specified. The single driving units for the pumps shall be electric motors as indicated and specified.

1.2.3 Governing Requirements

Fire pumps and appurtenances shall conform in all respects to NFPA 20.

1.2.4 Safety Requirements

Gears, couplings, projecting set-screws, keys, and other rotating parts, so

located that any person can come in close proximity thereto, shall be fully enclosed or properly guarded.

1.2.5 Nameplates

Pumps and motors shall have a standard nameplate securely affixed in a conspicuous place showing the manufacturer's name, address, type or style, model, serial number, and catalog number. In addition, the nameplate for each pump shall show the capacity in gpm at rated speed in rpm and head in feet of water. Nameplate for each electric motor shall show at least the minimum information required by 10.38 NEMA MG 1. Such other information as the manufacturer may consider necessary to complete identification shall be shown on the nameplate.

1.2.6 Electrical Work

Electrical motor driven equipment specified herein shall be provided complete with motors, motor starters, and controls. Electric equipment and wiring shall be in accordance with Section 16415 ELECTRICAL WORK, INTERIOR. Electrical characteristics shall be as indicated. Equipment for control of automatic fire pumps shall be in accordance with NFPA 20. Motor starters shall be provided complete with properly sized thermal overload protection in each phase and other appurtenances necessary for the motor control specified. Each motor shall be of sufficient capacity to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor when operating at proper electrical system voltage and frequency. Manual or automatic control and protective or signal devices required for the operation herein specified and any control wiring required for controls and devices but not shown on electrical plans shall be provided under this section of the specifications.

1.2.7 Selection Criteria

Pumps shall be designed using hydraulic criteria based upon actual model developmental test data. Pumps shall be selected at a point within the maximum efficiency for a given impeller casing combination. Deviations within 3 percent of maximum efficiency are permissible, provided the lesser efficiency is not less than the scheduled efficiency. Pumps having impeller diameters larger than 90 percent of the published maximum diameter of the casing or less than 15 percent larger than the published minimum diameter of the casing will be rejected. Acceptable maximum impeller diameter calculations shall not be based on percentage of impeller diameter range for a given casing.

1.2.8 Conformance With Agency Requirements

Where materials or equipment are specified to be an approved type, the seal or label of approval from a nationally recognized testing agency, adequately equipped and competent to perform such services, shall be attached thereto. A written certificate from the testing agency shall accompany the materials or equipment and shall be submitted to the Contracting Officer stating that the items have been tested and that they conform to the applicable requirements of the specifications and to the standards listed herein. The certificate shall indicate the methods of

testing used by the testing agency. In lieu of a certificate from a testing agency, published catalog specification data, accompanied by the manufacturer's certified statement to the effect that the items are in accordance with the applicable requirements of the specifications and the referenced standards, will be considered by the Contracting Officer and may be acceptable as evidence that the items conform with agency requirements.

1.2.9 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.

1.2.10 Factory Tests

Pumps shall be tested by the manufacturer or a nationally recognized testing agency in compliance with Hydraulic Institute Standards. Where two or more identical pumps are specified, only one representative pump shall be tested. Certified test results shall be submitted to the Contracting Officer.

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

Installation; G, SWAO

Drawings containing 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. A complete listing of equipment and materials shall be provided.

SD-03 Product Data

Materials and Equipment; G, SWAO

Manufacturer's descriptive data and technical literature, performance charts and curves for all impeller sizes for a given casing, catalog cuts, and installation instructions. Spare parts data for each different item of material and equipment specified, after approval of the detail drawings and not later than 3 months prior to the date of beneficial occupancy. Data shall include a complete list of parts and supplies, with current unit prices and source of supply.

Instructions; G, SWAO

Proposed diagrams, instructions, and other sheets, prior to posting. Approved wiring and control diagrams showing the complete layout of the entire system, including equipment, piping valves, and control sequence, framed under glass or in approved laminated plastic, 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.

Training Period; G, SWAO

Training course curriculum and training instructions shall be furnished to the Contracting Officer 14 days prior to the start of training.

SD-06 Test Reports

Tests; G, SWAO

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.

SD-07 Certificates

Manufacturer's Representative; G, SWAO

The names and qualifications of the manufacturer's representative and training engineers and written certification from the manufacturer that the representative and trainers are technically qualified.

SD-10 Operation and Maintenance Data

Centrifugal Pump System; G, SWAO

Six complete sets of instructions containing the manufacturer's operating and maintenance instructions for each piece of equipment. One complete set at the time the tests procedure is submitted; remaining sets before the contract is completed. 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 building, name of the Contractor, and contract number. Flysheets shall be placed before instructions covering each subject. Instruction sheets shall be approximately 8-1/2 by 11

inches, with large sheets of drawings folded in. Instructions shall include, but not be limited to, the following:

a. System layout showing piping, valves, and controls.

b. Approved wiring and control diagrams.

c. A control sequence describing startup, operation, and shutdown.

d. Operating and maintenance instructions for each piece of equipment, including lubrication instructions and troubleshooting guide.

e. Manufacturer's bulletins, cuts, and descriptive data; and parts list and recommended spare parts.

1.4 DELIVERY AND STORAGE

All equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, or other contaminants.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Materials and equipment shall be as specified below and as shown, and shall be suitable for the service intended. Materials and equipment shall be new and unused, except for tests. Where two or more pieces of equipment performing the same function are required, they shall be duplicate products of the same manufacturer.

2.2 CENTRIFUGAL WATER PUMPS

The pumps shall be as specified on the drawings. Pumps are to be designed for industrial service with all wetted parts manufactured with Carpenter 20 or approved equal.

2.2.1 Pump Service

The pumps shall be utilized for the Acid Waste/Acid Sewer and Nitrocellulose production systems.

2.2.2 Pump Drives

The pumps shall have the following driving units and shall be directly connected to the driving units through solid shafts, flexible couplings, or free wheeling clutches (as appropriate).

2.2.3 Pump Construction

Except as below specified, centrifugal pumps including required priming equipment shall be constructed in accordance with the Hydraulic Institute

HI 1.1-1.5.

2.2.4 Pump Characteristics

The pumps shall be capable of discharging quantities at total discharge heads measured at the discharge flange as specified on the drawings.

Pumps shall operate at optimum efficiencies to produce the most economical pumping system under the conditions encountered and shall be sized to make optimum match with the system head curve as shown for Goulds Model 3796 (or approved equal) for Pumps 3058-P1 & P2 and 3056-P1, P2 & P5; Goulds Model 3900 (or approved equal) for Pump 3058 - P3; Goulds Model 5150 Variable Speed (or approved equal) for Pump 3056-P3 & P4. Pumps shall furnish not less than 150 percent of rated capacity at a total discharge head of not less than 65 percent of total rated head.

2.2.5 Pump Casings

Pump casings shall be high chrome abrasive resistant alloy construction such as Carpenter 20 (or approved equal).

The casings shall be designed to permit replacement of wearing parts. Pump casings shall be of uniform quality and free from blowholes, porosity, hard spots, shrinkage defects, cracks and other injurious defects. Defects in casings shall not be repaired except when such work is approved and is done by or under the supervision of the pump manufacturer, and then only when the defects are small and do not adversely affect the strength or use of the casing. Casings shall be single volute with flanged piping connections conforming to ASME B16.1, Class 125. The direction of shaft rotation shall be conspicuously indicated. The casing shall have tapped openings for air venting, priming, draining, and suction and discharge gauges.

2.2.6 Impellers

Impellers shall be of semi-open, or enclosed design and shall be constructed of high chrome abrasion resistant alloy, carefully finished with smooth water passageways, and shall be dynamically balanced. Impellers shall be securely keyed to the pump shaft and connected through a thrust collar. Provisions shall be made for vertical impeller adjustment at the top of the motor.

2.2.7 Wearing Rings

Wearing rings shall not be provided for impellers.

2.2.8 Shaft

Shaft shall be of 400 series SS compatible with the working fluid, accurately machined, and shall be of sufficient size and strength to perform the work required. Vertical shafts shall be adequately provided with alignment bearings.

2.2.9 Gland

Gland shall be stainless steel with AISI 18-8 stainless steel eyebolts and pins or studs. Hex-nuts shall be nongalling stainless steel.

2.2.10 Mechanical Seals (if required)

Mechanical seals shall be balanced or unbalanced, as necessary to conform to specified service requirements. Mechanical seals shall be constructed in a manner and of materials particularly suitable for the temperature service range and quality of water being pumped. Seal construction shall not require external source cooling for pumped-fluid service temperatures up to 250 degrees F. Seal pressure rating shall be suitable for maximum system hydraulic conditions. Materials of construction shall include AISI 300 series stainless steel, solid tungsten-carbide rotating-seal face, and Buna-N vinylidene-fluoride-hexafluoropropylene, EPT, or tetrafluoroethylene seals. Bypass flushing water supply shall be free of iron rust products and other abrasive materials and shall be directed onto face of seal without dead ending. All piping and accessories shall be provided. Throttling bushing shall have clearances to minimize leakage in case of complete seal failure without restriction of flushing water. Mechanical seals shall not be subjected to hydrostatic test pressures in excess of the manufacturer's recommendations.

2.2.11 Couplings

Couplings shall be of the heavy-duty flexible type, keyed and locked to the shaft. Couplings for vertical pumps other than close-coupled vertical pumps may be of the universal type. Flexible couplings shall not be used to compensate for misalignment of pump.

2.2.12 Balance

All rotating parts of the equipment shall operate throughout the required range without excessive end thrust, vibration, or noise. Defects of this type that cannot be eliminated by installation adjustments will be sufficient cause for rejection of the equipment. Pump impeller assemblies shall be statically and dynamically balanced to within 4 W/N, where W equals weight and N equals speed. Shaft construction shall be substantial to prevent seal or bearing failure due to vibration. Total shaft peak-to-peak dynamic deflection measured by vibrometer at pump-seal face shall not exceed 2.0 mils under shutoff-head operating conditions. Flow from 1/4 inch iron pipe size (ips) pipe shall be provided during testing.

2.2.13 Bearings

Bearings shall be ball type, and the main bearings shall take all radial and down thrust. Pumps that depend only on hydraulic balance to overcome end thrust will not be acceptable.

2.2.14 Lubrication

Bearings on vertical shaft pumps shall be oil or grease type. Pumps with oil-lubrication systems shall be designed so that all shaft bearings will be isolated from the pumped liquid. An automatic sight feed oiler shall be

provided on a suitable mounting bracket with connection to the shaft tube. Grease type bearings shall be provided with fittings for a grease gun and, if the bearings are not easily accessible, with grease tubing extending to convenient locations. The grease fittings shall be of a type that prevent over lubrication and the buildup of pressure injurious to the bearings

2.2.15 Base Plates

The pumps shall be mounted on rigid simplex base/mounting plates. Vertical-shaft pumps shall be provided with complete mounting suitable for the type of pump furnished, with the base for the pump separate from the base of the driving unit. The drainage structure shall collect the packing box leakage and shall have a 15 nun (1/2-inch) 1/2-inch NPT connection to connect it to a drain.

2.2.16 Cocks, Plugs, and Accessories

The pumps shall be equipped with single gauges indicating pressures for all lines where indicated. Gauges, equipped with a shutoff cock and snubber, shall conform to ASME B40.l, and shall be calibrated in kilopascals and pounds per square inch pounds per square inch in not more than 10 kPa and 2 psi 2 psi increments. Gauge ranges shall be appropriate for the particular installation. Pressure relief valve shall be furnished and installed where indicated.

2.2.17 Piping Connections

The pump suction and discharge shall be provided with flanged connections of suitable size and suitably arranged for piping shown. Pipe flanges shall conform to ASME B16.1 and ASME B16.5. Piping shall be installed to preclude the formation of air pockets.

2.2.18 Finish

Pump shall have painted or enameled finish as is standard with the manufacturer.

2.3 ELECTRICAL EQUIPMENT

Electrical equipment shall conform to Section 16415 ELECTRICAL WORK, INTERIOR. Electrical motor driven equipment herein specified shall be provided complete with motors, motor starters, and controls. Motor controls, equipment, and wiring shall be in accordance with NFPA 70.

2.3.1 Electric Motors

Each electric motor-driven pump shall be driven by an electric motor. In non-hazardous areas the motors shall be totally-enclosed, fan-cooled. continuous-duty electric motors. Motors shall be squirrel-cage induction motors having nonnal starting torque and low starting current characteristics, and shall be of sufficient size so that the nameplate horsepower rating will not be exceeded throughout the entire published pump characteristic curve.

In hazardous areas the motors shall be rated for a Class 1 and 2, Division I. Groups C, D. E, F, and G areas, continuous duty electric motor. Motors shall be squirrel-cage induction motors having normal starting torque and low starting current characteristics, and shall be of sufficient size so that the nameplate horsepower rating will not be exceeded throughout the entire published pump characteristic curve.

Motor bearings shall provide smooth operations under the conditions encountered for the life of the motor. Adequate thrust bearing shall be provided in the motor to carry the weight of all -rotating parts plus the hydraulic thrust and shall be capable of withstanding upthrust imposed during pump starting. All motors shall conform to NEMA MG 1. Motors shall have a minimum service factor of 1.15.

All motors over 1 hp shall be rated for 460V, 3 phase operation. All motors shall be high efficiency design E type. Motors 200 hp and over shall be provided with space heaters operating at 120V, 200W maximum

2.3.2 Control Equipment

Manually controlled pumps shall have START-STOP pushbutton in cover. Automatically controlled pumps shall have three-position "MANUAL-OFF-AUTOMATIC" selector switch in cover. Additional controls or protective devices shall be as indicated. A pump low-water cutoff shall be installed in the well or on the suction pipe and shall shut the pump off when the fluid level in the well reaches the level shown.

2.3.3 Variable Speed Controls

The variable speed motor controller shall convert 460 volt plus 15 percent, minus 5 percent, three phase, 60 Hz (plus or minus 2 Hz) utility power to adjustable voltage/frequency, three phase, ac power for stepless motor control from 5 percent to 105 percent of base speed.

2.3.3.1 Description

The variable speed drive shall produce an adjustable ac voltage/frequency output for complete motor speed control. The variable speed drive shall be automatically controlled by a grounded electronic control signal. The variable speed drive shall be self contained, totally enclosed in a NEMA MG 1 ventilated cabinet and capable of operation between 32 and 104 degrees F. The variable speed drive maximum output current rating shall be equal to or exceed the motor nameplate full load. The manufacturer shall advise the maximum recommended motor sine wave current for each controller rating. Variable speed drive multiple motor operation at same frequency/speed shall be possible as long as the sum of connected motor full load sine wave currents are less than or equal to the variable speed drive maximum continuous current rating. Variable speed drive shall be 95 percent efficient at 100 percent rated output power, 60 Hz.

2.3.3.2 Governing Requirements

Variable speed drives shall conform to the following requirements:

a. Variable speed drive shall comply with 47 CFR 15 regulation of RF1/EM1 emission limits for Class A computing devices. The FCC label of compliance shall be displayed on the variable speed drive.

b. The variable speed drive and options shall comply with the applicable requirements and the standards of the American National Standards Institute (ANSI).

c. Variable speed drive and option design and construction thereof shall comply with all applicable provisions of NFPA 70, Article 43D, Sections A-L.

2.3.3.3 Quality Assurance

To ensure quality the variable speed drive shall be subject to the following tests:

a. The integrated circuits shall undergo a 160-hour "burn-in" to test reliability. During the "burn-in" the temperature shall be cycled between 32 and 158 degrees F.

b. The completed unit shall undergo a fully loaded 24-hour "burn-in."

c. The unit shall be subject to a series of in-plant quality controlled inspections before approval for shipment from manufacturer's facilities.

2.3.3.4 Service

The variable speed drive shall be supplied with the following:

a. One-year parts and labor warranty.

b. A troubleshooting guide to help the building operator determine what steps must be taken to correct any problem that may exist in the system.

2.3.3.5 Basic Features

The variable speed drive shall have the following basic features:

a. Hand/Off/Auto Operation.

b. Manual/Auto speed reference switch.

c. Minimum/maximum adjustable speeds.

d. Speed potentiometer.

e. Auto restart.

f. Linear timed acceleration and deceleration for soft

starting/stopping.

g. 3-63 Hz controlled speed range. (Factory set at 15 Hz minimum).

h. Terminal connections for time clock control, fire, smoke, freeze detectors, and EP relay pre-set speed override.

i. Output frequency terminals for remote metering.

2.3.3.6 Protective Circuits and Features

The variable speed drive controller shall include the following protective circuits/features:

a. Current limits to 100 percent design by slowing down motor.

b. Instantaneous Electronic Trip - automatically shutdown motor if current exceed 120 percent of design or phase-to-phase output short circuit occurs.

c. The variable speed drive will restart automatically when input line returns to normal in the event of intermittent power outage or phase loss or overvoltage shutdown.

d. Input power protection shuts down the unit if the following faults occur; low input line voltage or loss of an input phase.

e. Insensitive to incoming power phase.

f. Fast acting current limiting input fuses, (Class J) rated with 200,000 interrupting amperes capability.

g. Isolated 115 volt control circuit and dedicated control transformer.

h. Line-to-line fault protection.

i. Line-to-ground short circuiting and accidental motor grounding protection.

j. Output thermal overload relay trip.

2.3.3.7 Adjustments

The variable speed drive has the following adjustments available via potentiometers located on the faceplate of a single, regulator printed circuit board.

a. Minimum speed: 0-75 percent

b. Maximum speed: 100 percent

2.4 EQUIPMENT APPURTENANCES

2.4.1 Attachments

All necessary bolts, nuts. washers, bolt sleeves, and other types of attachments for the installation of the equipment shall be furnished with the equipment. Bolts shall conform to the requirements of ASTM A 307 and nuts shall be hexagonal of the same quality as the bolts used. Threads shall be clean-cut and shall conform to ASME B 1.1. Bolts, nuts. and washers shall be stainless steel type 316.

2.4.2 Equipment Guards

Equipment driven by open shafts, belts, chains, or gears shall be provided with all-metal guards enclosing the drive mechanism. Guard shall be constructed of galvanized sheet steel or galvanized woven wire or expanded metal set in a frame of galvanized steel members. Guards shall be secured in position by steel braces or straps which will permit easy removal for servicing the equipment. The guards shall conform in all respects to all applicable safety codes and regulations.

2.4.3 Tools

A complete set of all special tools which may be necessary for the adjustment, operation, maintenance, and disassembly of all equipment shall be furnished. Special tools are considered to be those tools which because of their limited use are not normally available, but which are necessary for the particular equipment. Special tools shall be high-grade, smooth, forged, alloy, tool steel. One pressure grease gun for each type of grease required for motors shall also be furnished. All tools shall be delivered at the same time as the equipment to which they pertain. The Contractor shall properly store and safeguard such tools until completion of the work, at which time they shall be delivered to the Contracting Officer.

2.4.4 Shop Painting

All motors, pump casings, and similar parts of equipment customarily finished in the shop shall be thoroughly cleaned, primed, and given two finish coats of paint at the factory in accordance with the recommendations of the manufacturer. Ferrous surfaces not to be painted shall be given a shop coat of grease or other suitable rust-resistant coating.

PART 3 EXECUTION

3.1 INSTALLATION

Each pump and engine shall be installed in accordance with the written instructions of the manufacturer and under the supervision of the manufacturer's representative.

3.1.1 Concrete Foundations

Concrete for equipment foundations and for any required ballast for fuel storage tanks shall be as specified in Section 03300 CONCRETE FOR BUILDING CONSTRUCTION. Concrete foundations shall be integral with and of the same class as that of the building floor unless otherwise indicated. Concrete

having a compressive strength of at least 2,500 psishall be used in foundations that are entirely separated from the surrounding floor. A premolded filler strip shall be installed between the foundation and floor slab as shown. Foundation bolts, as required, shall be furnished for proper positioning during the placement of the concrete.

3.2 TESTS

After installation of the pumping units and appurtenances is complete, operating tests shall be carried out to assure that the pumping installation operates properly. The Contractor shall make arrangements to have the manufacturer's representatives present when field equipment tests are made. Each pumping unit shall be given a running field test in the presence of the Contracting Officer for a minimum of 2 hours. Each pumping unit shall be operated at its rated capacity or such other point on its head-capacity curve selected by the Contracting Officer. The Contractor shall provide an accurate and acceptable method of measuring the discharge flow. Tests shall assure that the units and appurtenances have been installed correctly, that there is no objectionable heating, vibration, or noise from any parts, and that all manual and automatic controls function properly. If any deficiencies are revealed during any tests, such deficiencies shall be corrected and the tests shall be reconducted.

3.3 FIELD PAINTING

Stainless steel, galvanized steel, and nonferrous surfaces shall not be painted.

3.3.1 Touch-Up Painting

Factory painted items requiring touching up in the field shall be thoroughly cleaned of all foreign material and shall be primed and topcoated with the manufacturer's standard factory finish.

3.3.2 Exposed Ferrous Surfaces

Exposed ferrous surfaces shall be painted with two coats of enamel paint conforming to FS TT - E-489, Class A. Factory primed surfaces shall be solvent-cleaned before painting. Surfaces that have not been factory primed shall be prepared and primed with one coat of FS TT - E-489, Class A or in accordance with the enamel paint manufacturer's recommendations.

3.4 MANUFACTURER'S REPRESENTATIVE

The Contractor shall obtain the services of a manufacturer's representative experienced in the installation, adjustment, and operation of the equipment specified. The representative shall supervise the installation, adjustment, and testing of the equipment. Up to 5 days service shall be provided at no expense to the Government.

3.5 DEMONSTRATION

Upon completion of the work and at a time designated by the Contracting Officer, the services of one or more competent engineers shall be provided

by the Contractor for a training period of not less than 8 hours to instruct a representative of the Government in the operation and maintenance of equipment furnished under this section of the specifications. These field instructions shall cover all the items contained in the bound instructions.

-- End of Section --

SECTION 13121

PRECAST PREENGINEERED CONCRETE BUILDINGS
09/00

PART 1 GENERAL

Contractor to furnish precast concrete transportable building. Building to be delivered and placed on owners prepared stone foundation in accordance with manufacture's recommendations. Precast building to be EASI-SET Model as manufactured by SMITH-MIDLAND Corporation (SMC), Midland, Virginia, or SMITH-CAROLINA Corporation, Reidsville, North Carolina (or Approved Equal). Building to be provided by manufacturer with all necessary openings as specified by contractor in conformance with manufacturer's requirements.

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.

PRECAST/PRESTRESSED CONCRETE INSTITUTE (PCI)

PCI Mnl-116S	(1985) Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products
PCI Mnl-117	(1996) Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products
PCI Mnl-122	(1989) Architectural Precast Concrete

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7	(1998) Minimum Design Loads for Buildings and Other Structures
ACI-318-93	"Building Code Requirements for Reinforced Concrete". Concrete Reinforcing Institute, "Manual of Standard Practice"
ANSI/ASCE-7-93	Building Code Requirements for Minimum Design Loads in Buildings and Other Structures".
UL-752	Test method level 4 for bullet resistance certified by an independent structural engineer.

1.1.1 GENERAL REQUIREMENTS

Precast concrete units shall be designed and fabricated by an experienced and acceptable precast concrete manufacturer certified under the PCI Plant

Certification Program. The manufacturer shall have been regularly and continuously engaged in the manufacture of precast concrete work similar to that indicated on the drawings for at least 3 years. Precast work shall be coordinated with the work of other trades.
Fabricator must be producer member of National Precast Concrete Association (NPCA) and be a certified plant under its plant certification program.
Building fabricator must have a minimum of 5-years experience manufacturing and setting transportable precast concrete buildings.

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-02 Shop Drawings

Preengineered building; G

Submit as necessary to erect the building and install components.

SD-03 Product Data

Precast Preengineered Concrete building materials

Submit sufficient data indicating conformance to specified requirements on materials provided under this section.

SD-04 Samples

Factory color finish

Submit one sample of each color indicated for verification that the color matches the colors indicated. Where colors are not indicated, submit not less than four different samples of manufacturer's standard colors for selection by the Contracting Officer.

SD-05 Design Data

Building;Building engineering calculations that are designed and sealed by a professional engineer shall be submitted for approval G

SD-10 Operation and Maintenance Data

Preengineered Building, data package 1

Submit operation and maintenance data in accordance with Section 01780, "Operation and Maintenance Data."

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver, store, and handle manufactured items so that materials remain dry and undamaged. Do not store in contact with materials that might cause staining.

1.4 WARRANTY

Provide warranty against water leaks arising out of or caused by ordinary wear and tear by the elements for a period of 20 years. Such warranty shall start upon final acceptance of the work or the date the Government takes possession, whichever is earlier.

1.5 QUALITY ASSURANCE

1.5.1 Drawings: Preengineered Building

Submit complete design drawings for the preengineered building.

1.5.2 Design Data: Building

Submit design calculations for the entire preengineered building and foundations, prepared and stamped by a professional engineer. Also submit for components requested, and stamp with the seal of a professional engineer..

1.6 DESIGN REQUIREMENTS

1.6.1 Dimensions

A. Electrical Equipment House BLDG 3059

Exterior: 12' x 12' x 9'-8"
Interior: 11'-4" x 11'-4" x 9'-0"

C. Other Requirements

1. Seismic load performance category 'C', Exposure Group III

2. Standard Live Roof Load - 60 PSF

3. Standard Floor Load - 250 PSF

4. Standard Wind Loading - 130 MPH

C. Roof: Roof panel shall have a peak in center of 12 foot direction and shall slope 1/2" to each side. The roof shall extend a minimum of 2 1/2" beyond the wall panel on each side and have a turndown design which extends 1/2" below the top edge of the wall panels to prevent water migration into the building along top of wall panels. Roof shall also have an integral architectural ribbed edge.

D. Roof, floor and wall panels must each be produced as single component monolithic panels. No roof, floor, or vertical wall joints will be allowed, except at corners. Wall panels shall set on top of floor panel.

PART 2 PRODUCTS

2.1 MATERIALS

A. Concrete: Steel-reinforced, 5000 PSI minimum 28-day compressive

strength, air-entrained (ASTM C260).

B. Reinforcing Steel: ASTM A615, grade 60 unless otherwise indicated.

C. Post-tensioning Strand: 41K Polystrand CP50, .50, 270 KSI, 7-wire strand, greased plastic sheath, (ASTM A416), roof and floor to be each post-tensioned by a single, continuous tendon. Said tendon shall form a substantially rectangular configuration having gently curving corners and a corner where the tendon members are anchored. Tendons shall be greased and enclosed within a sheath.

D. Caulking: All joints between panels shall be caulked on the exterior and interior surface of the joints. Caulking shall be SIKAFLEX-1A elastic sealant or equal. Exterior caulk joint to be 3/8" x 3/8" square so that sides of joint are parallel for correct caulk adhesion. Back of joint to be taped with bond breaking tape to ensure adhesion of caulk to parallel sides of joint and not the back.

E. Louvers: A screened aluminum intake louver to be cast in walls as shown on the drawings. Louvers shall be Dayton #4F951, or equal.

F. Panel Connections: All panels shall be securely fastened together with 1/4" thick steel brackets. Steel is to be of structural quality, hot-rolled carbon complying with ASTM A283, Grade C and hot dipped galvanized after fabrication. All fasteners to be 1/2" diameter bolts complying with ASTM A307 for low-carbon steel bolts. Cast-in anchors used for panel connections to be Dayton-Superior #F-63, or equal. All inserts for corner connections must be bolted directly to form before casting panels. No floating-in of connection inserts shall be allowed.

2.2 ACCESSORIES

A. Doors and Frames: Shall comply with Steel Door Institute "Recommended Specifications for Standard Steel Doors and Frames" (SDI-100), and as herein specified. The buildings shall be equipped with 3'-0" x 7'-0" x 1-3/4", 16-gauge galvanized metal door with 14-gauge hot dipped galvanized frames. Door shall be insulated. Top of door shall be closed and sealed against water penetration. Doors and frames shall be bonderized and painted one coat of rust inhibitive primer and one finish coat of enamel paint, YORKTOWN BROWN, if no other color is specified.

B. Door Hardware:

1. Lockset: Mortised lock, Series 1000, BHMA A156.13, operational grade 1, armored front, ANSI FO5, US32. Removable cylinder, master keyed to match installation requirements. Provide 2 keys and cylinder to Government. Use construction cylinder during construction..

2. Hinges: BHMA A156.1, A156.7, 3 per door, ball bearing type, non removable pins, US32.

3. Closer: BHMA A156.4, grade 1, adjustable, with cover, surface type Series CO2000.

4. Weatherstripping: Weatherstrip head, jamb and sill with synthetic rubber or neoprene in a metal retainer (bronze finished aluminum).

5. Threshold: CECO #897 V or equal raised interior, extruded

aluminum threshold with neoprene seal, or equal.

6. Door Holder: Yale H940V26D, or equal, overhead slide type surface mounted door holder with safety release.

7. Drip Cap: Extruded bronze aluminum.

2.3 FINISHES

A. Interior of Building: Smooth steel form finish on all interior panel surfaces. Paint interior walls and ceiling white.

B. Exterior of Building: Architectural precast concrete brick finish: Finish must be imprinted in top face of panel while in form using an open grid impression tool similar to "EASI-Brick". Finished brick size shall be 2 3/8" x 7 5/7" with vertical steel float or light broom finish. Joints between each brick must be 3/8" wide x 3/8" deep. Back of joint shall be concave to simulate a hand tooled joint. Each brick face shall be coated with the following acrylic concrete stain: 1) Cementrate by FOSROC; or, 2) Canyon Tone stain by United Coatings. Stain color shall be brick red unless specified otherwise. Stain shall be applied per manufacturer's recommendation. Joints shall be kept substantially free of stain to maintain a gray concrete color.

2.4 WALL AND ROOF MATERIALS

Design roof and wall panels, accessories, and flashings to be completely weathertight and free of abrasions, loose fasteners, and deformations.

2.4.1 Minimum Thickness

As required to conform to design requirements but not less than the following:

2.5 LOUVERS

Provide louvers and frames of the sizes, design, and color indicated. Provide manufacturer's standard factory finish . Fold or bead blades at the edges, set at an angle to exclude driving rains, and secure to the frames by riveting or welding as standard with manufacturer. Provide mullions for louvers over 4 feet in width; provide not less than one mullion for each 4 foot width. Provide flanges on the interior face of frames where air intakes or exhaust louvers are indicated to be connected with mechanically-operated dampers or metal ductwork. Provide woven wire bird screening, not less than 3 by 3 mesh per square inch in rewirable frames, on the exterior of louvers; install screen frames by means of clips to allow easy removal for cleaning and rewiring. The screens and frames shall be of the same type metal as the louvers; screen wire shall be not less than 0.0475 inch in diameter. Provide framing and flashings as necessary for installation of louvers.

PART 3 EXECUTION

3.1 INSPECTION

Check concrete foundation dimensions and slab elevation with the precast

concrete building manufacturer's templates and drawings before setting any building.

3.2 ERECTION

Erect in accordance with the manufacturer's approved erection instructions and diagrams. Correct defects and errors in the fabrication of building components in a manner approved by the Contracting Officer. If defects or errors in fabrication of components cannot be corrected, remove and provide nondefective components. When installing wall and roof systems, install closure strips, flashing, sealing material, and other accessories in accordance with building manufacturer's instructions to provide a weathertight system, free of abrasions, loose fasteners, and deformations. After erection is complete, repair and coat abraded and damaged, primed or factory-finished surfaces to match adjacent surfaces.

3.2.1 ACCESS

Contractor must provide level unobstructed area large enough for crane and tractor trailer to park adjacent to pad. Crane must be able to place outriggers within 5'-0" of edge of pad and truck and crane must be able to get side-by-side under their own power. No overhead lines may be within 75' radius of center of pad. A minimum of 24" clearance is required between this building and adjacent buildings

3.2.2 Dissimilar Materials

Prevent direct contact between aluminum surfaces, and ferrous or other incompatible metals, by one of the following methods:

a. Paint the incompatible metal with a coating of manufacturer's standard heavy-bodied paint.

b. Paint the incompatible metal with a prime coat of corrosion inhibitive primer followed by one or two coats of aluminum metal-and-masonry paint, or other suitable protective coating, excluding products containing lead and chromium pigmentation.

c. Provide an approved nonabsorptive gasket.

d. Apply an approved calking between the aluminum and the incompatible metal.

If drainage from incompatible metal passes over aluminum, paint the incompatible metal by method (a) or (b). Paint aluminum surfaces in contact with concrete or masonry materials by method (a).

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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 PETROLEUM INSTITUTE (API)

API RP 1110	(1991) Pressure Testing of Liquid Petroleum Pipelines
API Spec 5L	(1992) Line Pipe
API Spec 6D	(1991; Supple 1) Pipeline Valves (Gate, Plug, Ball, and Check Valves)
API Spec 6FA	(1984; R 1990; Supple 1) Fire Test for Valves
API Std 610	(1989) Centrifugal Pumps for General Refining Service

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36	(1991) Structural Steel
ASTM A 53	(1990b) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 167	(1992b) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 181	(1990) Forgings, Carbon Steel, for General-Purpose Piping
ASTM A 182	(1992a) Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
ASTM A 193	(1992) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 194	(1992a) Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service
ASTM A 216	(1989) Steel Castings, Carbon Suitable for Fusion Welding, for High Temperature Service

ASTM A 234	(1992a) Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
ASTM A 276	(1991a) Stainless and Heat-Resisting Steel Bars and Shapes
ASTM A 307	(1992a) Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
ASTM A 733	(1989) Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
ASTM B 667	(1988) Brass, Copper, and Chromium-Plated Pipe Nipples
ASTM D 1751	(1983; R 1991) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	(1984; R 1992) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM E 94	(1992) Radiographic Testing
ASTM F 436	(1992) Hardened Steel Washers

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7	(1988) Minimum Design Loads for Buildings and Other Structures

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.3	(1985) Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.5	(1988; Errata; B16.5a) Pipe Flanges and Flanged Fittings
ASME B16.9	(1993) Factory-Made Wrought Steel Buttwelding Fittings
ASME B16.11	(1991) Forged Fittings,Socket-Welding and Threaded
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B31.3	(1993) Chemical Plant and Petroleum Refinery Piping
ASME BPV IX	(1992; Addenda Dec 1992) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications

AMERICAN WELDING SOCIETY (AWS)

AWS A5.1	(1991) Carbon Steel Electrodes for Shielded Metal Arc Welding
	(1992) Stainless Steel Electrodes for Shielded Metal Arc welding

FEDERAL SPECIFICATIONS (FS)

FS VV-F-800	(Rev D; Am 2) Fuel Oil, Diesel

INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS (ICBO)

ICBO-01	(1988; Supple 1990) Uniform Building Code

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58	(1988) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	(1991) Pipe Hangers and Supports - Selection and Application

MILITARY SPECIFICATIONS (MS)

MS MIL-C-4556	(Rev E) Coating Kit, Epoxy, for Interior of Steel Fuel Tanks
MS MIL-R-757S	(Rev C; Am 2; Notice 1) Resin, Polyester, Low-Pressure Laminating
MS MIL-S-13789	(Rev D) Strainers, Sediment, Pipeline, Basket Type
MS MIL-Y-1140	(Rev H; Am 1) Yarn, Cord, Sleeving, Cloth, and Tape-Glass

MILITARY STANDARDS (MIL-STD)

MIL-STD 271	(Rev F; Notice 1) Requirements for Nondestructive Testing methods

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(1993) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 30	(1993) Flammable and Combustible Liquids

NFPA 30A	(1993) Automotive and Marine Service Station
NFPA 70	(1993) National Electrical Code

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

SAE AMS 3275	(1989) Acrylonitrile Butadiene Rubber Sheet (NBS) Non-Asbestos Fiber, Fuel and oil Resistant

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC SP 5	(1991) white Metal Blast Cleaning
SSPC SP 6	(1991) Commercial Blast Cleaning

STEEL TANK INSTITUTE (STI)

UNDERWRITERS LABORATORIES (UL)

UL 58	(1986; Rev Aug 1990) Steel Underground Tanks for Flammable and Combustible Liquids
UL 142	(1993) Steel Aboveground Tanks for Flammable and Combustible Liquids
UL 567	(1992) Pipe Connectors for Flammable and Combustible Liquids and LP-Gas
UL 674	(1989) Electric Motors and Generators for Use in Hazardous (Classified) Locations
UL 698	(1991; Rev thru May 1993) Industrial Control Equipment for Use in Hazardous (Classified) Locations
UL 886	(1985; Rev thru Oct 1993) Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations
UL 1746	(1989; Rev Nov 1990) External Corrosion Protection Systems for Steel Underground Storage Tanks

1.2 SYSTEM DESCRIPTION

This specification section provides the requirements for a fuel storage and a dispensing type system. The completed installation shall conform to the applicable requirements of NFPA 30 and NFPA 30A as applicable.

1.3 SUBMITTALS

Government approval is required for submittals with a 11GA11 designation; submittals having an “FIO” designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL DESCRIPTIONS:

SD-01 Data

Fueling System; GA.

Manufacturer's standard catalog data, prior to the purchase or installation of the particular component, highlighted to show brand name, model number, size, options, performance charts and curves, etc. in sufficient detail to demonstrate compliance with contract requirements on all parts and equipment including storage tanks, storage tank components, accessories, and piping components.

Permitting; GA.

Six copies of all required Federal, state, and local permits.

Registration; GA.

Required tank registration forms, 30 days after contract award, in order for the Contracting Officer to submit the forms to the regulatory agency.

Spare Parts Data; FIO.

Spare parts data for each different item of equipment specified, after approval of detail drawings and not later than three 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.

SD-04 Drawings

Fueling System; GA.

Detail drawings including a complete list of equipment and materials. Detail drawings shall contain:

(1) Complete piping and wiring drawings and schematic diagrams of the overall system.

(2) Equipment layout and anchorage.

(3) Clearances required for maintenance and operation.

(4) Any other details required to demonstrate that the system has been coordinated and will properly function as a unit.

Certification; GA

The manufacturer shall provide a certificate of compliance that the tank complies with the specified strandard.

Installation; FIO.

The manufacturer's installation instructions and procedures for the storage tanks, storage tank components, accessories, piping components, and monitoring systems.

Framed Instructions; FIO.

Framed instructions for posting, at least 2 weeks prior to construction completion.

SD-07 Schedules

Tests; FIO.

A letter, at least 10 working days in advance of each test, advising the Contracting Officer of the test. Individual letters shall be provided for the piping tests, the system performance tests, and the system leak test.

Demonstrations; GA

A letter, at least 14 working days prior to the proposed training date, scheduling a proposed date for conducting the onsite training.

SD-08 Statements

Experience; GA.

A letter listing prior projects, the date of construction, a point of contact for each prior project, the scope of work of each prior project, and a detailed list of work performed. The letter shall also provide evidence of prior manufacturer's training, state licensing, etc.

Welding; GA.

A letter listing the qualifying procedures for each welder. The letter shall include supporting data such as test procedures used, what was tested to, etc. and a list of the names of all qualified welders and their identification symbols.

Radiographic Piping Tests; GA.

A letter, prior to performing any radiographic pipe tests, identifying the commercial or testing laboratory responsible for performing the test. The letter shall define the laboratory's qualifications and previously related job experience.

Verification of Dimensions; FIO.

A letter stating the date the site was visited and a listing of all discrepancies found.

Fuel Supply; FIO.

A letter, at least 120 days prior to fuel delivery, stating the amount of fuel required for testing, flushing, cleaning, or startup of the system. The letter shall define the required dates of each fuel delivery necessary.

Factory Tests; GA.

Six copies of the report in bound letter-size booklets. Report shall certify compliance with the testing and qualification procedures defined in API Publ 1581. The report shall contain complete records of the tests including data sheets, performance curves, chronological test records, photographs, sample calculations, test procedures, and a description of the test apparatus. The report shall include color photographs of the sample elements before and after tests.

Tests; GA.

Six copies of each test containing the information described below in bound letter-size booklets. Individual reports shall be provided for the storage tank tests, the piping tests, the system performance tests, and the system leak test. Drawings shall be folded blue lines, with the title block visible.

(1) The date the tests were performed.

(2) list of equipment used, with calibration certifications.

(3) copy of measurements taken.

(4) The parameters to be verified.

(5) The condition specified for the parameter.

(6) The inspection results, signed, dated, and certified by the installer. The certification shall state that required procedures were accomplished, that the procedures were conducted in compliance with the plans and specifications.

(7) A description of adjustments performed.

SD-19 Operation and Maintenance Manuals

Maintenance Manuals; GA.

Six complete copies, at least 2 weeks prior to the demonstrations, of maintenance manuals in bound letter-size booklets listing routine maintenance procedures, possible breakdowns and repairs, and a trouble shooting guide. The manuals shall include piping, equipment layouts, and simplified wiring and control diagrams of the system as installed.

1.4 QUALIFICATIONS

1.4.1 Experience

Each installation Contractor shall have successfully completed at least 3 projects of the same scope and the same size or larger within the last 6 years. Each installation Contractor shall demonstrate specific installation experience in regard to the specific system installation to be performed. Each installation Contractor shall have taken, if applicable, manufacturer's training courses on the installation of piping, tank systems and meet the licensing requirements in the state.

1.4.2 Welding

Welding shall be in accordance with qualifying procedures using performance qualified welders and welding operators. Welding tests shall be performed at the work site. Procedures and welders shall be qualified in accordance with ASME BPV IX. Each 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 05055 WELDING STRUCTURAL.

1.4.3 Radiographic Piping Tests

Radiographic piping inspectors shall have qualifications in accordance with MIL-STD 271 or ASTM E 94.

1.5 REGULATORY REQUIREMENTS

The design, fabrication, and installation of the entire fueling system shall be in accordance with this specification as well as meet all federal, state, and local code requirements.

1.5.1 Permitting

Contractor shall obtain necessary permits in conjunction with the installation of storage tanks as required by federal, state, or local authority.

1.5.2 Registration

Contractor shall obtain and prepare all required tank registration forms required by federal, state, and local authorities.

1.6 DELIVERY, STORAGE, AND HANDLING

Stored items shall be protected from the weather and contamination. Proper protection and care of material before, during, and after 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.

1.7 PROJECT/SITE CONDITIONS

1.7.1 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

1.7.2 Fuel Supply

Fuel required for the flushing, cleaning, and testing of materials, equipment, piping, pumps, instruments, etc. as specified in this section shall be provided by the Contracting officer. Fuel will be provided by tank trucks. The Contracting Officer will furnish the tank trucks, operators, equipment, and services required for the tank truck operations. The Contractor shall provide the labor, equipment, appliances, and materials required for the flushing, cleaning, and testing operations. Systems shall not be flushed, cleaned, or tested with any fuel or liquid not intended for final system operation. Fuel used in the system shall remain the property of the Government. Fuel shortages not attributable to normal handling losses shall be reimbursed to the Government.

PART 2 PRODUCTS

2.1 STANDARD 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 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. Products shall be supported by a service organization. System components shall be environmentally suitable for the indicated locations. The completed installation shall conform to the applicable requirements of NFPA 30.

2.2 NAMEPLATES

Storage tanks, storage tank components, accessories, and valves, within this specification shall have an attached nameplate to list the manufacturer's name, address, component type or style, model or serial number, catalog number, capacity or size, the standard under which the tank is produced, and the system which is controlled. Plates shall be durable and legible throughout equipment life and made of stainless steel. Plates shall be fixed in prominent locations with nonferrous screws or bolts.

2.3 ELECTRICAL WORK

Electrical equipment, motors, and wiring shall be in accordance with Section 16415 ELECTRICAL WORK, INTERIOR. Each motor shall conform to NEMA MG 1 and be of sufficient size to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor when operating at proper electrical system voltage. Electrical characteristics and enclosure type shall be as shown, and unless otherwise indicated, motors of 1 horsepower and above with open, dripproof, or totally enclosed fan cooled enclosures, shall be high efficiency type. Motors shall be continuous duty with the enclosure specified. Switches and devices necessary for controlling the electrical equipment shall be provided. Pumps shall be completely wired and ready for connection to the power circuit. Wiring, equipment, and fittings shall be explosion-proof in conformance with the applicable requirements of UL 674, UL 698, and UL 886 for Class I, Division 1, Group C and D hazardous locations. Electrical equipment shall conform to the requirements of NFPA 70. Electrical equipment shall have a maximum temperature rating of 356 degrees F in accordance with NFPA 70, Article 500-3.

2.4 MATERIALS

2.4.1 Fuels

Galvanized materials (zinc coated) shall not be allowed direct contact with any type fuel. Fuels as required by this specification shall be in accordance with the following:

2.4.1.1 Diesel

Diesel shall be in accordance with FS VV-F-800.

2.4.2 Gaskets

Gaskets shall be factory cut from 1 piece of material and be resistant to the effects of the fuel to be handled.

2.4.2.1 Nitrile Butadiene (Buna-N)

Buna-N material shall be in accordance with SAE AMS 3275.

2.4.2.2 Acrylonitrile Butadiene Rubber (NER)

NBR material shall conform to SAE AMS 3275.

2.4.3 Concrete Anchor Bolts

Concrete anchor bolts shall be group II, Type A, class 2 in accordance with ASTM A 307.

2.4.4 Bolts

Bolts shall be in accordance with ASTM A 193, Grade B8.

2.4.5 Nuts

Nuts shall be in accordance with ASTM A 194, Grade 8.

2.4.6 Washers

Washers shall be in accordance with ASTM F 436, flat circular stainless steel. Washers shall be provided under each bolt head and nut.

2.5 ABOVE GRADE STORAGE TANK

Tank shall be single-wall steel in conformance with UL 142 and NFPA 30 complete with steel saddles. Tank shall be designed and manufactured for above grade installation. Tank shall be installed on steel support saddles fabricated by the tank manufacturer specifically for each tank. Each saddle shall be designed by the manufacturer for wind and seismic loads based on being classified as an essential facility, occupancy Category I per ICBO-01 for seismic loads, and category III per ASCE 7 for wind and snow loads. Tank shall be designed and manufactured for horizontal installation.

2.5.1 Steel Tank

Tank shall be designed, constructed, and labeled in accordance with UL 58, Type II. Each tank shall have the UL label affixed to the exterior surface of the tank. Each tank requiring concrete anchor pads shall be provided with hold-down straps and accessories made specifically by the tank manufacturer for the tank. Filler strips a minimum 5/32 inch in thickness conforming to ASTM D 1751 or ASTM D 1752 shall be used between the tank shell and the metal straps. Concrete anchor pads shall be constructed as indicated. A tank constructed with lap shell or head joints shall be continuous fillet welded; both on the interior and exterior surfaces. Tank shall have painted exteriors in accordance with Section 09900 PAINTING, GENERAL.

2.6 STORAGE TANK COMPONENTS

2.6.1 Fill Nozzle/Cap

The fill nozzle/cap shall be of same material as tank. Cap shall create an air tight seal and shall be the threaded type. The size shall be standard for compatability with a mobile diesel fuel pump truck. The fill nozzle shall be accessible at grade. The cap shall remain airtight under the pressure and vacuum specified for the relief vents. The contractor shall provide a minimum of 3 (three) of any tool required for the caps removal.

2.6.2 Tank Gauge

Each storage tank shall be furnished with a combination tank gauge and fill indication. The gauge and fill indication shall be mechanical devices. The gauge and fill indication shall be visible at grade.

2.6.3 Manual Tank Gauge

Each storage tank shall be provided with 2 manual gauges (stick gauges) graduated in feet, inches, and eighths of an inch. Stick gauge shall be of wood and treated after graduating to prevent swelling or damage from the fuel being stored.

2.6.4 Pressure\Vacuum, vent Relief valve

Valve pressure and vacuum capacities shall be in accordance with NFPA 30. Valve shall be factory set for 1.5 psi pressure and 2 ounces per square inch vacuum for steel tanks. Pressure and vacuum relief shall be provided by a single valve. Valve shall be constructed of cast steel with flanged or threaded end connections. Trim shall be stainless steel. Inner valve pallet assemblies shall have a knife-edged drip ring around the periphery of the pallet to preclude condensation collection at the seats. Pallet seat inserts shall be of a material compatible with the fuel specified to be stored.

2.6.5 Rupture Disk Type Vent

Vent shall provide emergency venting in accordance with NFPA 30. Vent shall be the rupture disc type calibrated to burst at 2 psig pressure, and operate at 80 percent of burst setting. There is no vacuum relief requirement but the disc may be subjected to 3 ounces of vacuum. Discs shall be provided with a flanged end connection. Disc holder shall have a nameplate showing design rating.

2.7 ACCESSORIES

2.7.1 Pumps

Pump shall conform to API Std 610, except as modified herein. Mechanical seals within the pump shall be Buna-N. Pump casing, bearing housing, and impellor shall be close grained cast iron. Pump shaft shall be stainless steel ASTM A 276 Type 410 or 416. Pump baseplate shall be of cast iron construction. Internal pump components in direct contact with the fuel to be handled shall be of compatible construction. Pump assembly shall be statically and dynamically balanced for all flow rates from no flow to 120 percent of design flow. Pump bearings shall be selected to give a minimum L-10 rating life of 25,000 hours in continuous operation. Pump shall be driven by an explosion-proof motor for Class I, Division 1, Group D hazardous locations as defined in-NFPA 70. Pump motor shall not exceed a nominal 1,800 rpm. Pump shall be accessible for servicing without disturbing connecting piping.

2.7.1.1 In-Line Centrifugal

Pump shall be the in-line, split-case, double suction, single stage, self-priming, centrifugal type. Pump motor shall be mounted horizontal to the pump housing as indicated and be provided with flanged end connections.

2.7.2 Bonding

Electrical bonding of materials shall be performed in accordance with NFPA 70. The fuel piping system shall be bonded in metallic contact to provide electrical continuity to fixed and moving components for grounding the entire system. Jumpers shall be provided to overcome the insulating effects of gaskets, paints, or nonmetallic components. Minimum size ground conductor shall be Number 6, with single covered, flexible, stranded, copper conductor, Type RR-USE.

2.8 PIPING COMPONENTS

2.8.1 Steel Pipe

2.8.1.1 Pipe

Carbon steel pipe shall be in accordance with ASTM A 53, Type E or S, Grade A or B, or API Spec 5L, seamless or electric-weld, Grade A or B. Pipe smaller than 2-1/2 inches shall be Schedule 80. ASTM A 53 pipe 2-1/2 inches and larger shall be Schedule 40. API Spec 5L pipe 2-1/2 inches and larger shall be Schedule 40S.

2.8.1.2 Connections

Connections for pipe or fittings smaller than 2-1/2 inches shall be forged, socket weld type, 2000 W.O.G. conforming to ASTM A 182 and ASME B16.11. Connections for pipe or fittings 2-1/2 inches and larger shall be butt weld type conforming to ASTM A 234, Grade WPB and ASME B16.9 of the same wall thickness as the adjoining pipe.

2.8.1.3 Welding Electrodes

Welding electrodes shall be E70XX low hydrogen type conforming to AWS A5.1 or AWS A5.4.

2.8.1.4 Threaded Connections

Threaded connections shall only be used on fuel tank cap (for refilling) Connections shall be in accordance with ASME B16.3, Class 150.

2.8.2 Manual Valves

Portions of a valve coming in contact with fuel shall be compatible with the fuel to be handled. Valves shall have bodies, bonnets, and covers constructed of cast steel conforming to ASTM A 216, Grade WCB. Each valve shall have stainless steel stem and trim. Valves shall be suitable for a working pressure of 27S psig at 100 degrees F with a weatherproof housing and be provided with flanged end connections unless indicated otherwise. Seats, body seals, and stem seals shall be Viton or Buna-N.

2.8.2.1 Gate

valve shall be in accordance with API Spec 6D and conform to the fire test requirements of API Spec 6FA. Valve shall be of the flexible wedge disc type, conduit disc type, or double disc type. valve shall be of the rising stem type with closed yoke, or the non-rising s . tem type equipped with a device to give positive visual indication of the valve's position.

2.8.2.2 Relief valve

Valve shall be hydraulically operated and normally closed. valve shall be capable of maintaining a constant upstream pressure regardless of the downstream demand. Valve shall have an angle or straight pattern as indicated. Valves shall be factory-set to open at the indicated pressure and be field adjustable. Valve setpoint shall be adjustable within a minimum range of plus or minus 20 percent of the indicated setpoint. Each valve shall be provided with a cast steel sight flow indicator which has flanged end connections. The sight flow indicator shall consist of a housing containing a rotating propeller that is visible through a glass observation port.

2.8.3 Accessories

2.8.3.1 Flanges

Flanges installed on equipment, fittings, or pipe shall be Class 150 pound flanges which are rated in accordance with ASME B16.5. Flanges shall be the 1/16 inch raised face type. Carbon steel flanges shall conform to ASTM A 181, Grade 2.

2.8.3.2 Flange Gaskets

Flange gaskets shall be 1/16 inch thick, NBR, and be in accordance with ASME B16.21. Full-face gaskets shall be provided for flat-face flanged pipe joints. Ring gaskets shall be provided for raised-face flanged pipe joints.

2.8.3.3 Steel Coupling

Coupling shall be in accordance with API Spec 5L, seamless, extra heavy, wrought steel with recessed ends.

2.8.3.4 Welded Nipple

Nipple shall be in accordance with ASTM A 733 or ASTM B 687 and of the same material as the product piping.

2.8.3.5 Flexible Connector

Connectors shall conform to requirements of UL 567 and be the flexible metal hose, corrugated type with braided wire sheath covering. Connectors shall have close-pitch annular corrugations and be rated for a working pressure of at least 275 psig at 100 degrees F. Connectors shall have a minimum 12-inch live length with flanged end connections. Metal for hose and braided wire sheath shall be stainless steel in accordance with ASTM A 167.

2.8.3.6 Strainer

Strainer shall be in accordance with MS MIL-S-13789, except as modified herein. Strainer shall be the cleanable, basket or "Y" type, and be the same size as the pipeline. Strainer body shall be fabricated of cast steel or brass (approved for W.O.G.) with the bottom drilled and tapped with a ball valve. The body shall have arrows clearly cast on the sides indicating the direction of flow. Strainer shall be equipped with a removable cover and sediment screen. Screen shall be 60 mesh wire screen with larger wire mesh reinforcement. Screen shall be 22 gauge brass or corrosion-resistant steel. The ratio of net effective strainer area to the area of the connecting pipe shall be not less than 3 to 1.

2.8.3.7 Pipe Hangers and supports

Hangers and supports shall be of the adjustable type and conform to MSS SP-58 and MSS SP-69, except as modified herein. The finish of rods, nuts, bolts, washers, hangers, and supports shall be hot-dipped galvanized. Nuts, bolts, washers, and screws shall be Type 316 stainless steel when located under any pier. Miscellaneous metal shall be in accordance with ASTM A 36, standard mill finished structural steel shapes, hot-dipped galvanized.

a. Pipe Protection Shields. Shields shall conform to MSS SP-58 and MSS SP-69, Type 40, except material shall be Type 316 stainless steel. Shields shall be provided at each slide type pipe hanger and support.

b. Low Friction Supports. Supports shall have self-lubricating anti-friction bearing elements composed of 100 percent virgin tetrafluoroethylene polymer and reinforcing aggregates, prebonded to appropriate backing steel members. The coefficient of static friction between bearing elements shall be 0.06 from initial installation for both vertical and horizontal loads and deformation shall not exceed 0.002 inch under allowable static loads. Bonds between material and steel shall be heat cured, high temperature epoxy. Design pipe hangers and support elements for the loads applied. Anti-friction material shall be a minimum of 0.09 inch thick. Steel supports shall be hot-dipped galvanized. Units shall be factory designed and manufactured.

2.8.3.8 Exterior Coating for Above Grade Steel Piping

Above grade steel piping shall be painted as specified in Section 09900 PAINTING, GENERAL. Paint shall be rated for use on hot metal surfaces up to 450 degrees F and for surfaces exposed to the weather. Color of the finish coat shall be aluminum or light gray.

2.9 SUPPLEMENTAL COMPONENTS/SERVICES

2.9.1 Earthwork

Excavation and backfilling for foundations shall be as specified in Section 02222 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS.

2.9.2 Exterior Coating for Above Grade Tanks

External tank coating for above grade tanks shall be in accordance with Section 09900 PAINTING, GENERAL.

2.9.3 Exterior Coating of Miscellaneous Items

Steel surfaces to be externally coated or painted shall be cleaned to a commercial grade blast cleaning finish in accordance with SSPC SP 6 prior to the application of the coating. Exterior surfaces, other than stainless steel pipe and flexible connectors, which are not otherwise painted and do not require the application of an exterior coating, as well as all items supplied without factory-applied finish paint, not including primer only items, shall be painted as specified in Section 09900

PAINTING, GENERAL.

2.9.4 Identification Markings

Above grade tanks, pipe, equipment, etc. supplied under this section shall have identification markings applied in accordance with Section 09900 PAINTING, GENERAL.

PART 3 EXECUTION

3.1 INSTALLATION

Storage tanks shall be handled with extreme care to prevent damage during placement and shall be installed in accordance with the manufacturer's installation instructions and NFPA 30. The exterior surface of each tank shall be inspected for obvious visual damage prior to and proceeding the placement of each storage tank. Surface damage to a storage tank shall be corrected according manufacturer's requirements before proceeding with the system installation.

3.1.1 Above Grade Storage Tank

Initially, tank hold-down straps shall be loosely connected prior to required tank tightness tests. Following the tightness tests, the tank straps shall be completely tightened in accordance with manufacturer's installation procedures.

3.1.2 Interior Protective Coating for Steel Tanks

Coating system shall be applied in accordance with instructions from the coating manufacturer for application, including surface preparation, application equipment, and appropriate safety precautions. After completion of finished coat, surfaces shall be inspected by the Contractor for pinholes, skips, inadequate coating thickness, and other defects. Repair imperfections found in accordance with the coating manufacturer's instructions. Surface preparation for the area to be coated shall include the following:

(a) Grind rough surfaces on welded seams, sharp edges, and corners to a minimum of a 1/8-inch radius.

(b) Abrasive blast surfaces to white metal in accordance with SSPC SP 5.

(c) Clean blasted surfaces to remove oil, dust, sand, or other blasting residue and moisture.

(d) Apply prime coat within eight hours after cleaning.

3.1.3 Equipment

Equipment shall be properly leveled, aligned, and secured in place in accordance with manufacturer's instructions. Supports shall be provided for equipment, appurtenances, and pipe as required. Floor-mounted pumps shall be provided with mechanical vibration isolators or a vibration isolation foundation. Anchors, bolts, nuts, washers, and screws shall be installed where required for securing the work in place. Sizes, types, and spacings of anchors and bolts not indicated or specified shall be as required for proper installation.

3.1.4 Piping

Piping shall be inspected, tested, and approved before burying, covering, or concealing. Piping shall be installed straight and true to bear evenly on supports. Piping shall be free of traps, shall not be embedded in concrete pavement, and shall drain toward the corresponding storage tank. Any pipe, fittings, or appurtenances found defective after installation shall be replaced. Piping connections to equipment shall be as indicated or as required by the equipment manufacturer. Pipe and accessories shall be handled carefully to assure a sound, undamaged condition. The interior of the pipe shall be thoroughly cleaned of foreign matter and shall be kept clean during installation. The pipe shall not be laid in water or stored outside unprotected when weather conditions are unsuitable. When work is not in progress, open ends of pipe and fittings shall be secucely closed so that water, earth, or other substances cannot enter the pipe or fittings. Cutting pipe, when necessary, shall be done without damage to the pipe. Pipe shall be reamed to true internal diameter after cutting to remove burrs. Changes in pipe sizes shall be made through tapered reducing pipe fittings. Stainless steel pipe shall in no case be welded directly to carbon steel pipe. Vent and vapor recovery piping shall be in accordance with NFPA 30. Metallic piping connections to a steel storage tank shall be supplied with dielectric flanges or unions to electrically isolate the pipe from the tank. Fuel supply piping from a storage tank shall extend to within 6 inches of the tank's bottom.

3.1.4.1 Above Grade Piping

Pipe sections shall be installed as indicated and be complete prior to performing any piping tests. Vent and vapor recovery piping shall be single-wall steel pipe for above grade installations

3.1.4.2 Pipe Hangers and Supports

Additional hangers and supports shall be installed for concentrated loads in piping between hangers and supports, such as for valves. Miscellaneous steel shapes as required shall be installed in accordance with ASTM A 36. Piping shall be supported as follows:

Nominal Pipe Size (Inches)	One and Under	1.5	2	3	4	6	8	10	12
Maximum Hanger Spacing (Feet)	7	9	10	12	14	17	19	22	23

3.1.5 Field Painting

Painting required for surfaces not otherwise specified, and finish painting of items only primed at the factory, shall be painted and have identification markings applied as specified in Section 09900 PAINTING, GENERAL. Prior to any painting, surfaces shall be cleaned to remove dust, dirt, rust, oil, and grease.

3.1.6 Framed Instructions

Framed instructions shall include equipment layout, wiring and control diagrams, piping, valves, 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 framed instructions shall be framed under glass or laminated plastic and be posted where directed by the Contracting Officer. The framed instructions shall be posted before acceptance testing of the system.

3.2 TESTS

3.2.1 Storage Tank

3.2.1.1 Tightness Tests for Above Grade Storage Tanks

A tightness test shall be performed on each above grade storage tank. The tests shall be performed following the installation of the storage tanks onto the support saddles, but prior to making piping connections. Tests shall be capable of detecting a 0.1 gph leak rate from any portion of the tank while accounting for effects of thermal expansion or contraction. Gauges used in the tightness tests shall have a scale with a maximum limit of 10 psig. Each storage tank shall be pressurized with air to 5 psig and monitored for a drop in pressure over a 2-hour period during which there shall be no drop in pressure in the tank greater than that allowed for pressure variations due to thermal effects. This pressure shall be maintained and soapsuds or equivalent material applied to the exterior of the tank. While applying the soapsuds, the entire tank shall be visually inspected, including the bottom surfaces, for leaks (bubble formations). Leaks discovered during either the 2-hour waiting period or the soapsuds tests shall be repaired in accordance with manufacturer's instructions. The entire pneumatic test shall be performed again in the event a leak is discovered.

3.2.1.2 Manufacturer's Tests

Following the tank tightness test, each storage tank shall be leak tested in accordance with the manufacturer's written test procedure if the manufacturer's test procedure is different from the tightness tests already performed. Any test failure shall require corrective action and retest.

3.2.2 Piping

3.2.2.1 Pneumatic and Hydrostatic Tests

Testing shall comply with the applicable requirements of ASME B31.3, NFPA 30, and the requirements specified herein. Care shall be taken not to exceed pressure rating of various fittings. Hydrostatic testing shall be performed using fuel as the liquid. Water shall not be introduced into the system for testing. To facilitate the pneumatic and hydrostatic tests, various sections of the piping system may be isolated and tested separately. where such sections terminate at flanged valve points, the line shall be closed by means of blind flanges in lieu of relying on the valve. Tapped flanges shall be provided to allow a direct connection between the piping and the air compressor and/or pressurizing pump. Tapped flanges shall also be used for gauge connections. No taps in the permanent line will be permitted. Gauges shall be subject to testing and approval. In the event leaks are detected, the pipe shall be repaired and the test repeated. Following satisfactory completion of each pneumatic and hydrostatic test, the pressure shall be relieved and the pipe immediately sealed. Provision shall be made to prevent displacement of the piping during testing. Personnel shall be kept clear of the piping during pneumatic testing. Equipment such as pumps, tanks, and meters shall be isolated from the piping system during the testing.

a. Pneumatic Test Procedures for Product and Vent\Vapor Piping: Piping to be installed underground shall not receive field applied covering at the joints or be covered by backfill until the piping has passed the pneumatic test described herein. A pneumatic test pressure shall be applied in increments. A preliminary 25 psig test shall be applied. The pressure shall be maintained while soapsuds or equivalent materials are applied to the exterior of the piping. While applying the soapsuds, the entire run of piping, including the bottom surfaces, shall be visually inspected for leaks (bubble formations). Leaks discovered shall be repaired in accordance with manufacturer's instructions and retested. Following the preliminary test, the piping shall be tested at a pressure of So psig for not less than 2 hours, during which time there shall be no drop in pressure in the pipe greater than that allowed for thermal expansion and contraction. The pressure source shall be disconnected during the final test period. Any leaks revealed by the test shall be repaired and the test repeated.

b. Hydrostatic Test Procedures for Product Piping: Upon completion of pneumatic testing and after backfilling, each piping system shall be hydrostatically tested with fuel at not more than 275 psig in accordance with ASME B31.3 and API RP 1110, with no leakage or reduction in gauge pressure for 4 hours. The Contractor shall furnish electricity, instruments, connecting devices, and personnel for the test. Fuel will be furnished by the Government. Defects in work performed shall be corrected at the Contractor's expense, and the test repeated until the work is proven to be in compliance with the testing procedures. Any release of fuel (no matter the size) during testing shall be immediately contained, the pressure on the piping relieved, and the piping drained of fuel. The Contracting officer shall be notified immediately of a fuel release, the exact location, an estimated quantity of release, and a discussion of the containment measures taken.

3.2.3 System Performance Tests

After all components of the system have been properly adjusted, the system shall be tested to demonstrate that the system meets the performance requirements for which it was designed. The maximum rated capacity of the system shall be tested by using several tank trucks simultaneously, if applicable. The use of tank trucks shall be coordinated with the Contracting Officer prior to testing. If any portion of the system or any piece of equipment fails to pass the tests, the Contractor shall make the necessary repairs or adjustments and the test shall be repeated until satisfactory performance is obtained from the Contracting Officer. The tests shall demonstrate the following:

a. The capability of each fuel pump to deliver the indicated flow of fuel.

b. Vent piping is clear of debris and each pressure/vacuum relief vent is operating properly.

3.3 FLUSHING, CLEANING AND ADJUSTING

Following installation and equipment testing but prior to system performance testing, the following flushing, cleaning, and adjustments shall be performed.

3.3.1 Preparations for Flushing

3.3.1.1 Initial System Cleaning

The interior of each fuel storage tank shall be visually inspected and cleaned free of debris before filling. In the event of entry into a storage tank, the Contractor shall ensure a safe atmosphere exists. Contractor shall remove all preservatives and foreign matter from valves, line strainers, pumps, and other-equipment coming in contact with fuel. No fuel will be delivered to the system until the Contractor has satisfactorily completed this initial system cleaning.

3.3.1.2 Protection of Equipment

Temporary 40 mesh cone type strainers shall be installed in the suction line ahead of each fueling pump as well as ahead of each filter\separator. The strainers shall be constructed of the same material as the piping and shall be compatible with the fuel to be handled. The temporary strainers shall remain in place for a minimum of 2 days after system startup, after which time the Contractor shall remove the strainers and prepare the piping as intended for final system operation.

3.3.2 System Flushing

3.3.2.1 Initial Fuel Supply

Following the initial preparations, each storage tank shall be filled to a 25 percent capacity with the proper fuel according to the fueling system's final operational requirements. Following the initial fuel supply, each storage tank's fuel temperature and liquid level shall be measured and recorded. The liquid level shall be measured using a manual tank gauge.

3.3.2.2 Disposal of Initial Fuel Supply

In the event the fuel contained in the piping system at the conclusion of the flushing operation is not considered by the Contracting officer to be of satisfactory quality for the desired use, the Contractor shall be responsible for pumping out the entire fuel supply from the storage tanks and the piping system. The filter\separator and piping system shall be completely drained to the storage tank. Disposition of the fuel removed from the system shall be the responsibility of the Government.

3.3.3 Cleaning Equipment

Upon completion of flushing operations, permanent strainers shall be removed, cleaned, and reinstalled. If the pressure differential across the filter/separator elements exceeds that recommended by the manufacturer, the elements shall be replaced with the spare set furnished with the unit.

3.3.4 Initial System Adjustments

Following the flushing and cleaning operations, each system component shall be initially adjusted, if necessary, to meet the system's final operational requirements. The Government will deliver enough fuel to the storage tanks to enable the Contractor to make final adjustments to equipment and controls. Flow rates and pressures shall be adjusted as required to meet the indicated requirements. Pumps, control valves, filter separators, etc. shall operate as intended. The sequence of control for each component shall be adjusted to meet the indicated system requirements. Following the initial system adjustments, the equipment tests shall be performed in order to determine any necessary final system adjustments.

3.4 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 of 16 hours of normal working time and shall start after the system is functionally completed but prior to final system acceptance. The field instructions shall cover all of the items contained in the operation and maintenance manuals as well as demonstrations of routine maintenance operations.

-- End of Section --

SECTION 13206

STAINLESS STEEL PROCESS TANKS

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 PETROLEUM INSTITUTE (API)

API 650	(1993) Welded Steel Tanks for Oil Storage

AMERICAN SOCIETY FOR TESTING MATERIALS (ASTM)

ASTM A 240	(1993b) Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels

AMERICAN WELDING SOCIETY (AWS)

AWS A5.4	(1992) Stainless Steel Electrodes for Shielded Metal Arc Welding

1.2 GENERAL REQUIREMENTS

1.2.1 Welding for Tanks

Qualification of Welding Procedures, Welders, and Welding Operators for Welded Tanks to be done per Paragraph 7.2.1.1, and 7.3 of API 650.

1.2.2 Design Requirements

The process tank shall have a storage capacity as shown on drawing. Tank details not shown on drawings to be designed accordance with API 650. No additional thickness for corrosion allowance will be required. Allowable stresses shall be per ASME II, Part D, Division 1. The maximum allowable design stress shall not exceed 70% of the materials specified min. yield strength at the design temperature. If the vendor feels that it is necessary or prudent to make additional departures from API 650, in addition to those already allowed on the drawings or in this specification, these exceptions shall be clearly stated in the vendor's bid. Drawing review by RAAP or Stone & Webster Engineering Corporation does not relive the manufacturer of the responsibility to comply with the codes, standards, drawings, process sketches, and specifications. Lifting lugs shall be provided on shop fabricated tanks where necessary for installation, plant operation, or maintenance.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL DESCRIPTIONS:

SD-01 Data

General Requirements; GA.

Design analyses and calculations.

SD-04 Drawings

Stainless Steel Process Tanks; GA.

Detail and erection drawings, before proceeding with any fabrication. The drawings shall be complete with details of all steel, pipe, and concrete work and with details of the assembling of all items required for the complete installation. Standard welding symbols as recommended by the American Welding Society shall be used. Details of all joints referenced on the drawings shall also be included.

SD-09 Reports

Tank Installation; GA. Testing of Valves and Piping; GA; Mill test; GA.

Copies of the following test results:

a. Manufacturer's mill test reports for tank shapes and plate material.

b. Mill and shop inspections by a commercial inspection agency.

c. After acceptance of the structure, the radiographic film and/or test segments.

d. At the conclusion of the work, a written report prepared by the Contractor certifying that each tank was designed, fabricated, erected and tested in accordance with the applicable specifications and drawings.

SD-13 Certificates

General Requirements; GA.

A certificate signed by a registered professional engineer, providing the following information:

a. A statement verifying that the detail drawings have been checked by experienced engineers specializing in hydraulic structures to determine that they agree with the design calculations in member sizes, dimensions, and fabricating process as prescribed by the applicable API 650 standards.

PART 2 PRODUCTS

2.1 MATERIALS

Materials shall conform to the following requirements:

2.1.1 Steel and Other Tank Materials

Stainless steel 316L as per ASTM A 240. Materials and allowable stresses shall be from ASME Sec. 8, Division 1.

2.1.2 Shop Fabrication

Fabrication per drawings, specs, and API 650.

2.2 ASSEMBLIES

2.2.1 Tank Accessories

Accessories to be designed and detailed per minimum requirement of API 650, Section 3 and as hereinafter specified. Additional requirements for accessories are as follows:

2.2.1.1 Pipe Connections•

Section 3 of API 650 represents the minimum requirements. Number, type, location, and size of manholes and pipe connections will be as shown on the drawings. Flanges for process connections, which are 24 inches or smaller, shall be according to ANSI B16.5, latest edition. Flanges for process connections, which are within the size range of 26" to 60", inclusive, shall be in accordance with API 650.

2.2.2 Anchors

The following requirements shall be met:

a. An adequate number of anchors designed to prevent overturning of the stainless-steel process tank when empty shall be installed. If anchor bolts are used, the nominal diameter shall not be less than 25 mm (1 inch) 3/4 inch, plus a corrosion allowance of at least 6 mm (1/4 inch) 1/4 inch on the diameter.

b. The anchor bolts shall be a right angle bend, hook, or plate washer. The anchors shall be inserted into the foundation to resist the computed uplift.

c. Attachment of anchors to the shell shall not add significant localized stresses to the shell. The method of attachment shall consider the effects of deflection and rotation of the tank shell. Anchors shall not be attached to the tank bottom. Attachment of the anchor bolts to the shell shall be through stiffened chair-type assemblies or anchor rings of adequate size and height.

PART 3 EXECUTION

3.1 EXCAVATING, FILLING, AND GRADING

Excavating, filling, and grading shall conform to the applicable requirements of Section 02221 EXCAVATION, FILLING, AND BACKFILLING FOR BUILDINGS.

3.2 TANK FABRICATION

The fabricator shall locate longitudinal and girth weld seams so they do not interfere with welded attachments such as pipe connections. Location of all weld seams shall be indicated on the fabricator's drawings. A clearance of not less than 1.5 times the plate thickness shall be maintained from the edge of any weld and the toe of any other weld. Weld all clips with fillet welds all around. All interior welds shall be ground smooth. All exterior welds shall be continuous and shall be chipped free of all scale, spatter, and carefully inspected for imperfections. Upon completion, tank shall be broom-cleaned. All rods, stubs, slag, or foreign matter shall be removed, and the interior shall be pickled.

3.3 TANK INSTALLATION

Tank installation shall be in accordance with Attachment 1 and the following requirements:

3.3.1 WELDING

All seams shall be full penetration double-welded butt joints in accordance with paragraph 3.1.1.1 of API 650. Only ASME listed welding rods, wire, and flux shall be used in accordance with the welding procedure specifications. Qualification welders by use of radiographs is not acceptable. All other joints shall be full penetration double-welded joint. Welder qualification must be by samples for mechanical testing in accordance with ASME Code, Section IX.

3.3.1.1 Welding Equipment

All equipment used in welding or welding preparation shall be covered or faced with material, which will prevent mild steel particles from contaminating the stainless steel material. Equipment used to prepare welded joints, such as ground clamps, wire brushes, steel wool, chisels, files, and peen hammers shall be made of stainless steel. Grinding wheels shall be those which have been used solely for stainless steel.

3.3.1.2 Carbon Steel

Carbon steel shall not be welded directly to stainless steel vessels. A stainless steel pad equal to the thickness of the shell shall be welded to the shell and the carbon steel then attached to the pad.

3.3.1.3 Contamination

Every method and technique which will minimize carbon contamination in cutting, fabrication, transportation, storing, and erecting shall be employed. Signs of improper welding, such as rust or other forms of corrosion on stainless vessels, are grounds for rejection.

3.3.1.4 Welding Processes and Rods

Only shielded metal arc welding (SMAW), or automatic submerged arc welding (SAW), or manual and automatic inert gas tungsten arc welding (GTAW-TIG) shall be used. Only low hydrogen welding rods shall be used. Electrodes, filler metals, and flux-wire combinations shall be selected so that the principal elements in the weld metal are of the same nominal composition

and have as good mechanical properties as the base metal. Electrodes and all filler metals shall be clean and free of dampness, grease or oxidation. Manufacturer's storage procedures for welding rod and filler wire shall be followed. When Tungsten Inert Gas (TIG) welding is used, shielding gas protection shall be applied on the underside of the weld. Welding grade Argon or Helium-Argon mixture shall be used. Electrodes shall be non-consumable tungsten AWS 5.12, type EWTh - 2 for direct current and type EWTh-e for alternating current. Filler metal rods for wall thicknesses above 0.125 inch shall comply to AWS 5.9 as follows: Base Material A151 316L and Electrode ER 317L. Shielded metal arc welding electrodes shall conform to AWS A5.4 as follows: Shell Material AISI 316L and Electrode ER 317L.

3.3.2 Erection

Erection shall be in conformance with applicable specs, drawings, procedures, and API 650.

3.3.3 Inspections and Testing

Tank inspections and testing shall be in accordance with Attachment 1, Class Nitrocellulose (NC) Tank and Tubs-Fabrication, Erection and Testing. The Contractor shall perform the hydrostatic test all of the tank. Weld bevels shall be smooth, without cracks, defects, or uneven edges. As a minimum, all slag or flux shall be removed and the welds be visually inspected for smoothness, undercuts, non-penetration, porosity and, in general, that the weld is a quality weld.

3.3.3.1 Tolerances

Maximum out-of-plumbness, roundness peaking and banding for the shell shall be in strict accordance with API 650, Par. 4.4. Any deviation from these may be cause for tank rejection.

3.3.3.2 Hydrotesting

The method for hydrotesting the tank shell shall be by water filling. Tank shall be successfully hydrotested in the shop before shipment or at the site for field fabricated tanks. Water for testing stainless steel tanks shall have a maximum chloride content of 50 (fifty) ppm. Water with a chloride content not exceeding 200 ppm may be used when treated with 5 pounds of sodium nitrate per 1,000 gallons of water. If a higher chloride content is practically unavoidable, the fabricator shall propose an alternate procedure for Stone & Webster review, with the addition of an inhibitor and chloride neutralizer to the test water. Minimum temperature of hydrotest water shall be 50 degrees F. Test for at least 24 hours until leak free and drain when done.

3.3.3.3 Contamination

Stainless steel tanks shall be inspected for carbon or iron contamination and any affected areas shall be pickled and passivated.

ATTACHMENT 1
Class Nitrocellulose (NC) Tanks and Tubs-Fabrication, Erection and Testing Requirement

-- End of Section --

ATTACHMENT 1

CLASS NITROCELLULOSE (NC) TANKS AND TUBS - FABRICATION, ERECTION AND TESTING REQUIREMENTS

TYPE		
CLASS		
	NO.	TITLE
DO NOT SCALE DRAWING	REFERENCE DRAWINGS	
TOLERANCES UNLESS OTHERWISE SPECIFIED DECIMAL ± ____ FRACTIONAL ± ____ ANGULAR ± ____	RADFORD ARMY AMMUNITION PLANT U. S. ARMY RADFORD, VIRGINIA HERCULES INCORPORATED	
APPROVED FOR GENERAL DESIGN AND SPECIFICATIONS FOR HERCULES INCORPORATED Logan R. Neel 12/12/89 ENGINEERING DEPT. DATE FOR U. S. GOVERNMENT R W [illegible] 12/18/89 DATE	BUILDING — NO. — AREA: GPA DEPT.: ACID/NC TITLE WELDING & FABRICATION REQUIREMENTS - CLASS "NC" SCALE: — DATE: DEC. 5, 1989 DRAWN BY: — CHECKED BY: — APPROVALS C.L. Caines 12/8/89 C.L. CAINES DEPT. SUPT. [illegible] 12/11/89 SAFETY SUPT.	
THIS DRAWING SHALL NOT BE USED OR REPRODUCED EITHER WHOLLY OR IN PART EXCEPT WHERE AUTHORIZED IN CONNECTION WITH PROCUREMENT FOR THE UNITED STATES GOVERNMENT.	PROJ: CONTRACT NO. DAAA09-86-Z-0003 0 0 0 0 0 0 4 2 4 0 6 F 3 0 0 0 1 ACCOUNT NO. SERIAL NO. CLASS. CODE REV.	

CLASS NITROCELLULOSE (NC) TANKS AND TUBS - FABRICATION, ERECTION AND TESTING REQUIREMENTS

1.0 Scope: This drawing lists material, design, fabrication, erection, examination, and testing requirements for vertical cylindrical, aboveground, closed- and open-top welded steel storage tanks and tubs in various sizes and capacities for internal pressures approximating atmospheric pressure. The vessels covered by this drawing are those whose primary function is the processing and storage of nitrocellulose.

2.0 General Requirements for Ferrous and Non-Ferrous Construction and Repairs

2.1 Requirements listed herein are minimum standards and shall not have preference over any specification as stated on Hercules Incorporated approved drawings and specifications.

2.2 References: The latest edition (or the edition indicated) of the following standards and codes form a part of this specification:

American Petroleum Institute (API) Standard 650, "Welded Steel Tanks for Oil Storage"

American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (hereinafter referred to as the ASME Code)

American Welding Society (AWS) QC1: Standard for Qualification and Certification of Welding Inspectors

American Society of Nondestructive Testing (ASNT) Recommended Practice No. SNT-TC-IA, 1988 Edition

2.3 In general, design, fabrication, assembly and erection, examination, inspection, and testing shall meet the minimum requirements of the latest applicable edition of the American Petroleum Institute (API) Standard 650. It should be recognized that this standard is for oil storage tanks and some requirements may not apply. Additionally, more stringent requirements specified by Hercules Incorporated must be met.

2.3.1 The term "purchaser" as used throughout API 650 shall be understood as referring to Hercules Incorporated.

2.3.2 The term "manufacturer" as used throughout API 650 and this drawing shall be understood as referring to the vendor(s) or firm(s) subcontracted by Hercules Incorporated to perform their respective work, U.S. Army Corps of Engineers contractor(s), or they may be Hercules Incorporated, RAAP employees performing the work.

3.0 Design: NC Tanks and Tubs must meet the minimum design requirements of API 650 and the applicable Hercules Incorporated drawings and specifications.

4.0 Materials

4.1 Material requirements shall be as specified in the applicable Hercules Incorporated drawings and specifications. Where the materials specified are other than those listed and allowed by API 650, Section 2 - Materials, then alternately the materials shall meet the requirements of the ASME Boiler and Pressure Vessel Code, Section VIII, Division I, Subsection C for specification and design stress values.

4.2 Substitution (including thicker wall materials) is not permitted without written authority from Hercules Incorporated.

4.3 All tank or tub materials, nozzle components, flanges, fasteners, etc. shall be marked per their applicable specifications. Traceability by unique markings and supporting Certified Material Test Reports (MTR) or Certificates of Compliance (COC) shall be provided as required by Hercules Incorporated specifications.

5.0 Quality Control Program: The Manufacturer shall submit either a Quality Control Plan or Quality Control Manual to Hercules Incorporated for approval, that outlines how the Manufacturer's own Quality Control Function (including both the program and personnel) will perform and document the required examinations and tests that assure that the requirements of drawings and specifications are met. Additionally, the Manufacturer shall submit relevant qualifications and experience information on their designated QC Examination Personnel as described in the appropriate paragraphs below.

6.0 Fabrication and Erection

6.1 All fabrication and erection shall be performed in strict compliance with the Hercules Incorporated approved drawings, specifications and procedures, and the minimum requirements of API 650, for the particular scope of work.

6.2 Where particular methods, practices, or procedures are not specified by either API 650 or the Hercules Incorporated specifications, the workmanship performed shall be by qualified craftsmen in a neat and workmanlike manner consistent with acceptable trade practices.

6.3 Dimensional Tolerances: The purpose of the tolerances listed below is to produce a tank or tub of acceptable appearance that will provide a long operating life.

6.3.1 Plumbness: The requirements for plumbness shall be as shown in API 650, Paragraph 5.5.2.

6.3.2 Roundness: The requirements for roundness shall be as shown in API 650, Paragraph 5.5.3

7.0 Welding

7.1 In general, the welding procedure used shall result in welded joints that are of sufficient strength to carry the intended loads, that will offer resistance to corrosion equivalent to that of the base metal, with no cracks or crevices inside or outside the vessel which are detectable using one or more of the Non-Destructive Examination methods listed hereinafter.

7.2 Welding Processes: All welding shall be performed using any of the following welding processes: Shielded Metal Arc Welding (SMAW), Gas Tungsten Arc Welding (GTAW), Gas Metal Arc Welding (GMAW), or Flux-Cored Arc Welding.

7.3 Joint design: All tank or tub weld seams shall be full penetration, double-welded butt joints as defined in API 650 paragraph 3.1.1.1. Welds for nozzle penetrations shall be in accordance with the applicable drawings.

7.4 Welding Procedure and Performance Qualifications:

7.4.1 All welding (including tack welding) shall be performed in accordance with Welding Procedure Specifications (WPS) qualified by one or more Procedure Qualification Records (PQR) in accordance with API 650 paragraph 7.2.1.1 which references Section IX of the ASME Code.

7.4.2 All persons performing welding (including tack welds) shall be qualified and certified by the Manufacturer in accordance with API 650 Paragraph 7.3 (which also references Section IX of the ASME Code) for the applicable WPS's used in accordance with paragraph 7.4.1 above.

7.4.3 The Manufacturer shall submit copies of all applicable WPS's, PQR's and each Welder or Welding Operator Qualification Records (WPQ) to Hercules Incorporated for approval, prior to any welding. Additionally, the Manufacturer shall submit documented evidence of current qualification, or renewal of qualification for each welder/welding operator.

7.5 Weld seams shall be identified by welder in accordance with API 650 paragraph 7.4.

7.6 Welding Electrodes and Fillers shall be in accordance with the Hercules Incorporated specifications. Only those electrodes and fillers as identified on the approved WPS's shall be used by the Manufacturer. Substitution of electrodes or fillers is prohibited unless the substitution is approved by Hercules Incorporated, the WPS is properly qualified for the substitution, and the WPS is properly revised by the Manufacturer.

7.7 Storage of All Electrodes and Fillers shall at a minimum be as recommended by their manufacturers. Electrodes shall be purchased in sealed containers. All electrodes and fillers must be kept clean and dry. Exposed electrodes must be kept dry once the container seals are broken. Portable Storage Ovens shall be at the job site heated to the proper temperature recommended by their manufacturer. At the end of the work day, remaining electrodes shall be removed from portable ovens and returned to their controlled storage ovens, which must be kept at the electrode manufacturer's recommended temperatures.

7.8 Base Metal Preparation of the edges of the surfaces to be joined by welding shall be prepared by machining, sawing, plasma cutting or grinding. Surface oxides shall be removed after thermal cutting. The welding grooves shall be smooth, free of notches or harmful irregularities, clean of all oil, grease, cutting fluids or oxides, and shall meet the dimensional requirements of the approved Hercules Incorporated specifications, this drawing, and other applicable drawings.

7.9 Weld Joint alignment, fit-up, preheating and interpass temperature maintenance shall be in accordance with the approved fabrication drawings and applicable WPS's.

7.10 The edges of all welds shall merge with the surface of the plate without a sharp angle. The maximum acceptable undercutting is 1/64 inch in depth for vertical butt joints. For horizontal butt joints, undercutting not exceeding 1/32 inch in depth is acceptable.

7.11 The reinforcement of the welds on all butt joints on either side of the plate shall not exceed 3/32 inch on vertical joints and 1/8 inch on horizontal joints. The reinforcement need not be removed except to the extent that it exceeds the above limits.

7.12 Welding of the bottom and roof plates shall be done in such a sequence that the Manufacturer has found to result in the least distortion from shrinkage and thus to provide as nearly as possible a plane surface.

7.13 Shell plates to be joined by butt welding shall be aligned in accordance with API 650 paragraphs 5.2.3.1 and 5.2.3.2.

7.14 The reverse side of double-welded butt joints shall be thoroughly cleaned in accordance with API 650 paragraph 5.2.3.3 prior to the application of the first weld pass to the reverse side.

7.15 Temporary items (lifting lugs, alignment clips, etc.) welded to the tank or tub material shall be of the same material as the base metal. These items shall be completely removed and metal surface left with a smooth surface.

8.0 Inspection, Examination, and Testing

8.1 General

8.1.1 Inspections: All references to "Inspection(s)" shall be understood by the Manufacturer as referring to inspections performed by representatives of Hercules Incorporated.

8.1.2 Examinations: All references to "Examinations(s)" shall be understood by the Manufacturer as being those quality control functions required to be performed by the Manufacturer by this drawing and the applicable Hercules Incorporated drawings and specifications. The person(s) performing these examinations shall be free from production pressure, shall be given the responsibility and authority to perform the required examinations and be free to take corrective action for any non-conformance arising from non-compliance to the approved drawings, specifications, and procedures. Additionally, the QC Examiners are responsible to bring all non-conformances to the attention of the Hercules representative for approval, prior to taking corrective action (including repairs).

8.1.3 Hercules Representative: All references to the "Hercules Representative" shall be understood to mean any employee(s) of Hercules Incorporated that are assigned responsibility for the particular project or subcontract under which the work is being carried out.

8.2 The Hercules Representative shall have access to any place where work concerning tank or tub fabrication or erection is being performed. This includes manufacture, fabrication (including shop fabrication), assembly, erection, examination and testing of the tank or tub. The Hercules Representative shall have the right to inspect the tank or tub using any examination method specified by the design documents, review all certifications, records, and test reports to the satisfaction of Hercules Incorporated requirements.

8.3 Examination Requirements:

8.3.1 Liquid Penetrant Examination (PT): A minimum of 5% of all fabrication for <u>each</u> welder's and welding operator's work performed by the Manufacturer shall pass a Liquid Penetrant Examination (PT) performed to approved written procedure(s) in accordance with API 650 paragraph 6.4. Personnel qualification and examination procedures shall be in accordance with Section V, Articles 1 and 6, respectively, of the ASME Code. The Hercules Representative shall determine the areas to be examined.

8.3.1.1 If the spot examination reveals that any weld fails to meet the minimum quality requirements, two additional segments of the weld of the same length as the original segment shall be examined by the same procedure in the same weld unit at locations away from the original segment. The locations of these additional segments shall be determined by the Hercules Representative. If the two additional weld segments examined meet the quality requirements, the entire weld unit represented by the three segments is acceptable, provided the defective welding disclosed by the first of the three segment examinations is removed and the area repaired by welding. The repaired weld area shall be re-examined.

8.3.1.2 If either of the two additional segments examined show welding which does not comply with the minimum quality requirements, the entire unit of weld represented shall be rejected. The entire rejected weld shall be removed and the joint shall be re-welded, or at the Manufacturer's option, the entire unit of weld represented shall be completely examined and defective welding only corrected.

8.3.2 Visual Examination:

8.3.2.1 One hundred percent (100%) of all fabrication by the Manufacturer shall be subjected to visual examination by the Manufacturer. Examination shall be performed to an approved written procedure in accordance with the ASME Code, Section V, Article 9. Qualification of examiner(s) shall be in accordance with one or more of the following:

- ASME Code, Section V, Article 1
- AWS QC1, Standard for Qualification and Certification of Welding Inspectors
- ASNT Recommended Practice No. SNT-TC-IA

8.3.2.2 Acceptance Criteria for Visual Examination: One or more of the following defects as detected by visual examination and/or during hydrostatic testing shall be cause for rejection.

(1) Welding performed by unqualified persons.

(2) Cracks or pinholes.

(3) Evidence of peening.

(4) Oxidation around welds.

(5) Welds not uniform in appearance.

(6) Lack of fusion or incomplete penetration (none allowed).

(7) Presence of porosity, slag inclusion or overlaps.

(8) Undercutting adjacent to completed weld or evidence of undercutting by grinding in excess of that stated in paragraph 7.10 of this drawing.

(9) Misalignment exceeding the requirements listed in 7.13 of this drawing.

(10) Reinforcement exceeding the requirements listed in paragraph 7.11 of this drawing.

(11) Leaks detected during hydrostatic tests.

8.3.3 Radiographic Examination: For vessels in which the stressed components have a nominal thickness of 1/2" or greater, welds shall be radiographically examined in accordance with Paragraph 6.1 of API 650. "Stressed components" shall be as defined in API 650, Appendix A, Paragraph 1.1. Personnel qualification and procedures shall be in accordance with Section V, Articles 1 and 2 of the ASME Code.

8.3.4 Defective Welds: Defective welds may be repaired subject to the authority of the Hercules Representative. Defect removal to acceptable levels, as verified by approved NDE methods, must precede any allowed repairs. All repairs must be documented, as per the approved Quality Program in Paragraph 5.0 of this drawing. Repairs shall be performed using a qualified procedure. The repaired areas shall be re-examined.

8.3.5 Examination to Resolve Uncertainty: Any applicable, recognized NDE method as listed in API 650 may be used to resolve doubtful indications. Acceptance criteria shall be those as listed for the required examination(s).

9.0 <u>Hydrostatic testing</u> shall be performed on each NC tank or tub after completion of other required NDE examinations. The Manufacturer shall blank off all openings so that the tank or tub may be filled with water and allowed to stand for a period of 24 hours. Manufacturer shall furnish blanks and teflon gaskets for testing. If leaks develop, Manufacturer shall drain tank or tub to at least one foot below the defect, repair the defect, and test again. Testing shall be performed until it is ascertained that no leaks are present. After a successful test, Manufacturer shall drain tank or tub.

10.0 Documentation, Records, and Markings

10.1 The Manufacturer shall submit to Hercules Incorporated copies of all required Mill Test Reports, Certificates of Compliance, reports of liquid penetrant examinations, all radiographic film, reports of radiographic examinations, and weld maps showing locations of areas examined by both liquid penetrant and radiography (where applicable). (NOTE: This is in addition to the documentation and certifications required hereinbefore.)

10.2 The Manufacturer shall affix a nameplate to each tank or tub in accordance with the specifications.

10.3 Letter of Certification: The Manufacturer shall provide a letter of certification for each tank or tub stating that the vessel was designed, fabricated, erected, and tested in accordance with the applicable Hercules Incorporated specifications and this drawing.

SECTION 15200A

PIPELINES, PROCESS PIPING
05/01
Classes 35P 47P 121, 156L, 35HP

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 H35.2	(1997) Dimensional Tolerances for Aluminum Mill Products
ANSI H35.2M	(1997) Dimensional Tolerances for Aluminum Mill Products

AMERICAN PETROLEUM INSTITUTE (API)

API Spec 5L	(2000) Line Pipe

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M	(2000) Carbon Structural Steel
ASTM A 47/A 47M	(1999) Ferritic Malleable Iron Castings
ASTM A 48	(1994ael) Gray Iron Castings
ASTM A 48M	(1994el) Gray Iron Castings (Metric)
ASTM A 53/A 53M	(1999b) Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded, and Seamless
ASTM A 105/A 105M	(1998) Carbon Steel Forgings for Piping Applications
ASTM A 106	(1999el) Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A 108	(1999) Steel Bars, Carbon, Cold-Finished, Standard Quality
ASTM A 126	(1995el) Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A 153/A 153M	(2000) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 167	(1999) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

ASTM A 181/A 181M	(2000) Carbon Steel Forgings, for General-Purpose Piping
ASTM A 182/A 182M	(2000) Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
ASTM A 183	(1983; R 1998) Carbon Steel Track Bolts and Nuts
ASTM A 193/A 193M	(2000) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 194/A 194M	(2000) Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service
ASTM A 216/A 216M	(1993; R 1998) Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service
ASTM A 240/A 240M	(2000) Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels
ASTM A 268/A 268M	(2000) Seamless and Welded Ferritic and Martensitic Stainless Steel Tubing for General Service
ASTM A 269	(2000) Seamless and Welded Austenitic Stainless Steel Tubing for General Service
ASTM A 276	(2000) Stainless Steel Bars and Shapes
ASTM A 307	(2000) Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 312/A 312M	(2000) Seamless and Welded Austenitic Stainless Steel Pipes
ASTM A 304	(2002) Standard Specification for Carbon and Alloy Steel Bars Subject Subject to End-Quench Hardeenability Requirements
ASTM A 334/A 334M	(1999) Seamless and Welded Carbon and Alloy-Steel Tubes for Low-Temperature Service
ASTM A 351/A 351M	(2000) Castings, Austenitic, Austenitic-Ferric (Duplex), for Pressure-Containing Parts
ASTM A 352/A 352M	(1993; R 1998) Steel Castings, Ferritic and Martensitic, for Pressure-Containing Parts, Suitable for Low-Temperature Service

ASTM A 395/A 395M	(1988; R 1998) Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures
ASTM A 403/A 403M	(2000) Wrought Austenitic Stainless Steel Piping Fittings
ASTM A 423/A 423M	(1995) Seamless and Electric-Welded Low-Alloy Steel Tubes
ASTM A 436	(1984; R 1997el) Austenitic Gray Iron Castings
ASTM A 479/A 479M	(2000) Stainless Steel Bars and Shapes for use in Boilers and Other Pressure Vessels
ASTM A 513	(2000) Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing
ASTM A 536	(1984; R 1999el) Ductile Iron Castings
ASTM A 576	(1990b; R 1995el) Steel Bars, Carbon, Hot-Wrought, Special Quality
ASTM A 587	(1996) Electric-Resistance-Welded Low-Carbon Steel Pipe for the Chemical Industry
ASTM A 632	(1998) Seamless and Welded Austenitic Stainless Steel Tubing (Small-Diameter) for General Service
ASTM A 727/A 727M	(2000) Forgings, Carbon Steel, for Piping Components with Inherent Notch Toughness
ASTM A 780	(2000) Repair of Damaged and Uncoated Areas of Hot-Dipped Galvanized Coatings
ASTM A 789/A 789M	(2000) Seamless and Welded Ferritic/Austenitic Stainless Steel Tubing for General Service
ASTM A 813/A 813M	(1995e2) Single- or Double-Welded Austenitic Stainless Steel Pipe
ASTM A 814/A 814M	(1996; R 1998) Cold-Worked Welded Austenitic Stainless Steel Pipe
ASTM A 815/A 815M	(2000) Wrought Ferritic, Ferritic/Austenitic, and Martensitic Stainless Steel Piping Fittings
ASTM A 858/A 858M	(2000) Heat-Treated Carbon Steel Fittings for Low-Temperature and Corrosive Service
ASTM A 865	(1997) Threaded Couplings, Steel, Black or Zinc-Coated (Galvanized) Welded or Seamless, for Use in Steel Pipe Joints

ASTM B 32	(1996) Solder Metal
ASTM B 42	(1998) Seamless Copper Pipe, Standard Sizes
ASTM B 61	(1993) Steam or Valve Bronze Castings
ASTM B 62	(1993) Composition Bronze or Ounce Metal Castings
ASTM B 75	(1999) Seamless Copper Tube
ASTM B 75M	(1999) Seamless Copper Tube (Metric)
ASTM B 88	(1999) Seamless Copper Water Tube
ASTM B 88M	(1999) Seamless Copper Water Tube (Metric)
ASTM B 98/B 98M	(1998) Copper-Silicon Alloy Rod, Bar, and Shapes
ASTM B 124/B 124M	(2000) Copper and Copper Alloy Forging Rod, Bar, and Shapes
ASTM B 150	(1998e2) Aluminum Bronze Rod, Bar, and Shapes
ASTM B 150M	(1995a) Aluminum Bronze Rod, Bar, and Shapes (Metric)
ASTM B 161	(2000) Nickel Seamless Pipe and Tube
ASTM B 164	(1998) Nickel-Copper Alloy Rod, Bar, and Wire
ASTM B 165	(1996) Nickel-Copper Alloy UNS N04400 Seamless Pipe and Tube
ASTM B 167	(1998) Nickel-Chromium-Iron Alloys (UNS N06600, N06601, N06690, N060625, and N06045) Seamless Pipe and Tube
ASTM B 210	(2000) Aluminum and Aluminum-Alloy Drawn Seamless Tubes
ASTM B 210M	(2000) Aluminum and Aluminum-Alloy Drawn Seamless Tubes (Metric)
ASTM B 211	(2000) Aluminum and Aluminum-Alloy Bar, Rod, and Wire
ASTM B 211M	(1995a) Aluminum and Aluminum-Alloy Bar, Rod, and Wire (Metric)
ASTM B 241/B 241M	(2000) Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube
ASTM B 247	(2000) Aluminum and Aluminum-Alloy Die Forgings, Hand Forgings, and Rolled Ring

	Forgings
ASTM B 247M	(2000) Aluminum and Aluminum-Alloy Die Forgings, Hand Forgings, and Rolled Ring Forgings (Metric)
ASTM B 302	(1998) Threadless Copper Pipe
ASTM B 345/B 345M	(2000) Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube for Gas and Oil Transmission and Distribution Piping Systems
ASTM B 361	(1995) Factory-Made Wrought Aluminum and Aluminum-Alloy Welding Fittings
ASTM B 366	(2000) Factory-Made Wrought Nickel and Nickel Alloy Fittings
ASTM B 517	(1998) Welded Nickel-Chromium-Iron-Alloy (UNS N06600), UNS N06045 Pipe
ASTM B 546	(1998) Electric Fusion-Welded Ni-Cr-Co-Mo Alloy (UNS N06617), Ni-Fe-Cr-Si Alloys (UNS N08330 and UNS N08332), Ni-Cr-Fe Alloy (UNS NO6025), and Ni-Cr-Fe-Si Alloy (UNS NO6045) Pipe
ASTM B 564	(2000a) Nickel Alloy Forgings
ASTM B 574	(1999a) Low-Carbon Nickel-Molybdenum-Chromium, Low-Carbon Nickel-Chromium-Molybdenum, and Low-Carbon Nickel-Chromium-Molybdenum-Tungsten Alloy Rod
ASTM B 619	(2000) Welded Nickel and Nickel-Cobalt Alloy Pipe
ASTM B 622	(2000) Seamless Nickel and Nickel-Cobalt Alloy Pipe and Tube
ASTM B 725	(1995) Welded Nickel (UNS N02200/UNS N02201) and Nickel Copper Alloy (UNS N04400) Pipe
ASTM B 775	(2000) General Requirements for Nickel and Nickel Alloy Welded Pipe
ASTM B 813	(2000) Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube
ASTM B 829	(1999) General Requirements for Nickel and Nickel Alloy Seamless Pipe and Tube
ASTM C 600	(1985; R 1995el) Thermal Shock Test on Glass Pipe

ASTM D 729	(1995) Vinylidene Chloride Molding Compounds
ASTM D 1418	(1999) Rubber and Rubber Latices - Nomenclature
ASTM D 1527	(1999) Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe, Schedules 40 and 80
ASTM D 1784	(1999a) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 1785	(1999) Poly(Vinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2000	(1999) Rubber Products in Automotive Applications
ASTM D 2104	(1999el) Polyethylene (PE) Plastic Pipe, Schedule 40
ASTM D 2235	(1996a) Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings
ASTM D 2239	(1999) 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 2282	(1999) Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe (SDR-PR)
ASTM D 2310	(1997) Machine-Made "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe
ASTM D 2447	(1999) Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, Based on Outside Diameter
ASTM D 2464	(1999) Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2466	(1999) Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2467	(1999) Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2468	(1996a) Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe Fittings, Schedule 40
ASTM D 2564	(1996a) Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems

ASTM D 2609	(2000) Plastic Insert Fittings for Polyethylene (PE) Plastic Pipe
ASTM D 2657	(1997) Heat Fusion Joining Polyolefin Pipe and Fittings
ASTM D 2683	(1998) Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing
ASTM D 2737	(1999) Polyethylene (PE) Plastic Tubing
ASTM D 2774	(1994) Underground Installation of Thermoplastic Pressure Piping
ASTM D 2855	(1996) Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D 2992	(1996el) Obtaining Hydrostatic or Pressure Design Basis for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe and Fittings
ASTM D 3035	(1995) Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter
ASTM D 3222	(1999) Unmodified Poly(Vinylidene Fluoride) (PVDF) Molding Extrusion and Coating Materials
ASTM D 3261	(1997) Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
ASTM D 3307	(2000) PFA-Fluorocarbon Molding and Extrusion Materials
ASTM D 3308	(1997) PTFE Resin Skived Tape
ASTM D 3350	(1999) Polyethylene Plastics Pipe and Fittings Materials
ASTM D 3754	(1996) "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer and Industrial Pressure Pipe
ASTM D 3839	(1994a) Underground Installation of "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe
ASTM D 3892	(1993; R 1998) Packaging/Packing of Plastics
ASTM D 3965	(1999) Rigid Acrylonitrile-Butadiene-Styrene (ABS)

	Materials for Pipe and Fittings
ASTM D 4024	(2000) Machine Made "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Flanges
ASTM D 4101	(2000) Propylene Plastic Injection and Extrusion Materials
ASTM D 4161	(1996) "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Joints Using Flexible Elastomeric Seals
ASTM D 5421	(1993) Contact Molded "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Flanges
ASTM D 5685	(1995) "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pressure Pipe Fittings
ASTM D 5686	(1995) "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe and Pipe Fittings, Adhesive Bonded Joint Type Epoxy Resin, for Condensate Return Line
ASTM E 438	(1992) Glasses in Laboratory Apparatus
ASTM E 814	(2000) Fire Tests of Through-Penetration Fire Stops
ASTM F 336	(1997) Standard Practice for Design and Construction of Nonmetallic Enveloped Gaskets for Corrosive Service
ASTM F 402	(1993; R 1999) Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings
ASTM F 423	(1995) Polytetrafluoroethylene (PTFE) Plastic-Lined Ferrous Metal Pipe, Fittings, and Flanges
ASTM F 437	(1999) Threaded Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
ASTM F 438	(1999) Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40
ASTM F 439	(1999) Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
ASTM F 441/F 441M	(1999) 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	(1999) Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F 491	(1995) Poly(Vinylidene Fluoride) (PVDF) Plastic-Lined Ferrous Metal Pipe and Fittings
ASTM F 492	(1995) Propylene and Polypropylene (PP) Plastic-Lined Ferrous Metal Pipe and Fittings
ASTM F 493	(1997) Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings
ASTM F 599	(1995) Poly(Vinylidene Chloride) (PVDC) Plastic-Lined Ferrous Metal Pipe and Fittings
ASTM F 656	(1996a) Primers for Use in Solvent Cement Joints of Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings
ASTM F 714	(2000) Polyethylene (PE) Plastic Pipe (SDR-PR) Based On Outside Diameter
ASTM F 781	(1995) Perfluoro (Alkoxyalkane) Copolymer (PFA) Plastic-Lined Ferrous Metal Pipe and Fittings
ASTM F 876	(2000) Crosslinked Polyethylene (PEX) Tubing
ASTM F 1055	(1998) Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing
ASTM F 1056	(1997) Socket Fusion Tools for Use in Socket Fusion Joining Polyethylene Pipe or Tubing and Fittings
ASTM F 1199	(1988; R 1998) Cast (All Temperatures and Pressures) and Welded Pipe Line Strainers (150 psig and 150 degrees F Maximum)
ASTM F 1200	(1988; R 1998) Fabricated (Welded) Pipe Line Strainers (Above 150 psig and 150 degrees F)
ASTM F 1290	(1998a) Electrofusion Joining Polyolefin Pipe and Fittings

ASME INTERNATIONAL (ASME)

ASME B1.1	(1989) Unified Inch Screw Threads (UN and

	UNR Thread Form)
ASME B1.20.1	(1983; R 1992) Pipe Threads, General Purpose (Inch)
ASME B1.20.7	(1991; R 1998) Hose Coupling Screw Threads (Inch)
ASME B16.1	(1998) Cast Iron Pipe Flanges and Flanged Fittings
ASME B16.3	(1998) Malleable Iron Threaded Fittings
ASME B16.5	(1996; B16.5a) Pipe Flanges and Flanged Fittings NPS 1/2 thru NPS 24
ASME B16.9	(1993) Factory-Made Wrought Steel Buttwelding Fittings
ASME B16.11	(1996) Forged Fittings, Socket-Welding and Threaded
ASME B16.15	(1985; R 1994) Cast Bronze Threaded Fittings Classes 125 and 250
ASME B16.18	(1984; R 1994) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.20	(1993; R 1998) Metallic Gaskets for Pipe Flanges - Ring Joint, Spiral-Wound, and Jacketed
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.22	(1995; B16.22a1998) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.26	(1988) Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B16.28	(1994) Wrought Steel Buttwelding Short Radius Elbows and Returns
ASME B16.34	(1997) Valves - Flanged, Threaded, and Welding End
ASME B16.42	(1998) Ductile Iron Pipe Flanges & Flanged Fittings, Classes 150-300
ASME B18.2.1	(1996) Square and Hex Bolts and Screws (Inch Series)
ASME B18.2.2	(1987; R 1993) Square and Hex Nuts (Inch Series)
ASME B31.1	(1998) Power Piping

ASME B31.3	(1999) Process Piping
ASME B36.10M	(1996) Welded and Seamless Wrought Steel Pipe
ASME B36.19M	(1985; R 1994) Stainless Steel Pipe
ASME B40.1	(1991) Gauges - Pressure Indicating Dial Type - Elastic Element

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1001	(1990) Pipe Applied Atmospheric Type Vacuum Breakers
ASSE 1012	(1995) Backflow Preventers with Intermediate Atmospheric Vent
ASSE 1013	(1999) Reduced Pressure Principle Backflow Preventers
ASSE 1015	(1999) Double Check Backflow Prevention Assembly
ASSE 1020	(1998) Pressure Vacuum Breaker Assembly (Recommended for Outdoor Usage)

AMERICAN WATER WORKS ASSOCIATION (AWWA)

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. (75mm Through 1200 mm), for Water and Other Liquids
AWWA C111	(2000) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115	(1999) Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges
AWWA C150	(1996) Thickness Design of Ductile-Iron Pipe
AWWA C151	(1996) Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids
AWWA C153	(2000) Ductile-Iron Compact Fittings, 3 In. Through 24 In. (76 mm Through 610 mm) and 54 In. Through 64 In. (1,400 mm Through 1,600 mm) for Water Service
AWWA C207	(1994) Steel Pipe Flanges for Waterworks Service - Sizes 4 In. Through 144 In. (100 mm Through 3,600 mm)
AWWA C500	(1993; C500a) Metal-Seated Gate Valves for

	Water Supply Service
AWWA C504	(1994) Rubber-Seated Butterfly Valves
AWWA C508	(1993; C508a) Swing-Check Valves for Waterworks Service, 2 In. (50 mm) Through 24 In. (600 mm) NPS
AWWA C509	(1994; Addendum 1995) Resilient-Seated Gate Valves for Water Supply Service
AWWA C510	(1997) Double Check Valve Backflow-Prevention Assembly
AWWA C511	(1997) Reduced-Pressure Principle Backflow-Prevention Assembly
AWWA C540	(1993) Power-Activating Devices for Valves and Sluice Gates
AWWA C550	(1990) Protective Epoxy Interior Coatings for Valves and Hydrants
AWWA C606	(1997) Grooved and Shouldered Joints
AWWA C651	(1999) Disinfecting Water Mains

AMERICAN WELDING SOCIETY (AWS)

AWS A5.3/A5.3M	(1999) Aluminum and Aluminum Alloy Electrodes for Shielded Metal Arc Welding
AWS A5.8	(1992) Filler Metals for Brazing and Braze Welding
AWS A5.10/A5.10M	(1999) Bare Aluminum and Aluminum Alloy Welding Electrodes and Rods
AWS A5.11/A5.11M	(1997) Filler Metal Nickel & Nickel Alloy CVD
AWS A5.14/A5.14M	(1997) Filler Metal Specifications for Nickel and Nickel Alloy Bare Welding Electrodes and Rods
AWS D1.1	(2000) Structural Welding Code - Steel

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910	Occupational Safety and Health Standards

DUCTILE IRON PIPE RESEARCH ASSOCIATION (DIPRA)

DIPRA-Restraint Design	(1997) Thrust Restraint Design for Ductile Iron Pipe

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 228-1	(1994) Pipe Threads Where Pressure-Tight

	Joints are not Made on the Threads - Part 1: Dimensions, Tolerances and Designation

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-43	(1991; R 1996) Wrought Stainless Steel Butt-Welding Fittings
MSS SP-58	(1993) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	(1996) Pipe Hangers and Supports - Selection and Application
MSS SP-89	(1998) Pipe Hangers and Supports - Fabrication and Installation Practices

NACE INTERNATIONAL (NACE)

NACE RP0185	(1996) Extruded, Polyolefin Resin Coating Systems With Soft Adhesives for Underground or Submerged Pipe

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(1997) Enclosures for Electrical Equipment (1000 Volts Maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 49	(1994) Hazardous Chemicals Data
NFPA 325-1	(1994) Fire Hazard Properties of Flammable Liquids, Gases and Volatile Solids
NFPA 704	(1996) Identification of the Fire Hazards of Materials for Emergency Response

RUBBER MANUFACTURERS ASSOCIATION (RMA)

RMA IP-2	(1996) Hose Handbook

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 6/NACE 3	(1994) Commercial Blast Cleaning

1.2.2.1 Connections to Existing Piping

Connections to existing piping systems where new fittings in the existing line are required will be paid for according to the contract prices for such connection. The price will be considered as full compensation for material and labor required for the removal and replacement of the existing pipe as necessary.

1.2.2.2 Connections to Existing Equipment

Connections to existing equipment where new fittings for the existing equipment are required will be paid for according to the contract prices for such connection. The price will be considered as full compensation for material and labor required for the installation of new fittings or the removal and replacement of existing fittings, as necessary.

1.2 SYSTEM DESCRIPTION

This specification covers the requirements for above and below grade liquid process pipe, pipe supports, fittings, equipment and accessories located both inside and outside of tanks.

1.2.1 Design Requirements

Support systems shall be selected and designed within the specified spans and component requirements. The absence of pipe supports and details on the contract drawings does not relieve the Contractor of responsibility for sizing and providing supports throughout facility.

1.2.2 Performance Requirements

The pressure ratings and materials specified represent minimum acceptable standards for piping systems. The piping systems shall be suitable for the services specified and intended. Each piping system shall be coordinated to function as a unit. Flanges, valves, fittings and appurtenances shall have a pressure rating no less than that required for the system in which they are installed.

1.2.2.1 Buried Piping Systems

Piping systems shall be suitable for design conditions, considering the piping both with and without internal pressure. Consideration shall be given to all operating and service conditions both internal and external to the piping systems.

1.2.2.2 Above Grade Piping Systems

Piping systems shall be suitable for design conditions, considering the piping both with and without internal pressure, and installation factors such as insulation, support spans, and ambient temperatures. Consideration shall be given to all operating and service conditions both internal and external to the piping systems.

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

Pipe and Equipment;

Equipment shop drawings and support system detail drawings showing piping systems and appurtenances, such as mechanical

joints, valves, local indicators and hangers, including a complete list of equipment and materials. As-built drawings showing pipe anchors and guides, and layout of piping systems relative to other parts of the work including clearances for maintenance and operation. As-built piping and instrumentation diagrams (P&IDs) identifying and labeling equipment, instrumentation, valves, vents, drains, and all other inline devices; if the contract drawings contained P&IDs, the P&IDs found in the contract drawings shall be revised to reflect the constructed process system, as directed by the Contracting Officer.

SD-03 Product Data

Qualifications;

A statement certifying that the Contractor has the specified experience.

Welders;

The names of all qualified welders, their identifying symbols, and the qualifying procedures for each welder including support data such as test procedures used, standards tested to, etc.

Waste Water Disposal;

The method proposed for disposal of waste water from hydrostatic tests and disinfection, and all required permits, prior to performing hydrostatic tests.

Assistance and Training;

A signed statement certifying 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.

Delivery, Storage and Handling;

Material safety data sheets

Materials and Equipment;

Manufacturer's descriptive and technical literature for each piping system, including design recommendations; pressure and temperature ratings; dimensions, type, grade and strength of pipe and fittings; thermal characteristics (coefficient of expansion and thermal conductivity); and chemical resistance to each chemical and chemical mixture in the liquid stream.

Installation

The manufacturer's installation recommendations or instructions for each material or procedure to be utilized, including materials preparation.

Pipe Schedule:
Valve Schedule:

Operator Schedule: See Spec 16900

A list of valve materials, pressure ratings, valve operator's materials, air supply pressure, electrical service, location, source of supply, and reference identification as indicated in the contract drawings. A list of any special tools necessary for each valve type and appurtenances furnished for adjustment, operation, maintenance and disassembly.

SD-06 Test Reports

Pipe Leakage Tests;

Hydrostatic Tests;

Pneumatic Tests;

Copies of all field test reports within 24 hours of the completion of the test.

SD-07 Certificates

Plastic Piping System;

Documentation certifying that the manufacturer of each thermoplastic piping system is listed with the Plastic Pipe Institute as meeting the recipe and mixing requirements of the resin manufacturer for the resin used to manufacture each of the respective thermoplastic pipe systems.

Contractor's Installation;

A statement signed by the reinforced thermosetting resin pipe and plastic pipe manufacturer's representative certifying that the Contractor's personnel are capable of properly installing the piping system on the project.

SD-10 Operation and Maintenance Data

Piping and Appurtenances;

Six copies each of operation and maintenance manuals in indexed booklet form. Operation manuals shall detail the step-by-step procedures required for specialized startup, operation and shutdown of piping systems, and shall include the manufacturer's name, model number, parts list and brief description of piping equipment such as valves and other appurtenances and their basic operating features. Maintenance manuals shall list routine maintenance procedures and troubleshooting guides for the equipment, and shall include piping layout and valve locations.

1.4 QUALIFICATIONS

1.4.1 Contractor

Contractor shall have successfully completed at least 3 projects of the same scope and size or larger within the last 6 years. Contractor shall demonstrate specific experience in regard to the system installation to be performed.

1.4.2 Welders

The welding of pressure piping systems shall be in accordance with qualifying procedures using performance qualified welders and operators. Procedures and welders shall be qualified in accordance with this Section and Structural members shall be welded in accordance with Section 05090 WELDING, STRUCTURAL.

1.5 GENERAL JOB REQUIREMENTS

Piping materials and appurtenances shall be as specified and as shown on the drawings, and shall be suitable for the service intended. Piping materials, appurtenances and equipment supplied as part of this contract shall be new and unused except for testing equipment. Components that serve the same function and are the same size shall be identical products of the same manufacturer. The general materials to be used for the piping systems are indicated by service in the Pipe Schedule G0008 piping class 35P, 47P, 121L, 35HP, and 156L.

1.5.1 Components

Piping equipment and appurtenances shall be new products of equal material and ratings as the connecting pipe.

1.5.2 Standard Products

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacturing of the products and shall essentially duplicate items that have been in satisfactory use for at least 5 years prior to bid opening. Nominal sizes for standardized products shall be used. Pipe, valves, fittings and appurtenances shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site.

1.5.3 Identification

Each piece of pipe shall bear the ASTM designation and all other markings required for that designation. Valves shall bear a securely attached tag with the manufacturer's name, valve model number, and valve identification permanently displayed and be marked in accordance with MSS SP-25.

1.6 DELIVERY, STORAGE AND HANDLING

Materials delivered and placed in storage shall be stored with protection from the weather, excessive humidity variation, excessive temperature variation, dirt, dust and/or other contaminants. Proper protection and care of material before, during and after installation is the Contractor's responsibility. Any material found to be damaged shall be replaced at the Contractor's expense. During installation, piping shall be capped to keep out dirt and other foreign matter. A material safety data sheet in conformance with 29 CFR 1910 Section 1200(g) shall accompany each chemical delivered for use in pipe installation. At a minimum, this includes all solvents, solvent cements, glues and other materials that may contain hazardous compounds. Handling shall be in accordance with ASTM F 402. Storage facilities shall be classified and marked in accordance with NFPA 704, with classification as indicated in NFPA 49 and NFPA 325-1. Materials shall be stored with protection from puncture, dirt, grease, moisture, mechanical abrasions, excessive heat, ultraviolet (UV) radiation damage, or

other damage. Pipe and fittings shall be handled and stored in accordance with the manufacturer's recommendation. Plastic pipe shall be packed, packaged and marked in accordance with ASTM D 3892.

1.7 PROJECT/SITE CONDITIONS

1.7.1 Environmental Requirements

Buried piping at the site may be subject to corrosion from the surrounding soil. Stainless pipe shall have protective coating field applied.

1.7.2 Existing Conditions

The Contractor shall be responsible for the verification of existing piping and penetrations. Prior to ordering materials, the Contractor shall expose all existing pipes which are to be connected to new pipelines. The Contractor shall verify the size, material, joint types, elevation, horizontal location, and pipe service of existing pipes, and inspect size and location of structure penetrations to verify adequacy of wall sleeves, and other openings before installing connecting pipes.

1.7.3 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 the work.

1.8 SEQUENCING AND SCHEDULING

For slab, floor, wall, and roof penetrations, the Contractor shall have onsite pertinent wall pipes and sleeves before they are required for placement in concrete forms. The Contractor shall verify and coordinate the size and location of building and structure pipe penetrations before forming and placing concrete.

1.9 MAINTENANCE

1.9.1 Service

Services for automatic valve or double containment leak detection monitoring system shall be provided by a manufacturer's representative who is experienced in the installation, adjustment and operation of the equipment specified. The representative shall inspect the installation, and supervise the adjustment and testing of the equipment.

1.9.2 Extra Materials

PART 2 PRODUCTS

2.1 DUCTILE IRON PIPING SYSTEM

2.1.1 Ductile Iron Pipe

Ductile iron pipe for pressure service shall have a design and wall thickness conforming to AWWA C150. Ductile iron pipe shall have a double thickness] cement lining conforming to AWWA C104 standard asphaltic lining].

2.1.2 Ductile Iron Joints

Joints shall have a working pressure rating for liquids equal to the pressure rating of the connected pipe. Mechanical joints conforming to AWWA C110 and AWWA C111. Push-on type joints conforming to AWWA C111 Flanged joints conforming to AWWA C110. Restrained joints conforming to the requirements of AWWA C111, and designed for a working pressure equal to connected pipe rating,150 psi shall be used. Gaskets, glands, bolts and nuts shall be furnished with mechanical joints glands, bolts, nuts and lubricants, shall be furnished with push-on joints, bolts and nuts shall be provided with flanged joints; in sufficient quantity for the complete assembly of each joint. Dielectric fittings or isolation joints shall be provided between all dissimilar metals.

2.1.2.1 Mechanical Joints

Glands shall be ductile or gray iron with an asphaltic coating. Gaskets shall be vulcanized synthetic rubber, reclaimed rubber is not acceptable. For grooved shoulder piping, self-centering gasketed couplings designed to mechanically engage piping and lock in a positive watertight couple shall be used. Housings shall be composed of malleable iron, ASTM A 47/A 47M or ductile iron, ASTM A 536 and gaskets of molded synthetic rubber, halogenated isobutylene isoprene nitrile shall be used. Bolts and nuts shall be heat treated carbon steel, ASTM A 183, minimum tensile 110,000 psi. Mechanical joints shall have bolt holes oriented straddling the vertical centerline of the valves and fittings.

2.1.2.2 Push-on Joints

Push on joints shall be supplied complete with gasket and lubricant. Gaskets shall be compatible with joint design and comprised of vulcanized synthetic rubber, reclaimed rubber is not acceptable. Lubricant shall be specifically formulated for use with push-on joints and shall be non-toxic, odorless, tasteless and shall not support bacteria growth.

2.1.2.3 Restrained Joints

When using ductile iron pipe with restrained joints, field cuts shall be supplied with a lock ring complete with retainer, retainer lock and roll-pin, as required by manufacturer's recommendations, procedures and/or installation instructions.

2.1.3 Ductile Iron Fittings

Fittings shall be gray iron ASTM A 48 or ductile iron AWWA C110 . Up to 16 inches inclusive, the fittings shall be 250 psig rated. Gray iron fittings shall be cement mortar lined double thickness. Flanges and flanged fittings shall conform to AWWA C110 and shall be rated for 250 psig service. Materials shall be ductile iro] or gray iron . For tie-in to existing flanges, the Contractor shall field check existing flanges for nonstandard bolt hole configurations and shall design as required to assure new pipe and flange mate properly. Bolts and nuts shall be carbon steel conforming to ASTM A 307, Grade B. Bolts shall be provided with washers of the same material as the bolts. Gaskets shall be rubber ring full face, maximum 0.125 in thick.

2.1.4 Corrosion Control

Ductile iron piping shall be coated with the manufacturer's standard asphaltic coating, approximately 1 mil thick, applied to the outside of pipe and fittings hot-dipped galvanized in accordance with ASTM A 153/A 153M.

Buried pipe shall be coated and wrapped, and provided with cathodic protection in accordance with Section 13110 CATHODIC PROTECTION SYSTEM (SACRIFICIAL ANODE) Section 13112 CATHODIC PROTECTION SYSTEM (IMPRESSED CURRENT.

2.2 CARBON STEEL PIPING SYSTEM

2.2.1 Carbon Steel Pipe

2.2.1.1 General Service

Carbon steel pipe shall meet the requirements of ASTM A 53/A 53M seamless, Grade A API Spec 5L, Schedule 40 and shall be in accordance with Pipe Schedule, hot-dipped galvanized. Buried carbon steel piping and fittings shall be Schedule 80.

2.2.1.2 High Temperature Service, Stainless steel/PVC

2.2.1.3 Chemical Process Service

2.2.2 Carbon Steel Tubing

Tubing shall meet the requirements of ASTM A 334/A 334M, seamless Grade 1 carbon steelASTM A 423/A 423M, seamless, Grade 1 low-alloy carbon steel with nominal size and wall thickness in accordance with Pipe Schedule.

2.2.3 Carbon Steel Joints

Carbon steel piping shall be joined by straight-threaded couplings Tubing shall be joined using compression fittings. Dielectric fittings or isolation joints shall be provided between all dissimilar metals.

2.2.4 Carbon Steel Fittings

Fittings shall be carbon steel. Where cast fittings are not available, segmental welded steel fittings, ASTM A 53/A 53M, Grade B, meeting the requirements of manufacturer's recommended wall thicknesses shall be fabricated.

2.2.4.1 Threaded Fittings

Threaded fittings shall be Class 150, malleable iron, ASTM A 47/A 47M, conforming to ASME B16.3, black, banded, forged carbon steel ASTM A 105/A 105M, conforming to ASME B16.11 low carbon steel, ASTM A 858/A 858M, conforming to ASME B16.11, and threaded in accordance with ASME B1.20.1. Threaded, rigid couplings shall be welded, black Type I hot-dipped galvanized and threaded in accordance with ASME B1.20.1. Polytetrafluoroethylene (PTFE) pipe-thread tape conforming to ASTM D 3308 shall be used for lubricant/sealant.

2.2.4.2 Welding Fittings

Welding fittings shall be butt-welding. Welding fittings shall be forged steel, ASTM A 105/A 105M Class 150 low-carbon steel, ASTM A 858/A 858M welded conforming to ASME B16.9 and ASME B16.28.

2.2.4.3 Flanged Fittings

The internal diameter bores of flanges and flanged fittings shall be the

same as that of the associated pipe. The flanges shall be slip-on or threaded type. Flanges and flanged fittings shall be forged steel, ASTM A 105/A 105M, faced and drilled to ASME B16.5 Class 150 with flat face. Cast steel backing flanges, ASTM A 216/A 216M Grade WCA, Van Stone type, shall be drilled in conformance with ASME B16.5 Class 150. For tie-in to existing flanges, the Contractor shall field check existing flanges for non-standard bolt hole configurations and shall design as required to assure new pipe and flange mate properly. Bolting shall be alloy-steel ASTM A 193/A 193M Grade B7 hex head bolts and ASTM A 194/A 194M Grade A hex head nuts. When mating flange on valves or equipment is cast iron, ASTM A 193/A 193M Grade B8 Class 1 bolts and ASTM A 194/A 194M Grade 8 heavy hex head nuts shall be used. Bolts shall be provided with washers of the same material as the bolts. Gaskets shall meet the requirements of ASME B16.5. Nonmetallic gaskets shall conform to ASME B16.21 and be a maximum 0.125 in. thick chloroprene rubber, durometer hardness No.80, 1,500 psi minimum tensile strength, 125 percent minimum elongation, flat ring type for use with raised face flanges and full face type for use with flat face flanges. Metallic ring joint gaskets shall conform to ASME B16.20 and be constructed of SS.

2.2.5 Carbon Steel Coatings

Carbon steel piping components shall be coated with corrosion resistant materials. Coatings and finishes shall be 100 percent holiday free.

2.2.5.1 Silicone Coating

Carbon steel piping surfaces shall be prepared in accordance with SSPC SP 6/NACE 3. The surfaces shall have an alkyd primer of mils dry film thickness followed by two alkyd modified silicone final coats.

2.2.5.2 Zinc Coating

Galvanizing shall be hot-dip applied and meet the requirements of ASTM A 153/A 153M; electroplated zinc or cadmium plating is unacceptable. Stainless steel components may be substituted where galvanizing is specified.

2.2.5.3 Thermoplastic Resin Coating System

Carbon steel piping surfaces shall have a minimum of 4 coats of phenolic type coatings applied at a minimum dry film thickness of 1.6 mils per coat. Each coat shall be baked at 300 degrees F for 10 minutes. The full coating system shall be cured in an oven at 375 degrees F for 30 minutes. Carbon steel piping system components shall be coated with an adhesively mounted polyethylene coating system. The continuously extruded polyethylene and adhesive coating system materials shall conform to NACE RP0185 Type A.

2.2.6 Carbon Steel Cathodic Protection

Buried ferrous piping shall have cathodic protection.

2.2.7 Lined Steel Cathodic Protection

Buried ferrous piping shall have cathodic protection.

2.3 STAINLESS STEEL PIPING SYSTEM

2.3.1 Austenitic Piping

2.3.1.1 Stainless Steel Pipe

Stainless steel pipe intended for general corrosive service shall meet the requirements of ASTM A 312/A 312M, seamless for fit-up and alignment quality, Class SW ASTM A 814/A 814M for flanged and cold-bending quality, Class SW, Grade TP304L, Schedule 40S in accordance with Standard Schedule Pipe

2.3.1.2 Stainless Steel Tubing

Stainless steel tubing shall meet the requirements of ASTM A 269ASTM A 632, welded, Grade TP304LASTM A 789/A 789M, seamless] Grade S32760 with nominal size and wall thickness in accordance with Pipe Schedule.

2.3.1.3 Stainless Steel Joints

Stainless steel piping shall be joined by threaded couplings . Tubing shall be joined using compression fittings. Dielectric fittings or isolation joints shall be provided between all dissimilar metals.

2.3.1.4 Stainless Steel Welding Fittings

Welding fittings shall be butt-welding. Welding fittings shall be forged austenitic stainless steel, ASTM A 403/A 403M Grade TP304L, butt-welding fittings, Class CR, conforming to ASME B16.9 and ASME B16.28socket-welding fittings, Class WP-S, conforming to ASME B16.11.

2.3.1.5 Stainless Steel Flanged Fittings

The internal diameter bores of flanges and flanged fittings shall be the same as that of the associated pipe. The flanges shall be welding neck type. Flanges and flanged fittings shall be forged austenitic stainless steel, ASTM A 182/A 182M Grade TP304L, Class 150, drilled to ASME B16.5 with a . For tie-in to existing flanges, the Contractor shall field check existing flanges for non-standard bolt hole configurations and shall design as required to assure new pipe and flange mate properly. Bolting shall be alloy-steel ASTM A 193/A 193M Grade hex head bolts and ASTM A 194/A 194M Grade 8 hex head nuts. When mating flange on valves or equipment is cast iron, ASTM A 193/A 193M Grade B8 Class 1 bolts and ASTM A 194/A 194M Grade 8 heavy hex head nuts shall be used. Bolts shall be provided with washers of the same material as the bolts. Gaskets shall meet the requirements of ASME B16.5. Nonmetallic gaskets shall conform to ASME B16.21 and be a maximum 1/8 inch thick chloroprene rubber, durometer hardness No.80, 1,500 psi minimum tensile strength, 125 percent minimum elongation, flat ring type for use with raised face flanges and full face type for use with flat face flanges. Metallic ring joint gaskets shall conform to ASME B16.20 and be constructed of

2.3.1.6 Compression Fittings for Tubing

Compression fittings shall be of ASTM A 479/A 479M stainless steel, Grade TP316, nuts, ferrules and bodies rated to a minimum psig. Threads shall be straight conforming to ISO 228-1ASME B1.1.

2.3.2 Ferritic and Martensitic Piping

2.3.2.1 Pipe

Stainless steel pipe shall meet the requirements of ASTM A 268/A 268M, seamless, Grade S44627, Schedule standard in accordance with Pipe Schedule

2.3.2.2 Joints

Stainless steel piping shall be joined by welding fittings flanges.

2.3.2.3 Welding Fittings

Welding fittings shall be butt-welding. Welding fittings shall be forged stainless steel, ASTM A 815/A 815M Grade TP430, butt-welding fittings, Class CR, conforming to ASME B16.9 and ASME B16.28.

2.3.2.4 Flanged Fittings

The internal diameter bores of flanges and flanged fittings shall be the same as that of the associated pipe. The flanges shall be welding neck type. Flanges and flanged fittings shall be forged stainless steel, ASTM A 182/A 182M Grade TP430 6a Class 1, Class 150, drilled to ASME B16.5 with a flat face. Cast stainless steel backing flanges, ASTM A 352/A 352M Grade, Van Stone type, shall be drilled to ASME B16.5ASME B16.1 Class 150. For tie-in to existing flanges, the Contractor shall field check existing flanges for non-standard bolt hole configurations and shall design as required to assure new pipe and flange mate properly. Bolting shall be alloy-steel ASTM A 193/A 193M Grade L7 hex head bolts and ASTM A 194/A 194M Grade 7 hex head nuts. Bolts shall be provided with washers of the same material as the bolts. Gaskets shall meet the requirements of ASME B16.5. Gaskets shall be Teflon, flat ring type for use with raised face flanges and full face type for use with flat face flanges.

2.3.3 Polyethylene (PE) Line designation 35P

2.3.3.1 PE Pipe

The pipe shall be extruded from PE, ASTM D 3350 with a minimum cell classification of 324433-C. The PE pipe shall be Schedule 40 conforming to ASTM D 2447manufactured to an SDR rating in accordance with ASTM D 3035 for piping systems less than 4 inches in diameter, or in accordance with ASTM F 714 for piping systems with a diameter equal to or greater than 4 inches manufactured to an SDR rating in accordance with ASTM D 2239 for use with insert fittings], so that the pressure rating of the pipe shall be consistent for all pipe sizes. The pipe shall be SDR 35 with a pressure rating of 100 psig at 140 degrees F and Schedule 40 conforming to ASTM D 2104 for use with insert fittings.

2.3.3.2 PE Joints

PE pipe shall be joined by thermal butt-fusion socket heat fusion and/or socket electrofusion, except where connecting to valves and equipment that may require future disassembly, then joints shall be flanged.

2.3.3.3 PE Fittings

PE fittings shall have the same or higher pressure rating as the pipe when installed in accordance with the latest technical specifications. PE fittings shall be molded. Butt-fusion fittings shall conform to ASTM D 3261. Socket-fusion fittings shall conform to ASTM D 2683 with tools meeting the requirements of ASTM F 1056. Insert fittings shall conform to ASTM D 2609.

a. Couplings. Couplings and saddle joints shall be joined by electrofusion in accordance with ASTM F 1055.

b. Flanged Fittings. Flanges and flanged fittings shall be Class 150, ASTM A 240/A 240M, TP304 stainless steel backing flanges with ASME B16.1ASME B16.5 drilling. Flanges shall be complete with one-piece, molded PE stub ends. Flanged connections shall have the same pressure rating as the pipe or greater. Bolting shall be stainless steel, ASTM A 193/A 193M, Grade B8 hex head bolts and ASTM A 194/A 194M, Grade 8 hex head nuts. Bolts shall be provided with washers of the same material as the bolts. Gaskets shall be full-faced, maximum 1/8 inch thick, fabricated from polytetrafluoroethylene (PTFE) in accordance with ASME B16.21.

c. Tubing Fittings. Fittings shall be compression type comprised of forged brass alloy C37700, conforming to ASTM B 124/B 124M, nuts, ferrules and bodies acetal polyvinylidene fluoride (PVDF)nuts and bodies, with elastomeric O-ring seals polypropylene bodies, barb and holding nut, rated to a minimum psig with straight threads conforming to ISO 228-1ASME B1.1.

2.4 DOUBLE CONTAINMENT PIPING SYSTEM

Double containment piping systems shall conform to the requirements of ASME B31.3.

2.4.1 Primary (Carrier) Pipe

The primary, or carrier, pipe of the double containment piping system shall be TP304 stainless steel, Schedule 40 or PE Schedule 40, as specified elsewhere in this Section. The primary piping shall be rated at a working pressure of at least 100 psig at a maximum operating temperature of 140 degrees F. The piping shall be free of flanges and other joints that are not compatible with the secondary piping installation. The piping shall be equipped with expansion loops, offsets, or direction changes as necessary to counter thermal expansion and contraction, which shall be coordinated with the secondary piping.

2.4.2 Secondary (Containment) Pipe

The secondary, or containment, pipe of the double containment piping system shall be PE, Schedule 40, as specified elsewhere in this Section. The secondary piping shall be resistant to weathering, impacts, and ambient temperature variations, and rated at a working pressure of at least 100 psig at a maximum operating temperature of 140 degrees F. The piping shall be equipped with expansion joints, expansion loops, offsets, or direction changes as necessary to counter thermal expansion and contraction. Equipment for addressing thermal movement shall be coordinated with the primary piping. The secondary piping shall be drainable and dryable, and capable of being tested using air pressure. The secondary piping system shall be continuous. Drains, vents and pressure relief devices shall be provided as specified elsewhere in this Section. The piping shall be designed to allow pulling of the leak detection cable into the containment pipe both during and after piping installation. Minimum annular clearance shall be 0.75 inches.

2.4.3 Connections and Fittings For Double Containment System

All fittings shall be factory manufactured of material compatible with the process fluids and associated piping. All secondary contained fittings shall be of unitized construction with the carrier and containment integrally anchored together to prevent the movement of the carrier relative to the containment within the fitting. Anchors shall be of sufficient thickness to withstand the maximum possible end loads that will be generated by the carrier pipe during the life of the system. Elbows must be anchored on both ends. Tees must be anchored on both the run and the branch.

2.4.3.1 Fitting Pressure Rating

Pressure rating of connections and fittings shall be greater than or equal to the design pressure of the system with a minimum safety factor of five.

2.4.3.2 End Seals

End seals and other subassemblies shall be designed and factory prefabricated to prevent the ingress of moisture into the system. Subassemblies shall be designed to allow for complete draining of the secondary containment.

2.4.4 Leak Detection

The leak detection system shall be a visual detection system.

2.4.4.1 Visual Leak Detection System

All low points of the secondary piping system shall be equipped with sample valves meeting the requirements specified in paragraph SAMPLE PORTS of this Section.

2.4.5 Supports

Supports shall be designed and supplied for the conveyance and containment piping to prevent distortion of the pipes and strain on joints and fittings. Supports shall be designed by the double containment piping system manufacturer. No field fabricated supports will be allowed. The manufacturer shall design and fabricate the system taking into account pressure and temperature requirements when placing the pipe supports.

2.5 ISOLATION JOINTS AND COUPLINGS

2.5.1 Dielectric Fittings

Dielectric fittings shall be provided between threaded ferrous and nonferrous metallic pipe, fittings and valves. Dielectric fittings shall prevent metal-to-metal contact of dissimilar metallic piping elements and shall be suitable for the required working pressure, temperature and corrosive application.

2.5.2 Isolation Joints

Isolation joints shall be provided between nonthreaded ferrous and nonferrous metallic pipe fittings and valves. Isolation joints shall consist of an isolation gasket of the dielectric type, isolation washers

and isolation sleeves for flange bolts. Isolation gaskets shall be full faced with an outside diameter equal to the flange outside diameter. Bolt isolation sleeves shall be full length. Units shall be of a shape to prevent metal-to-metal contact of dissimilar metallic piping elements.

2.5.3 Metallic Piping Couplings

Thrust ties shall be provided where shown on the contract drawings and where required to restrain the force developed by 1.5 times the maximum allowable operating pressures specified. For metallic pipe other than ductile iron, thrust ties shall be attached with fabricated lugs. For ductile iron pipe, thrust ties shall be attached with socket clamps against a grooved joint coupling or flange. For exposed installations, zinc-plated nuts and bolts shall be used. However, high-strength, low-alloy steel, in accordance with AWWA C111, may be substituted for use on cast iron and ductile iron couplings. For buried and submerged installations, stainless steel bolts and nuts shall be provided. Steel middle rings and followers shall be pressure tested beyond yield point.

2.5.3.1 Sleeve-Type Couplings

Sleeve-type couplings shall be used for joining plain end pipe sections in a flexible manner with a diameter to properly fit the pipe. A coupling shall consist of one steel ductile iron middle ring, two steel ductile iron followers, two elastomeric wedge section gaskets and elliptic-neck, track-head steel bolts designed to properly compress the gaskets. For pipe sizes between 0.5 inch through 1.5 inch, the followers shall be ductile iron, and the middle ring shall be in accordance with ASTM A 513 with AWWA C111 bolting, light pattern coupling. For pipe sizes 2 inches and larger, the followers shall be ASTM A 395/A 395M , and the middle ring shall be ASTM A 513 with AWWA C111 bolting, light pattern coupling. Gaskets shall be natural rubber. Split sleeve-type couplings may be used in aboveground installations under special situations and when approved in advance by the Contracting Officer.

2.5.3.2 Transition Couplings

Transitional couplings may be used to connect two pipes of the same material that have small differences in outside diameter. A fully assembled transitional coupling shall be sized to properly fit pipe diameters. The coupling shall consist of one steel middle ring, two steel followers, two elastomeric wedge section gaskets and elliptic-neck, track-head steel bolts designed to properly compress the gaskets. The coupling shall use natural rubber, insulated gaskets. The coupling shall be sized to match the associated piping.

2.5.3.3 Flanged Coupling Adapters

Flanged coupling adapters shall be fully assembled units manufactured to meet ASTM A 126 Class B, cast iron. The flanges shall mate with ASME B16.1 Class B flanges of the same nominal size. A factory applied corrosion resistant coating shall be applied. The coupling shall use natural rubber gaskets. Where pipe movement out of the adaptor may occur, proper anchorage of the pipe shall be provided and couplings shall be furnished with lock pins. The coupling shall be sized to match the associated piping.

2.5.4 Couplings for Nonmetallic Piping

2.5.4.1 Bellows Coupling

A bellows coupling shall have a minimum of two polytetrafluoroethylene (PTFE) convolutions unless otherwise shown, with ductile iron flanged, faced and drilled to ASME B16.1 Class 150 end connections, and metal reinforcing bands. The maximum allowable working pressure shall be 140 psig] at 120 degrees F. Bolting shall be limited to restrain the force developed by 1.5 times the specified maximum allowable operating pressure. The coupling shall be sized to match the associated piping.

2.6 VALVES

2.6.1 General Requirements For Valves

Valves shall include operator, actuator, handwheel, chain wheel, extension stem, floor stand, worm and gear operator, operating nut, chain, wrench, and all other accessories required for a complete operation. The valves shall be suitable for the intended service. Renewable parts are not to be of a lower quality than those specified. Valves shall be the same size as adjoining pipe. Valve ends shall be compatible with adjacent piping system. An operator shall be sized to operate the associated valve for the full range of pressures and velocities. Valves will open by turning counterclockwise . Operators, actuators, and accessories shall be factory mounted.

2.6.2 Valve Schedule

Requirements relative to this paragraph are shown on the Valve Schedule and Operator Schedule located in the contract drawings.

2.6.3 Check Valves

2.6.3.1 Swing Check Valves

Swing check valves shall conform to the following:

a. Swing check valves, 2 inches and smaller, shall have a TP316 stainless steel body, in accordance with ASME B16.11 socket-welding ASME B16.11 threadedASME B16.5 flangedASME B16.1 flangedASME B16.18 solder joint ends. Valves shall have a swing type, replaceable butadiene acrylonitrile polytetrafluoroethylene (PTFE) disc. Valves shall be rated for 200 psig service.

b. Swing check valves, 2.5 inches through 12 inches, shall have a TP316 stainless steel body, in accordance with ASME B16.11 socket-weldingASME B16.11 threadedASME B16.5 flangedASME B16.1 flanged ends. Valves shall have a bronze-mounted swing type, hinges, and stainless steel hinge shaft with outside lever and weight spring. Valves shall be rated for 200 psig service.

c. Swing check valves, 2 inches through 36 inches, shall conform to AWWA C508, and have ASME B16.1 Class flanged, welding, mechanical joint grooved end connections. Valves shall have a TP316 stainless steel body, bronze -mounted disc, solid ductile iron hinges, and a stainless steel hinge shaft. Valves 2 inches through 12 inches shall be rated for 175 psig service and valves 14 inches through 36 inches shall be rated for 150

psig service at 140 degrees F. Valves shall be fitted with an adjustable outside lever and spring adjustable outside lever and weight. An increasing-pattern body valve may be used where increased outlet piping size is shown.

2.6.3.2 Thermoplastic Check Valve

Thermoplastic check valves, 0.25 inch through 16 inches, shall be a ball-check design, manufactured of polyvinyl chloride (PVC) chlorinated polyvinyl chloride (CPVC) polypropylene (PP) polyvinylidene fluoride (PVDF) with flanged socket threaded, in accordance with ASME B1.20.1, end connections. Valves shall be rated for 150 psig service. Valves shall have fluoro-elastomeric O-ring seals and seats. Discs shall be fitted with a polyvinyl chloride (PVC) coil guide. Caps shall be of hex design.

2.6.3.3 Ball Check Valve

Ball check valves, 1 inch and larger, shall be in accordance with ASME B16.11 socket-weldingASME B16.11 threadedASME B16.5 flanged ends, and cast TP316 stainless steel polyvinyl chloride (PVC) bodies with a cleanout and floating ball. Flanges shall be ASME B16.1 Class 125. Valves shall be rated for 100 psig service and shall be suitable for vertical or horizontal flow.

2.6.4 Gate Valves

2.6.4.1 General Service Gate Valves

General service gate valves shall conform to the following:

a. Gate valves, 2 inches and smaller, shall have bronze bodies and stems, screwed bonnets, single solid wedge bronze discs, and rising stems. Valves shall be rated for 175 psig service and conform to ASME B16.34 Class A1. End connections shall be ASME B16.5 flanged ASME B16.1 flanged or ASME B16.11 threaded. Valves shall be equipped with handwheel operators.

b. Gate valves, 2.5 inches and larger, shall have Ni-resistant bodies with Ni-resistant stainless steel trim. Valves shall meet the requirements of AWWA C500AWWA C509 and have Class 250 flanged, in accordance with ASME B1.20.1, mechanical joint end connections. Bonnet shall be a clamp OS&Y Bolted type. Discs shall be per RFAAP requirements. Each gate valve, 16 inches and larger, shall include a by-pass of the same materials as the gate valve. The bypass shall meet the requirements of AWWA C500. Valves shall be rated for 200 psig service. Valves shall be equipped with handwheel operators.

2.6.5 Globe Valves

2.6.5.1 General Requirements For Globe Valves

Globe valves, 3 inches and smaller, shall be globe style valve and shall have TP316 stainless steel bodies, with stainless steel trim, and bonnets. Valves shall conform to ASME B16.34 Class A1, and shall have ASME B16.11 socket-weldingASME B16.11 threadedASME B16.5 flangedASME B16.1 flangedASME B16.18 solder joint end connections. Valves shall include threaded OS&Y bonnets, inside screws, rising stems, discs constructed of stainless steel , and stainless steel rings. Valves shall be rated for 200 psig

service. Valves shall be equipped with handwheel operators.

2.6.6 Butterfly Valves

2.6.6.1 Standard Service Butterfly Valve

Butterfly valves, 2 inches and larger, shall have iron stainless steel bodies, wafer with ASME B16.5 flanged end connections. Valves shall conform to AWWA C504 Class 150. Discs shall be contoured ASTM A 436 Type 1 Ni-resist cast iron with maximum lead content of 0.003 percent stainless steel. The valve shafts shall bestainless steel with self-lubricating, corrosion-resistant sleeve type bearings. Valve seats for 24 inch and smaller valves shall be attached to either the valve body or the disc and shall be constructed of chloroprene and approved equal. Valves shall have manual, locking hand lever.

2.6.7 Operators

2.6.7.1 Manual Operator

The force in a manual operator shall not exceed 39.3 pound under any operating condition, including initial breakaway. The operator shall be equipped with gear reduction when force exceeds 39.3 pound. The manual operator shall be a self-locking type or shall be equipped with a self-locking device. A position indicator shall be supplied on quarter-turn valves. Worm and gear operators shall be a one-piece design with worm-gears of gear bronze material. Worm shall be hardened alloy steel with the thread ground and polished. Traveling nut type operators shall have threader steel reach rods with an internally threaded bronze or ductile iron nut.

a. Exposed Operators. Exposed operators shall have galvanized and painted handwheels. Lever operators are allowed on quarter-turn valves 8 inches and smaller. Cranks shall be supplied on gear type operators. If located off of the operator floor, chain wheel operator with tiebacks, extension stem, floor stands, and other accessories shall be provided to permit operation from normal operation level. Valve handles shall be capable of padlocking, and wheels shall be lockable with a chain and padlock.

b. Underground Operators. Buried service operators on valves larger than 2.5 inches shall have a 2 inch operating nut. Buried operators on valves 2 inches and smaller shall have a cross handle for operation by a forked key. The moving parts of valve and operator shall be enclosed in housing to prevent contact with the soil. Buried service operators for quarter-turn valves shall be designed to withstand an input torque of 450 foot-pound of input torque at the fully open or fully closed positions, and shall be grease packed and gasketed to withstand a submersion in water to 10.2 psig. Buried valves shall have extension stems, bonnets, and valve boxes.

2.6.7.2 Pneumatic Operator

Pneumatic operators shall be provided complete with actuators, air sets, exhaust mufflers, speed controls, pilot solenoids, safety vented isolation valves, and accessories. The pneumatic operators shall be suitable for full operation range of valve at air supply pressure indicated. Actuators shall return the valve to the closed position upon loss of signal unless

otherwise indicated. Springs shall return valve to this failed position. Pneumatic operators shall be furnished with features noted on the Operator Schedule in the contract drawings. Limit switches shall be provided on all actuators.

a. Cylinder Actuators. Cylinder actuators shall conform to AWWA C540 and operate with an air supply pressure of 80 psig. The nonswivel type shall be totally enclosed with travel stops and position indicator, and shall be factory lubricated and sealed, requiring no additional lubrication. The double acting type shall be nonmetallic for operation on nonlubricated air and shall have a manual override independent of the cylinder. The manual overide shall be located as directed by CO.

b. Diaphragm Actuators. Diaphragm actuators shall have a spring return with a steel or aluminum diaphragm case and spring barrel, steel spring and actuator stem, and fabric-reinforced chloroprene diaphragm. The actuators used on quarter-turn valves shall include a totally enclosed valve actuating mechanism with adjustable travel stops and valve position indicator with manual override if indicated. The actuating mechanism shall be factory lubricated and sealed. Diaphragm actuators shall be sized and configured for the service indicated and an air supply pressure of 35 psig.

c. Air Sets. The air set shall include a pressure regulator with internal relief, filter, outlet pressure gauge, and adjustable reduced pressure range as required by the valve actuator. The air set shall have an aluminum body and handwheel, safety vented lockout isolation valve, and gauge range 1.33 to 2 times maximum operating pressure.

d. Limit Switches. Limit switches shall be single-pole, double-throw (SPDT) type, rated 10 amps at 120 volts ac, housed in a NEMA 250 Type 4 enclosure, and adjustable for open and closed valve positions.

e. Positioners. The positioners for modulating actuators shall be pneumatic force balance instruments to control valve positions as a function of the input signals. The positioners shall accomplish positive positioning of valve by a mechanical feedback connection from the valve actuating mechanism. Position feedback shall be provided through a characterized linear cam to allow adjustment of valve positioning and input signal. The positioner shall be suitable for either a double acting or spring return actuator. The positioner shall have zero and span adjustment and be field reversible for direct or reverse action. Gauges shall be included for supply and output pressure and for input signal pressure. Modulating valve positioners shall operate on a 3 to 15 psig pneumatic or 4 to 20 mA electric input signal unless otherwise indicated. A positioner for dc input signal with transducers shall convert the electrical signal to the appropriate pneumatic signal. The transducer shall be integral with the positioner or a separate component. If separate, the transducer shall be factory mounted on the pneumatic operator. Line electric power not shall not be required for transducer operation. Corrosion-resistant enclosures for positioners and transducers shall be splash- and moisture-proof with gasketed covers.

f. Solenoid Valve. A solenoid valve shall pilot the control actuator in the appropriate configuration for the type of actuator being controlled. A pilot operated diaphragm type solenoid valve shall have a brass body and resilient seat and operate with minimum operating pressure differential no greater than 10.2 psi and maximum operating pressure differential no less than 150 psi. Internal parts shall be corrosion-resistant. The solenoid valve shall have Class F molded coils for operation on 120 volts, 60-Hz, ac, unless otherwise indicated. The solenoid enclosure shall conform to NEMA 250 Type 4. Solenoids on double acting cylinders for open-close and throttling valves shall be four-way with dual coils. Solenoids on spring return cylinders for open-close and throttling valves shall be three-way, spring return. An air exhaust muffler shall be furnished in the exhaust port of all actuator pilot solenoid valves.

2.6.7.3 Electric Operator

Electric operators shall be provided complete with actuators, speed controls and accessories. The actuators shall operate on 120 VAC, 60 Hz with a 75 percent duty cycle and shall be equipped with an AC thermal overload protector with automatic rest, reversing bi-directional operation for use with quarter-turn valves, or rotating equipment to full rotation. Gearing shall be a two-stage planetary, permanently lubricated self-locking gear train with self-lubricating bearings; connections via male output staff. The start-up torque shall be 120 foot-pound. The stall torque shall be 150 foot-pound. Two travel stop limit switches with cams, internal, independent, adjustable, and actuated by cams shall be mounted on the drive shaft. A side mounted hand turn wheel shall be provided for a manual override. The actuators shall have a NEMA 250 Type 4 enclosure with a corrosion resistant, baked epoxy finish as standard. The actuator shall operate in a temperature range of -40 to 150 degrees F. Actuators shall fail in last position unless otherwise indicated. Electric operators shall be furnished with features noted on the Valve Schedule in the contract drawings. Limit switches shall be provided on all actuators.

a. Limit Switches. Limit switches shall be single-pole, double-throw (SPDT) type, rated 10 amps at 120 volts ac, housed in a NEMA 250 Type 4 enclosure, and adjustable for open and closed valve positions.

b. Positioners. The positioners for modulating actuators shall control valve positions as a function of the input signals. The positioner shall operate on 120 VAC, 60 Hz. voltage. The mode of operation shall be direct acting. Modulating valve positioners shall operate on a 4 to 20 mA input signal unless otherwise indicated. Corrosion-resistant enclosures for positioners shall be splash-and moisture-proof with gasketed covers.

2.6.8 Valve Accessories

2.6.8.1 Tagging

Identification tags made of brass indicating service and valve number shown on the Valve Schedule in the contract drawings shall be installed on valves using No. 12 AWG copper wire. Tags shall be 1.375 inch] minimum diameter. Indentations shall be black for reading clarity.

2.6.8.2 Extension Bonnet for Valve Operator

All extension bonnets shall be provided as necessary, complete with stem and accessories applicable to the specific valve and operator.

2.6.8.3 Floor Stand and Extension Stem

A floor stand and extension stem shall be the nonrising, indicating type; complete with stem, coupling, handwheel, stem guide brackets, and yoke attachment. The stem guide shall be spaced such that stem L/R ratio does not exceed 200. Anchors shall be supplied as required.

2.6.8.4 Floor Box and Stem

A floor box and stem shall be the plain type, for support of nonrising type stem; complete with stem, operating nut, and stem guide brackets. The stem guide shall be spaced such that stem L/R ratio does not exceed 200. Anchors shall be supplied as required.

2.6.8.5 Chain Wheel and Guide

A chain wheel and guide shall be the handwheel direct-mount type, complete with galvanized or cadmium-plated chain.

2.6.8.6 Valve Box

The Contractor shall provide valve boxes as follows: Cast iron valve boxes designed for traffic loads, and which are the sliding type with shafts that are a minimum of 6 inches in internal diameter. The boxes shall be cast iron with minimum depth of 10 inches. The lids shall be cast iron with a 3.1 inches minimum depth. Concrete valve boxes shall be designed for traffic loads, sliding type with shafts that have a minimum 8 inches internal diameter. The boxes shall be concrete, minimum depth inches, and have a cast iron ring seat. The lids shall be cast iron, minimum depth 3.1 inches, marked. Extensions shall be concrete acrylonitrile-butadiene-styrene (ABS), polyvinyl chloride (PVC) or cast iron pipe.

2.7 DRAINS

Valved drains may not be shown on the detailed drawings for individual pipelines; their absence will not relieve the Contractor of the responsibility for providing and installing them as indicated in the piping and instrumentation diagrams to complete the piping system for the use intended.

2.7.1 Locations

Drains shall be located as indicated on the contract drawings. All pipeline low points shall be drained.

2.7.2 Sizes

For pipelines 2.5 inches and larger, drains shall be 0.75 inch and equipped with globe valves. For pipelines 2 inches and smaller, drains shall be 0.5 inch and equipped with globe valves.

2.8 SAMPLE PORTS

Sample ports, shown on the flow diagrams and piping and instrument diagrams of the contract drawings, may not be shown on the detailed drawings of the individual pipelines; their absence shall not relieve the Contractor of the responsibility for providing them. Sample ports shall be provided as indicated in the piping and instrument diagrams to complete the piping systems for the use intended. The sample ports shall be located in easily accessible locations, and shall avoid potential stagnant points and/or areas where material could collect. A plug-type sampling valve with a stainless steel piston that extends beyond the inner surface of the pipe when closed shall be provided at all the sampling ports. The piston shall be sealed by two compressible replaceable polytetrafluoroethylene (PTFE) rings, one above the discharge port, the other below the discharge port. The valve body shall be stainless steel Class 150 with a male ASME B1.20.1 pipe threads inlet connection and female ASME B1.20.1 pipe threads outlet connection. Sampling ports shall be comprised of pipe fittings, pipe, and gate valves which comply with material, temperature, and pressure requirements of the associated piping system as specified elsewhere in this Section. A double block and bleed configuration shall be provided.

2.9 MISCELLANEOUS PIPING COMPONENTS

2.9.1 Air Release and Vacuum Breakers

Air release vents shall be located, and vented, such that a hazardous atmosphere will not be created upon operation.

2.9.1.1 Locations

Air release and vacuum breakers shall be located as indicated on the contract drawings. All pipeline high points shall have air release vents and vacuum breakers. Vacuum breakers shall be provided on all tanks and process equipment.

2.9.1.2 Vacuum Breakers

Vacuum breakers 2 inches and smaller shall be an angle type with all semi-steel bodies and bonnets, and shall be installed at least 6 inches above the flood line of associated equipment and shall conform to ASSE 1001 for pipe applied units.

2.9.1.3 Air and Vacuum Valve Suitable for Corrosive Service

The air and vacuum valve shall conform to ASSE 1001 ASSE 1020, and automatically exhaust air during the filling of a system while allowing air to re-enter during draining or when vacuum occurs. The valve shall be rated for 150 psig working pressure and built with a special short body. The valve shall have a semi-steel body and cover, with stainless steel float and trim. End connections shall be as follows: for 0.5 inch through 3 inches ASME B1.20.1 pipe threaded inlet and outlet, for 4 inches and larger ASME B16.5ASME B16.1 Class flanged inlet with outlet. The air and vacuum valve shall be fitted with blowoff valve, quick disconnect couplings, and a minimum 6.6 feet of hose in order to permit back flushing after installation without dismantling the valve.

2.9.1.4 Air Release Valve Suitable for Corrosive Service

The air release valve shall automatically exhaust entrained air that accumulates in a system and shall be Factory Mutual listed ASSE approved. The valve shall be rated for 150 psig working pressure and built with a

special short body. The valve shall have a semi-steel body and cover, with stainless steel float and trim. Valve end connections shall be ASME B1.20.1 pipe threaded ASME B16.5ASME B16.1 Class flanged . The air and vacuum valve shall be fitted with blowoff valve, quick disconnect couplings, and a minimum 6.6 feet of hose in order to permit back flushing after installation without dismantling the valve.

2.9.1.5 Combination Air Valve Suitable for Corrosive Service

The valve combines the operating functions of both an air and vacuum valve and an air release valve. The air and vacuum portion shall automatically exhaust air during filling of a piping system and allow air to re-enter during draining or when a vacuum occurs. Air release portion shall automatically exhaust entrained air that accumulates in the piping system. The valve shall be a single body unit or an individual air and vacuum valve and an air relief valve mounted on a common header. The valve shall be rated for 150 psig working pressure and built with a special short body. The valve shall have a semi-steel body and cover, with stainless steel float and trim. Valve end connections shall be ASME B1.20.1 pipe threaded ASME B16.5ASME B16.1 Class flanged . The air and vacuum valve to be fitted with a blowoff valve, quick disconnect couplings, and a minimum 6.6 feet of hose in order to permit back flushing after installation without dismantling the valve.

2.9.2 Backflow Preventer

The backflow preventer shall be identical in size to pipe. Total head loss through the complete backflow assembly shall not exceed 10.1 psi at rated flow.

2.9.2.1 Reduced Pressure Backflow Preventer

The assembly body shall be two independent bronze epoxy coated cast iron body check valves rated at 150 psig at 140 degrees F, with an intermediate relief valve, and isolation gate valve, full-ported ball valves as testing cocks. All internal parts shall be serviceable in-line. Port sizes shall be 1 inch and be ASME B1.20.1 threaded, female . The reduced pressure backflow prevention assembly shall be rated for 150 psig working pressure at 150 degrees F. The assembly body shall be in accordance with AWWA C511ASSE 1013.

2.9.2.2 Backflow Preventer with Intermediate Vent

The assembly body shall be two independent bronze epoxy coated cast iron body check valves rated at 175 psig at 140 degrees F, with an intermediate atmospheric vent, and isolation gate valve, full-ported ball valves as testing cocks. Port sizes shall be 1 inch and be ASME B1.20.1 threaded, . The backflow prevention assembly shall be rated for 150 psig working pressure at 150 degrees F. The assembly body shall be in accordance with AWWA C511ASSE 1012.

2.9.3 Strainers

Strainers shall be duplex with a Y-pattern body. Port sizes shall be 1 inch and be ASME B1.20.1 threaded, female male. The strainers shall be rated for 150 psig working pressure at 150 degrees F and conform to ASTM F 1199 ASTM F 1200. The body shall be cast iron with a bolted iron cap. The screen shall be heavy-gauge stainless steel Monel, 30 mesh and be equipped with a ASME B1.20.1 pipe threaded blowoff hole.

2.9.4 Indicating Devices

2.9.4.1 Pressure and Vacuum Gauges

Pressure and vacuum gauges shall be stem flush mounted, with glass filled nylon glass filled polypropylene (PP) cases equipped with safety pressure blowout backs and dry glycerine -filled dials. The gauge sensors shall be C-Type Bourdon tube actuated and constructed of Inconel. The gauges shall be equipped with TP316L stainless steel threaded 0.25 inch male connections. The dials of the gauges shall be 4.5 inches in diameter with scale readings in psig and inches of mercury ranging from zero to approximately twice the anticipated process operating or equipment pressure. A slotted adjustable pointer shall be provided with accuracy to conform to ASME B40.1, Grade A. A lever handled gauge cock and filter type snubber shall be provided. The gauges shall be isolated from the process fluids using remote corrosion resistant diaphragm seals. The housing of the corrosion resistant seals shall be constructed of stainless steel. Seals shall be composed of Monel.

2.9.4.2 Thermometers

Thermometers shall be bi-metal actuated, with 5 inches dished anti-parallax dials that have external calibration adjustment and stainless steel cases. The thermometers shall have stainless steel stems, back-connection type for the correct viewing angle. The union connections with associated thermowells shall be included. Scale shall be 25 to 125 degrees F with accuracy within one scale division.

2.9.4.3 Thermowells

Thermowells shall be TP316 stainless steel with a diameter of 1 inch. The length shall be as shown on the contract drawings and coordinated with the associated temperature element. Process connections shall be constructed of stainless steel and shall have flanges, faced and drilled to ASME B16.5 Class 150 fixed hex nipples male ASME B1.20.1 threaded sockets. Thermowells that shall be used with thermocouples or RTDs shall be equipped with terminal connection heads rated NEMA 250 Type 4X.

2.9.5 Expansion Joints

The Contractor shall provide all structural work and equipment required to control expansion and contraction of piping. The Contractor shall verify that the anchors, guides, and expansion joints provided, adequately protect the piping systems.

2.9.5.1 Expansion Joint for Metallic Pipe

The expansion joint shall be single slip teflon type with stainless steel wetted materials of construction. The expansion joint shall be sized to match the associated piping. The maximum allowable working pressure shall be 150 psig at 120 degrees F. End connections shall be as specified for the associated pipe jointsASME B16.5ASME B16.1 Class flangedASME B16.11 threaded welding. Required accessories for a complete assembly shall be provided including: swivel joints, limit stops, internal guides, anti-torque device, internal flow liners, control rods.

2.9.5.2 Expansion Joint for Nonmetallic Piping

A bellows expansion joint shall have a minimum of convolutions to accommodate an axial deflection of 1 inch, a lateral movement of 1 inch, and an angular rotation of 2 degrees, with ductile iron flanged, faced and drilled to ASME B16.1ASME B16.5 Class 150, end connections, and metal reinforcing bands. The maximum allowable working pressure shall be 140 psig at 120 degrees F. Bolting shall be limited to restrain the force developed by 1.5 times the specified maximum allowable operating pressure. The expansion joint shall be sized to match the associated piping.

2.9.6 Pressure Relief Devices

Pressure relief devices shall conform to the requirements of ASME B31.3.

2.9.6.1 Pressure-Relief Valve

Pressure-relief valves shall conform to the following:

a. Pressure-relief valves, 2 inches and smaller, shall be a direct diaphragm, spring controlled type with cast iron bodies and spring cases. Trim shall be stainless steel and seats, nitrile. Diaphragms shall be elastomeric, nylon reinforced butadiene acrylonitrile rubber. Miscellaneous parts such as the valve stems, nuts, and springs shall be stainless steel. End connections shall be flanged, faced and drilled to ASME B16.1ASME B16.5 Class 150ASME B16.11 threaded. The valves shall open when the upstream pressure reaches a maximum set point. Sizes and ratings as shown in the Valve Schedule in the contract drawings.

b. Pressure relief valves, 2.5 inches and larger, shall be hydraulically operated, diaphragm actuated, pilot controlled globe angle valves with externally mounted strainers and test cocks. Bodies shall be cast iron and trim shall be stainless steel. Stem shall be stainless steel. End connections shall be flanged, faced and drilled to ASME B16.1ASME B16.5 Class 150ASME B16.11 threaded. The valves shall open when the upstream pressure reaches a maximum set point. Sizes and ratings as shown in the Valve Schedule in the contract drawings.

2.10 PIPE SUPPORTS AND PENETRATIONS

Pipe supports shall be in accordance with MSS-SP-58 & 69. Auxiliary steel shall be provided by the Contractor where the support of piping systems and equipment is required between building structural elements. Light gauge and structural steel shapes shall conform to the requirements of ASTM A 36/A 36M. The Contractor shall have the option to use pre-engineered support systems of electrogalvanized steel products. However, a mixture of support system manufacturers products is not permitted. Where auxiliary steel is indicated as stainless steel, the Contractor shall provide TP304 stainless steel conforming to ASTM A 167, No. 1 Finish. For pipe supports in and around stainless steel tanks use same grade stainless steel support material.

2.10.1 Pipe Supports

Pipe supports shall conform to the requirements of MSS SP-58, MSS SP-69, and MSS SP-89. Where pipe supports contact bare piping or in-line devices, provide supports of compatible material so that neither shall have a deteriorating action on the other.

2.10.1.1 Beam Clamps

For upper attachments on structural steel, the Contractor shall provide beam clamps of ASTM A 36/A 36M carbon steel or ASTM A 181/A 181M forged steel and MSS SP-58 Types 19 through 23, 25 or 27 through 30. Holes drilled in structural steel for hanger support rods will not be permitted. Clamps shall be provided with hardened steel cup-point set screws and lock-nuts for anchoring in place. Clamp size selection shall only be based on the support of the required load.

2.10.1.2 Riser Clamps

Vertical runs of piping shall be supported at each floor, or closer where required, with ASTM A 36/A 36M carbon steel clamps bolted around pipes and attached to the building construction. Copper plated clamps shall be provided for copper tubing support. Two bolt-type clamps designed for installation under insulation shall be used on insulated pipe runs.

2.10.1.3 Brackets

Where piping is run adjacent to walls or steel columns, the Contractor shall provide welded ASTM A 36/A 36M steel brackets, pre-punched with a minimum of two fastener holes.

2.10.1.4 Offset Pipe Clamp

Where pipes are indicated as offset from wall surfaces, a double-leg design two-piece pipe clamp shall be supplied by the Contractor.

2.10.1.5 Racks

Multiple pipe racks or trapeze hangers shall be fabricated from ASTM A 36/A 36M steel , and designed to suit the conditions at the points of installation. Pipes shall be kept in their relative positions to each other by the use of clamps or clips. Pipelines subject to thermal expansion must be free to slide or roll.

2.10.1.6 Hangers

Hangers shall be fabricated of malleable iron, ASTM A 47/A 47M or ASTM A 36/A 36M carbon steel. All hangers shall be of a uniform type and material for a given pipe run and application. Coated or plated hangers shall be used to isolate steel hangers from dissimilar metal tube or pipe. Hangers for pipe sizes 2.5 inches or larger shall incorporate a means of vertical adjustment after erection while supporting the load. For piping systems with operating temperatures from 122 to 446 degrees F the following shall be used: MSS SP-58 Type 1 or 3 through 12 hangers with overhead support and appropriate saddle of MSS SP-58 Type 40 for insulated pipe; MSS SP-58 Types 41 or 43 through 46 hangers or supports with roller support and appropriate saddle of MSS SP-58 Type 39 on insulated pipe;MSS SP-58 Types 35 through 38 for sliding support. For piping systems with liquid temperatures up to 122 degrees F the following shall be used: MSS SP-58 Types 1,3 through 12, Types 24 and 26 with overhead support, or Types 35 through 38 with support from below.

2.10.1.7 Hanger Rods

Hanger rods shall be carbon steel conforming to ASTM A 576. The diameter of the rods for piping system support shall conform to and MSS-SP-58 & 69.

2.10.2 Pipe Guides

2.10.2.1 Intermediate Guides

For piping 6 inch and smaller, a pipe clamp with an oversize pipe sleeve shall be provided for a minimum .16 inch clearance. For piping 8 inch and larger, U-bolts with double nuts that are manufactured for the purpose shall be used to provide a minimum 0.28 inch clearance around pipe. The stock sizes for the U-bolts are as follows: for a 8 inch pipe use a 0.625 inch U-bolt; for a 10 inch pipe, use a 0.75 inch U-bolt; for a 12 inch to 16 inch pipe, use a 0.875 inch U-bolt; and for 18 inch to 30 inch pipes use 1 inch U-bolts.

2.10.2.2 Alignment Guides

For piping, 8 inch and smaller, alignment guides shall be galvanized steel, spider or sleeve type. For piping, 10 inch and larger, alignment guides shall be galvanized steel, roller type guides.

2.10.3 Flashing Sleeves

Galvanized steel flashing sleeves shall be installed wherever piping passes through concrete roof structures. Where piping penetrates roofs, 2 kg (4 lb.) 4 lb lead flashing shall be provided. The flashing shall extend mm inches from the pipe in all directions, extend up the pipe, and shall be fitted with double-threaded flashing for pipes 75 mm 3 inches and smaller. Flashing shall turn down inside the pipe for 100 mm 4 inches] mm inches and larger pipes.

2.10.4 Wall Penetrations

2.10.4.1 Above Grade Wall Penetrations

Piping which passes through fire-rated or smoke-rated walls, floors, or ceilings shall be provided with insulated and encased pipe sleeves. Penetrations through an existing fire or fire barrier wall shall be sealed with a fire stop system that has an "F" rating not less than the required fire resistance rating of the penetrated wall. The fire stopping sealant for metal piping systems shall be a water based vibration resistant, polysiloxane (also known as silicone) based, nonslumping, premixed sealant with intumescent properties , that is rated for hours pursuant to ASTM E 814 and UL requirements. The fire stopping sealant for plastic and insulated piping systems shall be a polysiloxane (also known as silicone) based, nonslumping, premixed sealant with intumescent properties acrylic based, nonslumping, premixed sealant with intumescent properties, that is vibration and moisture resistant, and is rated for 3 hours pursuant to ASTM E 814 and UL requirements with metal collars. Vented plastic pipe penetrations shall be fitted with galvanized steel collars that have intumescent inlays.

2.10.4.2 Below Grade Wall Penetrations

Below-grade wall penetrations shall be provided with hydrostatic seals designed to seal opening between pipe or conduit and a through-structure opening. The seals shall be modular mechanical type consisting of Teflon gaskets.

2.10.4.3 Galvanizing

Galvanizing shall be hot-dip applied and meet the requirements of ASTM A 153/A 153M]. Stainless steel components may be substituted where galvanizing is specified.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Protection

Pipe and equipment openings shall be closed with caps or plugs during installation. Equipment shall be protected from dirt, water, and chemical or mechanical damage.

3.1.2 System Preparation

3.1.2.1 Pipe and Fittings

Pipe and fittings shall be inspected before exposed piping is installed or buried piping is lowered into the trench. The Contractor shall clean the ends of pipes thoroughly, remove foreign matter and dirt from inside of pipes, and keep piping clean during and after laying.

3.1.2.2 Damaged Coatings

The Contractor shall repair damaged coating areas in the field with material equal to the original coating, except for damaged glass-lined pipe which shall be promptly removed from the site. The Contractor shall not install damaged piping materials. Field repair of damaged and uncoated areas of galvanized piping shall conform to ASTM A 780.

3.1.2.3 Field Fabrication

The Contractor shall notify the Contracting Officer at least 2 weeks prior to the field fabrication of pipe or fittings and at least 3 days prior to the start of any surface preparation or coating application work. Field welding shall be performed in accordance with Section 05093 WELDING PRESSURE PIPING. Welding electrodes shall be provided in accordance with Table 4.1 of AWS D1.1 as required for the applicable base metals and welding process. Fabrication of fittings shall be performed in accordance with the manufacturer's instructions.

3.2 EXPOSED PIPING INSTALLATION

Exposed piping shall be run as straight as practical along the alignment shown on the contract drawings and with a minimum of joints. Piping and appurtenances shall be installed in conformance with reviewed shop drawings, manufacturer's instructions and ASME B31.3. Piping shall be installed without springing or forcing the pipe.

3.2.1 Anchors and Fasteners

Impact expansion (hammer and explosive charge drive-type) anchors and fastener systems are not acceptable. Lead shields, plastic or fiber inserts, and drilled-in plastic sleeve/nail drive systems are also not acceptable.

3.2.1.1 Drilled-In Expansion Anchors and Fasteners

Anchors shall be designed to accept both machine bolts and/or threaded rods. Such anchors shall consist of an expansion shield and expander nut contained inside the shield. The expander nut shall be fabricated and designed to climb the bolt or rod thread and simultaneously expand the shield as soon as the threaded item, while being tightened, reaches, and bears against the shield bottom. The shield body shall consist of four legs, the inside of each shall be tapered toward shield bottom (or nut end). The end of one leg shall be elongated and turned across shield bottom. The outer surface of shield body shall be ribbed for grip-action. The expander nut shall be of square design with sides tapered inward from bottom to top. The anchor materials of construction shall be TP304 stainless steel of 43,541 psi minimum tensile strength. Fasteners shall be machine bolts for use with above anchors; nuts and washers shall conform to ASTM A 194/A 194M. The anchor length, diameter, and embedment depth shall meet the manufacturer's requirements for the maximum allowable working load of the application. The anchor/fastener assembly shall be UL listed with a one-piece stud (bolt) that has integral expansion wedges, nuts and washers. The stud shall be constructed of TP304 stainless steel, and nut and washer of TP304 stainless steel. The anchor length, diameter, and embedment depth shall meet the manufacturer's requirements for the maximum allowable working load of the application.

3.2.1.2 Drilled-In Adhesive Anchors

Drilled-in adhesive anchors shall not be used for overhead applications. The anchors shall be composed of an anchor rod assembly and an anchor rod adhesive cartridge. The anchor rod assembly shall be a chamfered and threaded stud rod of TP304 stainless steel with a nut and washer of ASTM A 194/A 194M alloy-steel TP316 stainless steel. The anchor length, diameter, and embedment depth shall meet the manufacturer's requirements for the maximum allowable working load of the application. The adhesive cartridge shall be a sealed capsule containing premeasured amounts of resin, quartz sand aggregate, and a hardener contained in a separate vial within the capsule. The capsule ingredients shall be activated by the insertion procedure of the anchor rod assembly.

3.2.2 Piping Expansion Provisions

The piping shall be installed to allow for thermal expansion resulting from the difference between installation and operating temperatures. Anchors shall be installed as shown in the contract drawings to withstand expansion thrust loads and to direct and control thermal expansion. An intermediate pipe guide shall be installed for every pipe at each metal channel framing support not carrying an anchor or alignment guide. Where pipe expansion joints are required, pipe alignment guides shall be installed adjacent to the expansion device and within four pipe diameters. Expansion devices shall be installed in accordance with the manufacturer's instructions and at the locations shown in the contract drawings.

3.2.3 Piping Flexibility Provisions

Thrust protection shall be provided as required. Flexible couplings and expansion joints shall be installed at connections to equipment, and where shown on the contract drawings. Additional pipe anchors and flexible couplings beyond those shown on the contract drawings, shall be provided to facilitate piping installation, in accordance with reviewed shop drawings.

3.2.4 Couplings, Adapters and Service Saddles

Pipes shall be thoroughly cleaned of oil, scale, rust, and dirt in order to provide a clean seat for gaskets. Gaskets shall be wiped clean prior to installation. Flexible couplings and flanged coupling adapter gaskets shall be lubricated with soapy water or the manufacturer's standard lubricant before installation on the pipe ends. Couplings, service saddles, and anchor studs shall be installed in accordance with manufacturer's instructions. Bolts shall be tightened progressively, drawing up bolts on opposite sides a little at a time until all bolts have a uniform tightness. Torque-limiting wrenches shall be used to tighten bolts.

3.2.5 Piping Equipment/Component Installation

Piping components and indicators shall be installed in accordance with manufacturer's instructions. Required upstream and downstream clearances, isolation valves, and miscellaneous devices shall be provided for an operable installation. Straight runs of piping upstream and downstream of flow measuring devices shall be as shown in the contract drawings. The upstream and downstream lengths of undisturbed piping shall be in accordance with flow indicator manufacturer's recommendations.

3.2.5.1 Backflow Preventers

Backflow preventers shall be installed with nameplate and test cocks accessible from front of unit, and with a minimum clearance of 12.2 inches between the port and grade. The assemblies shall be installed in accordance with local codes and shall discharge to an open drain with an air gap; vertical installation shall be avoided.

3.2.5.2 Local Indicators

All direct-reading indicator devices, thermometers, and pressure gauges shall be installed so that they can be easily read from floor level, and are readily accessible for maintenance and service. All temperature sensing bulbs shall be coated with a silver base heat transfer grease prior to insertion into the thermowell. Pressure gauges and thermometers shall be installed where indicated in the contract drawings. Field calibration of all indicators shall be performed at time of installation to ensure measuring and reading accuracy. Differential pressure gauges shall be installed across the process equipment indicated in the contract drawings, in accordance with the manufacturer's recommendations, and arranged for easy observation.

3.2.6 Pipe Flanges

Pipe flanges shall be set level, plumb, and aligned. Flanged fittings shall be installed true and perpendicular to the axis of the pipe. The bolt holes shall be concentric to the centerline of the pipe and shall straddle the vertical centerline of the pipe.

3.2.7 Valve Locations

Valves shall be located in accordance with the contract drawings where actuators are shown. Where actuators are not shown, valves shall be located and oriented to permit easy access to the valve operator, and to avoid interferences.

3.2.8 Pipe Tap Connections

Taps to pipe barrels are unacceptable. Taps to ductile iron piping shall be made only with a service saddle or at a tapping boss of a fitting, valve body, or equipment casting. Taps to steel piping shall be made only with a welded threadolet connection.

3.2.9 Plastic Pipe Installation

All plastic pipe shall be cut, made up, and installed in accordance with the pipe manufacturer's recommendations. Heat joining shall be performed in accordance with ASTM D 2657. Electrofusion joining shall be performed in accordance with ASTM F 1290. Schedule 40 pipe shall not be threaded. Schedule 80 threaded nipples shall be used where necessary to connect to threaded valves or fittings. Strap wrenches shall be used for tightening threaded plastic joints, and care shall be taken not to over tighten these fittings. Pipe shall not be laid when the temperature is below 40.1 degrees F, nor above 90 degrees F when exposed to direct sunlight. Any plastic pipe installed above grade and outdoors shall be ultraviolet (UV) protected or UV resistant. The pipe ends that are to be joined shall be shielded from direct sunlight prior to and during the laying operation. Adequate ventilation shall be provided when working with pipe joint solvent cement and the handling of solvent cements, primers and cleaners shall be in accordance with ASTM F 402. The Contractor shall provide and install supports and hangers in accordance with the manufacturer's recommendations and as specified and shown on the contact drawings. Where plastic pipe is subjected to severe temperature fluctuations, provisions for expansion and contraction must be provided. This shall be accomplished with the use of expansion joints and offset piping arrangements. All lines shall be hydrostatically tested at the maximum operating pressures as shown on the contract drawings].

3.2.9.1 PVC Piping

Solvent-cemented joints shall be constructed in accordance with ASTM D 2855.

3.2.10 Double Containment Piping Installation

Factory trained field representatives of the piping supplier shall provide technical field support during critical periods of piping .

3.2.11 Insulation

Insulation shall be installed on piping as indicated on the Pipe Schedule in the contract drawings in accordance with the provisions of the Section THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.3 BURIED PIPE PLACEMENT

Thermoplastic piping systems shall be installed underground in accordance with ASTM D 2774. Thermosetting resin and reinforced plastic mortar piping systems shall be installed underground in accordance with ASTM D 3839.

3.3.1 Excavation and Backfilling

Earthwork shall be performed as specified in the Section EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS. Backfilling shall be accomplished after inspection by the Contracting Officer. The Contractor shall exercise care when lowering pipe into the trench to prevent damage or twisting of the pipe.

3.3.2 Fittings

At valves and connections, the trench bottom shall be dug out with sufficient length, width, and depth to ensure clearance between the undisturbed trench bottom and the valves and such connections.

3.3.3 Thrust Restraint

Thrust restraint devices are generally not shown in the contract drawings; their absence will not relieve Contractor of the responsibility for providing them as required to provide complete systems for the use intended. The Contractor shall provide thrust blocks and ties where required, whether or not shown on the contract drawings. At a minimum, thrust restraint shall be provided at pipeline tees, plugs, caps, bends, and other locations where unbalanced forces exist.

3.3.3.1 Thrust Blocks

Thrust blocking shall be concrete of a mix not leaner than the ratio of 1 cement, 2.5 sand and 5 gravel, and have 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 blocks shall be poured against undisturbed earth. The sides of thrust blocks not subject to thrusts may be poured against forms. The area of bearing shall be as shown or directed. Blocking shall be placed so that fitting joints shall be accessible for repair. Steel rods and clamps, protected by galvanizing or a coating of bituminous paint shall be used to anchor vertical down bends into gravity thrust blocks.

3.3.3.2 Restrained Joints

The restrained pipe length shall be 25 feet. For ductile iron pipe, restrained joints shall be designed by the Contractor or the pipe manufacturer in accordance with DIPRA-Restraint Design.

3.3.4 Marking Tape

Pipe marking tape shall be provided and installed in accordance with the requirements of Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS.

3.3.5 Plastic Pipe Installation

Plastic pipe shall be cut, fabricated, and installed in strict conformance with the pipe manufacturer's recommendations. Offset loops from the trench centerline shall be as recommended by the manufacturer for the maximum temperature variation between the pipe temperature at the time of solvent welding and operating temperature. Flexible plastic pipe connected to heavy fittings, manholes, and rigid structures shall be supported in such a manner that no subsequent relative movement between the plastic pipe at the flanged joint and the rigid structures is possible. Thrust blocking shall not be used for flexible plastic piping. The piping shall be designed and installed to withstand the compression and expansion forces imposed by the trench conditions. Concrete thrust blocks shall be constructed where required on the contract drawings.

3.4 CONNECTING DISSIMILAR PIPE

Flexible transition couplings, dielectric fittings and isolation joints shall be installed in accordance with the manufacturer's instructions.

3.5 EXTERNAL CORROSION PROTECTION

Protect all pipe and piping accessories from corrosion and adverse environmental conditions.

3.5.1 Underground Metallic Piping

Buried metallic piping shall be protected from corrosion using protective coatings. Where dissimilar metals are joined underground, gas-tight isolation joints shall be used. Insulating joint material shall be provided where shown to control galvanic or electrical action.

3.5.2 Above Grade Metallic Piping

Nonferrous and stainless steel piping shall not be painted except for aluminum alloy piping. Where dissimilar metals are joined, isolation joints shall be used.

3.5.2.1 Ferrous Piping

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, mill scale or other foreign substances shall be mechanically cleaned by power wire brushing commercial sand blasting conforming to SSPC SP 6/NACE 3 and primed with a ferrous metal primer . Primed surfaces shall be finished with two coats of exterior vinyl paint in accordance with the Section PAINTING, GENERAL.

3.6 FLEXIBLE JOINTS AT CONCRETE STRUCTURES

Flexible joints shall be provided at the face of all structures, whether or not shown on the contract drawings. Ring joints, mechanical joints, flexible couplings, and proprietary restrained ductile iron pipe joints shall be considered flexible joints; welded pipe joints shall not. Joints may be flush with the structure face or may be located up to 1 pipe diameter away from face , but not further than 17.7 inches away from face. For pipelines larger than 18 inches in diameter the first joint shall be within 1 pipe diameter.

3.7 CLOSURES

Closure pieces shall be installed as necessary to end pipe runs and shall conform to ASME B16.9 or ASME B16.11. Elastomer sleeves bonded to pipe ends are not acceptable. Pressure piping shall have closures of butt-welded caps] blind flanges threaded plugs plain end pieces, with thickness matching the nominal wall thickness of the associated pipe, mounted on double flexible couplings, unless otherwise shown on contract drawings or approved by the Contracting Officer. Pipes with restrained joints shall have pipe closures installed with thrust tie-rod assemblies as required.

3.8 PENETRATIONS

Steel pipe sleeves shall be hot-dipped galvanized after fabrication for

above grade applications in nonsubmerged areas. For below grade, or in submerged and damp environments, steel pipe sleeves shall be lined and coated as specified in the Section PAINTING, GENERAL. Embedded metallic piping shall be isolated from concrete reinforcement using coated pipe penetrations. Coatings shall be as specified in the Section PAINTING, GENERAL. Wall pipes shall be securely supported by form work to prevent contact with reinforcing steel and tie-wires. Joints shall be caulked with rubber sealant or sealed with a wall penetration seal. For existing concrete walls, rotary drilled holes may be provided in lieu of sleeves.

3.9 VALVE INSTALLATION

Flanged valve bolt holes shall be installed so as to straddle the vertical centerline of pipe. Flanged faces shall be cleaned prior to inserting the gasket and bolts, and then the nuts shall be tightened progressively and uniformly. Threaded ends shall have the threads cleaned by wire brushing or swabbing prior to installation.

3.9.1 Valve Orientation

The operating stem of a manual valve shall be installed in a vertical position when the valve is installed in horizontal runs of pipe having centerline elevations 4.5 feet or less above finished floor, unless otherwise shown on contract drawings. The operating stem of a manual valve shall be installed in a horizontal position in horizontal runs of pipe having centerline elevations between 4.5 feet and 6.75 feet above finish floor, unless otherwise shown on contract drawings. Automatic valves shall be installed in accordance with the manufacturer's instructions and approved drawings.

3.9.1.1 Butterfly Valves

Orientation of butterfly valves shall take into account changes in pipe direction. Valve shafts shall be oriented so that unbalanced flows caused by pipe direction changes or other disturbances are equally divided to each half of the disc.

3.9.1.2 Plug Valves

If a plug valve seat position is not shown in the contract drawings, locate the seat position as follows: for horizontal flow, the flow shall produce an "unseating" pressure, and the plug shall open into the top half of valve; and for vertical flow, the seat shall be installed in the highest portion of the valve.

3.9.2 Line Size Ball Valves

A line size ball valve and union shall be installed upstream of each solenoid valve, in-line flow switch, or other in-line electrical device, excluding magnetic flowmeters, for isolation during maintenance.

3.9.3 Isolation Valve

Safety isolation valves shall be installed on compressed air supplies. The valve shall be located to provide accessibility for control and maintenance. If necessary, access doors shall be installed in finished walls and plaster ceilings for valve access.

3.9.4 Operator Extension Stems

Where the depth of the valve is such that its centerline is more than 3 feet below grade, an operator extension stem shall be furnished with a 2 inch operating nut to bring the operating nut to a point 5.9 inches below the surface of the ground and/or box cover. The operating nut shall be located in a floor box.

3.9.5 Torque Tube

Where the operator for quarter-turn valve is located on a floor stand, an extension stem torque tube shall be furnished, properly sized for the maximum torque capacity of the valve.

3.9.6 Chain Wheel and Guide

Chain wheel and guide assemblies or chain lever assemblies shall be installed on manually operated valves located over 6.73 feet above finished floor elevation. Where chains hang in normally traveled areas, appropriate "L" type tie-back anchors shall be used.

3.10 AIR RELEASE, DRAINS AND SAMPLE PORTS

Sample ports shall be provided where indicated on the contract drawings. The Contractor shall install specified vents at piping high points for entrapped air release and install drains in the low points of pipelines regardless of whether shown on contract drawings.

3.11 PIPING SUPPORT SYSTEMS INSTALLATION

The absence of pipe supports and details on the contract drawings shall not relieve the Contractor of responsibility for sizing and providing supports throughout plant.

3.11.1 General Support Requirements

Pipe support systems shall meet the requirements of MSS SP-58. Contractor-designed and selected support systems shall be installed in accordance with MSS SP-69, and as specified herein. Piping connections to equipment shall be supported by pipe supports and not off the equipment. Large or heavy valves, fittings, and/or equipment shall be supported independently of associated piping. Pipes shall not be supported off other pipes. Supports shall be provided at piping changes in direction or in elevation, adjacent to flexible joints and couplings, and where otherwise shown on the contract drawings. Pipe supports and hangers shall not be installed in equipment access areas or bridge crane runs. Hanging pipes shall be braced against horizontal movement by both longitudinal and lateral sway bracing. At each channel type support, every pipe shall be provided with an intermediate pipe guide, except where pipe anchors are required. Existing support systems may be used to support additional new piping only if the Contractor can demonstrate that the existing support systems are adequate for the additional loads, or if the existing systems are strengthened to support the additional loads. Pedestal type pipe supports shall be provided under base flanges adjacent to rotating equipment and where required to isolate vibration. Piping 2.5 inches in diameter and larger shall be braced for seismic forces. Lateral supports for seismic loads shall be installed at all changes in direction.

3.11.2 Support of Insulated Piping

The Contractor shall install oversized supports to fit the insulation inserts. Supports shall be provided with galvanized or stainless steel protection shields and oversized rollers.

3.11.3 Dielectric Barriers

Dielectric barriers shall be installed between supports and copper or stainless steel piping, and between stainless steel supports and non-stainless steel ferrous piping.

3.11.4 Support Spacing

3.11.4.1 Acceptable Limits for Metallic Piping

Stainless steel Schedule 10S, diameter 6 inches, shall have a maximum span of 72 inches and a minimum rod size for single rod hangers of 0.5 inches.

3.11.4.2 Acceptable Limits for Thermoplastic Piping

PVC, Schedule 40 SDR 35, diameter 6 inches, shall have a maximum span of 60 inches and a minimum rod size for single rod hangers of 0.5 inches.

3.11.4.3 Acceptable Limits for Rubber/Elastomer Piping

Chloroprene, internal diameter 6 inches, shall have a maximum span of 60 inches and a minimum rod size for single rod hangers of 0.5 inches.

3.11.5 Support Methods

Piping support shall be provided as specified and as shown in the contract drawings. Single horizontal suspended piping shall be supported by adjustable swivel-ring, split-ring, or clevis hangers. Multiple horizontal suspended piping shall be supported by trapeze hangers with channel type supports. Horizontal pedestal mounted piping shall have saddle type supports. Horizontal wall mounted piping shall have wall brackets. Vertical piping shall be supported by wall brackets, base elbows, or riser clamps on floor penetrations.

3.11.6 Supports and Hangers for Stainless Steel Piping

All hanger-pipe contact surfaces shall have a dielectric barrier consisting of chloroprene rubber wrapping or plastic coated hangers. The load rating of universal concrete inserts shall not be less than that of the hanger rods they support.

3.12 PIPE IDENTIFICATION, PAINTING AND COLOR CODING

Color, coating, and lettering requirements for exposed piping shall be in accordance with the Section PAINTING, GENERAL. Except where piping is required to be completely painted in its code color, piping or its insulation covering may be banded either with plastic adhesive tapes or painted stripes around pipe designating piping contents in accordance with following options and requirements. A single individual band, of plastic adhesive tape or paint, designating pipe contents shall be provided with sufficient length to permit the stenciling of pipe contents in letters. Identification shall be provided at branch connections, inlets and outlets of equipment, every 19.7 feet of straight run, upstream of valves, and within 3.3 feet of entrance to or exit from wall curtains, or other similar type barrier.

3.13 FIELD QUALITY CONTROL

3.13.1 Hydrostatic Tests

Where any section of a pipeline is provided with concrete thrust blocking for fitting, the hydrostatic tests shall not be made until at least days after the installation of the concrete thrust blocking, unless otherwise approved by the Contracting Officer.

3.13.1.1 Buried Piping

After the pipe is laid, the joints completed 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 test pressure of 150 psig. Each valve shall be opened and closed several times during the test. Exposed pipe, joints, fittings, and valves shall be carefully examined during the partially open trench test. Joints showing visible leakage shall be replaced as necessary. Defective pipe, joints, fittings, and valves found during the pressure test shall be removed and replaced with new material, and the test 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 are encountered: (1) wet or unstable soil conditions in the trench; (2) 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; or (3) maintaining the trench in an open condition would delay completion of the Contract. 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 hydrostatic tests. Backfill placed prior to the tests shall be placed in accordance with the requirements of the Section EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS.

3.13.1.2 Exposed Piping

Hydrostatic testing shall be conducted in accordance with ASME B31.3. Piping systems shall be tested under normal service conditions (as indicated in the Pipe Schedule in the contract drawings) to demonstrate compliance. The test pressure shall not be less than 1.5 times the design pressure. Water shall be used as the hydrostatic test fluid. The Contractor shall provide clean test water of such quality to prevent corrosion of the piping system materials. Air release vents shall be opened at all high points of the piping system in order to purge air pockets while the piping system is filling.

a. For rigid piping hydrostatic testing, the maximum test pressure shall be calculated according to ASME B31.3, but shall not exceed the yield strength of the piping system. The maximum velocity during filling shall be 0.25 fps applied over full area of pipe in accordance with the manufacturer's instructions. Venting during filling may also be provided by loosening flanges with a minimum of four bolts or by the use of equipment vents. The Contractor shall test all parts of the piping system. The hydrostatic test pressure shall be maintained continuously for 30 minutes minimum and for such additional time as necessary to conduct examinations for leakage. All joints and connections shall be examined by the Contractor for leakage. The piping system, exclusive of possible

localized instances at pump or valve packing, shall show no visual evidence of leaking. The Contractor shall correct visible leakage and retest. Unless otherwise directed by the Contracting Officer, the piping system shall be left full of water after leaks are repaired.

b. For non-rigid, non-metallic piping and metallic piping with a non-metallic liner hydrostatic testing, the maximum test pressure shall be calculated according to ASME B31.3, but shall not exceed 1.5 times the maximum pressure rating of the lowest rated component in the piping system. The maximum velocity during filling shall be 0.25 fps applied over full area of pipe] in accordance with the manufacturer's instructions. The system shall be initially pressurized to 50 percent of the normal service conditions and inspected. Any leaks shall be repaired by the Contractor. The system shall then be pressurized to the test pressure. Small amounts of water shall be added as required on a hourly basis for a maximum of 3 hours in order to maintain the test pressure. After 4 hours, the test pressure shall be lowered by 10.2 psi. If the hydrostatic pressure remains steady for 1 hour, then no leakage is indicated. The Contractor shall inspect for leaks, repair and retest if necessary. The piping system shall be allowed to relax for 8 hours before retesting.

3.13.1.3 Time for Making Test

Except for joint material setting or where concrete thrust blocks necessitate a delay, underground piping 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. Tests for above ground pressure piping shall be conducted after the piping has been completely installed, including all supports, hangers, and anchors, and inspected for proper installation but prior to installation of insulation.

3.13.2 Pneumatic Tests

Pneumatic testing shall be prepared for and conducted in accordance with the requirements of ASME B31.3. Care must be taken to minimize the chance of a brittle fracture or failure during a pneumatic leak test. Only non-toxic, nonflammable, inert gases or air shall be used.

3.13.2.1 Pressure Relief Device

During pneumatic testing, a pressure relief device shall be provided for each piping section being tested. The device shall have a set pressure not higher than the test pressure plus the lesser of 10 percent of the test pressure or 50.8 psi.

3.13.2.2 Pneumatic Testing Procedures

The test fluid shall be air and the test pressure shall be 110 percent of the design pressure. The test pressure shall be incrementally increased until the gage pressure reaches the lesser of 50 percent of the test pressure or 25 psig. The Contractor shall examine piping joints for leakage. If no leakage is occurring, the Contractor shall continue to increase the pressure incrementally, while maintaining each incremental increase long enough to equalize pipe strains, until the test pressure is reached. The test pressure shall then be reduced to the design pressure

and maintained for 10 minutes without additional energy expenditure. If the pneumatic pressure remains steady, then no leakage is indicated. The Contractor shall inspect for and repair leaks, and retest if necessary.

3.13.3 Pipe Leakage Tests

Unless approved by the Contracting Officer, leakage testing 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 piping shall be subjected to not less than 200 psig pressure. Leakage is defined as the quantity of the test liquid, water, that is supplied to the piping system, or any valved or approved section thereof, in order to maintain pressure within 5 psi of the specified leakage test pressure after the piping has been filled with the test liquid and all air is expelled. No piping installation will be accepted if leakage exceeds the allowable leakage determined by the following formula:

L = Cf x N x D x P0.5
Cf = conversion factor = 0.0001351
L = allowable leakage, gallons per hour
N = number of joints in the length of piping tested
D = nominal pipe diameter, inches
P = average test pressure during the test, psig.]

Should any test disclose leakage greater than that allowed, the leaks shall be located and repaired until the leakage is within the specified allowance, without additional cost.

3.13.4 Testing New to Existing Connections

New piping connected to existing pipe, existing equipment, existing treatment systems, or tanks and treatment systems furnished under other Sections shall be tested. The Contractor shall isolate the new piping with pipe caps, spectacle blinds, or blind flanges. The joint between new piping and existing piping shall be tested by methods that do not place the entire existing system under the test load. The Contractor shall then proceed with the testing of new piping systems as specified herein.

3.13.5 Valve Testing

Valves may either be tested while testing pipelines, or as a separate step. It shall be demonstrated that valves open and close smoothly with operating pressure on one side and atmospheric pressure on the other, and in both directions for two-way valve applications. The Contractor shall count and record the number of turns required to open and close each valve, and account for any discrepancies with manufacturer's data. Air and vacuum relief valves shall be examined as the associated pipe is being filled to verify venting and seating is fully functional. The Contractor shall set, verify, and record set pressures for all relief and regulating valves. Self-contained automatic valves shall be tested at both maximum and minimum operating ranges, and reset upon completion of test to the design value. Automatic valves that are not self-contained shall be tested in conjunction with control system testing.

3.14 FINAL CLEANING

3.14.1 Interim Cleaning

The Contractor shall prevent the accumulation of weld rod, weld spatter,

pipe cuttings and filings, gravel, cleaning rags, and other foreign material within piping sections during fabrication. The piping shall be examined to assure removal of these and other foreign objects prior to assembly and installation.

3.14.2 Flushing

Following assembly and testing, and prior to final acceptance, piping systems shall be flushed with to remove accumulated construction debris and other foreign matter. The piping shall be flushed until all foreign matter is removed from the pipeline. The Contractor shall provide all hoses, temporary pipes, ditches, and other items as required to properly dispose of flushing water without damage to adjacent properties. The minimum flushing velocity shall be 2.5 fps. For large diameter pipe where it is impractical to flush the pipe at the minimum flushing velocity, the pipeline shall be cleaned in-place from the inside by brushing and sweeping, then flushing the pipeline at a lower velocity. Cone strainers shall be installed in the flushing connections of attached equipment and left in place until cleaning is completed. Accumulated debris shall be removed through drains, or by removing spools or valves.

3.14.3 Disinfection

The Contractor shall disinfect the pipelines as noted. Before acceptance of piping system operation, each section of completed pipeline shall be disinfected in accordance with AWWA C651. After pressure tests have been made, the piping section 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 liquid chlorine calcium hypochlorite or sodium hypochlorite . The chlorinating material shall provide a dosage of not less than 50 ppm and shall be introduced into the piping in an approved manner. PVC pipe lines shall be chlorinated using only the above specified chlorinating material in solution. In no case shall the agent 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. All 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 outlet on the line shall be opened and closed several times. From several points in the pipeline section, contractor personnel, approved by the Contracting Officer, shall take samples in sterilized containers and have a bacterial examination performed by a commercial laboratory in accordance with state approved methods. The commercial laboratory must be certified by the state's approving authority for examination of potable water. The disinfection shall be repeated until the piping system passes the bacterial examination for 2 consecutive days. The piping system will not be accepted until satisfactory bacteriological results have been obtained.

3.15 WASTE WATER DISPOSAL

The water used for testing, cleaning, flushing and/or disinfection shall be disposed of in accordance with all applicable regulations. Disposal is solely the responsibility of the Contractor. The method proposed for disposal of waste water shall be provided to, and approved by, the Contracting Officer prior to performing any testing, cleaning, flushing and

disinfection activities.

3.16 SCHEDULES

The Contractor shall comply with the following schedules found in the contract drawings: Pipe Schedule Valve Schedule and Valve Operator Schedule.

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THERMAL INSULATION FOR MECHANICAL SYSTEMS

PART 1 GENERAL

1.1 REFERENES

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 SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167	(1992b) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 580	(1991b) Stainless and Heat Resisting Steel Wire
ASTM B 209	(1992a) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM C 449	(1988) Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement
ASTM C 533	(1985; R 1990) Calcium Silicate Block and Pipe Thermal Insulation
ASTM C 534	(1988) Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
ASTM C 547	(1977) Mineral Fiber Preformed Pipe Insulation
ASTM C 552	(1991) Cellular Glass Thermal Insulation
ASTM C 553	(1992) Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM C 612	(1983) Mineral Fiber Block and Board Thermal Insulation
ASTM C 795	(1992) Thermal Insulation for Use in Contact With Austenitic Stainless Steel
ASTM C 920	(1987) Elastomeric Joint Sealants
ASTM C 921	(1989) Determining the Properties of Jacketing Materials for Thermal Insulation
ASTM E 84	1989 (Rev. A) Surface Burning Characteristics of Building Materials

FEDERAL SPECIFICATIONS (FS)

FS L-P-535	(Rev E; Notice 2) Plastic Sheet (Sheeting): Plastic Strip: Poly (Vinyl Chloride) and Poly (Vinyl Chloride-Vinyl Acetate), Rigid

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

(1991) Pipe Hangers and Supports Selection and Application

MIDWEST INSULATION CONTRACTORS ASSOCIATION (MICA)

MICA-01 (1993)	National Commercial & Industrial Insulation Standards

MILITARY SPECIFICATIONS (MS)•

MS MIL-A-3316	(Rev C; Am 2) Adhesives, Fire-Resistant, Thermal Insulation
MS MIL-A-24179	(Rev A; Am 2; Notice 1) Adhesive, Flexible Unicellular-Plastic Thermal Insulation
MS MIL-C-19565	(Rev C; Am 1) Coating Compounds, Thermal Insulation, Fire- and Water-Resistant, Vapor-Barrier
MS MIL-C-20079	(Rev H) Cloth, Glass; Tape, Textile Glass; and Thread, Glass and Wire-Reinforced Glass

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.

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 rating no higher than 75 and a smoke developed rating no higher than 150. The outside surface of insulation systems which are located in air plenums, in ceiling spaces, and in attic spaces shall have a flame spread rating no higher than 25 and a smoke developed rating no higher than 50. Insulation materials located exterior to the building perimeter are not required to be fire-rated. Flame spread and smoke developed ratings shall be determined by ASTM E 84. All insulation shall be tested in the same density and installed thickness as the material that will be used in the actual construction. Jackets shall comply with the flame spread and smoke developed ratings required by ASTM C 921.

1.3.4 Identification of Materials

Packages or standard containers of insulation, jacket material, cements, adhesives, and coatings delivered for use, and all 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

NOTE: Submittals must be limited to those necessary for adequate quality control. The importance of an item in the project should be one of the primary factors in determining if a submittal for the item should be required.

Indicate submittal classification in the blank space using "GA" when the submittal requires Government approval or "FIO" when the submittal is for information only.

SD-14: Designer will exclude ductwork insulation display samples for small, simple projects where the extent of duct insulation is not likely to cause a problem of enforcement with the requirements of the specification.

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL DESCRIPTIONS:

SD-01 Data

Thermal Insulation Materials; GA

A complete list of materials, including manufacturer's descriptive and technical literature, performance data, catalog cuts, and installation instructions. Materials furnished under this section of the specification shall be submitted at one time. A schedule indicating the product number, k-value, thickness and furnished accessories for each mechanical system requiring insulation shall be included.

SD-14 Samples

Thermal Insulation Materials; GA

A display of insulated sections as specified in this section, after approval of materials and prior to insulating any piping or ductwork. Each material used shall be identified, by indicating on an attached sheet the specification requirement for the material and the material by each manufacturer intended to meet the requirement. Display sample sections will be inspected at the jobsite by the Contracting

Officer. Approved display sample sections shall remain on display at the jobsite during the construction period. Upon completion of construction, the display sample sections will be returned to the Contractor.

Pipe Insulation Display Sections: Display sample sections shall include as a minimum an elbow or tee, a valve, dielectric unions and flanges, a hanger with protection shield and insulation insert, or dowel as required, at support point, method of fastening and sealing insulation at longitudinal lap, circumferential lap, butt joints at fittings and on pipe runs, and terminating points for each type of pipe insulation used on the job, and for hot pipelines and cold pipelines, both interior and exterior, even when the same type of insulation is used for these services.

Duct Insulation Display Sections: Display sample sections for rigid and flexible duct insulation used on the job. A display section for duct insulation exposed to weather.

SD-18 Records

Thermal Insulation Materials; GA

Three copies of a booklet indicating the types of insulation by referencing MICA-01-\, at the jobsite. After approval of materials and prior to insulating any equipment, a booklet shall be prepared and submitted for approval which contains marked-up \-MICA-01-\ plates or detail drawings showing the insulation material and insulating system for each type of equipment which is required to be insulated per paragraph EQUIPMENT INSULATION INSTALLATION. 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 all portions of the equipment. The drawings shall be labeled with a description of each material type with all materials and insulating systems, in accordance with this specification. Each material and insulating system that is used shall be identified by indicating the specification requirement for the material, and the material by each manufacturer that is intended to meet the requirement. 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 display sample and two copies shall be provided for Government use.

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 by the Contractor. Insulation material and supplies that become dirty, dusty, wet, or otherwise contaminated may be rejected by the Contracting Officer.

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 be low chloride and meet \-ASTM C 795-\ requirements. Materials shall be asbestos free and conform to the following:

2.1.1 Adhesives

MS MIL-A-3316-, Class 1, Grade A, or Class 2 as specified.

2.1.2 Contact Adhesive

MS MIL-A-24179, Type II, Class 1 or Type III.

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 inch by 1 inch with factory applied kraft backing. Aluminum shall be ASTM B 209, Alloy 3003, 3105, or 5005.

2.1.5 Finishing Cement

Mineral fiber hydraulic-setting thermal insulating cement ASTM C 449.

2.1.6 Glass Tape

MS MIL-C-20079 Type II, Class 1 or 3. Tape shall be 4-inch wide rolls. Class 3 shall be (4.5 ounce/square yard).

2.1.7 Glass Cloth

MS MIL-C-20079, Type I, Class 1, untreated.

2.1.8 Staples

Outward clinching type ASTM A 167, Type 304 or 316 stainless steel.

2.1.9 Jackets

ASTM C 921, Type I, moisture vapor transmission maximum 0.02 perms, puncture resistance minimum 50 Beach units on all surfaces except concealed ductwork, where a minimum puncture resistance of 25 Beach units is allowable, tensile strength minimum 35 pounds/inch width; Type II, puncture resistance minimum 25 Beach units, tensile strength minimum 20 pound/inch width. 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 barrier. 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 diameter. Aluminum jacket circumferential seam bands shall be 3/4-inch by 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. Polyvinyl chloride (PVC) jacket and fitting

covers shall be FS L-P-535, Composition A, Type II, with minimum thickness 0.030 inch). Insulation under PVC jacket shall meet jacket manufacturer's written recommendations.

2.1.10 Vapor Barrier Coating

MS MIL-C-19565, Type II. Color shall be white.

2.1.11 Wire

Soft annealed ASTM A 580 Type 302, 304 or 316 stainless steel, 16 or 18 gauge.

2.2 PIPE INSULATION MATERIALS

Insulating materials applied to stainless steel pipe must be low chloride. Pipe insulation materials shall be as follows:

2.2.1 Aboveground Cold Pipeline

Insulation for minus 34 degrees C to plus 16 degrees F shall be as follows:

2.2.1.1 Mineral Fiber

ASTM C 547, Class 1 for use up to 450 degrees F and Class 2 for use up to 650 degrees F.

2.2.1.2 Cellular Glass

ASTM C 552, Type II, and Type III.

2.2.2 Aboveground Hot Pipeline

For aboveground hot pipeline (above 60 degrees F) insulation the following requirements shall be met.

2.2.2.1 Mineral Fiber

ASTM C 547, Class 1 or Class 2 as required for the operating temperature range.

2.2.2.2 Calcium Silicate

ASTM C 533, Type I indoor only, or outdoors above 250 degrees F pipe temperature.

2.2.2.3 Cellular Glass

ASTM C 552, Type II and Type III

2.2.2.4 Flexible Cellular Insulation (only for Flex Joints)

ASTM C 534, Type I to 200 degrees F service.

2.3 DUCT INSULATION MATERIALS

Duct insulation materials shall be as follows:

2.3.1 Rigid Mineral Fiber

ASTM C 612, Class 1

2.3.2 Flexible Mineral Fiber

ASTM C 553, Type I, Class B-2.

2.4 EQUIPMENT INSULATION MATERIALS

Equipment insulation materials shall be as follows:

2.4.1 Cold Equipment (Below 60 degrees F) Insulation

2.4.1.1 Rigid Mineral Fiber

ASTM C 612, Class 1

2.4.1.2 Flexible Mineral Fiber

ASTM C 553, Type I, Class B-4

2.4.1.3 Cellular Glass

ASTM C 552, Type I, Type III, or Type IV as required.

2.4.1.4 Flexible Cellular Insulation

ASTM C 534, Type II

PART 3 EXECUTION

3.1 APPLICATION - GENERAL

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 and heat tracing 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 at all times. 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 aforementioned cleaning does not restore the surfaces to like new condition, the insulation may be rejected, and if rejected, shall be immediately removed from the jobsite. Joints shall be staggered on multilayer insulation. Mineral fiber thermal insulating cement shall be mixed with demineralized water when used on stainless steel surfaces. All insulation, jacketing and accessories shall be installed in accordance with \-MICA-01-\ standard plates except where modified herein or on the drawings.

3.1.2 Fire Seal

Where pipes and ducts pass through fire walls, insulation shall be interrupted and a fire seal shall be provided.

3.1.3 Painting and Finishing

Painting shall be as specified in Section 09900 PAINTING, GENERAL.

3.1.4 Flexible Cellular Insulation

Flexible cellular insulation shall be installed with seams and joints sealed with a contact adhesive. Flexible cellular insulation shall not be used on surfaces greater than 200 degrees F. 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.

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.

3.2 PIPE INSULATION INSTALLATION

3.2.1 Pipe Insulation

3.2.1.1 General

Pipe insulation shall be continuous and installed on all 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. 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.

b. Sanitary drain lines.

c. Unions in pipe above 60 degrees F

d. Strainers in pipe above 60 degrees F

e. Check valves in pipe above 60 degrees F

f. Air chambers.

3.2.1.2 Pipes Passing Through Sleeves•

a. Pipe insulation shall be continuous through the sleeve except at firewall penetrations.

b. An aluminum jacket with factory applied moisture barrier shall be provided over the insulation wherever penetrations require sealing.

c. Where penetrating 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 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.

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 insulation in accordance with MSS SP-69 without the use of a high density insulation insert.

b. Horizontal pipes larger than 2 inches 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 or calcium silicate 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.

c. 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. 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 hangers in the vertical run of the pipe which 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.

d. 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 cellular insulation shall conform to ASTM C 921, Type 1, and is allowed to be of a different material than the adjoining insulation material.

3.2.2 Aboveground Cold Pipelines•

The following shall be included for aboveground cold pipelines (minus 30 degrees to Plus 60 degrees F):

a. Domestic cold and chilled drinking water.•

b. Air conditioner condensate drains.•

c. Filtered water.

3.2.3 Insulation Thickness•

Thickness of insulation shall be as indicated in TABLE I.

TABLE I
Pipe Size (Inches)

Service or Range of Temp (degrees F)	Run-outs* 1/4 to 1/4 to 1-1/2	1/4 to 1-1/4	1-1/2 to 3	3-1/2 to 5	6 to 10	11 to 24	25 to 33
60 to 35							
(CG)		1-1/2	1-1/2	2	2	2	2
(MF)		1	1	1-1/2	1-1/2	1-1/2	1-1/2
34 to 0							
(CG)		2-1/2	2-1/2	2-1/2	3	3	3-1/2
(MF)		1-1/2	1-1/2	2	2	2-1/2	2-1/2
-1 to –30							
(CG)		3	3	3-1/2	3-1/2	3-1/3	4
(MF)		1-1/2	2	2-1/2	2-1/2	3	3
Cold Water CG)		1	1	1	1-1/2	1-1/2	1-1/2
and Interior (MF)		1/2	1/2	1/2	1	1	1

NOTES: CG - Cellular Glass
MF - Mineral Fiber

*When runouts to terminal units exceed 12 feet, the entire length of runout shall be insulated like the main feed pipe.

3.2.3.1 Jacket for Fibrous and Cellular Glass Insulated Pipe

Insulation shall be covered with a factory applied vapor barrier jacket or field applied seal welded PVC jacket. Insulation within 3 feet of valves or instruments shall be protected with an aluminum jacket and have the insulation and vapor barrier 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 where it is not exposed to weather.

3.2.3.2 Insulation for Straight Runs (Fibrous and Cellular Glass)

a. Insulation shall be applied to the pipe with joints tightly butted. The ends of fibrous insulation shall be sealed off with vapor barrier coating at intervals not to exceed 15 feet.

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.

d. Factory self-sealing lap systems may be used when the ambient temperature is between 40 degrees and 120 degrees 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. Staples and seams, including those on self-sealing lap systems with adhesive on one side shall be coated with a vapor barrier coating. Double pressure-sensitive adhesive seams need not be coated.

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 coated with vapor barrier coating. 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 barrier coating.

3.2.3.3 Insulation for Fittings and Accessories

a. Pipe insulation shall have ends thoroughly coated with a vapor barrier coating not more than 6 inches from each flange, union, valve, anchor, or fitting in all directions.

b. Insulation may be premolded or segmented. Insulation of the same thickness and conductivity as the adjoining pipe insulation shall be used. If nesting size insulation is used, the insulation should be overlapped 2 inches or one pipe diameter. Loose fill mineral fiber or insulating cement shall be used to fill the voids. Insulation for elbows less than 3-inch size shall be premolded. Insulation for elbows 3-inch size and larger shall be either premolded or segmented. Elbows insulated using segments shall not have less than 3 segments per elbow. Insulation may be secured by wire or tape until finish is applied.

c. Upon completion of installation of insulation on flanges, unions, valves, anchors, fittings and accessories, all terminations and all insulation not protected by factory vapor barrier jackets or PVC fitting covers shall be protected with two coats of vapor barrier coating with a minimum total thickness of 1/16th 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.

d. Flexible connections at pumps and other equipment shall be insulated with 1/2-inch flexible cellular insulation, unless otherwise indicated.

e. Insulation shall be marked showing the location of all unions, strainers and check valves.

3.2.4 Aboveground Hot Pipelines (Above 60 degrees F)

Note: Steam piping shall be insulated per Section 02697 ABOVE GROUND HEAT DISTRIBUTION SYTEM.

The following shall be included:

a. Domestic hot water.

3.2.4.1 Insulation Thickness

TABLE IV

REQUIRED THICKNESS (IN INCHES) OF PIPE INSULATION
FOR PIPES HANDLING DOMESTIC HOT WATER. MF - MINERAL FIBER
CG - CELLULAR GLASS FC - FLEXIBLE CELLULAR

Range of Service (degrees F)	Run-outs* 1/4 to 1-1/2	2 or less	2-1/2 to 3	Pipe Size, Inches 4
61 to 200 (MF)		1.0	1.5	1.5
(CG)		1.5	2.5	2.5
(FC)	1/2	1.0	1.5	1.5

*When runouts to terminal units exceed 12 feet, the entire length of runout shall be insulated like the main feed pipe.

3.2.4.3 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 not be used. Laps and butt strips shall be stapled whenever there is nonadhesion 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 wrapping a strip of jacket material around the pipe and be secured with adhesive and stapled on 4-inch centers. Adhesive may be omitted where pipe is concealed. Patch shall extend not less than 1-1/2 inches past the break.

3.2.4.4 Insulation for Fittings and Accessories

a. The run of the line pipe insulation shall have the ends brought up to the item.

b. Insulation of the same thickness and conductivity as the adjoining pipe insulation, either premolded or segmented, shall be placed around the item abutting the adjoining pipe insulation,

or if nesting size insulation is used, overlapping 2 inches or one pipe diameter. Loose fill mineral fiber or insulating cement shall be used to fill the voids. Insulation for elbows less than 3-inch size shall be premolded. Insulation for elbows 3-inch size and larger shall be either premolded or segmented. Elbows insulated using segments shall have not less than 3 segments per elbow. Insulation may be wired or taped on until finish is applied.

c. Upon completion of installation of insulation on flanges, unions, valves, fittings, and accessories, all terminations and all insulation not protected by factory vapor barrier jackets or PVC fitting covers shall be protected with two coats of Class 1 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 premolded one- or two-piece PVC fitting covers may be used in lieu of the adhesive and embedded glass tape. Factory premolded 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 barrier tape, adhesive, seal-welding or with tacks made for securing PVC covers.

3.2.5 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 shall be applied. PVC jacketing requires no factory-applied jacket beneath it.

3.2.5.1 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 uninsulated surface, joints shall be caulked to prevent moisture penetration. Joints on piping above 60 degrees F~\ shall be sealed with a moisture barrier.

3.2.5.2 Insulation for Fittings

Flanges, unions, valves, fittings, and accessories shall be insulated and finished as specified for the applicable service. Two coats of an emulsion type weatherproof mastic recommended by the insulation manufacturer shall be applied with glass tape embedded between coats. Tape overlaps shall be not less than 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 used with PVC lagging and adhesive welded moisture tight.

3.2.5.3 PVC Lagging

PVC lagging shall be ultraviolet resistant and adhesive welded vapor tight with manufacturer's recommended adhesive. Installation shall include provision for thermal expansion.

3.3 DUCT INSULATION INSTALLATION

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 the following:

a. Exposed supply and return ducts in air conditioned spaces unless otherwise shown. Air conditioned spaces shall be defined as those spaces directly supplied with conditioned air, hot or cold, or provided with a cooling or heating device such as a fan-coil unit.

b. Return ducts in ceiling spaces. Ceiling spaces shall be defined as those spaces between the ceiling and bottom of floor deck or roof deck inside the air conditioned space insulated envelope.

c. Ducts within HVAC equipment.

d. Exhaust air ducts unless noted.

3.3.1 Insulation and Vapor Barrier for Cold Air Duct

Insulation and Vapor Barrier for Cold Air Duct (Below 60 degrees F:) Ducts and associated equipment shall be insulated to a thickness of 2 inches. The following shall be insulated:

a. Supply ducts.

b. Ducts exposed to weather.

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 all round ducts shall be flexible type, minimum density 3/4 pcf with a factory Type I jacket. Fibrous and cellular glass insulation for exposed ducts shall be provided with either a factory-applied Type I vapor barrier jacket or a vapor barrier coating finish as specified. Fibrous and cellular glass insulation on concealed duct shall be provided with a factory-applied Type I vapor barrier jacket. Vapor barrier coating finish where indicated to be used shall be accomplished by applying two coats of vapor barrier coating with a layer of glass cloth embedded between the coats. The total dry film thickness shall be approximately 1/16 inch). Duct insulation shall be continuous through sleeves and prepared openings except fire wall 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 barrier shall cover the collar and retaining angles of diffusers, registers and grills. Vapor barrier materials shall be applied to form a complete unbroken vapor seal over the insulation.

3.3.1.1 Installation on Concealed Duct•

a. For rectangular, oval or round ducts, insulation shall be attached by applying Class 2 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 18-inch centers and not more than 18 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 18-inch centers and not more than 18 inches from duct corners.

d. Insulation shall be impaled on the mechanical fasteners where used and shall be pressed thoroughly into the adhesive. Care shall be taken to ensure vapor barrier 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 hanger.

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 under the overlap with Class 2 adhesive and stapled on 4-inch centers. Staples and seams shall be coated with a brush coat of vapor barrier coating.

g. Breaks in the jacket material shall be covered with patches of the same material as the vapor barrier. The patches shall extend not less than 2 inches beyond the break or penetration in all directions and shall be secured with Class 2 adhesive and staples. Staples and joints shall be sealed with a brush coat of vapor barrier coating.

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 barrier coating.

i. Insulation terminations and pin punctures shall be sealed and flashed with a reinforced vapor barrier coating finish. The coating shall overlap the adjoining insulation and uninsulated 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.

3.3.1.2 Installation on Exposed Duct Work

a. 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.

b. Duct insulation shall be formed with minimum jacket seams. Each piece of rigid insulation shall be fastened to the duct using mechanical fasteners. Insulation shall be brought up to standing seams, reinforcing, and other vertical projections and shall not be carried over. Vapor barrier 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.

c. Insulation shall be impaled on the fasteners; self-locking washers shall be installed and the pin trimmed and bent over.

d. Joints in the insulation jacket shall be sealed with a 4-inch wide strip of the same material as the vapor barrier jacket. The strip shall be secured with Class 2 adhesive and stapled. Staples and seams shall be sealed with a brush coat of vapor barrier coating.

e. 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 Class 2 adhesive and stapled. Staples and joints shall be sealed with a brush coat of vapor barrier coating.

f. 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 barrier coating.

g. Insulation terminations and pin punctures shall be sealed and flashed with a reinforced vapor barrier coating finish. The coating shall overlap the adjoining insulation and uninsulated surface 2 inches. Pin puncture coatings shall extend 2 inches from the puncture in all directions.

h. Oval and round ducts, flexible type, shall be insulated with factory Type I jacket insulation with minimum density of \^12 kg per cubic meter (3/4 pcf) attached by applying Class 2 adhesive around the entire perimeter of the duct in 6-inch wide stripe on 12-inch centers.

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.

3.3.5 Duct Test Holes

After all duct systems have been tested, adjusted, and balanced, all 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.

3.3.6 Duct Exposed to Weather

3.3.6.1 Installation

Ducts exposed to weather shall be insulated and finished as specified for the applicable service for exposed duct inside the building. After the above is accomplished, the insulation shall then be further finished. When polyethylene with ultraviolet resistant stabilizers is applied to external duct, it shall be finished with two coats of acrylic latex paint on all exposed surfaces.

3.3.6.2 Round Duct

Aluminum jacket with factory applied moisture barrier shall be applied with the joints lapped not less than 3 inches and secured with bands located at circumferential laps and at not more than 12-inch intervals throughout. Horizontal joints shall lap down to shed water and located at 4 or 8 o'clock position. All joints shall be sealed with caulking to prevent moisture penetration. Where jacketing abuts an uninsulated surface, joints shall be sealed with caulking.

3.3.6.3 Fittings

Fittings and other irregular shapes shall be finished as specified for rectangular ducts.

3.3.6.4 Rectangular Ducts

Two coats of weatherproof mastic shall be applied to the entire surface with a layer of glass cloth embedded between coats. Glass cloth overlaps at joints and adjoining surfaces shall be not less than 2 inches. Each coat of weatherproof mastic shall be 1/16 inch minimum thickness.

3.4 EQUIPMENT INSULATION INSTALLATION

3.4.1 General

Removable insulation sections shall be provided to cover parts of equipment which must be opened periodically for maintenance including vessel covers, fasteners, flanges and accessories. Equipment insulation shall be omitted on the following:

a. Manufacturer's nameplates.

3.4.2 Insulation for Cold Equipment (Below 60 deg F)

Insulation shall be furnished on all equipment handling media below 60 degrees F including the following:

a. Pumps (as indicated).

b. Air handling equipment parts that are not factory insulated.

3.4.2.1 Insulation Type

Insulation thicknesses shall be as follows:

a. Equipment 2-1/2-inch thick mineral fiber, or 3-1/ 2-inch~\ thick cellular glass, or 2-1/2-inch flexible cellular.

3.4.2.2 Pump Insulation
(for Pumps listed on Drawing G0010, 2027-P1 through 420-1-P2)

a. Pumps shall be insulated by forming a box around the pump housing. The box shall be constructed by forming the bottom and sides using joints which 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 cellular insulation. The box shall conform to the requirements of MICA-01 plate No. 49 when using flexible 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 barrier 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 HVAC 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 cellular which shall be adhered. Insulation corners shall be protected under wires and bands with suitable corner angles.

c. Cellular glass insulation shall be set in a coating of bedding compound, and joints shall be sealed with bedding compound as recommended by the manufacturer. Mineral fiber insulation joints shall be filled with finishing cement.

d. Exposed insulation corners shall be protected with corner angles.

3.4.2.4 Vapor Barrier

Upon completion of installation of insulation, penetrations shall be caulked. Two coats of vapor barrier coating 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.

3.4.3 Insulation for Hot Equipment (Above 60 deg F)

Insulation shall be furnished on all equipment handling media above 60 degrees F including the following:

a. Water heaters.

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 thicknesses shall be as follows:

a. Equipment handling media to 600 degrees F: 6-inch thick material.

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.

--- End of Section ---

SECTION 15400

PLUMBING, GENERAL PURPOSE

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 1010	(1984) Drinking-Fountains and Self-Contained, Mechanically-Refrigerated Drinking-Water Coolers

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.22	(1990; Z21.22a) Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36	(1993a) Structural Steel
ASTM A 47	(1990) Ferritic Malleable Iron Castings
ASTM A 53	(1993a) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 74	(1987) Cast Iron Soil Pipe and Fittings
ASTM A 105	(1990) Forgings, Carbon Steel, for Piping Components
ASTM A 183	(1983; R 1990) Carbon Steel Track Bolts and Nuts
ASTM A 193	(1991a) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A312/A312M	(1993) Seamless and Welded Austenitic Stainless Steel Pipe
ASTM A 515	(1990) Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service
ASTM A 516	(1990) Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
ASTM A 518	(1986; R 1991) Corrosion-Resistant High-Silicon Iron Castings

ASTM A 536	(1984) Ductile Iron Castings
ASTM A 733	(1989) Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
ASTM B 32	(1991) Solder Metal
ASTM B 42	(1992) Seamless Copper Pipe, Standard Sizes
ASTM B 43	(1991) Seamless Red Brass Pipe, Standard Sizes
ASTM B 88	(1992) Seamless Copper Water Tube
ASTM B 117	(1990) Salt Spray (Fog) Testing
ASTM B 306	(1988) Copper Drainage Tube (DWV)
ASTM B 370	(1988) Copper Sheet and Strip for Building Construction
ASTM B 641	1992) Seamless and Welded Copper Distribution Tube (Type D)
ASTM C 564	(1988) Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM C 1053	(1990) Borosilicate Glass Pipe and Fittings for Drain, Waste, and Vent (DWV) Applications
ASTM D 638	(1990) Tensile Properties of Plastics
ASTM D 1004	(1990) Initial Tear Resistance of Plastic Film and Sheeting
ASTM D 1248	(1984; R 1989) Polyethylene Plastics Molding and Extrusion Materials
ASTM D 1785	(1991) Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2000	(1990) Rubber Products in Automotive Applications
ASTM D 2235	(1988) Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings
ASTM D 2241	(1989) Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)

ASTM D 2447	(1989) Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, Based on Outside Diameter
ASTM D 2464	(1991) Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2466	(1990a) Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2467	(1990) Socket-Type Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2485	(1991) Evaluating Coatings for High Temperature Service
ASTM D 2564	(1991) Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D 2661	(1991) Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM D 2665	(1991b) Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM D 2666	(1989) Polybutylene (PB) Plastic Tubing
ASTM D 2672	(1989) Joints for IPS PVC Pipe Using Solvent Cement
ASTM D 2683	(1990) Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing
ASTM D 2737	(1989) Polyethylene (PE) Plastic Tubing
ASTM D 2822	(1991) Asphalt Roof Cement
ASTM D 2846	(1990a) Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems
ASTM D 2855	(1990) Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D 2996	(1988) Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe
ASTM D 3000	(1989) Polybutylene (PB) Plastic Pipe (SDR-PR) Based on Outside Diameter

ASTM D 3035	(1991) Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Controlled Outside Diameter
ASTM D 3138	(1990) Solvent Cements for Transition Joints Between Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Non-pressure Piping Components
ASTM D 3139	(1989) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D 3212	(1989) Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D 3261	(1990) Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
ASTM D 3309	(1989a) Polybutylene (PB) Plastic Hot-and Cold-Water Distribution Systems
ASTM D 4060	(1990) Abrasion Resistance of Organic Coatings by the Taber Abraser
ASTM D 4101	(1982; R 1988) Propylene Plastic Injection and Extrusion Materials
ASTM E 96	(1992) Water Vapor Transmission of Materials
ASTM F 437	(1989b) Threaded Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
ASTM F 438	(1990) Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40
ASTM F 439	(1990) Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
ASTM F 441	(1989) Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80
ASTM F 442	(1989) Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR)
ASTM F 493	(1989) Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 90A	(1980; 90A-a) Energy Conservation in New Building Design

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME-16	(1989; Addenda 1989, 1990, 1991) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage
ASME-17	(1989; Addenda 1989, 1990, 1991) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications
ASME A112.1.2	(1991) Air Gaps in Plumbing Systems
ASME A112.6.1M	(1988) Supports for Off-the-Floor Plumbing Fixtures for Public Use
ASME A112.14.1	(1975; R 1990) Backwater Valves
ASME A112.21.1M	(1991) Floor Drains
ASME A112.21.2M	(1991) Roof Drains
ASME A112.36.2M	(1991) Cleanouts
ASME B1.20.1	(1983) Pipe Threads, General Purpose (Inch)
ASME B16.3	(1985) Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.4	(1985) Cast Iron Threaded Fittings Class 125 and 250
ASME B16.5	(1988; Errata Oct 1988) Pipe Flanges and Flanged Fitting
ASME B16.12	(1991) Cast Iron Threaded Drainage Fittings
ASME B16.15	(1985) Cast Bronze Threaded Fittings, Classes 125 and 250
ASME B16.18	(1984) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.21	(1978) Nonmetallic Flat Gaskets for Pipe Flanges

ASME B16.22	(1989) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.23	(1984) Cast Copper Alloy Solder Joint Drainage Fittings - (DWV)
ASME B16.24	(1991) Bronze Pipe Flanges and Flanged Fittings, Class 150 and 300
ASME B16.29	(1986) Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV
ASME B16.39	(1986) Malleable Iron Threaded Pipe Unions (Classes 150, 250, and 300)
ASME B19.3	(1991) Safety Standard for Compressors for Process Industries
ASME B31.1	(1992) Power Piping
ASME B40.1	(1991) Gauges - Pressure Indicating Dial Type - Elastic Element
ASME CSD-1	(1992) Controls and Safety Devices for Automatically Fired Boilers

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1001	(1988) Pipe Applied Atmospheric Type Vacuum Breakers
ASSE 1003	(1981) Water Pressure Reducing Valves for Domestic Water Supply Systems
ASSE 1005	(1986) Water Heater Drain Valves - 3/4-Inch Iron Pipe Size
ASSE 1006	(1986) Residential Use (Household) Dishwashers
ASSE 1011	(1981) Hose Connection Vacuum Breakers
ASSE 1012	(1978) Backflow Preventers with Intermediate Atmospheric Vent
ASSE 1013	(1988) Reduced Pressure Principle Backflow Preventers
ASSE 1018	(1986) Trap Seal Primer Valves Water Supply Fed
ASSE 1037	(1990) Pressurized Flushing Devices for Plumbing

Fixtures/F

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA-01	(1989) Standard Methods for the Examination of Water and Wastewater
AWWA C105	(1993) Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA C203	(1986) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot Applied
AWWA C606	(1987) Grooved and Shouldered Joints
AWWA M20	(1973) Water Chlorination Principles and Practices

CAST IRON SOIL PIPE INSTITUTE (CISPI)

CISPI Std 301	(1990) Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
CISPI Std HSN	(1985) Neoprene Rubber Gaskets for Hub and Spigot Cast Iron Soil Pipe and Fittings

CODE OF FEDERAL REGULATIONS (CFR)

CFR 21 Part 175	Indirect Food Additives: Adhesives and Components of Coatings

COMMERCIAL ITEM DESCRIPTION (CID)

CID A-A-238	(Rev B) Seat, Water Closet

COPPER DEVELOPMENT ASSOCIATION (CDA)

CDA 1.0	(1990) Standard Test Method 1.0 for Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube

FEDERAL SPECIFICATIONS (FS)

FS OO-D-431	(Rev E) Dishwashing Machines, Commercial (Rack, Stationary)
FS QQ-L-201	(Rev F; Am 2) Lead Sheet

FS TT-P-1536	(Rev A) Plumbing Fixture Setting Compound
FS TT-S-00230	(Rev C) Sealing Compound, Elastomeric Type, Single Component for Calking, Sealing, and Glazing (for Buildings and Other Structures)
FS TT-S-001543	(Rev A) Sealing Compound: Silicone Rubber Base (for Calking, Sealing, and Glazing in Buildings and Other Structures)
FS WW-C-440	(Rev B; Am 2) Clamps, Hose, (Low-Pressure)
FS WW-P-541/GEN	(Rev E; Am 1) Plumbing Fixtures
FS WW-P-541/1	(Rev B; Am 1) Plumbing Fixtures (Water Closets)
FS WW-P-541/2	(Rev B; Am 1) Plumbing Fixtures (Urinals)
FS WW-P-541/3	(Rev B; Am 1) Plumbing Fixtures (Bathtubs)
FS WW-P-541/4	(Rev B; Am 1) Plumbing Fixtures (Lavatories)
FS WW-P-541/5	(Rev B; Am 1) Plumbing Fixtures (Sinks, Kitchen, Service, and Laundry Trays)
FS WW-P-541/6	(Rev B; Int Am 1) Plumbing Fixtures (Drinking Fountains)
FS WW-P-541/7	(Rev C; Am 1) Plumbing Fixtures (Shower Bath and Emergency Eye and Face Wash Outfits)
FS WW-P-541/9	(Rev B; Am 1) Plumbing Fixtures (Medical Facilities, Land Use)
FS WW-S-1913	(Rev A) Shower Head, Ball Joint (Integral Flow Control)
FS WW-U-516	(Rev B; Notice 1) Unions, Brass or Bronze, Threaded Pipe Connections and Solder-Joint Tube Connections
FS WW-V-35	(Rev C) Valve, Ball

FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH (FCCHR)

FCCHR-01	(Jun 1988) Manual of Cross-Connection Control

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-25	(1978; R 1988) Standard Marking System for Valves, Fittings, Flanges and Unions
MSS SP-44	(1991) Steel Pipe Line Flanges
MSS SP-58	(1988) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-67	(1990) Butterfly Valves
MSS SP-69	(1991) Pipe Hangers and Supports - Selection and Application
MSS SP-70	(1990) Cast Iron Gate Valves, Flanged and Threaded Ends
MSS SP-71	(1990) Cast Iron Swing Check Valves, Flanged and Threaded Ends
MSS SP-72	(1992) Ball Valves with Flanged or Buttwelding Ends for General Service
MSS SP-73	(1991) Brazing Joints for Copper Alloy Pressure Fittings
MSS SP-78	(1987; R 1992) Cast Iron Plug Valves, Flanged and Threaded Ends
MSS SP-80	(1987) Bronze Gate, Globe, Angle and Check Valves
MSS SP-83	(1987) Steel Pipe Unions Socket-Welding and Threaded
MSS SP-84	(1990) Steel Valves - Socket Welding and Threaded Ends
MSS SP-85	(1985) Cast Iron Globe and Angle Valves - Flanged and Threaded Ends

MILITARY SPECIFICATIONS (MS)

MS MIL-T-27730	(Rev A) Tape, Antiseize, Polytetrafluoroethylene, With Dispenser

NATIONAL ASSOCIATION OF PLUMBING-HEATING-COOLING CONTRACTORS (NAPHCC)

NAPHCC-01	(1990; Supple 1991) National Standard Plumbing Code

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A	(1989) Installation of Air Conditioning and Ventilating Systems

NATIONAL SANITATION FOUNDATION (NSF)

NSF Std 14	(Oct 1965; Rev Dec 1988) Plastic Piping Components and Related Materials

PLUMBING AND DRAINAGE INSTITUTE (PDI)

PDI WH 201	(1977) Water Hammer Arresters

UNDERWRITERS LABORATORIES (UL)

UL 174	(1989; Rev Jan 1991) Household Electric Storage-Tank Water Heaters

1.2 GENERAL REQUIREMENTS

1.2.1 Standard Products

Materials and equipment shall be the standard products 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.

1.2.2 Verification of Dimensions

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.

1.2.3 Code

All plumbing work shall be in accordance with NAPHCC-01, unless otherwise stated.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL DESCRIPTIONS:

SD-04 Drawings

Plumbing System; GA.

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; and 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.

SD-09 Reports

Tests, Flushing and Sterilization; FIO.

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.

SD-13 Certificates

Materials and Equipment; GA.

Where materials or equipment are specified to comply with requirements of AGA, or ASME, proof of such compliance. 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 if specified to conform to requirements of the ASME Boiler and Pressure Vessel Code, the design, fabrication, and installation shall conform to the code.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Pipe

Pipe fittings shall be compatible with the applicable pipe materials. Pipe threads (except dry seal) shall conform to ASME B1.20.1. Grooved pipe couplings and fittings shall be of the same manufacturer. Material or equipment containing lead shall not be used in any potable water system. Pipe materials shall be in accordance with Tables I and II.

2.1.1.1 Hubless Pipe

Hubless cast-iron soil pipe shall not be installed under concrete floor slabs or in crawl spaces below kitchen floors.

2.1.1.2 Plastic Pipe

Plastic pipe shall not be installed under concrete floor slabs, or in air plenums. Plastic pipe shall not be installed in a pressure piping system in buildings greater than three stories including any basement levels. Plastic pipe, fittings, and solvent cement shall meet NSF Std 14 and 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 shall conform to dimensional requirements for Schedule 40, Iron Pipe Size.

2.1.2 Pipe Joint Materials

Joints and gaskets materials shall conform to the following:

a. Coupling for Cast-Iron Pipe: ASTM A 74, AWWA C606.

b. Coupling for Steel Pipe: AWWA C606.

c. Flange Gaskets. Gaskets shall be made of non-asbestos material in accordance with ASME B16.21. Gaskets shall be flat, 1.6 mm (1/16 inch) 1/16 inch thick, and contain Arimid 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.

d. Neoprene Gaskets for Hub and Cast-Iron Pipe and Fittings: CISPI Std HSN.

e. Brazing Material. Brazing material shall have a liquidus temperature not exceeding 425 degrees C (800 degrees F), 800 degrees F., an operating temperature of 705-845 degrees C (1300-1500 degrees F), 1300-1550 degrees F., and a composition of 2 percent silver, 91 percent copper, 7 percent phosphorus within a maximum deviation of no more than 0.5 percent of all other materials combined.

f. Brazing Flux. Flux shall be in paste or liquid form, be appropriate for use with brazing material, be lead-free, have a 100 percent flushable residue, contain slightly acetic reagents, contain potassium borides, and contain fluorides.

g. Solder Material. Solder metal shall be in conformance with ASTM B 32 95-5 tin - antimony.

h. Solder Flux. Flux shall be liquid form, non-corrosive, and in conformance with CDA 1.0, Standard Test 1.

i. PTFE Tape, for use with Threaded Metal or Plastic Pipe: MS MIL-T-27730.

j. Rubber Gaskets for Cast-Iron Soil-Pipe and Fittings: ASTM C 564.

k. Solvent Cement for Transition Joints between ABS and PVC Nonpressure Piping Components: ASTM D 3138.

l. Plastic Solvent Cement for ABS Plastic Pipe: ASTM D 2235.

m. Plastic Solvent Cement for PVC Plastic Pipe: ASTM D 2564 and ASTM D 2855.

n. Plastic Solvent Cement for CPVC Plastic Pipe: ASTM F 493.

o. 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. Blind flange material shall conform to ASTM A 516 cold service and ASTM A 515 for hot service. Bolts shall be high strength or intermediate strength with material conforming to ASTM A 193.

2.1.3 Miscellaneous Materials

Miscellaneous materials shall conform to the following:

a. Water Hammer Arrester: PDI WH 201.

b. Metallic Cleanouts: ASME A112.36.2M.

c. Plumbing Fixture Setting Compound: FS TT-P-1536, Type II.

2.1.4 Pipe Insulation Material

Insulation shall be as specified in Section 15250 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 65 mm (2-1/2 inches) 2-1/2 inches and smaller shall be bronze with threaded bodies for pipe and solder-type connections for tubing. Valves 80 mm (3 inches) 3 inches and larger shall have flanged iron bodies and bronze trim. Pressure ratings shall be based upon the application. Valves used for water service shall have the zinc content limited to no more than 6 percent for the stem, body, bonnet, wedge, or disk in contact with the fluid. Grooved end valves may b provided if the manufacturer certifies that the valves meet the performance requirements of applicable MSS standard.

Description	Standard
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	FS WW-V-35
Bronze Gate, Globe, Angle, and Check Valves	MSS SP-80
Steel Valves-Socket Welding and Threaded Ends	MSS SP-84
Cast-Iron Globe and Angle Valves, Flanged and Threaded Ends	MSS SP-85
Backwater Valves	ASME A112.14.1
Water Pressure Reducing Valves	ASSE 1003
Water Heater Drain Valves	ASSE 1005
Temperature and Pressure Relief Valves for Hot Water Supply Systems	ANSI Z21.22

2.3.1 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 must 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 s less than 59 kW (200,000 Btuh) 200,000 BTUH shall have 20 mm (3/4 inch) 3/4 inch minimum inlets, and 20 mm (3/4 inch) 3/4 inch outlets. A vacuum relief valve shall be installed on the cold water supply line to the water heater or hot water storage tank. The discharge pipe from the relief valve shall be the size of the valve outlet.

2.4 FIXTURES

Fixtures shall be water conservation type, in accordance with the National Standard Plumbing Code. 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 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 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 82 degrees C (180 degrees F) 180 degrees F water temperature. Plumbing fixtures shall generally be in accordance with FS WW-P-

541/GEN, and shall be as indicated in Plumbing Fixture Schedule attached at the end of this section of the specifications.

2.5 BACKFLOW PREVENTERS

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 FCCHR-01. Backflow preventers with intermediate atmospheric vent shall be in accordance with ASSE 1012. Reduced pressure principle backflow preventers shall be in accordance with ASSE 1013. Hose connection vacuum breakers shall be in accordance with ASSE 1011. Pipe applied atmospheric type vacuum breakers shall be in accordance with ASSE 1001. Air gaps in plumbing systems shall be in accordance with ASME A112.1.2.

2.6 DRAINS

2.6.1 Floor Drains

Floor 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 or caulked connection. In lieu of a caulked joint 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 drains shall conform to ASME A112.21.1M.

2.7 TRAPS

Unless otherwise specified herein, traps shall be 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 0.813 mm (0.032-inch) 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 50 mm (2 inches). 2 inches. The interior diameter shall be not more than 3.2 mm (1/8 inch) 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 treaded 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 HEATER

Water heater types and capacities shall be as indicated. Each primary water heater shall have controls adjustable from 32 to 38 degrees C (90 to 100 degrees F). 90 to 100 degrees F.

2.8.1 Electric Type

Electric type water heaters shall conform to UL 174 with one heating element. The element shall be 2 kW.

2.9 COMPRESSED AIR SYSTEM

2.9.1 Intake Air Supply Filter

Dry type air filter shall be provided having a collection efficiency of 99 percent of particles larger than 10 microns. Filter body and media shall withstand a maximum 862 kPa (125 psi), 125 psi, capacity as indicated.

2.9.2 Pressure Regulators

The air system shall be provided with the necessary regulator valves to maintain the desired pressure for the installed equipment. Regulators shall be designed for a maximum inlet pressure of 862 kPa (125 psi) 125 psi and a maximum temperature of 93 degrees C (200 degrees F). 200 degrees F. Regulators shall be single-seated, pilot-operated with valve plug, bronze body and trim, and threaded connections. The regulator valve shall include a pressure gauge and shall be provided with an adjustment screw for adjusting the pressure differential from 0 kPa to 862 kPa (0 to 125 psi). 0 to 125 psig. Regulator shall be sized as indicated.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

All piping located in air plenums shall conform to NFPA 90A requirements. The plumbing system shall be installed complete with necessary fixtures, fittings, traps, valves, and accessories. Water and drainage piping shall be extended 1.5 m 5 feet outside the building, unless otherwise indicated. A gate valve or ball valve and drain on the water service line shall be installed inside the building approximately 50 mm 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. All exterior underground utilities shall be at least 300 mm 12 inches below the average local frost depth 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 horizontal or above.

3.1.1 Soil, Waste, Drain, and Vent Piping

No joint shall be located within 150 mm 6 inches of any floor. Vent lines for corrosive waste systems shall be the same material as the corrosive waste piping and shall be separate from other vents.

3.1.1.1 Roof Penetrations

Metallic pipe shall be used through the roof from at least 150 mm 6 inches below the roof to the required point of termination above the roof.

3.1.1.2 Fire Wall Penetrations

Metallic pipe shall be used through the fire wall to a point at least 150 mm \~6 inches on both sides of the wall.

3.1.1.3 Floor/Ceiling Penetrations

Metallic pipe shall be used through the floor/ceiling from at least 150 mm 6 inches below the ceiling to at least 150 mm 6 inches above the floor.

3.1.2 Water Pipe, Fittings, and Connections

3.1.2.1 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, or other control valves which are supplied with integral stops, shall be equipped with a shut-off 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, and wall shall be anchored to prevent movement.

3.1.2.2 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.

3.1.2.3 Protection to 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.

3.1.2.4 Mains, Branches, and Runouts

Piping shall be installed as indicated. Pipe shall be accurately cut and worked into place without springing or forcing. Care shall be taken not to weaken structural portions of the building. 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 will be kept a sufficient distance from other work and other services to permit not less than 15 mm 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. No water pipe shall 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. Change in direction shall be made with fittings, except that bending of pipe 100 mm (4 inches) 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 6 diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be acceptable.

3.1.2.5 Pipe Drains

Pipe drains indicated shall consist of 20 mm (3/4-inch) 3/4-inch hose bibb with renewable seat and gate valve or ahead of hose bibb. At other low points, 20 mm (3/4-inch) 3/4-inch brass plugs or caps shall be provided. Disconnection of the supply piping at the fixture is an acceptable drain.

3.1.2.6 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 where indicated and 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 15 m 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.

3.1.2.7 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 be in accordance with PDI WH 201. Vertical capped pipe columns will not be permitted.

3.1.3 Compressed Air Piping (Nonoil-Free)

Compressed air piping shall be installed as specified for water piping and suitable for 862 kPa (125 psig) 125 psig working pressure. Compressed air piping shall have supply lines and discharge terminals legibly and permanently marked at both ends with the name of the system and the direction of flow.

3.1.4 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.

3.1.4.1 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.

3.1.4.2 Mechanically Coupled

Mechanical couplings may be used in conjunction with grooved pipe for aboveground, ferrous, domestic hot-and cold-water systems in lieu of unions, welded, flanges, or threaded joints. Mechanical couplings are permitted in accessible locations, including behind access plates. Flexible grooved joints will not be

permitted, except as vibration isolators adjacent to mechanical equipment. Rigid grooved joints shall incorporate an angle bolt pad design which maintains metal-to metal contact with equal amount of pad offset of housings upon installation to ensure positive rigid clamping of the pipe. Designs which can only clamp on the bottom of the groove or which utilize gripping teeth or jaws, or which use misaligned housing bolt holes, or which require a torque wrench or torque specifications will not be permitted. Rigid grooved pipe couplings shall be for use with grooved end pipes, fittings, valves and strainers. Rigid couplings shall be designed for not less than 862 kPa (125 psi) 125 psi service and appropriate for static head plus the pumping head, and shall provide a water-tight joint. Grooved fittings and couplings, and grooving tools shall be provided from the same manufacturer. Segmentally welded elbows shall not be used. Grooves shall be prepared in accordance with the coupling manufacturer's latest published standards. Grooving shall be performed by qualified grooving operators having demonstrated proper grooving procedures in accordance with the tool manufacturer's recommendations. The Contracting Officer shall be notified 24 hours in advance of test to demonstrate operator's capability, and the test shall be performed at the work site, if practical, or at an agreed upon site. The operator shall demonstrate the ability to properly adjust the grooving tool, groove the pipe, and to verify the groove dimensions in accordance with the coupling manufacturer's specifications.

3.1.4.3 Union and Flanged

Unions and flanges and mechanical couplings shall not be concealed in walls, ceilings, or partitions. Unions shall be used on pipe sizes 65 mm (2-1/2 inches) 2-1/2 inches and smaller; flanges shall be used on pipe sizes 80 mm (3 inches) 3 inches and larger.

3.1.4.4 Copper Tube and Pipe

Joints shall use fittings made for the purpose, have clearances of 0.0254 mm to 0.0762 mm", 0.001 to 0.003", be brazed, and be made with flux. Tubes shall be cut square and reamed to remove burrs. The outside surface of the tube to contact the fitting and inside surface of the fitting shall be cleaned with an abrasive material just prior to making connections. Care shall be taken to prevent annealing of the tube or fittings when making connections. Connections of 65 mm (2-1/2 inch)" 2-1/2" and larger shall be made with heat applied uniformly around the entire circumference of the tube and fittings by a multiflame torch.

a. Brazed. Brazed joints shall be made in conformance with MSS SP-73, with flux and are acceptable for all line sizes. Excess flux and brazing material shall be wiped off the line and fitting exterior before it dries and hardens. Excess flux or brazing material on the inside surface of the tube or fitting shall be avoided.

b. Soldered. Soldered joints shall be made with flux and are only acceptable for lines 2 inches) and smaller. Joints shall be heated to 850 degrees F before the solder is applied.

c. Copper Tube Extracted Joint. An extracted mechanical 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. Also branch tube shall be notched for proper penetration into fitting to ensure a free flow joint. Extracted joints shall be brazed in accordance with NAPHCC-01 using B-Cup series filler metal in accordance with MSS SP-73. Soldered extracted joints will not be permitted.

3.1.4.5 Plastic Pipe

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. PB pipe shall have joints made with copper or brass fittings of the compression or mechanical type for 20 mm (3/4 inch) 3/4 inch and 25 mm (1 inch) 1 inch sizes and the heat type socket-fusion fittings for 25 mm (1 inch), 1 inch, 32 mm (1 1/4 inch), 1 1/4 inch, and 50 mm (2 inch) 2 inch sizes.

3.1.4.6 Corrosive Waste Stainless Steel Pipe

Buried stainless steel waste pipe and fittings shall be completely encased in polyethylene tube or sheet in accordance with AWWA C105. Welding of stainless steel piping shall refer to Section 15052.

3.1.5 Dissimilar Pipe Materials

Connections between ferrous and copper pipe shall be made with dielectric unions or flanges. Connecting joints between plastic and metallic pipe shall be made with transition fitting for the specific purpose.

3.1.6 Corrosion Protection for Buried Pipe and Fittings

3.1.6.1 Cast Iron and Ductile Iron

Pressure pipe shall have protective coating, a cathodic protection system, and joint bonding. Pipe, fittings, and joints shall have a protective coating. The protective coating shall be completely encasing polyethylene tube or sheet, joints, and fittings shall be cleaned, coated with primer, and wrapped with tape. The pipe shall be cleaned, coated, and wrapped prior to pipe tightness testing. Joints and fittings shall be cleaned, coated, and wrapped after pipe tightness testing. Tape shall be applied with a 50 percent overlap. Primer shall be as recommended by the tape manufacturer.

3.1.6.2 Steel

Steel pipe, joints, and fittings shall be cleaned, coated with primer, and wrapped with tape. Pipe shall be cleaned, coated, and wrapped prior to pipe tightness testing. Joints and fittings shall be cleaned, coated, and wrapped after pipe tightness testing. Tape shall conform to AWWA C203 and be applied with a 50 percent overlap. Primer shall be as recommended by the tape manufacturer.

3.1.7 Pipe Sleeves and Flashing

Pipe sleeves shall be furnished and set in their proper and permanent location.

3.1.7.1 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 shall not be required for cast-iron soil 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 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 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 100 mm 4 inches above the finished floor.

Unless otherwise indicated, sleeves shall be of a size to provide a minimum of 6 mm (1/4-inch) 1/4-inch clearance all-around between bare pipe and inside of sleeve or between jacket over insulation and sleeves. Sleeves in bearing walls shall be steel pipe or cast-iron pipe. Sleeves for membrane waterproof floors shall be steel pipe, cast-iron pipe, or plastic pipe. Membrane clamping devices shall be provided on pipe sleeves for waterproof floors. Sleeves in nonbearing walls or ceilings may be steel pipe, cast-iron pipe, galvanized sheet metal with lock-type longitudinal seam, or moisture-resistant fiber or plastic. Plastic sleeves shall not be used in nonbearing fire walls, roofs, or floor/ceilings. Except as otherwise specified, the annular space between pipe and sleeve, or between jacket over insulation and sleeve, shall be sealed as indicated and with sealants conforming to FS TT-S-00230 or FS TT-S-001543 and with a primer, backstop material and surface preparation as specified in Section 07920 CAULKING AND SEALANTS. Pipes passing through sleeves in concrete floors over crawl spaces shall be sealed as specified above. The annular space between pipe 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 15 mm 1/2 inch from wall surfaces on both sides. Fill annular space between pipe and sleeve with backing material and install sealants in the joint between the pipe and masonry wall as specified above. Sealant selected for the earth side of the wall shall be compatible with waterproofing materials that are to be applied over the joint sealant.

3.1.7.2 Flashing Requirements

Pipes passing through roof or floor waterproofing membrane shall be installed through a 19.5 kg per square meter (4-pound) 4-pound lead flashing or a 4.9 kg per square meter (16-ounce) 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 200 mm 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 250 mm. 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 200 mm 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 250 mm (10 inches) 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. In addition, a waterproofing clamping flange shall be installed.

3.1.7.3 Waterproofing

Waterproofing at floor-mounted water closets shall be accomplished by forming a flashing guard from lead or soft-tempered sheet copper. The center of the sheet shall be perforated and turned down approximately 40 mm 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 40 mm; 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 lead or sheet copper shall extend not less than 200 mm 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 40 mm 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 caulked with oakum and lead to form a seal.

3.1.7.4 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 150 mm (6 inches) 6 inches in diameter.

b. A tack-welded or banded-metal rain shield around the pipe.

3.1.7.5 Pipe Penetrations of Slab on Grade Floors

Where pipes, fixtures 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, form a groove 6 mm to 13 mm 1/4 inch to 1/2 inch wide by 6 mm to 10 mm 1/4 inch to 3/8 inch deep around the pipe, fitting or drain. Fill the groove with a sealant as specified in Section 07920 CAULKING AND SEALANTS. Coordinate these requirements with the General Contractor.

3.1.8 Supports

3.1.8.1 General

Hangers used to support piping 50 mm (2 inches) 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. 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. 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.

3.1.8.2 Seismic Requirements, Pipe Supports, and Structural Bracing

All piping and attached valves shall be supported and braced to resist seismic loads as specified in accordance with TM5-809-10. 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.

3.1.8.3 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts and supports installation 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 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 all insulated pipe 100 mm (4 inches) 4 inches and larger when the temperature of the medium is 15 degrees C 60 degrees F or higher. Type 39 saddles shall be welded to the pipe.

h. Type 40 shields shall:

(1) be used on all insulated pipe less than 100 mm (4 inches). 4 inches.

(2) be used on all insulated pipe 100 mm (4 inches) 4 inches and larger when the temperature of the medium is 15 degrees C 60 degrees F or less.

(3) have a high density insert for pipe 50 mm (2 inches) 2 inches and larger. High density inserts shall have a density of 128 kg per cubic meter (8 pcf) 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 300 mm one foot from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 1.5 m 5 feet apart at valves. Use 49 degrees C 120 degrees F for PVC pipe and 82 degrees C 180 degrees F for CPVC as operating temperatures in determining hanger spacing for PVC or CPVC pipe.

j. Vertical pipe shall be supported at each floor, except at slab-on-grade, and at intervals of not more than 4.5 m, 15 feet, not more than 2 m 8 feet from end of risers, and at vent terminations.

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 100 mm (4 inches) 4 inches and larger when the temperature of the medium is 15 degrees C 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 100 mm (4 inches) 4 inches a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.

(3) on pipe 100 mm (4 inches) 4 inches and larger carrying medium less that 15 degrees C 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, 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 100 mm, 4 inches, or by an amount adequate for the insulation, whichever is greater.

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 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 100 mm (4 inches). 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 450 mm 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

3.2.1 RELIEF VALVES

No valves shall be installed between a relief valve and its water heater. 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 heater and mounted 150 mm 6 inches above the top of the tank or water heater.

3.2.4 Heat Traps

Piping to and from each water heater shall be routed horizontally and downward a minimum of 600 mm two feet before turning in an upward direction.

3.2.5 Connections to Water Heaters

Connections of metallic pipe to water heaters shall be made with dielectric unions or flanges.

3.3 FIXTURES AND FIXTURE TRIMMINGS

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 Height of Fixture Rims Above Floor

Lavatories shall be mounted with rim 775 mm 31 inches above finished floor. Wall-hung drinking fountains, and water coolers shall be installed with rim 1020 mm 42 inches above floor. Wall-hung service sinks shall be mounted with rim 700 mm 28 inches above the floor.

3.3.3 Backflow Prevention Devices

No plumbing fixture, equipment, or pipe connection shall be installed that will provide a cross connection or interconnection between a potable water supply and any source of nonpotable water. A reduced pressure backflow prevention device shall be installed where indicated and located so that no

part of the device will be submerged. Access shall be provided for maintenance and testing. Each device shall be a standard commercial unit.

3.3.4 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 05500 MISCELLANEOUS METAL.

3.3.5 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 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 PAINTING, GENERAL.

3.7 TESTS, FLUSHING, AND STERILIZATION

3.7.1 Plumbing System

The plumbing system shall be tested in accordance with NAPHCC-01.

3.7.1.1 Compressed Air Piping (Nonoil-Free)

Piping systems shall be filled with oil-free dry air or gaseous nitrogen to 1.03 MPa 150 psig and hold this pressure for 2 hours with no drop in pressure.

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. No caulking of screwed joints or holes will be acceptable.

3.7.3 System Flushing

After tests are completed, potable water piping shall be flushed. In general, sufficient water shall be used to produce a minimum water velocity of 0.762 meters per second (2.5 feet per second) 2.5 feet per second through piping being flushed. Flushing shall be continued until discharge water shows no discoloration. System shall be drained at low points. Strainer screens shall be removed, cleaned, and replaced in line. After flushing and cleaning, systems shall be prepared for service 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 work is complete, the hot-water system shall be adjusted for uniform circulation. Flush valves and automatic control devices shall be adjusted for proper operation.

3.7.4 Operational Test

Upon completion of and prior to acceptance of the installation, 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. Temperature of each domestic hot-water supply.

f. Operation of each vacuum breaker and backflow preventer.

3.7.5 Sterilization

After pressure tests have been made, the entire domestic hot- and cold-water distribution system shall be sterilized. System shall be thoroughly flushed with water of sufficient velocity until all entrained dirt and other foreign material 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 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 sterilized 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. The system including the tanks shall then be flushed with clean water until the residual chlorine is reduced to less than one part per million. During the flushing period each valve and faucet shall be opened and closed several times. From several points in the system the Contracting Officer will take samples of water in properly sterilized containers for bacterial examination. The samples of water shall be tested for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with AWWA-01. The testing method used shall be either the multiple - tube fermentation technique or the membrane - filter technique. The sterilizing 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:

Vitreous china toilet siphon action elongated bowl, close-coupled tank. Floor flange shall be copper alloy, cast iron, or plastic.

Gasket shall be wax type.

Seat - CID A-A-238, Type A, white-solid plastic, elongated, open front.

P-5 LAVATORY:

Manufacturer's standard sink depth, FS WW-P-541/4, vitreous china, countertop, rectangular.

Faucet - Faucets shall be center set, 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.

Handle - Lever type. Drop forged copper alloy.

Drain - Strainer shall be stainless steel, pop-up drain shall include lift rods, jam nut, washer, and tail piece.

P-7 KITCHEN SINK:

FS WW-P-541/5, countertop rectangular with holes for faucet and spout, single bowl 24 by 30 stainless steel.

Faucet and Spout - Cast copper alloy. Aerator shall have internal threads.

Handle - Cast copper. Single lever type.

Drain Assembly - Cup strainer, crossbars, jam nuts, washers, couplings, stopper, etc. shall be stainless steel.

P-10 LABORATORY SINK:

FS WW-P-541/5, countertop rectangular sink, 32 in. length, 20 in. wide, 6 3/4 in. deep, acid-resistant plastic. Thickness of sinks shall be manufacturer's standard. Drain and trap shall be ACID RESISTING PLASTIC.

Faucet and Spout - Cast copper alloy, without 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.

Handles - Cast copper alloy. Lever type.

Emergency showers: Shower/eyewash shall be equipped with 1 inch or 1 ½ inch stay-open freeze-proof valves, cross-connection backflow prevention valve, and must be connected to drinking water supply. Minimum flow rate shall be 50 gpm shower, 2.5 gpm eyewash. Water supply shall contain no valves other than the operating valve for that location. Unit shall be designed and installed with supply and drain features which will permit testing/use in winter without freezing.

P-11 SHOWER:

Wall Mounted – Shower head shall conform to FS A-A-240, Type I, nonadjustable spray, stainless steel or chromium plated brass with wall joint and tamperproof flow control device either integral with shower head or as a separate unit for assembly between the shower head and the arm. The flow control device shall limit the flow to a maximum of 2.75 gpm. Handles shall be chrome-plated die cast zinc alloy. Control valves shall be copper alloy and have metal integral parts of copper alloy, nickel alloy, or CRES. Valves shall be thermostatic mixing type. Shower head shall be vandalproof with integral back.

Cabinet Shower – 32 inches wide x 32 inches deep, polypropylene with molded stone or plastic receptor. Provide with curtain rod and concealed fittings and trim.

P-15 WATER COOLER DRINKING FOUNTAINS: Water cooler drinking fountains shall be self-contained, conform to ARI 1010, use one of the halogenated fluorocarbons as a refrigerant, have a capacity to deliver 30.2 liters per hour (8 gph) 8 gph of water at 10 degrees C (50 degrees F) 50 degrees F with an inlet water temperature of 27 degrees C (80 degrees F) 80 degrees F while residing in a room environment of 32 degrees C (90 degrees F) 90 degrees F, have self-closing valves. Self-closing valves shall have automatic stream regulators, have a flow control capability, have a push button actuation or have a cross-shaped index metal turn handle without a hood. All exposed surfaces of stainless steel shall have No. 4 general polish finish. Spouts shall provide a flow of water at least 100 mm (4 inches) 4 inches high so as to allow the insertion of a cup or glass under the flow of water.

Interior Free Standing - Free standing units shall be 1016 mm to 1054.1 mm (40 to 41-1/2 inches) 40 to 41-1/2 inches high, 304.8 mm to 457.2 mm (12 to 18 inches) 12 to 18 inches wide, and 304.8 mm to 355.6 mm (12 to 14 inches) 12 to 14 inches deep. The bowl shall be made of stainless steel. The unit shall be for interior installation.

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.

TABLE I

PIPE AND FITTING MATERIALS FOR
DRAINAGE, WASTE, AND VENT PIPING SYSTEMS

Item No.	Pipe and Fitting Materials	SERVICE A	B	C	D	E	F
1	Cast iron soil pipe and fittings, hub and spigot, ASTM A 74 with compression gaskets	X	X	X	X	X	
2	Cast iron soil pipe and fittings hubless, CISPI Std 301		X		X		
3	Cast iron drainage fittings, threaded, ASME B16.12 for use with Item 6		X		X		
4	Cast iron screwed fittings (threaded) ASME B16.4 for use with Item 6					X	
5	Malleable-iron threaded fittings, galvanized ASME B16.3 for use with Item 6			X	X		
6	Steel pipe, seamless galvanized, ASTM A 53, Type S, Grade B		X		X	X	
7	Copper drainage tube, (DWV), ASTM B 306	X*	X	X*	X	X	
8	Acrylonitrile-Butadiene-Styrene (ABS) plastic drain, waste, and vent pipe and fittings ASTM D 2661	X					
9	Polyvinyl Chloride plastic, drain and Vent pipe and fittings, ASTM D 2665	X				X	
10	Polypropylene (PP) drain, and vent pipe and fittings, ASTM D 2665						X
11	Stainless Steel, Schedule 40 waste pipe and fittings, ASTM A312. TP316						X

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 3a		X		
2	Steel pipe: a. Seamless, galvanized, ASTM A 53, Type S, Grade B b. Seamless, black ASTM A 53, Type S, Grade B			X X	
3	Seamless red brass pipe, ASTM B 43	X	X		
4	Bronze flanged fittings ASME B16.24 for use with Items 4 and 6	X	X		
5	Seamless copper pipe, ASTM B 42	X	X	X	
6	Seamless copper water tube ASTM B 88	X*	X*		X***
7	Seamless and welded copper distribution tube (Type D) ASTM B 641	X	X		X****
8	Cast bronze threaded fittings, ASME B16.15 for use with Items 4 and 6	X	X		X
9.	Wrought copper and bronze				

	solder-joint pressure fittings, ASME B16.22 for use with Items 7 and 8	X	X	X	X
10	Cast copper alloy solder-joint pressure fittings, ASME B16.18 for use with Items 7 and 8	X	X	X	X
11	Nipples, pipe threaded ASTM A 733	X	X	X	

A - Cold Water Aboveground
B - Hot Water 180 F Maximum Aboveground
C - Compressed Air Nonoil-Free
D - Cold Water Service Belowground
Indicated types are minimum wall thicknesses.
* - Type M - Hard
** - 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

-- End of Section --

SECTION 15895

AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM
02/94

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 350	(1986) Sound Rating of Non-Ducted Indoor Air-Conditioning Equipment
ARI 410	(1991) Forced-Circulation Air-Cooling and Air-Heating Coils
ARI 430	(1989) Central-Station Air-Handling Units
ARI 440	(1989) Room Fan-Coil Air-Conditioners
ARI 445	(1987) Room Air-Induction Units
ARI 880	(1990) Air Terminals
ARI Guideline D	(1987) Application and Installation of Central Station Air-Handling Units

AIR CONDITIONING CONTRACTORS OF AMERICA (ACCA)

ACCA Manual 4	(1990) Installation Techniques for Perimeter Heating and Cooling

AIR DIFFUSION COUNCIL (ADC)

ADC 1062:GRD	(1984) Test Codes for Grilles, Registers and Diffusers

AIR MOVEMENT AND CONTROL ASSOCIATION (AMCA)

AMCA 210	(1985) Laboratory Methods of Testing Fans for Rating
AMCA 300	(1985; Rev 1987; Errata) Reverberant Room Method for Sound Testing of Fans

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI S12.32	(1990) Precision Methods for the Determination of Sound Power Levels of Discrete-Frequency and Narrow-Band Noise Sources in Reverberation Rooms

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 47	(1990) Ferritic Malleable Iron Castings
ASTM A 53	(1990b) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 106	(1991) Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A 123	(1989a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 167	(1992b) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 181	(1990) Forgings, Carbon Steel, for General-Purpose Piping
ASTM A 183	(1983; R 1990) Carbon Steel Track Bolts and Nuts
ASTM A 193	(1992) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 234	(1992a) Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
ASTM A 525	(1991b) General Requirement for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
ASTM A 536	(1984) Ductile Iron Castings
ASTM A 733	(1989) Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
ASTM B 62	(1993) Composition Bronze or Ounce Metal Castings
ASTM B 75	(1992a) Seamless Copper Tube
ASTM B 88	(1993) Seamless Copper Water Tube
ASTM B 117	(1990) Salt Spray (Fog) Testing
ASTM B 650	(1985) Electrodeposited Engineering Chromium Coatings of Ferrous Substrates
ASTM C 107	(1989) Panel Spalling Testing High-Duty Fireclay Brick
ASTM C 1071	(1991) Thermal and Acoustical Insulation (Glass Fiber, Duct Lining Material)
ASTM D 1384	(1987) Corrosion Test for Engine Coolants in Glassware

ASTM D 1654	(1992) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D 1785	(1991) Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2000	(1990) Rubber Products in Automotive Applications
ASTM D 2466	(1990a) Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2564	(1991a) Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D 2855	(1990) Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D 3359	(1992a) Measuring Adhesion by Tape Test

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 15	(1992) Safety Code for Mechanical Refrigeration
ASHRAE 52	(1968; R 1976) Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter
ASHRAE 68	(1986) Laboratory Method of Testing In-Duct Sound Power Measurement Procedures for Fans
ASHRAE 84	(1991) Method of Testing Air-to-Air Heat Exchangers

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B1.20.1	(1983; R 1992) Pipe Threads, General Purpose (Inch)
ASME B16.3	(1992) Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.5	(1988; Errata; B16.5a) Pipe Flanges and Flanged Fittings
ASME B16.9	(1993) Factory-Made Wrought Steel Buttwelding Fittings
ASME B16.11	(1991) Forged Fittings, Socket-Welding and Threaded
ASME B16.18	(1984) Cast Copper Alloy Solder Joint Pressure Fittings

ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.22	(1989) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.26	(1988) Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B16.39	(1986) Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300
ASME B31.1	(1992; B31.1a) Power Piping
ASME B40.1	(1991) Gauges - Pressure Indicating Dial Type - Elastic Element
ASME BPV VIII Div 1	(1992; Addenda Dec 1992) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage
ASME BPV IX	(1992; Addenda Dec 1992) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C606	(1987) Grooved and Shouldered Joints

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1	(1992) Structural Welding Code - Steel

ANTI-FRICTION BEARING MANUFACTURERS ASSOCIATION (AFBMA)

AFBMA 9	(1990) Load Ratings and Fatigue Life for Ball Bearings
AFBMA 11	(1990) Load Ratings and Fatigue Life for Roller Bearings

COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-1419	(Rev D) Filter Element, Air Conditioning (Viscous-Impingement and Dry Types, Replaceable)

FEDERAL SPECIFICATIONS (FS)

FS F-F-300	(Rev B) Filter, Air Conditioning: Viscous Impingement and Dry Types, Cleanable
FS F-F-320	(Rev B; Notice 1) Filters, Electronic Air Cleaning, Ionizing Plate Type
FS F-F-2790	(Basic) Filter, Air-Extended Area, Initial Installation

FS RR-W-360	(Rev A) Wire Fabric, Industrial
FS WW-V-35	(Rev C) Valve, Ball

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-25	(1993) Standard Marking System for Valves, Fittings, Flanges and Unions
MSS SP-58	(1993) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	(1991) Pipe Hangers and Supports - Selection and Application
MSS SP-70	(1990) Cast Iron Gate Valves, Flanged and Threaded Ends
MSS SP-71	(1990) Cast Iron Swing Check Valves, Flanged and Threaded Ends
MSS SP-80	(1987) Bronze Gate, Globe, Angle and Check Valves
MSS SP-85	(1985) Cast Iron Globe & Angle Valves Flanged and Threaded Ends

MILITARY SPECIFICATIONS (MS)

MS MIL-A-3316	(Rev C; Am 2) Adhesives, Fire-Resistant, Thermal Insulation
MS MIL-E-17813	(Rev F) Expansion Joints, Pipe, Metallic Bellows
MS MIL-E-17814	(Rev F) Expansion Joints, Pipe, Slip-Type Packed
MS MIL-F-51068	(Rev F; Int Am 3) Filters, Particulate (High-Efficiency Fire Resistant)
MS MIL-P-21035	(Rev B) Paint, High Zinc Dust Content, Galvanizing Repair (Metric)

MILITARY STANDARDS (MIL-STD)

MIL-STD 282	(Basic; Notice 1, 2 & 3) Filter Units, Protective Clothing, Gas-Mask Components and Related Products: Performance-Test Methods

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(1993) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1993) National Electrical Code
NFPA 90A	(1993) Installation of Air Conditioning and Ventilating Systems
NFPA 96	(1991) Installation of Equipment for the Removal of Smoke and Grease-Laden Vapors from Commercial Cooking Equipment

NORTH AMERICAN INSULATION MANUFACTURERS ASSOCIATION (NAIMA)

NAIMA-01	(1989) TIMA Fibrous Glass Duct Construction Standards

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA-01	(1975) Accepted Industry Practice for Industrial Duct Construction
SMACNA-05	(1992) Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems
SMACNA-06	(1985) HVAC Duct Construction Standards - Metal and Flexible
SMACNA-10	(1985) HVAC Air Duct Leakage Test Manual

UNDERWRITERS LABORATORIES (UL)

UL-01	(1993; Supple) Building Materials Directory
UL-03	(1993; Supple) Electrical Construction Materials Directory
UL-05	(1993; Supple) Fire Resistance Directory
UL 94	(1991; Rev thru May 1993) Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
UL 181	(1990; Rev Nov 1990) Factory-Made Air Ducts and Connectors
UL 214	(1993) Tests for Flame-Propagation of Fabrics and Films
UL 555	(1990; Rev thru Nov 1993) Fire Dampers
UL 586	(1990) High-Efficiency, Particulate, Air Filter Units
UL 705	(1984; Rev thru Sep 1993) Power Ventilators
UL 900	(1987; Rev thru Jul 1993) Test Performance of Air Filter Units
UL 1995	(1990) Heating and Cooling Equipment

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.

1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL DESCRIPTIONS:

SD-01 Data

Components and Equipment Data; GA.

Manufacturer's catalog data shall be 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. Terminal Units

SD-04 Drawings

Air Supply, Distribution, Ventilation, and Exhaust Equipment; FIO.

Drawings shall consist of 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. 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-06 Instructions

Test Procedures; FIO.

Proposed test procedures for piping hydrostatic test, ductwork leak test, and performance tests of systems, at least 2 weeks prior to the start of related testing.

System Diagrams; GA.

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.

SD-07 Schedules

Test Schedules; FIO.

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.

SD-08 Statements

Similar Services; FIO.

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.

SD-09 Reports

Test Reports; FIO.

Test reports for the 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-19 Operation and Maintenance Manuals

Air Supply, Distribution, Ventilation, and Exhaust Manuals; FIO.

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 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 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 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 16415 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 on the drawings.

2.7 DUCTWORK COMPONENTS

All aspects of ductwork shall be as specified in Section 15653 AIR-CONDITIONING SYSTEMS (UNITARY TYPE).

2.8 AIR SYSTEMS EQUIPMENT

2.8.1 Fans

Fans shall be tested and rated according to AMCA 210. Fans shall be

connected to the motors directly. 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 Type Power Roof Ventilators for Laboratory Hood

Fans shall be direct driven with 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, and extended base. Motors enclosure shall be explosion-proof type. Lubricated bearings shall be provided.

2.8.1.2 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.

2.9 FACTORY PAINTING

Units which are not of galvanized construction according to ASTM A 123 or ASTM A 525 shall be factory painted with a corrosion resisting paint finish. Internal and external ferrous metal surfaces shall be cleaned, phosphatised 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 MS MIL-P-21035.

PART 3 EXECUTION

3.1 INSTALLATION

Work shall be installed as shown and according to the manufacturer's diagrams and recommendations.

3.1.1 Insulation

Thickness and application of insulation materials for ductwork and equipment shall be according to Section 15250 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.1.2 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.

3.1.3 Power Transmission Components Adjustment

Alignment of direct driven couplings shall be to within 50 percent of manufacturer's maximum allowable range of misalignment.

3.2 FIELD PAINTING

Finish painting of items only primed at the factory or surfaces not specifically noted otherwise are specified in Section 09900 PAINTING, GENERAL.

3.3 CLEANING AND ADJUSTING

Inside of unit ventilators, ducts, 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. 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. Fans shall be adjusted to the speed indicated by the manufacturer to meet specified conditions.

3.4 TESTING, ADJUSTING, AND BALANCING

Testing, adjusting, and balancing shall be as specified in Section 15990 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.

3.5 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 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 3 days for each system and shall demonstrate that the entire system is functioning according to the specifications.

3.6 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 8 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 --

SECTION 16262

AUTOMATIC TRANSFER SWITCH AND BY-PASS/ISOLATION SWITCH
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.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 117	(1997) Operating Salt Spray (Fog) Apparatus

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C37.13	(1990; R 1995) Low-Voltage AC Power Circuit Breakers Used in Enclosures
IEEE C37.90.1	(1989; R 1994) IEEE Standard Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems
IEEE C62.41	(1991; R 1995) Surge Voltages in Low-Voltage AC Power Circuits
IEEE Std 602	(1996) Electric Systems in Health Care Facilities

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 1	(1993) Industrial Controls and Systems
NEMA ICS 2	(1993) Industrial Controls and Systems Controllers, Contactors, and Overload Relays Rated Not More Than 2,000 Volts AC or 750 Volts DC
NEMA ICS 4	(1997) Industrial Control and Systems Terminal Blocks
NEMA ICS 6	(1993) Industrial Control and Systems, Enclosures
NEMA ICS 10	(1999) Industrial Control and Systems: AC Transfer Switch Equipment - Part 2: Static AC Transfer Equipment

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code
NFPA 110	(1999) Emergency and Standby Power Systems

UNDERWRITERS LABORATORIES (UL)

UL 1008	(1996; Rev thru Feb 1999) Transfer Switch Equipment
UL 1066	(1997) Low-Voltage AC and DC Power Circuit Breakers Used in Enclosures

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

Switches; G, SWAO

Schematic, external connection, one-line schematic and wiring diagram of each ATS assembly. Interface equipment connection diagram showing conduit and wiring between ATS and related equipment. Device, nameplate, and item numbers shown in list of equipment and material shall appear on drawings wherever that item appears. Diagrams shall show interlocking provisions and cautionary notes, if any. Operating instructions shall be shown either on one-line diagram or separately. Unless otherwise approved, one-line and elementary or schematic diagrams shall appear on same drawing.

Equipment; G, SWAO
Installation; G, SWAO

Dimensioned plans, sections and elevations showing minimum clearances, weights, and conduit entry provisions for each ATS.

SD-03 Product Data

Material; G, SWAO
Equipment; G, SWAO

List of proposed equipment and material, containing a description of each separate item.

SD-06 Test Reports

Testing; G,

A description of proposed field test procedures, including proposed date and steps describing each test, its duration and expected results, not less than 2 weeks prior to test date.

Certified factory and field test reports, within 14 days following completion of tests. Reports shall be certified and dated and shall demonstrate that tests were successfully completed prior to shipment of equipment.

SD-07 Certificates

Equipment; G
Material; G

Certificates of compliance showing evidence of UL listing and conformance with applicable NEMA standards. Such certificates are not required if manufacturer's published data, submitted and approved, reflect UL listing or conformance with applicable NEMA standards.

Switching Equipment; G,

Evidence that ATS withstand current rating (WCR) has been coordinated with upstream protective devices as required by UL 1008. Upon request, manufacturer shall also provide notarized letter certifying compliance with requirements of this specification, including withstand current rating.

SD-10 Operation and Maintenance Data

Switching Equipment; G,
Instructions; G,
Six copies of operating manual outlining step-by-step procedures for system startup, operation, and shutdown. Manual shall include manufacturer's name, model number, service manual, parts list, and brief description of equipment and basic operating features. Manufacturer's spare parts data shall be included with supply source and current cost of recommended spare parts. Six copies of maintenance manual listing routine maintenance, possible breakdowns, repairs, and troubleshooting guide. Manual shall include simplified wiring and control diagrams for system as installed.

1.3 GENERAL REQUIREMENTS

1.3.1 Standard Product

Material and equipment shall be standard products of a manufacturer regularly engaged in manufacturing the products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. The experience use shall include applications in similar circumstances and of same design and rating as specified ATS. Equipment shall be capable of being serviced by a manufacturer-authorized and trained organization that is, in the Contracting Officer's opinion,

reasonably convenient to the site.

1.3.2 Nameplate

Nameplate showing manufacturer's name and equipment ratings shall be made of corrosion-resistant material with not less than 1/8 inch tall characters. Nameplate shall be mounted to front of enclosure and shall comply with nameplate requirements of NEMA ICS 2.

1.4 SERVICE CONDITIONS

ATS shall be suitable for prolonged performance under following service conditions:

a. Altitude: 1800 feet above mean sea level.

b. Relative Humidity: 100 percent maximum, continuous.

c. Temperature: Minus -10 to 110 degrees F.

PART 2 PRODUCTS

2.1 AUTOMATIC TRANSFER SWITCH (ATS)

ATS shall be electrically operated and mechanically held in both operating positions. ATS shall be suitable for use in standby systems described in NFPA 70. ATS shall be UL listed. ATS shall be manufactured and tested in accordance with applicable requirements of IEEE C37.90.1, IEEE C37.13, IEEE C62.41, IEEE Std 602, NEMA ICS 1, NEMA ICS 2, NEMA ICS 10, UL 1008 and UL 1066. ATS shall conform to NFPA 110. To facilitate maintenance, manufacturer's instruction manual shall provide typical maximum contact voltage drop readings under specified conditions for use during periodic maintenance. Manufacturer shall provide instructions for determination of contact integrity. ATS shall be rated for continuous duty at specified continuous current rating. ATS shall be fully compatible and approved for use with BP/IS specified. BP/IS shall be considered part of ATS system. ATS shall have following characteristics:

a. Voltage: 480 volts ac.

b. Number of Phases: Three.

c. Number of Wires: Four.

d. Frequency: 60 Hz.

e. Poles: As shown on drwgs.

f. ATS WCR: Rated to withstand short-circuit current of 30 amperes, RMS symmetrical.

g. Nonwelding Contacts: Rated for nonwelding of contacts when used with upstream feeder overcurrent devices shown and with available fault current specified.

h. Main and Neutral Contacts: Contacts shall have silver alloy composition. Neutral contacts shall have same continuous current rating as main or phase contacts.

2.1.1 Override Time Delay

Time delay to override monitored source deviation shall be adjustable from 0.5 to 6 seconds and factory set at 1 second. ATS shall monitor phase conductors to detect and respond to sustained voltage drop of 25 percent of nominal between any two normal source conductors and initiate transfer action to alternate source and start engine driven generator after set time period. Pickup voltage shall be adjustable from 85 to 100 percent of nominal and factory set at 90 percent. Dropout voltage shall be adjustable from 75 to 98 percent of pickup value and factory set at 85 percent of nominal.

2.1.2 Transfer Time Delay

Time delay before transfer to alternate power source shall be adjustable from 0 to 5 minutes and factory set at 3 minutes. ATS shall monitor frequency and voltage of alternate power source and transfer when frequency and voltage are stabilized. Pickup voltage shall be adjustable from 85 to 100 percent of nominal and factory set at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal and factory set at 90 percent.

2.1.3 Return Time Delay

Time delay before return transfer to normal power source shall be adjustable from 0 to 30 minutes and factory set at 30 minutes. Time delay shall be automatically defeated upon loss or sustained undervoltage of alternate power source, provided that normal supply has been restored.

2.1.4 Engine Shutdown Time Delay

Time delay shall be adjustable from 0 to 30 minutes and shall be factory set at 10 minutes.

2.1.5 Exerciser

Provide a generator exerciser timer. Run times shall be user programmable. The generator exerciser shall be selectable between load transfer and enginer run only, and shall have a fail-safe feature that will retransfer the ATS to normal during the exercise period.

2.1.6 Auxiliary Contacts

Two normally open and two normally closed auxiliary contacts rated at 15 amperes at 480 volts shall operate when ATS is connected to normal power source, and two normally open and two normally closed contacts shall operate when ATS is connected to alternate source.

2.1.7 Supplemental Features

ATS shall be furnished with the following:

a. Engine start contact.

b. Alternate source monitor.

c. Test switch to simulate normal power outage.

d. Voltage sensing. Pickup voltage adjustable from 85 to 100 percent of nominal; dropout adjustable from 75 to 98 percent of pickup.

e. Time delay bypass switch to override return time delay to normal.

f. Manual return-to-normal switch.

g. Means shall be provided in the ATS to insure that motor/transformer load inrush currents do not exceed normal starting currents. This shall be accomplished with either in-phase monitoring, time-delay transition, or load voltage decay sensing methods. If manufacturer supplies an in-phase monitoring system, the manufacturer shall indicate under what conditions a transfer cannot be accomplished. If the manufacturer supplies a time-delay transition system, the manufacturer shall supply recommendations for establishing time delay. If load voltage decay sensing is supplied, the load voltage setting shall be user programmable.

2.1.8 Operator

Manual operator conforming to UL 1008 shall be provided, and shall incorporate features to prevent operation by unauthorized personnel. ATS shall be designed for safe manual operation under full load conditions. If manual operation is accomplished by opening the door, then a dead-front shall be supplied for operator safety.

2.1.9 Override Switch

Override switch shall bypass automatic transfer controls so ATS will transfer and remain connected to alternate power source, regardless of condition of normal source. If alternate source fails and normal source is available, ATS shall automatically retransfer to normal source.

2.1.10 Green Indicating Light

A green indicating light shall supervise/provide normal power source switch position indication and shall have a nameplate engraved NORMAL.

2.1.11 Red Indicating Light

A red indicating light shall supervise/provide alternate power source switch position indication and shall have a nameplate engraved ALTERNATE.

2.2 BY-PASS/ISOLATION SWITCH (BP/IS)

2.2.1 Design

Bypass/isolation switch (BP/IS) shall permit load by-pass to either normal or alternate power source and complete isolation of associated ATS, independent of ATS operating position. BP/IS and associated ATS shall be products of same manufacturer and shall be completely interconnected and tested at factory and at project site as specified. BP/IS shall be manufactured, listed, and tested in accordance with paragraph AUTOMATIC TRANSFER SWITCH (ATS) and shall have electrical ratings that exceed or equal comparable ratings specified for ATS. Operating handles shall be externally operated and arranged so that one person can perform the bypass and isolation functions through the operation of a maximum of two handles within 5 seconds. The ATS shall have provisions for locking in the isolation position. Handle for manual operation shall be permanently attached to operating mechanism. BP/IS operation shall be accomplished without disconnecting switch load terminal conductors. Isolation handle positions shall be marked with engraved plates or other approved means to indicate position or operating condition of associated ATS, as follows:

a. Indication shall be provided to show that ATS section is providing power to the load.

b. Indication shall be provided of ATS isolation. The ATS controls shall remain functional with the ATS isolated or in bypass mode to permit monitoring of the normal power source and automatic starting of the generator in the event of a loss of the normal power source. In the isolated mode, the bypass section shall be capable of functioning as a manual transfer switch to transfer the load to either power source. The ATS shall be capable of undergoing functional operation testing without service interruption. The ATS may also be completely removed from the enclosure, if required for maintenance or repair, while the bypass section continues to power the load.

2.2.2 Switch Construction

Bypass/isolation switch shall be constructed for convenient removal of parts from front of switch enclosure without removal of other parts or disconnection of external power conductors. Contacts shall be as specified for associated ATS, including provisions for inspection of contacts without disassembly of BP/IS or removal of entire contact enclosure. To facilitate maintenance, manufacturer shall provide instructions for determination of contact integrity. BP/IS and associated ATS shall be interconnected with suitably sized copper bus bars silver-plated at each connection point, and braced to withstand magnetic and thermal forces created at WCR specified for associated ATS.

2.3 ENCLOSURE

ATS and accessories shall be installed in floor-mounted, unventilated NEMA ICS 6, Type 4, smooth sheet metal enclosure constructed in accordance with applicable requirements of UL 1066 and/or UL 1008. Metal gauge shall be not less than No. 14. Enclosure shall be equipped with at least two

approved grounding lugs for grounding enclosure to facility ground system using No. 4 AWG copper conductors. Factory wiring within enclosure and field wiring terminating within enclosure shall comply with NFPA 70. If wiring is not color coded, wire shall be permanently tagged or marked near terminal at each end with wire number shown on approved detail drawing. Terminal block shall conform to NEMA ICS 4. Terminals shall be arranged for entrance of external conductors from top and bottom of enclosure as shown. Main switch terminals, including neutral terminal if used, shall be pressure type suitable for termination of external conductors as shown.

2.3.1 Construction

Enclosure shall be constructed for ease of removal and replacement of ATS components and control devices from front without disconnection of external power conductors or removal or disassembly of major components. Enclosure of ATS with BP/IS shall be constructed to protect personnel from energized BP/IS components during ATS maintenance.

2.3.2 Cleaning and Painting

Both the inside and outside surfaces of an enclosure, including means for fastening, shall be protected against corrosion by enameling, galvanizing, plating, powder coating, or other equivalent means. Protection is not required for metal parts that are inherently resistant to corrosion, bearings, sliding surfaces of hinges, or other parts where such protection is impractical. Finish shall be manufacturer's standard material, process, and color and shall be free from runs, sags, peeling, or other defects. An enclosure marked Type 1, 3R, 4 or 12 shall be acceptable if there is no visible rust at the conclusion of a salt spray (fog) test using the test method in ASTM B 117, employing a 5 percent by weight, salt solution for 24 hours. Type 4X enclosures are acceptable following performance of the above test with an exposure time of 200 hours.

2.4 TESTING

2.4.1 Factory Testing

A prototype of specified ATS shall be factory tested in accordance with UL 1008. In addition, factory tests shall be performed on each ATS as follows:

a. Insulation resistance test to ensure integrity and continuity of entire system.

b. Main switch contact resistance test.

c. Visual inspection to verify that each ATS is as specified.

d. Mechanical test to verify that ATS sections are free of mechanical hindrances.

e. Electrical tests to verify complete system electrical operation and to set up time delays and voltage sensing settings.

2.4.2 Factory Test Reports

Manufacturer shall provide three certified copies of factory test reports.

2.5 FACTORY TESTING (MEDICAL FACILITIES)

The factory tests for ATS and By-Pass/Isolation switches used in medical facilities shall be conducted in the following sequence:

a. General
b. Normal
c. Overvoltage
d. Undervoltage
e. Overload
f. Endurance
g. Temperature Rise
h. Dielectric Voltage-Withstand
i. Contact Opening
j. Dielectric Voltage-Withstand (Repeated)
k. Withstand
l. Instrumentation and Calibration of High Capacity
m. Closing
n. Dielectric Voltage-Withstand (Repeated)
o. Strength of Insulating Base and Support

2.5.1 Viewing Ports

ATS and BP/IS switches shall be of draw-out construction. Viewing ports to inspect the contacts without requiring disassembly shall be provided.

2.5.2 Operating Handles

The operating handles shall be externally operated, and designed and constructed not to stop in an intermediate or neutral position during operation, but shall permit load by-pass and transfer switch isolation in no more than two manual operations which can be performed by one person in 5 seconds or less. The transfer speed will be independent of the operational speed of the switch handle or handles.

PART 3 EXECUTION

3.1 INSTALLATION

ATS shall be installed as shown and in accordance with approved manufacturer's instructions.

3.2 INSTRUCTIONS

Manufacturer's approved operating instructions shall be permanently secured to cabinet where operator can see them. One-line and elementary or schematic diagram shall be permanently secured to inside of front enclosure door.

3.3 SITE TESTING

Following completion of ATS installation and after making proper adjustments and settings, site tests shall be performed in accordance with manufacturer's written instructions to demonstrate that each ATS functions satisfactorily and as specified. Contractor shall advise Contracting Officer not less than 5 working days prior to scheduled date for site testing, and shall provide certified field test reports within 2 calendar weeks following successful completion of site tests. Test reports shall describe adjustments and settings made and site tests performed. Minimum operational tests shall include the following:

a. Insulation resistance shall be tested, both phase-to-phase and phase-to-ground.

b. Power failure of normal source shall be simulated by opening upstream protective device. This test shall be performed a minimum of five times.

c. Power failure of emergency source with normal source available shall be simulated by opening upstream protective device for emergency source. This test shall be performed a minimum of five times.

d. Low phase-to-ground voltage shall be simulated for each phase of normal source.

e. Operation and settings shall be verified for specified ATS features, such as override time delay, transfer time delay, return time delay, engine shutdown time delay, exerciser, auxiliary contacts, and supplemental features.

f. Manual and automatic ATS and BP/IS functions shall be verified.

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SECTION 16263

DIESEL-GENERATOR SET STATIONARY 100-2500 KW, WITH AUXILIARIES

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 C2	(1993) National Electrical Safety Code
ANSI C12.11	(1987) Instrument Transformers for Revenue Metering, 10 kV BIL through 350 kV BIL (0.6 kV NSV through 69 kV NSV)
ANSI C39.1	(1981) Electrical Analog Indicating Instruments

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53	(1993) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 106	(1993) Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A 181	(1993a) Forgings, Carbon Steel, for General-Purpose Piping
ASTM A 234	(1992a) Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
ASTM D 975	(1993) Diesel Fuel Oils

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.3	(1992) Malleable Iron Threaded Fittings
ASME B16.5	(1988; Errata B16.5a) Pipe Flanges and Flanged Fittings
ASME B16.11	(1991) Forged Fittings, Socket-Welding and Threaded
ASME B31.1	(1992; B31.1a; B31.1b) Power Piping
ASME BPV IX	(1992; Addenda Dec 1992, Dec 1993) Boiler and Pressure Vessel Code; Section IX, Welding

and Brazing Qualifications

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE Std 43	(1974; R 1991) Testing Insulation Resistance of Rotating Machinery
IEEE Std 95	(1977; R 1991) Insulation Testing of Large AC Rotating Machinery with High Direct Voltage
IEEE Std 112	(1991) Polyphase Induction Motor and Generators
IEEE Std 115	(1983; R 1991) IEEE Guide: Test Procedures for Synchronous Machines
IEEE Std 519	(1992) Harmonic Control in Electric Power Systems

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	(1991) Pipe Hangers and Supports - Selection and Application
MSS SP-80	(1987) Bronze Gate, Globe, Angle and Check Valves

MILITARY STANDARDS (MIL-STD)

MIL-STD 705	(Rev C) Generator Sets, Engine Driven Methods of Tests and Instructions

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 2	(1993) Industrial Control Devices, Controllers and Assemblies
NEMA ICS 6	(1993) Enclosures for Industrial Control and Systems
NEMA MG 1	(1993) Motors and Generators
NEMA PB 1	(1990; PB 1.1) Panelboards
NEMA PB 2	(1989; PB 2.1) Deadfront Distribution Switchboards

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 30	(1993) Flammable and Combustible Liquids

NFPA 37	(1994) Installation and Use of Stationary Combustion Engines and Gas Turbines
NFPA 70	(1993) National Electrical Code

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

SAE ARP 892	(1965; R 1988) General Specification for D-C Starter-Generator, Engine
SAE J537	(1992) Storage Batteries

UNDERWRITERS LABORATORIES (UL)

UL 891	(1994; Rev Jun 1994) Dead-Front Switchboards
UL 1236	(1994) Battery Chargers for Charging Engine-Starter Batteries

1.2 SYSTEM DESCRIPTION

Each engine-generator set shall be provided and installed complete and totally functional, with all necessary ancillary equipment to include: air filtration; starting system; generator controls, protection, and isolation; instrumentation; lubrication; fuel system; cooling system; and engine exhaust system. Each engine-generator set shall satisfy the requirements specified in the Engine-Generator Parameter Schedule.

1.2.1 Engine-Generator Parameter Schedule

ENGINE-GENERATOR PARAMETER SCHEDULE

Power Application	Standby
Service Load	437.5 kVA
Generator Size	350 kW
Power Factor	0.8 lagging
Engine-Generator Applications	stand-alone
Heat Exchanger Type	fin-tube
Governor Type	Electrical
Governor Application	Droop
Frequency Bandwidth (steady state)	plus/minus 0.4 percent
Maximum Speed	1800 rpm

ENGINE-GENERATOR PARAMETER SCHEDULE

Frequency	60 Hz
Voltage	480 volts
Phases	3 Phase, Wye
Phase Rotation	ABC
Motor Starting kVA	1749 kVA
Max Step Load Increase	100 percent of Service Load at .9 PF
Transient Recovery Time with Step Load Increase (Voltage)	2 seconds
Transient Recovery Time with Step Load Increase (Frequency)	2 seconds
Maximum Voltage Deviation with with Step Load Increase	10 percent of rated voltage
Maximum Frequency Deviation with Step Load Increase	5 percent of rated frequency
Max Step Load Decrease	100 percent of Service Load at .9 PF
Transient Recovery Time with Step Load Decrease (Voltage)	1 second
Transient Recovery Time with Step Load Decrease (Frequency)	1 second
Maximum Voltage Deviation with Step Load Decrease	10 percent of rated voltage
Maximum Frequency Deviation with Step Load Decrease	5 percent of rated frequency
Max Time to Start and be Ready to Assume Load	10 seconds
Max Summer Indoor Temp	100 degrees
Min Winter Indoor Temp	0 degrees
Seismic Zone	1
Installation Elevation	1740 above sea level
Max Summer Outdoor Temp	100 degrees

ENGINE-GENERATOR PARAMETER SCHEDULE

Min Winter Outdoor Temp 0 degrees

1.2.2 Rated Output Capacity

Each engine-generator-set shall provide power equal to the sum of Service Load plus the machine's efficiency loss and associated ancillary equipment loads. Rated output capacity shall also consider engine and/or generator oversizing required to meet transient response requirements and subtransient reactance requirements.

1.2.3 Power Applications

Each prime power engine-generator set application shall be capable of 8760 hours of continuous operation per year (subject to normal outages for periodic and preventive maintenance) at output capacity. Each standby power engine-generator set application shall be capable of 500 cumulative hours of operation per year with a maximum period of continuous operation of 300 hours at output capacity.

1.2.4 Transient Response

The engine-generator set governor and voltage regulator shall cause the engine-generator set to respond to the maximum step load changes such that output voltage and frequency recover to and stabilize within the operational bandwidth within the transient recovery time. The engine-generator set shall respond to maximum step load changes such that the maximum voltage and frequency deviations from bandwidth are not exceeded.

1.2.5 Reliability and Durability

1.2.5.1 Standby

Each standby engine-generator set shall have both an engine and a generator capable of delivering the specified power on a standby basis with an anticipated mean time between overhauls of no less than 5,000 hours up to 400 kW, 7,500 hours up to 800 kW, 10,000 hours up to 1250 kW, and 15,000 hours up to 2500 kW operating with an 80 percent load factor. Two like engines and two like generators shall be cited that have performed satisfactorily in a stationary power plant, independent and separate from the physical location of the manufacturer's and assembler's facilities, for standby without any failure to start, including all periodic exercise. Each like engine and generator must have had no failures resulting in downtime for repairs in excess of 72 hours nor any failure due to overheating during the 2 consecutive years of service. Like engines shall be of the same model, speed, bore, stroke, number and configuration of cylinders, and rated output capacity. Like generators shall be of the same model, speed, pitch, cooling, exciter, voltage regulator and rated output capacity.

1.3 GENERAL REQUIREMENTS

1.3.1 Engine-Generator Set

Each set shall consist of one engine, one generator, and one exciter mounted, assembled, and aligned on one base; and other necessary ancillary equipment which may be mounted separately. Sets having a capacity of 750 kW or smaller shall be assembled and attached to the base prior to shipping. Sets over 750 kW capacity may be shipped in sections. Each set component shall be environmentally suitable for the location shown and shall be the manufacturer's standard product offered in catalogs for commercial or industrial use. Any nonstandard products or components and the reason for their use shall be specifically identified in paragraph SUBMITTALS.

1.3.2 Nameplates

Each major component of this specification shall have the manufacturer's name, type or style, model or serial number and rating on a plate secured to the equipment. As a minimum, nameplates shall be provided for:

- Engines
- Generators
- Regulators
- Pumps and pump motors
- Generator Breaker
- Economizers
- Relays
- Transformers (CT & PT)
- Day tanks
- Governors
- Heat exchangers (other than base mounted)

Where the following equipment is not provided as a standard component by the diesel engine generator set manufacturer, the nameplate information may be provided in the maintenance manual in lieu of nameplates.

- Battery charger
- Battery
- Heaters
- Exhaust mufflers
- Silencers
- Exciters

1.3.3 Personnel Safety Devices

Exposed moving parts, parts that produce high operating temperatures, 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. The safety devices shall be installed so that proper operation of the equipment is not impaired.

1.3.4 Verification of Dimensions

Before performing any work, the premises shall be visited and all details of the work verified. The Contracting Officer shall be advised in writing of any discrepancies.

1.3.5 Conformance to Codes and Standards

Where equipment is specified to conform to requirements of any code or standard such as UL, NEMA, etc., the design, fabrication and installation shall also conform to the code.

1.3.6 Site Welding

Welding shall be in accordance with qualifying procedures using performance qualified welders and welding operators. Procedures and welders shall be qualified in accordance with ASME BPV IX. Welding procedures qualified by others, and welders and welding operators qualified by a previously qualified 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 05055 WELDING, STRUCTURAL.

1.3.7 Engine-Generator Set Enclosure

The engine-generator set enclosure shall be corrosion resistant and fully weather resistant. The enclosure shall contain all set components and provide ventilation to permit operation at Service Load under secured conditions. Doors shall be provided for access to controls and equipment requiring periodic maintenance or adjustment. Removable panels shall be provided for access to components requiring periodic replacement. The enclosure shall be capable of being removed without disassembly of the engine-generator set or removal of components other than the exhaust system.

1.3.8 Vibration Limitation

The maximum engine-generator set vibration in the horizontal, vertical, and axial directions shall be limited to 6 mils (peak-peak RMS), with an overall velocity limit of 0.95 inches/second RMS.

1.3.9 Vibration Isolation

The engine-generator set shall be provided with a vibration-isolation system in accordance with the manufacturer's standard recommendation. Vibration-isolation systems shall be designed and qualified (as an integral part of the base and mounting system) to the seismic zone specified. Where the vibration-isolation system does not secure the base to the structure floor or unit foundation, seismic restraints shall be provided in accordance with the seismic zone specified.

1.3.10 Fuel Consumption (Prime Applications)

Engine fuel consumption shall not exceed the following maximum limits based on the conditions listed below.

Size Range Net kW	% of Rated Output Capacity	Fuel Usage-LBS./kWH
100 - 299 kW	75 and 100%	0.600
	50%	0.643
300 - 999 kW	75 and 100%	0.575
	50%	0.600
1000 - 2500 kW	75 and 100%	0.536
	50%	0.573

Conditions:

a. Net kW of the Set corrected for engine auxiliaries that are electrically driven, where kW is electrical kilowatt hours.

b. 19,350 Btu per pound high-heat value for fuel used.

c. Sea level operation.

d. Intake-air temperature not over 90 degrees F.

e. Barometric pressure of intake air not less than 28-1/4 inches of mercury.

1.3.11 Fuel-Consumption Rebates (Prime Applications)

Fuel consumption rebates shall be assessed for failure of engine generator set to meet guaranteed rates. If the guaranteed fuel-consumption rate for 100 percent rated output capacity is verified in the tests but the rates for 75 or 50 percent rated output capacity are not verified, the appropriate 75 or 50 percent rate differences shall be used in assessing the rebates. If more than one fuel consumption guarantee is not met, rebates shall be computed for 100, 75, and 50 percent rated output capacity, and the highest computed figure shall be used in assessing the rebates.

Rebate = H x C x D x N where:

C = Local fuel costs in dollars per pound *
D = A - G
A = Measured fuel consumption in pounds per hour
G = kW x R = Guaranteed fuel consumption in pounds per hour
N = Number of generator sets provided
H = Operating hours over a projected period of 15 years

*Fuel costs shall be adjusted to the heat value kJ/kg (BTU/lb.) for the fuel used in the test (requires fuel laboratory test) ratioed to the 45,000 kJ/kg (19,350 Btu per pound) heat value used as the basis of the

guarantee.

1.3.12 Harmonic Requirements

Non-linear loads to be served by each engine-generator set are as indicated. The maximum linear load demand (kVA @ PF) when non-linear loads will also be in use is as indicated. Each engine-generator shall be designed and configured to meet the total harmonic distortion limits of IEEE Std 519.

1.3.13 Starting Time Requirements

Upon receipt of a signal to start, each engine generator set will start, reach rated frequency and voltage and be ready to assume load within the time specified. For standby sets used in emergency power applications, each engine generator set will start, reach rated frequency and voltage, and power will be supplied to the load terminals of the automatic transfer switch within the starting time specified.

1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL DESCRIPTIONS:

SD-01 Data

Equipment and Performance; GA.

Calculations of the engine and generator output power capability, including efficiency and parasitic load data.

Harmonic and Non-linear Load Capability; FIO.

Description of the generator features which mitigate the effects of the non-linear loads listed.

Torsional Vibration; FIO.

Calculations which show that no damaging or dangerous torsional vibrations will occur when the prime mover is connected to the generator.

Day Tank Capacity; FIO.

Calculations for the capacity of each day tank.

Power Factor Capability Curve; FIO.

The generator capability curve showing generator kVA output capability (kW vs. kvar) for both leading and lagging power factors ranging from 0 to 1.0.

Cooling Equipment and Performance; FIO.

A letter which certifies that the engine-generator set and cooling system

function properly in the ambient temperature specified.

a. The maximum allowable inlet temperature of the coolant fluid.

b. The minimum allowable inlet temperature of the coolant fluid.

c. The maximum allowable temperature rise in the coolant fluid through the engine.

Alarm Set Points; FIO.

The magnitude of monitored values which define alarm or action set points, and the tolerance (plus and/or minus) at which the devices activate the alarm or action for items contained within the alarm panels.

Generator Data; GA.

Manufacturer's standard data for each generator (prototype data at the specified rating or above is acceptable), listing the following information:

Temperature rise in accordance with NEMA MG 1, Part 22.

Direct-Axis synchronous reactance (per unit).

Direct-Axis transient reactance (per unit).

Direct-Axis subtransient reactance (per unit).

Quadrature synchronous reactance (per unit).

Quadrature subtransient reactance (per unit).

Zero sequence reactance (per unit).

Negative sequence reactance and impedance (per unit).

Direct-Axis transient open-circuit time constant (seconds).

Direct-Axis short circuit time constant (seconds).

The generator kW rating and short circuit current capacity (both symmetric and asymmetric)

Manufacturer's Catalog; FIO.

Manufacturer's standard catalog data describing and depicting each engine-generator set and all ancillary equipment in sufficient detail to demonstrate complete specification compliance.

Site Welding; FIO.

A copy of qualifying procedures and a list of names and identification symbols of qualified welders and welding operators.

Spare Parts; FIO.

A complete list of spare parts for each piece of equipment and a complete list of all material and supplies needed for continued operation. Lists shall include supply source and current prices. Each list shall be separated into two parts, those elements recommended by the manufacturer to be replaced after 3 years of service, and the remaining elements.

Training; FIO.

A letter giving the date proposed for conducting the onsite training course, the agenda of instruction, a description of the video taping service to be provided, and the kind and quality of the tape to be left with the Contracting Officer at the end of the instructional period.

Battery Charger; FIO.

Battery charger sizing calculations.

Vibration-Isolation; FIO.

Vibration isolation system performance data for the range of frequencies generated by the engine-generator set during operation from no load to full load and the maximum vibration transmitted to the floor. Description of seismic qualification of the engine-generator mounting, base, and vibration isolation.

SD-04 Drawings

Layout and Shop Drawings; GA.

Drawings shall include the following:

a. Base-mounted equipment, complete with base and attachments, including anchor bolt template and recommended clearances for maintenance and operation.

b. Complete starting system.

c. Complete fuel system.

d. Complete cooling system.

e. Complete exhaust system.

f. Layout of relays, breakers, switchgear, and switches including applicable single line and wiring diagrams with written description of sequence of operation and the instrumentation provided.

g. The complete lubrication system, including piping, pumps, strainers, filters, heat exchangers for lube oil and turbocharger cooling, electric heater, controls and wiring.

h. Location, type, and description of vibration isolation devices for all applications.

i. The safety system, together with a detailed description of how it is to work. Wiring schematics, safety devices with a listing of their normal ranges, alarm and shutdown values (to include operation parameters such as pressures, temperatures voltages, currents, and speeds) shall be included.

j. One-line schematic and wiring diagrams of the generator, exciter, regulator, governor, and instrumentation.

k. Layout of each panel.

l. Mounting and support for each panel and major piece of electrical equipment.

m. Engine-generator set lifting points and rigging instructions.

As-Built Drawings; GA.

Drawings which accurately depict the as-built configuration of the installation, upon acceptance of the diesel-generator set installation.

SD-06 Instructions

Posted Data; GA.

Posted data including wiring and control diagrams showing the key mechanical and electrical control elements, and a complete layout of the entire system.

Framed Instructions; GA.

Instructions including: the manufacturers pre-start checklist and precautions; startup procedures for test-mode, manual-start mode, and automatic-start mode (as applicable); running checks, procedures, and precautions; and shutdown procedures, checks, and precautions.

SD-08 Statements

Qualifications; GA.

Documentation to demonstrate that:

a. Each component manufacturer has a minimum of 3 years experience in the manufacture, assembly and sale of components used with stationary diesel engine-generator sets for commercial and industrial use.

b. The engine-generator set manufacturer/assembler has a minimum of 3 years experience in the manufacture, assembly and sale of stationary diesel engine-generator sets for commercial and industrial use.

c. The field engineer is qualified to perform the specified functions.

d. Certification that the engine-generator set and cooling system function properly in the ambient temperatures specified.

Welder Qualification; FIO.

A letter listing the welder qualifying procedures for each welder, complete with supporting data such as test procedures used, what was tested to, and a list of the names of all welders and their identification symbols.

Installation Procedures; FIO.

A copy of the manufacturer's installation procedures and a detailed description of the manufacturer's recommended break-in procedure.

Listing of Product Installations; FIO.

A list of five installations using each type of engine and generator proposed for use. Each component used as the basis for the durability and reliability certification shall be identified in the list. The list shall give the name of installations, completion dates, and name and telephone number of a point of contact.

SD-09 Reports

Factory Inspection and Tests; FIO.

Six complete reproducible copies of the factory inspection result on the checklist format specified in paragraph FACTORY INSPECTION AND TESTS.

Factory Tests; FIO.

a. A letter giving notice of the proposed dates of factory inspections and tests at least 14 days prior to beginning tests.

b. A detailed description of the manufacturer's procedures for factory tests.

Six copies of the Factory Test data described below in 8-1/2 by 11 inch binders having a minimum of 3 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. Data plots shall be full size (8-1/2 by 11 inch minimum), showing grid lines, with full resolution.

(1) A detailed description of the procedures for factory tests.

(2) A list of equipment used, with calibration certifications.

(3) A copy of measurements taken, with required plots and graphs.

(4) The date of testing.

(5) A list of the parameters verified.

(6) The condition specified for the parameter.

(7) The test results, signed and dated.

(8) A description of adjustments made.

On Site Tests; FIO.

a. A letter giving notice of the proposed dates of onsite inspections and tests.

b. A detailed description of the Contractor's procedures for onsite tests including the test plan and a listing of equipment necessary to perform the tests.

c. Six copies of the onsite test data described below in 8-1/2 by 11 inch binders having a minimum of 3 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. Data plots shall be full size (8-1/2 by 11 inch minimum), showing grid lines, with full resolution.

(1) A detailed description of the procedures for onsite tests.

(2) A list of equipment used, with calibration certifications.

(3) A copy of measurements taken, with required plots and graphs.

(4) The date of testing.

(5) A list of the parameters verified.

(6) The condition specified for the parameter.

(7) The test results, signed and dated.

(8) A description of adjustments made.

SD-13 Certificates

Reliability and Durability; FIO.

A reliability and durability certification letter from the manufacturer and assembler to prove that existing facilities are and have been successfully utilizing the same components proposed to meet this specification section in similar service. Certification may be based on components, i.e. engines used with different models of generators and generators used with different engines, and does not exclude annual technological improvements made by a manufacturer in his basic standard-model component on which experience was obtained, provided parts interchangeability has not been substantially affected and his current standard model meets the performance requirements of this specification.

Emissions; FIO.

A certification from the engine manufacturer stating that the engine emissions meet the federal, state, and local regulations and restrictions specified.

Site Visit; FIO.

A letter stating the date the site was visited and listing discrepancies found.

Flywheel Balance; FIO.

A certification stating that the flywheel has been statically and dynamically balanced and is capable of being rotated at 125 percent of rated speed without vibration or damage.

Regulatory Compliance; FIO.

A certification stating that where materials or equipment are specified to comply with requirements of UL, written proof of such compliance has been obtained. The label or listing of the specified agency, or 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 are acceptable as proof.

Functional Facilities; FIO.

A letter certifying that all facilities are complete and functional; that each system is fully functional; and that each item of equipment is complete, free from damage, adjusted, and ready for beneficial use.

SD-19 Operation and Maintenance Manuals

Operation Manual; GA.

Six copies of the operation manual in 8-1/2 by 11 inch binders, having a minimum of 3 rings from which material may readily be removed and replaced, including a separate section for each system or subsystem. Sections shall be separated by heavy plastic dividers with tabs which identify the material in the section. Drawings shall be folded blue lines, with the title block visible, and placed in 8-1/2 by 11 inch plastic pockets with reinforced holes. One full size reproducible mylar of each drawing shall accompany the booklets. Mylars shall be rolled and placed in a heavy cardboard tube with threaded caps on each end. The manual shall include: step-by-step procedures for system startup, operation, and shutdown; drawings, diagrams, and single-line schematics to illustrate and define the electrical, mechanical, and hydraulic systems together with their controls, alarms, and safety systems; the manufacturer's name, model number, and a description of equipment in the system. The instructions shall include procedures for interface and interaction with related systems to include automatic transfer switches Each booklet shall include 1.2 megabyte, 5-1/4 inch floppy disks containing an ASCII file of procedures. The floppy disks shall be placed in 8-1/2 by 11 inch plastic pockets with reinforced holes. The operation manual shall be submitted and approved prior to commencing onsite tests.

Maintenance Manual; GA.

Six copies of the maintenance manual containing 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 item listed. Each section shall be separated by a heavy plastic divider with tabs. Drawings shall be folded, with the title block visible, and placed in plastic pockets with reinforced holes.

a. Procedures for each routine maintenance item.

b. Procedures for troubleshooting.

c. Factory-service, take-down overhaul, and repair service manuals, with parts lists.

d. A copy of the posted instructions.

e. A component list which includes the manufacturer's name, address, type or style, model or serial number, rating, and catalog number for the major components specified for nameplates.

Six complete reproducible copies of the final relay and protective device settings. The settings shall be recorded with the name of the company and individual responsible for their accuracy.

Special Tools and Filters; FIO.

Two complete sets of special tools required for maintenance (except for electronic governor handset). Special tools are those that only the manufacturer provides, for special purposes, or to reach otherwise inaccessible parts. The tools shall be supplied complete with a suitable tool box. One handset shall be provided for each electronic governor when required to indicate and/or change governor response settings. Two complete sets of filters shall be supplied in a suitable storage box.

1.5 STORAGE AND INSTALLATION

The Contractor shall properly protect material and equipment, before, during, and after installation. Stored items shall be protected from the weather and contamination. During installation, piping and similar openings shall be capped to keep out dirt and other foreign matter.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

2.1.1 Filter Elements

Fuel-oil, lubricating-oil, and combustion-air filter elements shall be manufacturer's standard.

2.1.2 Instrument Transformers

ANSI C12.11.

2.1.3 Pipe (Sleeves, Fuel/Lube-Oil, Compressed Air, Coolant, and Exhaust)

ASTM A 53, or ASTM A 106 steel pipe. Pipe smaller than 2 inches shall be Schedule 80. Pipe 2 inches and larger shall be Schedule 40.

a. Flanges and Flanged Fittings: ASTM A 181, Class 60, or ASME B16.5, Grade 1, Class 150.

b. Pipe Welding Fittings: ASTM A 234, Grade WPB or WPC, Class 150 or ASME B16.11, 3000 lb.

c. Threaded Fittings: ASME B16.3, Class 150.

d. Valves: MSS SP-80, Class 150.

e. Gaskets: Manufacturer's standard.

2.1.4 Thermometer for Oil or Water Service

Flush-mounted dial with range to suit the service encountered, standard with the manufacturer.

2.1.5 Pipe Hangers

MSS SP-58 and MSS SP-69.

2.1.6 Electrical Enclosures

2.1.6.1 General

NEMA ICS 6.

2.1.6.2 Switchboards

NEMA PB 2.

2.1.7 Pressure Gauges

Manufacturer's standard.

2.1.8 Electric Motors

Electric motors shall conform to the requirements of NEMA MG 1. Motors shall have sealed ball bearings and a maximum speed of 1800 rpm. Motors used indoors shall have drip-proof frames; those used outside shall be totally enclosed. Alternating current motors larger than 1/2 Hp shall be of the squirrel-cage induction type for operation on 400 volts or higher, 60 Hz, and three-phase power. Alternating current motors 1/2 Hp or smaller, shall be suitable for operation on 120 volts, 60 Hz, and single-phase power.

2.1.9 Motor Controllers

Motor controllers and starters shall conform to the requirements of NFPA 70 and NEMA ICS 2.

2.2 ENGINE

Each engine shall operate on No. 2-D diesel fuel conforming to ASTM D 975, shall be designed for stationary applications and shall be complete with ancillaries. The engine shall be a standard production model described in the manufacturer's catalog. The engine shall be naturally aspirated, supercharged, or turbocharged. The engine shall be 2- or 4-stroke-cycle and compression-ignition type. The engine shall be vertical in-line, V- or opposed-piston type, with a solid cast block or individually cast cylinders. The engine shall have a minimum of two cylinders. Opposed-piston type engines shall have not less than four cylinders. Each block shall have a coolant drain port.

2.2.1 Transient Load Capability

Each engine shall be capable of receiving and responding to specified maximum step load changes within the transient loading recovery time.

2.2.2 Speed Sensor

Each engine shall be equipped with an overspeed sensor.

2.3 FUEL SYSTEM

The entire fuel system for each engine-generator set shall conform to the requirements of NFPA 30 and NFPA 37 and contain the following elements.

2.3.1 Pumps

2.3.1.1 Main Pump

Each engine shall be provided with an engine driven pump. The pump shall supply fuel at a minimum rate of 200 percent of the expected fuel consumption at 110 percent of full rated output capacity.

2.3.2 Fuel Filter

A minimum of one full-flow fuel filter shall be provided for each engine. The filter shall be readily accessible and capable of being changed without disconnecting the piping or disturbing other components. The filter shall have inlet and outlet connections plainly marked. An indicating differential pressure gauge shall be provided across the filter.

2.3.3 Relief/Bypass Valve

A relief/bypass valve shall be provided to regulate pressure in the fuel supply line, return excess fuel to a return line and prevent the build-up of excessive pressure in the fuel system.

2.3.4 Day Tank

Each engine shall be provided with a separate self-supporting day tank. Each day tank shall be provided with connections for fuel supply line, fuel

return line, fuel overflow line, local fuel fill port, gauge, vent line, drain line, and float switch assembly for control. A fuel return line cooler shall be provided as recommended by the manufacturer and assembler. The temperature of the fuel returning to the day tank shall be below the flash point of the fuel. A temperature sensing device shall be installed in the fuel supply line. Each engine-generator set provided with weatherproof enclosures shall have its day tank mounted within the enclosure. The fuel fill line shall be accessible without opening the enclosure.

2.3.4.1 Capacity, Standby

Each day tank shall have capacity to supply fuel to the engine for an uninterrupted 8 hr. period at 100 percent rated load without being refilled, plus any fuel which may be returned to the main fuel storage tank. The calculation of the capacity of each day tank shall incorporate the requirement to stop the supply of fuel into the day tank at 90 percent of the ultimate volume of the tank.

2.3.4.2 Drain Line

Each day tank drain line shall be accessible and equipped with a shutoff valve. Self-supporting day tanks shall be arranged to allow drainage into a 12 inch tall bucket.

2.3.4.3 Local Fuel Fill

Each local fuel fill port on the day tank shall be provided with a screw-on cap.

2.3.4.4 Fuel Level Controls

a. Each day tank shall have a float-switch assembly to perform the following functions:

(1) Start the supply of fuel into the day tank when the fuel level is at the "Low" level mark, 75 percent of the total tank capacity.

(2) Stop the supply of fuel into the day tank when the fuel level is at 90 percent of the total tank capacity.

(3) Activate the "Overfill Fuel Level" alarm at 95 percent of the total tank volume.

(4) Activate the "Low Fuel Level" alarm at 70 percent of the total tank volume.

(5) Activate the automatic fuel supply shut-off valve located on the fill line of the day tank and shut down the fuel pump which supplies fuel to the day tank at 95 percent of the total tank volume. The flow of fuel shall be stopped before any fuel can be forced into the fuel overflow line.

2.3.4.5 Arrangement

Each self-supporting day tank shall either be arranged so that the fuel level in the day tank remains above the suction port of the engine driven fuel pump or be provided with a transfer pump to provide fuel to the engine driven pump. The overflow connection and fuel supply line shall be arranged so that the highest possible fuel level is below the fuel injectors. The fuel supply line from the day tank to the manufacturer's standard engine connection shall be welded pipe.

2.3.5 Fuel Supply System

The fuel supply from the main storage of fuel to the day tank shall be as specified in Section 13202 FUEL STORAGE SYSTEMS.

2.4 LUBRICATION

Each engine shall have a separate lube-oil system conforming to NFPA 30 and NFPA 37. Each system shall be pressurized by engine-driven pumps. System pressure shall be regulated as recommended by the engine manufacturer. A pressure relief valve shall be provided on the crankcase. The crankcase shall be vented in accordance with the manufacturer's recommendation except that it shall not be vented to the engine exhaust system. Crankcase breathers, if provided on engines installed in buildings or enclosures, shall be piped to vent to the outside. The system shall be readily accessible for service such as draining, refilling, etc. Each system shall permit addition of oil and have oil-level indication with the set operating. The system shall utilize an oil cooler as recommended by the engine manufacturer.

2.4.1 Lube-Oil Filter

One full-flow filter shall be provided for each pump. The filter shall be readily accessible and capable of being changed without disconnecting the piping or disturbing other components. The filter shall have inlet and outlet connections plainly marked. An indicating differential pressure gauge shall be provided across the filter.

2.4.2 Lube-Oil Sensors

Each engine shall be equipped with lube-oil temperature and pressure sensors. Temperature sensors shall provide signals for Pre-High and High Lube-Oil indication and alarms. Pressure sensors shall be located downstream of the filters and provide signals for Pre-Low and Low Lube-Oil indication and alarms.

2.5 COOLING

Each engine shall have its own cooling system. Each system shall operate automatically while its engine is running. The cooling system coolant shall use a combination of water and ethylene-glycol sufficient for freeze protection at the minimum winter outdoor temperature specified. The maximum temperature rise of the coolant across each engine shall not exceed that recommended and submitted in paragraph SUBMITTALS.

2.5.1 Coolant Pumps

Coolant pumps shall be the centrifugal type. Each engine shall have an engine-driven primary pump. Secondary pumps shall be electric motor driven and have automatic controllers.

2.5.2 Heat Exchanger

Each heat exchanger shall be of a size and capacity to limit the maximum allowable temperature rise in the coolant across the engine to that recommended and submitted in paragraph SUBMITTALS for the maximum summer outdoor design temperature and site elevation. Each heat exchanger shall be corrosion resistant, suitable for service in ambient conditions of application.

2.5.2.1 Fin-Tube-Type Heat Exchanger (Radiator)

Heat exchanger may be factory coated with corrosive resistant film, provided that correction measures are taken to restore the heat rejection capability of the radiator to the initial design requirement via over sizing, or other compensating methods. Internal surfaces shall be compatible with liquid fluid coolant used. Materials and coolant are subject to approval by the Contracting Officer. Heat exchangers shall be pressure type incorporating a pressure valve, vacuum valve and a cap. Caps shall be designed for pressure relief prior to removal. Each heat exchanger and the entire cooling system shall be capable of withstanding a minimum pressure of 7 psi and shall be protected with a strong grille or screen guard. Each heat exchanger shall have at least two tapped holes; one tapped hole shall be equipped with a drain cock, the rest shall be plugged.

2.5.3 Thermostatic Control Valve

A modulating type, thermostatic control valve shall be provided in the coolant system to maintain the coolant temperature range submitted in paragraph SUBMITTALS.

2.5.4 Ductwork

Ductwork shall be as specified in Section 15895 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS except that a flexible connection shall be used to connect the duct to the diesel engine radiator. Material for the connection shall be wire-reinforced glass. The connection shall be rendered as airtight as possible.

2.5.5 Temperature Sensors

Each engine shall be equipped with coolant temperature sensors. Temperature sensors shall provide signals for pre-high and high indication and alarms.

2.6 SOUND LIMITATIONS

The limits listed are applicable only as referenced in this specification.

Frequency Band (Hz)	Maximum Acceptable Sound Level (Decibels)	
20-75	87	81
75-150	77	71
150-300	70	64
300-600	64	58
600-1,200	61	55
1,200-2,400	60	54
2,400-4,800	60	54
4,800-10 kHz	62	56

2.7 AIR INTAKE EQUIPMENT

Filters and silencers shall be provided in locations that are convenient for servicing. The silencer shall be of the high-frequency filter type, located in the air intake system as recommended by the engine manufacturer. Silencer shall be capable of reducing the noise level at the air intake to a point below the maximum acceptable levels specified in paragraph SOUND LIMITATIONS. A combined filter-silencer unit meeting requirements for the separate filter and silencer items may be provided. Expansion elements in air-intake lines shall be rubber.

2.8 EXHAUST SYSTEM

The system shall be separate and complete for each engine. Piping shall be supported to minimize vibration. Where a V-type engine is provided, a V-type connector, with necessary flexible sections and hardware, shall connect the engine exhaust outlets.

2.8.1 Flexible Sections and Expansion Joints

A flexible section shall be provided at each engine and an expansion joint at each muffler. Flexible sections and expansion joints shall have flanged connections. Flexible sections shall be made of convoluted seamless tube without joints or packing. Expansion joints shall be the bellows type. Expansion and flexible elements shall be stainless steel suitable for diesel-engine exhaust gas at 1000 degrees F. Expansion and flexible elements shall be capable of absorbing vibration from the engine and compensation for thermal expansion and contraction.

2.8.2 Exhaust Muffler

A chamber type exhaust muffler shall be provided. The muffler shall be of welded steel and designed for inside horizontal mounting. Eyebolts, lugs, flanges, or other items shall be provided as necessary for support in the location and position indicated. Pressure drop through the muffler shall not exceed the recommendations of the engine manufacturer. The muffler and exhaust piping together shall reduce the noise level to less than the maximum acceptable level listed for sound limitations in paragraph SOUND LIMITATIONS, at a distance of 75 feet from the end of the exhaust piping

directly along the path of discharge for horizontal discharged exhausts; or at a radius of 75 feet from the muffler/discharge piping, at 45 degrees apart in all directions, for vertically discharged exhausts, with the engine-generator set operating at 100 percent of rated output capacity. The muffler shall have a drain valve, nipple, and cap at the low-point of the muffler.

2.8.3 Exhaust Piping

Horizontal sections of exhaust piping shall be sloped downward away from the engine to a drip leg for collection of condensate with drain valve and cap. Changes in direction shall be long radius. Exhaust piping, mufflers and silencers installed inside any building shall be insulated in accordance with paragraph THERMAL INSULATION and covered to protect personnel. Vertical exhaust piping shall be provided with a hinged, gravity-operated, self-closing, rain cover.

2.9 EMISSIONS

The finished installation shall comply with Federal and local regulations and restrictions regarding the limits of emissions.

2.10 STARTING SYSTEM

2.10.1 Controls

An engine start-stop switch shall be provided with functions including: test, reset, manual-run/start, manual stop, and automatic modes. Start-stop logic shall be provided for adjustable cycle cranking and cooldown operation. The logic shall be arranged for manual starting and fully automatic starting in accordance with paragraph AUTOMATIC ENGINE-GENERATOR-SET SYSTEM OPERATION. Electrical starting systems shall be provided with an adjustable cranking limit device to limit cranking periods from 8 seconds up to the maximum duration.

2.10.2 Capacity

The starting system shall be of sufficient capacity, at the maximum outdoor summer temperature specified to crank the engine without damage or overheating. The system shall be capable of providing one 30 second cranking period.

2.10.3 Electrical

An electrical starting system shall be provided to operate on a 24-volt dc system utilizing a negative circuit ground. Starting motors shall be in accordance with SAE ARP 892.

2.10.3.1 Battery

A starting battery system shall be provided and shall include the battery, battery rack, intercell connectors, spacers, automatic battery charger with overcurrent protection, metering and relaying. The battery shall be in accordance with SAE J537. Critical system components (rack, protection, etc.) shall be sized to withstand the seismic acceleration

forces of the zone specified in paragraph Engine-Generator Parameter Schedule. The battery shall be lead-acid, with sufficient capacity, at the minimum outdoor and maximum outdoor temperature specified, to provide the specified cranking periods.

2.10.3.2 Battery Charger

A current-limiting battery charger, conforming to UL 1236, shall be provided and shall automatically recharge the batteries. The charger shall be capable of an equalize-charging rate for recharging fully depleted batteries within 8 and a floating charge rate for maintaining the batteries at fully charged condition. An ammeter shall be provided to indicate charging rate. A voltmeter shall be provided to indicate charging voltage. A timer shall be provided for the equalize-charging-rate setting.

2.10.4 Starting Aids

2.10.4.1 Jacket-Coolant Heaters

A thermostatically controlled electric heater shall be mounted in the engine coolant jacketing to automatically maintain the coolant within plus or minus 3 degrees F of the control temperature. The heater shall operate independently of engine operation so that starting times are minimized. Power for the heaters shall be 120 volts ac.

a. Standby Rated Sets

The control temperature shall be the temperature recommended by the engine manufacturer to meet the starting time specified at the minimum winter outdoor temperature.

2.10.4.2 Lubricating-Oil Heaters

A thermostatically controlled electric heater shall be mounted in the engine lubricating-oil system to automatically maintain the oil temperature within plus or minus 3 degrees F of the control temperature. The heater shall operate independently of engine operation so that starting times are minimized. Power for the heaters shall be 120 volts ac.

2.10.5 Exerciser

A programmable, timing device or sequential controller shall be provided to start, operate, and automatically stop the engine-generator set to permit periodic operation for a preset period of time at preset intervals. Intervals shall be adjustable from 100 hours to not less than 168 hours, and factory set at 160 hours. Running periods shall be adjustable from 0 to 60 minutes, including the engine cool-down period, and factory set at 30 minutes. The design of the system exerciser shall include the following provisions:

a. Manual activation switch.

b. Manual reset switch. Reset switch shall terminate the run period and activate control logic to return system loads to the normal or preferred source, and to shut down the engine generator set after the

cooldown period.

c. Coordination with the automatic transfer switch controls and logic so that the system loads are returned to the normal or preferred source upon manual reset, and upon loss of engine generator set output voltage, if the normal or preferred source is available.

2.11 SAFETY SYSTEM

Devices, wiring, remote annunciator panels, panels, etc. shall be provided and installed as a complete system to automatically activate the appropriate signals and initiate the appropriate actions. The safety system shall be provided with a self-test method to verify its operability. Alarm signals shall have manual acknowledgment and reset devices. The alarm signal systems shall reactivate for new signals after acknowledgment is given to any signal. The systems shall be configured so that loss of any monitoring device shall be dealt with as an alarm on that system element.

2.11.1 Audible Signal

The audible alarm signal shall sound at a frequency of 70 Hz at a volume of 75 dB at 10 feet. The sound shall be continuously activated upon alarm and silenced upon acknowledgment. Signal devices shall be located as shown.

2.11.2 Visual Signal

The visual alarm signal shall be a panel light. The light shall be normally off, activated to be blinking upon alarm. The light shall change to continuously lit upon acknowledgment. If automatic shutdown occurs, the display shall maintain activated status to indicate the cause of failure and shall not be reset until cause of alarm has been cleared and/or restored to normal condition. Shutdown alarms shall be red; all other alarms shall be amber.

2.11.3 Alarms and Action Logic

2.11.3.1 Shutdown

Simultaneous activation of the audible signal, activation of the visual signal, stopping the engine, and opening the generator field and main circuit breakers shall be accomplished.

2.11.3.2 Problem

Activation of the visual signal shall be accomplished.

2.11.4 Alarm Panel

The panel shall be as specified in paragraph PANELS and shall contain the following functions:

Function/Device	Alarm/Action
a. Red emergency stop (push button or switch)	Shutdown
b. Day tank overfill limit indication (95 percent volume)	Problem/ (Shutdown pump supplying fuel to the day tank)
c. Engine overspeed indication (110 percent of rated speed)	Shutdown
d. High lube-oil temperature indication (Temperature as submitted)	Shutdown
e. Low lube-oil pressure indication (Pressure as submitted)	Shutdown
f. High coolant fluid outlet temperature indication (Temperature as submitted)	Shutdown
g. Pre-Low lube-oil pressure indication (110 percent of low lube-oil pressure)	Problem
h. Pre-high coolant fluid temperature indication (5 degrees C lower than coolant-fluid outlet shutdown temperature)	Problem
i. Pre-high lube-oil temperature indication (5 degrees C before shutdown)	Problem
j. Day tank low fuel limit indication (70 percent volume remaining)	Problem
k. Failure to start within the specified time indication.	Problem

2.11.5 Time-Delay on Alarms

For startup of the engine-generator set, time-delay devices shall be installed bypassing the low lubricating oil pressure alarm during cranking, and the coolant-fluid outlet temperature alarm. The lube-oil time-delay device shall return its alarm to normal status after the engine starts. The coolant time-delay device shall return its alarm to normal status 5 minutes after the engine starts.

2.11.6 Remote Alarm Panel

A remote alarm panel shall be 100 percent redundant to the Alarm Panel.

2.12 GOVERNOR

Each engine shall be provided with a governor which maintains the frequency within a bandwidth of the rated frequency, over a steady-state load range of zero to 100 percent of rated output capacity. The governor shall be configured for safe manual adjustment of the speed/frequency during operation of the engine-generator set, without special tools, from 90 to 110 percent of the rated speed/frequency.

2.12.1 Governor Performance

2.12.1.1 Droop Governors

Droop governors shall maintain the midpoint of the frequency bandwidth linearly for steady-state loads over the range of zero to 100 percent of rated output capacity, with 3 percent droop.

2.12.2 Bandwidths

2.12.2.1 Electrical

Electrical governors shall have electrical speed sensing and maintain a frequency bandwidth of plus or minus 0.25 percent, maximum.

2.13 ENGINE PANEL

The panel shall be as specified in paragraph PANELS and shall contain the following items:

a. Coolant-fluid inlet temperature display.

b. Lubricating-oil pressure indicator.

c. Lubricating-oil inlet temperatures display.

d. Red emergency stop (push-button or switch).

e. Run-time meter.

f. Fuel meter display.

g. Fuel-header-pressure display.

h. Tachometer display.

i. Engine start-stop switch.

j. Start-attempt light indicator.

k. Lubricating-oil prelubricating pump start-stop switch.

l. Alarm Panel.

2.14 GENERATOR

Each generator shall be of the synchronous type, one or two bearing, conforming to NEMA MG 1, equipped with winding terminal housings in accordance with NEMA MG 1, equipped with an amortisseur winding, and directly connected to the engine. Insulation shall be Class F. Generator design shall protect against mechanical, electrical and thermal damage due to vibration, 25 percent overspeeds, or voltages and temperatures at a rated output capacity of 110 percent for prime applications and 100 percent for standby applications. Generator ancillary equipment shall meet the short circuit requirements of NEMA MG 1. Frames shall be the drip-proof type. For two-bearing generators, the maximum voltage drop due to shaft current through the generator bearings at 100 percent output capacity shall be less than 100 mV with sealed-ball or spherical roller bearings and less than 200 mV with sleeve bearings.

2.14.1 Current Balance

At 100 percent rated output capacity, and load impedance equal for each of the 3 phases, the permissible current difference between any 2 phases shall not exceed 2 percent of the largest current on either of the 2 phases.

2.14.2 Voltage Balance

At any balanced load between 75 and 100 percent of rated output capacity, the difference in line-to-neutral voltage among the 3 phases shall not exceed 1 percent of the average line-to-neutral voltage. For a single-phase load condition, consisting of 25 percent load at unity power factor placed between any phase and neutral with no load on the other 2 phases, the maximum simultaneous difference in line-to-neutral voltage between the phases shall not exceed 3 percent of rated line to neutral voltage. The single-phase load requirement shall be valid utilizing normal exciter and regulator control. The interpretation of the 25 percent load for single phase load conditions means 25 percent of rated current at rated phase voltage and unity power factor.

2.14.3 Waveform

The deviation factor of the line-to-line voltage at zero load and at balanced rated output capacity shall not exceed 10 percent. The RMS of all harmonics shall be less than 5.0 percent and that of any one harmonic less than 3.0 percent of the fundamental at rated output capacity.

2.15 EXCITER

The generator exciter shall be of the brushless type. Semiconductor rectifiers shall have a minimum safety factor of 300 percent for peak inverse voltage and forward current ratings for all operating conditions, including 110 percent generator output at 104 degrees F ambient. The exciter and regulator in combination shall maintain generator-output voltage within the limits specified. The exciter shall maintain output current at the level and duration required to trip the generator breaker (IEEE device 52) under fault conditions.

2.16 VOLTAGE REGULATOR

Each generator shall be provided with a solid-state voltage regulator, separate from the exciter, which maintains the voltage within a bandwidth of the rated voltage, over a steady-state load range of zero to 100 percent of rated output capacity. Regulator shall be configured for safe manual adjustment of the engine-generator voltage output without special tools, during operation, from 90 to 110 percent of the rated voltage. Regulation drift shall not exceed plus or minus 0.5 percent for an ambient temperature change of 68 degrees F.

2.16.1 Steady State Performance

The voltage regulator shall have a maximum droop of 3 percent of rated voltage over a load range from 0 to 100 percent of rated output capacity and automatically maintain the generator output voltage within the specified operational bandwidth.

2.16.2 Regulator Bandwidth

Regulators shall have an operational bandwidth of plus or minus 2 percent of rated voltage.

2.17 GENERATOR ISOLATION AND PROTECTION

Devices necessary for electrical protection and isolation of each engine-generator set and its ancillary equipment shall be provided. The generator circuit breaker (IEEE Device 52) ratings shall be consistent with the generator rated voltage and frequency, with continuous, short circuit withstand, and interrupting current ratings to match the generator capacity. The generator circuit breaker shall be manually operated. Monitoring and control devices shall be as specified in paragraph GENERATOR PANEL.

2.17.1 Switchboards

Switchboards shall be free-standing, metal-enclosed, general purpose, 3-phase, 4-wire, 480 volt rated, with neutral bus and continuous ground bus, conforming to NEMA PB 2 and UL 891. Neutral bus and ground bus capacity shall be full capacity. Panelboards shall conform to NEMA PB 1. Enclosure designs, construction, materials and coatings shall be suitable for the application and environment. Bus continuous current rating shall be as indicated. Current withstand (short circuit rating) shall be equal to the breaker interrupting rating. Buses shall be aluminum.

2.18 SYNCHRONIZING PANEL

The panel shall be as specified in paragraph PANELS and shall provide controls, gauges, meters, and displays to include:

a. Frequency meters, dial type, with a range of 90 to 110 percent of rated frequency. Vibrating-reed type meters shall not be used. One shall monitor generator output frequency ("Running Frequency Meter") and the other shall monitor the frequency of the parallel source ("Incoming

Frequency Meter").

b. Voltmeter, ac, dial type, 3-phase, with 4-position selector switch for the generator output ("Running Volt Meter").

c. Voltmeter, ac, dial type, 3-phase, with 4-position selector switch for the parallel power source ("Incoming Volt Meter").

d. Automatic synchronizer.

e. Manual synchronizing controls.

f. Indicating lights for supplementary indication of synchronization.

g. Synchroscope.

2.19 GENERATOR PANEL

The panels shall be as specified in paragraph PANELS and shall provide controls, gauges, meters, and displays to include:

a. Frequency meter, dial type, with a range of 90 to 110 percent of rated frequency. Vibrating-reed type meters shall not be used.

b. Voltmeter, ac, dial type, 3-phase, with 4-position selector switch for the generator output.

c. Ammeter, 3-phase, with 4-position selector switch.

d. Generator field contactor or circuit breaker and discharge resistor, if provided.

e. Voltage regulator control.

2.20 PANELS

Each panel shall be of the type and kind necessary to provide specified functions. Panels shall be mounted on the engine-generator set base by vibration/shock absorbing type mountings. Instruments shall be mounted flush or semiflush. Convenient access to the back of panels shall be provided to facilitate maintenance. Instruments shall be calibrated using recognized industry calibration standards. Each panel shall be provided with a panel identification plate which clearly identifies the panel function. Each instrument and device on the panel shall be provided with a plate which clearly identifies the device and its function as indicated. Switch plates shall clearly identify the switch-position function.

2.20.1 Enclosures

Enclosures shall be designed for the application and environment, conforming to NEMA ICS 6. Locking mechanisms are optional.

2.20.2 Analog

Analog electrical indicating instruments shall be true RMS indicating instruments, in accordance with ANSI C39.1 with semiflush mounting. Switchboard, switchgear, and control-room panel-mounted instruments shall have 250 degree F scales with an accuracy of not less than 99 percent. Unit-mounted instruments shall be the manufacturer's standard with an accuracy of not less than 98 percent. The instrument's operating temperature range shall be minus 4 to plus 158 degrees F. Distorted generator output voltage waveform of a crest factor less than 5 shall not affect metering accuracy for phase voltages, hertz and amps.

2.20.3 Electronic

Electronic indicating instruments shall be true RMS indicating instruments, 100 percent solid state, state-of-the-art, microprocessor controlled to provide specified functions. Control, logic, and function devices shall be compatible as a system, sealed, dust and water tight, and shall utilize modular components with metal housings and digital instrumentation. An interface module shall be provided to decode serial link data from the electronic panel and translate alarm, fault and status conditions to set of relay contacts. Instrument accuracy shall be not less than 98 percent for unit mounted devices and 99 percent for control room, panel mounted devices, throughout a temperature range of minus 4 to 158 degrees F. Data display shall utilize LED or back lit LCD. Additionally, the display shall provide indication of cycle programming and diagnostic codes for troubleshooting. Numeral height shall be 0.5 inch.

2.20.4 Parameter Display

Continuous indication of the tachometer, lubricating-oil pressure, ac voltmeter, ac ammeter, frequency meter, and safety system parameters shall be provided. A momentary switch shall be specified for other panels.

2.21 AUTOMATIC ENGINE-GENERATOR-SET SYSTEM OPERATION

Fully automatic operation shall be provided for the following operations: engine-generator set starting and load transfer upon loss of normal source; retransfer upon restoration of the normal source; sequential starting; paralleling, and load-sharing for multiple engine-generator sets; and stopping of each engine-generator set after cool-down. Devices shall automatically reset after termination of their function.

2.21.1 Automatic Transfer Switch

Automatic transfer switches shall be in accordance with Section 16262 AUTOMATIC TRANSFER SWITCHES.

2.21.2 Monitoring and Transfer

Devices shall be provided to monitor voltage and frequency for the normal power source and each engine-generator set, and control transfer from the normal source and retransfer upon restoration of the normal source. Functions, actuation, and time delays shall be as described in Section 16262 AUTOMATIC TRANSFER SWITCHES.

2.22 MANUAL ENGINE-GENERATOR-SET SYSTEM OPERATION

Complete facilities shall be provided for manual starting and testing of each set without load, loading and unloading of each set.

2.23 BASE

The base shall be constructed of steel. The base shall be designed to rigidly support the engine-generator set, ensure permanent alignment of rotating parts, be arranged to provide easy access to allow changing of lube-oil, and ensure that alignment is maintained during shipping and normal operation. The base shall permit skidding in any direction during installation and shall withstand and mitigate the affects of synchronous vibration of the engine and generator. The base shall be provided with suitable holes for anchor bolts and jacking screws for leveling.

2.24 THERMAL INSULATION

Thermal insulation shall be as specified in Section 15250 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.25 PAINTING AND FINISHING

The engine-generator set shall be cleaned, primed and painted in accordance with the manufacturer's standard color and practice.

2.26 FACTORY INSPECTION AND TESTS

Factory inspections and tests shall be performed on each engine-generator set. Each engine and each generator shall be tested by being operated for at least 1 hour at Service Load before being assembled into an engine-generator set. Each engine-generator set shall be run not less than 1 hour at Service Load prior to inspections. Inspections shall be completed and all necessary repairs made, prior to testing. The Contracting Officer may provide one or more representatives to witness inspections and tests.

2.26.1 Factory Inspection

Inspections shall be performed prior to beginning and after completion of testing of the assembled engine-generator set. Inspectors shall look for leaks, looseness, defects in components, proper assembly, etc. and any item found to be in need of correction shall be noted as a necessary repair. The following checklist shall be used for the inspection:

INSPECTION ITEM	GOOD	BAD	NOTES
1. Drive belts			
2. Governor and adjustments			
3. Engine timing mark			
4. Starting motor			
5. Starting aids			
6. Coolant type and concentration			

INSPECTION ITEM	GOOD	BAD	NOTES
7. Radiator drains			
8. Block coolant drains			
9. Coolant fill level			
10. All coolant line connections			
11. All coolant hoses			
12. Combustion air filter			
13. Combustion air silencer			
14. Lube oil type			
15. Lube oil sump drain			
16. Lube-oil filter			
17. Lube-oil-level indicator			
18. Lube-oil-fill level			
19. All lube-oil line connections			
20. All lube-oil lines			
21. Fuel type and amount			
22. All fuel-line connections			
23. All fuel lines			
24. Fuel filter			
25. Coupling and shaft alignment			
26. Voltage regulators			
27. Battery-charger connections			
28. All wiring connections			
29. Instrumentation			
30. Hazards to personnel			
31. Base			
32. Nameplates			
33. Paint			

2.26.2 Factory Tests

The following tests shall be performed on each engine-generator set except where the component manufacturer's production line test is noted as acceptable. On engine-generator set tests where the engine and generator are required to be connected and operated together, the load power factor shall be the power factor specified in the engine generator set parameter schedule. Tests specified as MIL-STD 705 tests may be performed in accordance with the equivalent NEMA MG 1 or IEEE Std 115, or IEEE Std 112 tests. Manufacturer's standard test instruments may be substituted for test instruments specified in MIL-STD 705 tests, as approved by the Contracting Officer. In the following tests where measurements are to be recorded after stabilization of an engine-generator set parameter (voltage, frequency, current, temperature, etc.), stabilization is considered to have occurred when measurements are maintained within the specified bandwidths or tolerances, for a minimum of four consecutive readings.

a. Insulation Resistance for Stator and Exciter Test, per MIL-STD 705 method 301.1: to the performance criteria in NEMA MG 1, 22.51, minimum of 1 megohm per 1000 Volts of rated voltage for armature and field or the recommended polarization index in IEEE Std 43, whichever is more stringent. Generator manufacturer's production line test is acceptable.

b. High Potential Test, per MIL-STD 705 method 302.1: to the performance criteria in MIL-STD 705 or NEMA MG 1, 22.51 and the recommended polarization index in IEEE Std 95. Generator manufacturer's production line test is acceptable.

c. Winding Resistance Test, per IEEE Std 115. Generator manufacturer's production line test is acceptable.

d. Start-and-Stop Test. Record: the starting time; engine manufacturer's after-starting checks and inspections; readings of gauges and instruments; and the time to stop after activation of the manual emergency stop switch. The set shall operate for 5 minutes at rated voltage and frequency and no load prior to activation of the manual emergency stop switch.

e. The engine generator-set shall be operated for at least: 15 minutes at 50 percent of Service Load; 75 percent of Service Load for at least 15 minutes; 100 percent of Service Load at least 30 minutes; and 110 percent of Service Load at least 30 minutes for prime rated sets. Readings of gauges and instruments shall be checked after each load change.

f. Torsion-graphic Test, per MIL-STD 705 method 504.2: to determine that the maximum torsional stress is 5000 psi or less. The test shall be performed at a maximum frequency of 61.8 Hz. and a minimum frequency of 58.2 Hz. Alternatively the engine-generator set manufacturer may submit calculations which clearly demonstrate that the maximum torsional stress is not exceeded.

g. Overspeed Vibration Test, per MIL-STD 705 method 505.1a: to the performance criteria in NEMA MG 1, Part 22. The test shall be performed at 110 percent of rated speed for 5 minutes. The vibration shall be measured at the end bearings (front and back of engine, outboard end of generator) in the horizontal, vertical, and axial directions. Vibration amplitude and speed shall be recorded at one minute intervals.

h. Overspeed Protective Device Test, per MIL-STD 705 method 505.2a: to the performance criteria specified in paragraph SAFETY SYSTEM. The engine overspeed alarm shall be verified.

i. Phase Sequence Rotation Test, per MIL-STD 705 method 507.1: to the performance criteria shown on the contract drawings. Generator manufacturer's production line test is acceptable.

j. Phase Balance Voltage Test, per MIL-STD 705 method 508.1 or IEEE Std 112: to the performance criteria specified in paragraph GENERATOR.

k. Voltage Waveform (Oscillographic), per MIL-STD 705 method 601.1: to the performance criteria specified in paragraph GENERATOR.

l. Voltage Waveform (Harmonic Analysis) Test, per MIL-STD 705 method 601.4: to the performance criteria specified in paragraph GENERATOR. High-speed chart recording instruments capable of recording transient voltage and speed changes shall be used.

m. Current Balance on Stator Winding Test, by measuring the current on each phase of the winding with the generator operating at 100 percent of Service Load, with the load impedance equal for each of the three phases: to the performance criteria specified in paragraph GENERATOR. This test may be performed using any prime mover.

n. Voltage and Frequency Droop Test. Perform and record engine manufacturer's recommended prestarting checks and inspections. Start the engine, make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period. For the following steps, verify that the output voltage and frequency return to and stabilize within the specified bandwidth values following each load change. The generator output frequency and line-line and line-neutral voltages shall be recorded following each load change.

1. With the generator operating at 0 percent load, adjust voltage and frequency to rated voltage and frequency. Record the generator output frequency and line-line and line-neutral voltages.

2. Apply and drop load equal to the Maximum Step Load Increase three times in succession.

3. Increase load to 100 percent of Service Load in steps equal to the Maximum Step Load Increase. Adjust the load, voltage and frequency to 100 percent of Service Load and rated voltage and frequency. No further adjustments may be made to any set controls after this step.

4. Reduce the load to no load in one step.

5. Increase load to 100 percent of Service Load in steps equal to the Maximum Step Load Increase. Decrease load to 0 percent of Service Load in steps of 10 percent (operate at each step until voltage and frequency stabilization is achieved).

6. Plot frequency vs. percent of rated load. Plot voltage vs. percent of rated load.

7. Calculate the percent droop for voltage and frequency with the following equations:

$$\text{Voltage droop \%} = \frac{\text{(No-Load Volts)} - \text{(Service-Load volts)}}{\text{(Service-Load Volts)}} \times 100$$

$$\text{Frequency droop \%} = \frac{\text{(No-Load Hertz)} - \text{(Service-Load hertz)}}{\text{(Service-Load hertz)}} \times 100$$

o. Frequency and Voltage Stability and Transient Response. Verify that the engine-generator set responds to addition and dropping of blocks of load in accordance with the transient response requirements. Document maximum voltage and frequency variation from bandwidth and verify that voltage and frequency return to and stabilize within the specified

bandwidth, within the specified response time period. Document results with high resolution, high speed strip chart recorders and express the results as detailed in MIL-STD 705 method 608.1. Data taken shall include the following:

Ambient temperature (at 15 minute intervals).

Generator output current (before and after load changes).

Generator output voltage (before and after load changes).

Frequency (before and after load changes).

Charts of momentary overshoot and undershoot (generator terminal voltage and frequency) and recovery time for each load change together with the voltage and frequency maximum and minimum trace excursions for each steady state load condition prior to and immediately following each load change.

Charts which show the generator terminal voltage and frequency transient recovery time for each step load increase and decrease.

1. Perform and record engine manufacturer's recommended prestarting checks and inspections.

2. Start the engine, make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period and no load. Verify stabilization of voltage and frequency within specified bandwidths.

3. With the unit at no load, apply the Maximum Step Load Increase.

4. Apply load in steps equal to the Maximum Step Load Increase until the addition of one more step increase will exceed the Service Load.

5. Decrease load to the unit such that addition of the Maximum Step Load Increase will load the unit to 100 percent of Service Load.

6. Apply the Maximum Step Load Increase.

7. Decrease load to zero percent in steps equal to the Maximum Step Load Decrease.

8. Repeat steps 3. through 7.

p. Voltage Unbalance with Unbalanced Load (Line-to-Neutral) Test in accordance with MIL-STD 705 method 620.1a: to the performance criteria specified in paragraph GENERATOR. Prototype test data is acceptable in lieu of the actual test. This test may be performed using any prime mover.

q. For two-bearing generators, perform Shaft Current Test in accordance with MIL-STD 705 method 652.1a.

PART 3 EXECUTION

3.1 GENERAL

Installation shall provide clear space for operation and maintenance in accordance with NFPA 70 and ANSI C2. Installation of pipe, duct, conduit, and ancillary equipment shall be configured to facilitate easy removal and replacement of major components and parts of the engine-generator set.

3.2 PIPING INSTALLATION

3.2.1 General

Piping shall be welded. Connections at valves shall be flanged. Connections at equipment shall be flanged except that connections to the diesel engine may be threaded if the diesel-engine manufacturers standard connection is threaded. Except where otherwise specified, welded flanged fittings shall be utilized to allow for complete dismantling and removal of each piping system from the facility without disconnecting or removing any portion of any other system's equipment or piping. Connections to equipment shall be made with flexible connectors. Pipes extending through the roof shall be properly flashed. Piping shall be installed clear of windows, doors and openings, to permit thermal expansion and contraction without damage to joints or hangers, and shall be installed with a 1/2 inch drain valve with cap at each low point.

3.2.2 Support

Hangers, inserts, and supports shall be of sufficient size to accommodate any insulation and shall conform to MSS SP-58 and MSS SP-69. Supports shall be spaced not more than 7 feet on center for pipes 2 inches in diameter or less, not more than 12 feet on center for pipes larger than 2 inches but smaller than 4 inches in diameter, and not more than 17 feet on center for pipes larger than 4 inches in diameter. Supports shall be provided at pipe bends or change of direction.

3.2.2.1 Ceiling and Roof

Exhaust piping shall be supported with appropriately sized Type 41 single pipe roll and threaded rods; all other piping shall be supported with appropriately sized Type 1 clevis and threaded rods.

3.2.2.2 Wall

Wall supports for pipe shall be made by suspending the pipe from appropriately sized Type 33 brackets with the appropriate ceiling and roof pipe supports.

3.2.3 Flanged Joints

Flanges shall be Class 125 type, drilled, and of the proper size and configuration to match the equipment and diesel engine connections. Flanged joints shall be gasketed and made up square and tight.

3.2.4 Cleaning

After fabrication and before assembly, piping interiors shall be manually wiped clean of debris.

3.2.5 Pipe Sleeves

Pipes passing through construction such as ceilings, floors, or walls shall be fitted with sleeves. Each sleeve shall extend through and be securely fastened in its respective structure and shall be cut flush with each surface. The structure shall be built tightly to the sleeve. The inside diameter of each sleeve shall be minimum 1/2 inch, and where pipes pass through combustible materials 1 inch larger than the outside diameter of the passing pipe or pipe insulation/covering.

3.3 ELECTRICAL INSTALLATION

Electrical installation shall comply with NFPA 70, ANSI C2, and Section 16415 ELECTRICAL WORK, INTERIOR.

3.3.1 Vibration Isolation

Flexible fittings shall be provided for conduit, cable trays, and raceways attached to engine-generator sets.

3.4 FIELD PAINTING

Field painting shall be as specified in Section 09900 PAINTING, GENERAL.

3.5 ONSITE INSPECTION AND TESTS

3.5.1 Test Conditions

3.5.1.1 Data

Measurements shall be made and recorded of all parameters necessary to verify that each set meets specified parameters. If the results of any test step are not satisfactory, adjustments, replacements, or repairs shall be made and the step repeated until satisfactory results are obtained. Unless otherwise indicated, data shall be recorded in 15 minute intervals during engine-generator set operation and shall include: readings of all engine-generator set meters and gauges for electrical and power parameters; oil pressure; ambient temperature; and engine temperatures available from meters and gauges supplied as permanent equipment on the engine-generator set.

3.5.1.2 Power Factor

For all engine-generator set operating tests the load power factor shall be the power factor specified in the engine-generator set parameter schedule.

3.5.1.3 Contractor Supplied Items

The Contractor shall provide equipment and supplies required for inspections and tests including fuel, test instruments, and loadbanks at the specified power factors.

3.5.1.4 Instruments

Readings of panel gauges, meters, displays, and instruments provided as permanent equipment shall be verified during test runs, using test instruments of greater precision and accuracy. Test instrument accuracy shall be within the following: current plus or minus 1.5 percent, voltage plus or minus 1.5 percent, real power plus or minus 1.5 percent, reactive power plus or minus 1.5 percent, power factor plus or minus 3 percent, frequency plus or minus 0.5 percent. Test instruments shall be calibrated by a recognized standards laboratory within 30 days prior to testing.

3.5.1.5 Sequence

The sequence of testing shall be as specified in the approved testing plan unless variance is authorized by the Contracting Officer. Field testing shall be performed in the presence of the Contracting Officer. Tests may be scheduled and sequenced in order to optimize run-time periods; however, the following general order of testing shall be followed: Construction Tests; Inspections; Pre-operational Tests; Safety Run Tests; and Performance Tests.

3.5.2 Construction Tests

Individual component and equipment functional tests for fuel piping, coolant piping, and lubricating-oil piping, electrical circuit continuity, insulation resistance, circuit protective devices, and equipment not provided by the engine-generator set manufacturer shall be performed prior to connection to the engine-generator set.

3.5.2.1 Piping Test

a. Lube-oil and fuel-oil piping shall be flushed with the same type of fluid intended to flow through the piping, until the outflowing fluid has no obvious sediment or emulsion.

b. Piping which is external to the engine-generator set shall be pressure tested with air pressure at 150 percent of the maximum anticipated working pressure, but not less than 150 psi, for a period of 2 hours to prove the piping has no leaks. If piping is to be insulated, the test shall be performed before the insulation is applied.

3.5.2.2 Electrical Equipment Tests

a. Insulation integrity tests shall be performed for cables connecting the generator breaker to the automatic transfer switch in accordance with Section 16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND.

b. Ground-Resistance Tests shall be performed in accordance with Section 16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND.

c. Circuit breakers shall be examined and tested in accordance with the manufacturer's published instructions for functional testing.

3.5.3 Inspections

The following inspections shall be performed jointly by the Contracting Officer and the Contractor, after complete installation of each engine-generator set and its associated equipment, and prior to startup of the engine-generator set. Checks applicable to the installation shall be performed. The results of those which are physical inspections (I) shall be documented by the Contractor and submitted in accordance with paragraph SUBMITTALS. The Contractor shall present manufacturer's data for the inspections designated (D) at the time of inspection. Inspections shall verify that equipment type, features, accessibility, installation and condition are in accordance with the contract specification. Manufacturer's statements shall certify provision of features which cannot be verified visually.

1. Drive belts. (I)
2. Governor type and features. (I)
3. Engine timing mark. (I)
4. Starting motor. (I)
5. Starting aids. (I)
6. Coolant type and concentration. (D)
7. Radiator drains. (I)
8. Block coolant drains. (I)
9. Coolant fill level. (I)
10. Coolant line connections. (I)
11. Coolant hoses. (I)
12. Combustion air filter. (I)
13. Intake air silencer. (I)
14. Lube oil type. (D)
15. Lube oil sump drain. (I)
16. Lube-oil filter. (I)
17. Lube-oil level indicator. (I)
18. Lube-oil fill level. (I)
19. Lube-oil line connections. (I)
20. Lube-oil lines. (I)
21. Fuel type. (D)
22. Fuel-level. (I)
23. Fuel-line connections. (I)
24. Fuel lines. (I)
25. Fuel filter. (I)
26. Access for maintenance. (I)
27. Voltage regulator. (I)
28. Battery-charger connections. (I)
29. Wiring & terminations. (I)
30. Instrumentation. (I)
31. Hazards to personnel. (I)
32. Base. (I)
33. Nameplates. (I)
34. Paint. (I)
35. Exhaust muffler. (I)
36. Access provided to controls. (I)

37. Enclosure is weather resistant. (I)
38. Engine & generator mounting bolts (application). (I)

3.5.4 Pre-operational Tests

3.5.4.1 Insulation Test

Generator and exciter circuits insulation resistance shall be tested with an insulation tester. Stator readings shall be taken at the circuit breaker, to include generator leads to ATS. Results of insulation resistance tests shall be recorded. Readings shall be within limits specified by the manufacturer. Mechanical operation, insulation resistance, protective relay calibration and operation, and wiring continuity of ATS assembly shall be verified. Precautions shall be taken to preclude damaging generator components during test.

3.5.4.2 Engine-Generator Connection Coupling Test

When the generator provided is a two-bearing machine, the engine-generator connection coupling shall be inspected and checked by dial indicator to prove that no misalignment has occurred. The dial indicator shall measure variation in radial positioning and axial clearance between the coupling halves. Readings shall be taken at four points, spaced 90 degrees apart. Solid couplings and pin-type flexible couplings shall be aligned within a total indicator reading of 0.0005 to 0.001 inch for both parallel and angular misalignment. For gear-type or grid-type couplings, 0.002 inch will be acceptable.

3.5.5 Safety Run Test

a. Perform and record engine manufacturer's recommended prestarting checks and inspections.

b. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period.

c. Activate the manual emergency stop switch and record the time to stop.

d. Remove the high and pre-high lubricating oil temperature sensing elements from the engine and temporarily install a temperature gauge in their normal locations on the engine (required for safety, not for recorded data). Where necessary provide temporary wiring harness to connect the sensing elements to their permanent electrical leads.

e. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period. Operate the engine-generator set at no load until the output voltage and frequency stabilize. Monitor the temporarily installed temperature gauges. If either temperature reading exceeds the value required for an alarm condition, activate the manual emergency stop switch.

f. Immerse the elements in a vessel containing controlled-temperature hot oil and record the temperature at which the pre-high alarm activates

and the temperature at which the engine shuts down. Remove the temporary temperature gauges and reinstall the temperature sensors on the engine.

g. Remove the high and pre-high coolant temperature sensing elements from the engine and temporarily install a temperature gauge in their normal locations on the engine (required for safety, not for recorded data). Where necessary provide temporary wiring harness to connect the sensing elements to their permanent electrical leads.

h. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period. Operate the engine generator-set at no load until the output voltage and frequency stabilize.

i. Immerse the elements in a vessel containing controlled-temperature hot oil and record the temperature at which the pre-high alarm activates and the temperature at which the engine shuts down. Remove the temporary temperature gauges and reinstall the temperature sensors on the engine.

j. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period.

k. Operate the engine generator-set for at least 2 hours at 75 percent of Service Load.

l. Verify proper operation and setpoints of gauges and instruments.

m. Verify proper operation of ancillary equipment.

n. Manually adjust the governor to increase engine speed past the overspeed limit. Record the RPM at which the engine shuts down.

o. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections and operate the engine generator-set for at least 15 minutes at 75 percent of Service Load.

p. Manually adjust the governor to increase engine speed to within 2 percent of the overspeed trip speed previously determined and operate at that point for 5 minutes. Manually adjust the governor to the rated frequency.

q. Manually fill the day tank to a level above the overfill limit. Record the level at which the overfill alarm sounds. Verify shutdown of the fuel transfer pump. Drain the day tank down below the overfill limit.

r. Shut down the engine. Remove the time-delay low lube oil pressure alarm bypass and try to start the engine.

s. Attach a manifold to the engine oil system that contains a shutoff valve in series with a connection for the engine's oil pressure sensor followed by an oil pressure gauge ending with a bleed valve. The engine's oil pressure sensor shall be moved from the engine to the manifold and its normal location on the engine temporarily sealed. The manifold shutoff valve shall be open and bleed valve closed.

t. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections and operate the engine generator-set for at least 15 minutes at 75 percent of Service Load.

u. Close the manifold shutoff valve. Slowly allow the pressure in the manifold to bleed off through the bleed valve while watching the pressure gauge. Record the pressure at which the engine shuts down. Catch oil spillage from the bleed valve in a container. Add the oil from the container back to the engine, remove the manifold, and reinstall the engine's oil pressure sensor on the engine.

v. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections and operate the engine generator-set for at least 15 minutes at 100 percent of Service Load. Record the maximum sound level in each frequency band at a distance of 75 feet from the end of the exhaust piping directly along the path of discharge for horizontally discharged exhausts, or at a radius of 35 feet from the engine at 45 degrees apart in all directions for vertically discharged exhausts.

w. Manually drain off fuel slowly from the day tank to empty it to below the low fuel level limit and record the level at which the audible alarm sounds. Add fuel back to the day tank to fill it above low level alarm limits.

x. Manually adjust the governor to speed up the engine to a level beyond the over frequency alarm setpoint and record the frequency when the audible alarm sounds. Manually adjust the governor to slow down the engine to a level below the under frequency alarm setpoint and record the frequency when the audible alarm sounds. Return the speed to the rated value. Shut down the engine-generator set.

3.5.6 Performance Tests

In the following tests, where measurements are to be recorded after stabilization of an engine-generator set parameter (voltage, frequency, current, temperature, etc.), stabilization is considered to have occurred when measurements are maintained within the specified bandwidths or tolerances, for a minimum of four consecutive readings.

3.5.6.1 Engine Load Run Test

Test the engine-generator set and ancillary systems at service load to demonstrate durability; verify that heat of extended operation does not adversely affect or cause failure in any part of the system; and check all parts of the system. The engine load run test shall be accomplished principally during daylight hours, with an average ambient temperature of 80 degrees F. Data taken at 15 minute intervals shall include the following:

Electrical: Output amperes, voltage, real and reactive power, power factor, frequency.

Pressure: Lube-oil.

Temperature: Coolant.
Lube-oil.
Exhaust.
Ambient.

a. Perform and record engine manufacturer's recommended prestarting checks and inspections. Include as a minimum checking coolant fluid, fuel, and lube-oil levels.

b. Start the engine, make and record engine manufacturer's after-starting checks and inspections during a reasonable warmup period.

c. Operate the engine generator-set for 2 hours at 75 percent of Service Load.

d. For standby rated sets, increase load to 100 percent of Service Load, operate the engine generator-set for 4 hours, and skip the next two steps.

e. Decrease load to 100 percent of Service Load and operate the engine generator-set for 2 hours or until all temperatures have stabilized.

f. Remove load from the engine-generator set.

3.5.6.2 Voltage and Frequency Droop Test

For the following steps, verify that the output voltage and frequency return to and stabilize within the specified bandwidth values following each load change. Record the generator output frequency and line-line and line-neutral voltages following each load change.

a. Perform and record engine manufacturer's recommended prestarting checks and inspections. Start the engine, make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period.

b. With the generator operating at 0 percent load, adjust voltage and frequency to rated voltage and frequency.

c. Apply and drop load equal to the Maximum Step Load Increase three times in succession.

d. Increase load to 100 percent of Service Load in steps equal to the Maximum Step Load Increase. Adjust the load, voltage and frequency to 100 percent of Service Load and rated voltage and frequency. No further adjustments may be made to any set controls after this step.

e. Reduce the load to no load in one step.

f. Increase load to 100 percent of Service Load in steps equal to the Maximum Step Load Increase. Decrease load to 0 percent of Service Load in steps of 10 percent (operate at each step until voltage and frequency stabilization is achieved).

g. Plot frequency vs. percent of rated load. Plot voltage vs. percent of rated load.

h. Calculate the percent droop for voltage and frequency with the following equations.

$$\text{Voltage droop \%} = \frac{\text{(No-Load Volts)} - \text{(Service-Load Volts)}}{\text{(Service-Load Volts)}} \times 100$$

$$\text{Frequency droop \%} = \frac{\text{(No-Load Hertz)} - \text{(Service-Load Hertz)}}{\text{(Service-Load Hertz)}} \times 100$$

3.5.6.3 Voltage Regulator Range Test

For the following steps, record the output line-line and line-neutral voltages and frequency after performing each step instruction (after stabilization of voltage and frequency).

a. Perform and record engine manufacturer's recommended prestarting checks and inspections. Start the engine, make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period.

b. Apply load in steps no larger than the Maximum Step Load Increase to load the engine-generator set to 100 percent of Service Load. Adjust voltage and frequency to rated voltage and frequency. No further adjustments may be made to any set control for the remainder of this test except the control panel voltage adjust device.

c. Remove all load.

d. While operating at 0 percent of Service Load, adjust the voltage regulator to 110 percent of rated voltage.

e. Increase load from 0 to 100 percent of Service Load.

f. Decrease load from 100 to 0 percent of Service Load.

g. While operating at 0 percent of Service Load, adjust the voltage regulator to the maximum attainable voltage or to a value just prior to actuation of the over-voltage protective device.

h. Increase load from 0 to 100 percent of Service Load.

i. Decrease load from 100 to 0 percent of Service Load.

j. While operating at 0 percent of Service Load, adjust the voltage regulator to 90 percent of rated voltage.

k. Increase load from 0 to 100 percent of Service Load.

l. Adjust the voltage regulator to the minimum attainable value or the value just prior to activation of the undervoltage protection device.

m. Decrease the load to 0 percent of Service Load.

n. With the data recorded while the voltage regulator setpoint was at 110 percent rated voltage, calculate the percent voltage droop with the following equation.

$$\text{Voltage Droop \%} = \frac{\text{(No-Load Volts)} - \text{(Service-Load Volts)}}{\text{(Service-Load Volts)}} \times 100$$

o. Repeat the above calculation for the data recorded for the voltage regulator setpoint of 90 percent rated voltage, and for the maximum and minimum attainable voltage levels.

3.5.6.4 Governor Adjustment Range Test

For the following steps, record the output line-line and line-neutral voltages and frequency after performing each step instruction (after stabilization of voltage and frequency). Operate for approximately two minutes at each step.

a. Perform and record engine manufacturer's recommended prestarting checks and inspections. Start the engine, make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period.

b. Make initial adjustments to the load, voltage and frequency to obtain rated values. No further adjustments may be made to any set control for the remainder of this test except the control panel frequency adjust device.

c. While operating at rated voltage and 0 percent of Service Load, adjust the governor to 90 percent of rated frequency or just above the underfrequency trip setpoint.

d. Increase load to 100 percent of Service Load in steps equal to the maximum step load increase.

e. Decrease load from 100 to 0 percent of Service Load. Adjust the governor control to just below the engine overspeed trip setpoint.

f. Apply 100 percent of Service Load in steps equal to the maximum step load increase and operate for approximately two minutes at each step.

g. With the data recorded while the governor setpoint was at 90 percent rated frequency calculate the percent frequency regulation with the following equation.

$$\text{Frequency Droop \%} = \frac{\text{(No-Load Hertz)} - \text{(Service-Load Hertz)}}{\text{(Service-Load Hertz)}} \times 100$$

h. Repeat the above calculation using the data recorded with the governor control at just below the engine overspeed trip setpoint.

3.5.6.5 Frequency and Voltage Stability and Transient Response

Verify that the engine-generator set responds to addition and dropping of blocks of load in accordance with the transient response requirements. Document maximum voltage and frequency variation from bandwidth and verify that voltage and frequency return to and stabilize within the specified bandwidth, within the specified response time period. Document results with high resolution, high speed strip chart recorders and express the results as detailed in MIL-STD 705 method 608.1. Data taken shall include the following:

Ambient temperature (at 15 minute intervals).

Generator output current (before and after load changes).

Generator output voltage (before and after load changes).

Frequency (before and after load changes).

Charts of momentary overshoot and undershoot (generator terminal voltage and frequency) and recovery time for each load change together with the voltage and frequency maximum and minimum trace excursions for each steady state load condition prior to and immediately following each load change.

Charts which show the generator terminal voltage and frequency transient recovery time for each step load increase and decrease.

a. Perform and record engine manufacturer's recommended prestarting checks and inspections.

b. Start the engine, make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period and no load. Verify stabilization of voltage and frequency within specified bandwidths.

c. With the unit at no load, apply the Maximum Step Load Increase.

d. Apply load in steps equal to the Maximum Step Load Increase until the addition of one more step increase will exceed the Service Load.

e. Decrease load to the unit such that addition of the Maximum Step Load Increase will load the unit to 100 percent of Service Load.

f. Apply the Maximum Step Load Increase.

g. Decrease load to zero percent in steps equal to the Maximum Step

Load Decrease.

h. Repeat steps c. through g.

3.5.6.6 Parallel Operation Test

Test the capability of each engine-generator set to parallel and share load with other generator sets, individually and in all combinations. During operations record load-sharing characteristics of each set in parallel operation. Perform a voltage and frequency stability and transient response test for each load change. Data taken shall include the following:

Ambient temperature (at 15 minute intervals).

Generator output current (before and after load changes).

Generator output voltage (before and after load changes).

Charts of momentary overshoot and undershoot (generator output voltage and frequency) and recovery time for each load change together with the voltage and frequency maximum and minimum trace excursions for each steady state load condition prior to and immediately following each load change.

Charts which show the generator output voltage and frequency transient recovery time for each step load increase and decrease.

Power division and exchange between generator sets.

Real power (watts) and reactive power (vars) on each set.

a. Connect each set, while operating at no load, parallel with one other set in the system, while operating at rated load, until all possible two-unit-in-parallel combinations have been achieved. Verify stabilization of voltage and frequency within specified bandwidths and perform the following for each combination.

b. Divide the load proportionally between the sets and operate in parallel for 15 minutes. Verify stabilization of voltage and frequency within specified bandwidths.

c. Increase the load, in steps equal to the Maximum Step Increase, until both sets are fully loaded. Verify stabilization of voltage and frequency within specified bandwidths and proportional sharing of real and reactive load.

d. Decrease the load, in steps equal to the Maximum Step Decrease, until both sets are approximately 25 percent loaded. Verify stabilization of voltage and frequency within specified bandwidths and proportional sharing of real and reactive load.

e. Increase the load, in steps equal to the Maximum Step Increase, until both sets are 50 percent loaded. Verify stabilization of voltage and frequency within specified bandwidths and proportional sharing of real and

reactive load.

f. Reduce the sum of the loads on both sets to the output rating of the smaller set.

g. Transfer a load equal to the output rating of the smaller of the 2 sets to and from each set. Verify stabilization of voltage and frequency within specified bandwidths and proportional sharing of real and reactive load.

h. Document the active power division, active power exchange, reactive power division, and voltage and frequency stability and transient response as detailed in MIL-STD 705 Method 630.1.

i. Connect each set, while operating at no load, parallel with each other set in the system, while operating at rated load, until all sets are in simultaneous, parallel operation.

j. Document the active power division, active power exchange, reactive power division, and voltage and frequency stability within specified bandwidths.

k. Connect each set parallel with the commercial power source. Operate in parallel for 15 minutes. Verify stabilization of voltage and frequency within specified bandwidths. Record the output voltage, frequency, and loading to demonstrate ability to synchronize with the commercial power source.

l. Shut down the engine. Verify shutdown and record the time to stop.

3.5.6.7 Automatic Operation Tests for Stand-Alone Operation

The automatic loading system shall be tested to demonstrate automatic starting, and loading and unloading of engine-generator set. The loads for this test shall utilize the actual loads to be served, and the loading sequence shall be the indicated sequence. Data taken shall include the following:

Ambient temperature (at 15 minute intervals).

Generator output current (before and after load changes).

Generator output voltage (before and after load changes).

Generator output frequency (before and after load changes).

Charts of momentary overshoot and undershoot (generator terminal voltage and frequency) and recovery time for each load change together with the voltage and frequency maximum and minimum trace excursions for each steady state load condition prior to and immediately following each load change.

Charts which show the generator terminal voltage and frequency transient recovery time for each step load increase and decrease.

a. Initiate loss of the primary power source.

b. Verify starting of the engine generator set and function of the automatic transfer switch. Record the time to start and assume load (voltage and frequency measurements are required on the load terminals of the automatic transfer switch). Verify stabilization of voltage and frequency within specified bandwidths.

c. Verify that the automatic loading system sequences load onto the system as indicated. Verify stabilization of voltage and frequency within specified bandwidths after each load change.

d. Restore the primary power source and monitor transfer from the alternate power source to the primary power source. Verify operation and time delay settings for the automatic transfer switch. Verify stabilization of voltage and frequency of the primary system. Verify stabilization of the engine-generator set voltage and frequency at no load.

e. Monitor the cool-down period for the engine. Record the ambient temperature, coolant temperature, and time from system transfer until engine shutdown.

f. Verify resetting of controls to normal.

3.5.7 Final Inspection

a. Remove the lube oil filter and have the oil and filter examined by the engine manufacturer for excessive metal, abrasive foreign particles, etc. Any corrective action shall be verified for effectiveness by running the engine for 8 hours at Service Load, then re-examining the oil and filter.

b. Visually inspect and check engine and generator mounting bolts for tightness and visible damage.

c. Start the engine, record the starting time, make and record all engine manufacturer's after-starting checks and inspections during a reasonable warm-up period.

d. Increase the load in steps no greater than the Maximum Step Load Increase to 100 percent of Service Load, and operate the engine-generator set for at least 30 minutes.

e. Measure the vibration at the end bearings (front and back of engine, outboard end of generator) in the horizontal, vertical, and axial directions. Verify that the vibration is within the same range as previous measurements and is within the required range.

f. Remove load and shut down the engine-generator set after the recommended cool down period.

3.6 FRAMED INSTRUCTIONS

Two sets of instructions shall be typed and framed under weatherproof laminated plastic, and posted side-by-side where directed before

acceptance. First set of instructions shall include wiring and control diagrams and a complete layout of the system. Second set of instructions shall include the condensed operating instructions describing manufacturer's pre-start checklist and precautions; startup procedures for test-mode, manual-start mode, and automatic-start mode (as applicable); running checks, procedures, and precautions; and shutdown procedures, checks, and precautions. Instructions shall include procedures for interrelated equipment (such as heat recovery systems, co-generation, load-shedding, and automatic transfer switches).

3.7 MANUFACTURER'S FIELD SERVICE

3.7.1 Onsite Training

The Contractor shall conduct training course for operating staff as designated by the Contracting Officer. The training period shall consist of a total 16 hours of normal working time and shall start after the system is functionally completed but prior to final acceptance. The course instructions shall cover pertinent points involved in operating, starting, stopping, servicing the equipment, as well as major elements of the operation and maintenance manuals. Additionally, the course instructions shall demonstrate routine maintenance operations such as oil change, oil filter change, air filter change, etc. Two copies of a VHS format video tape of the entire training session shall be submitted.

3.7.2 Field Engineer

The engine-generator set manufacturer or assembler shall furnish a qualified field engineer to supervise the complete installation of the engine-generator set, assist in the performance of the onsite tests, and instruct personnel as to the operational and maintenance features of the equipment.

3.8 ACCEPTANCE

Final acceptance of the engine-generator set will not be given until the contractor has successfully completed all tests and all defects in installation material or operation have been corrected.

-- End of Section --

SECTION 16370

ELECTRICAL DISTRIBUTION SYSTEM, AERIAL

11/92

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 LTS-2	(1985; Rev 1986, 1987, 1988) Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C2	(1993) National Electrical Safety Code
ANSI C29.1	(1988) Electrical Power Insulators - Test Methods
ANSI C29.2	(1983) Insulators - Wet-Process Porcelain and Toughened Glass - Suspension Type
ANSI C29.3	(1986) Wet Process Porcelain Insulators - Spool Type
ANSI C29.4	(1989) Wet-Process Porcelain Insulators - Strain Type
ANSI C29.5	(1984) Wet-Process Porcelain Insulators - Low- and Medium-Voltage Types
ANSI C29.6	(1984) Wet-Process Porcelain Insulators - High-Voltage Pin Type
ANSI C29.7	(1983; C29.7a) Wet-Process Porcelain Insulators - High-Voltage Line-Post Type
ANSI C29.8	(1985) Wet-Process Porcelain Insulators - Apparatus, Cap and Pin Type
ANSI C29.9	(1983) Wet-Process Porcelain Insulators - Apparatus, Post-Type
ANSI C37.32	(1990) High-Voltage Air Switches, Bus Supports, and Switch Accessories - Schedules of Preferred Ratings,

	Manufacturing Specifications, and Application Guide
ANSI C57.12.20	(1988) Overhead-Type Distribution Transformers, 500 kVA and Smaller: High Voltage 34 500 Volts and Below; Low Voltage, 7970/13 800Y Volts and Below
ANSI C135.1	(1979) Galvanized Steel Bolts and Nuts for Overhead Line Construction
ANSI C135.2	(1987) Threaded Galvanized Ferrous Strand-Eye Anchor Rods and Nuts for Overhead Line Construction
ANSI C135.4	(1987) Zinc-Coated Ferrous Eyebolts and Nuts for Overhead Line Construction
ANSI C135.14	(1979) Staples with Rolled or Slash Points for Overhead Line Construction
ANSI C135.17	(1988) Galvanized Ferrous Bolt-Type Insulator Pins with Lead Threads for Overhead Line Construction
ANSI C135.22	(1988) Galvanized Ferrous Pole-Top Insulator Pins with Lead Threads for Overhead Line Construction
ANSI C135.30	(1988) Zinc-Coated Ferrous Ground Rods for Overhead or Underground Line Construction
ANSI C135.33	(1988) Galvanized Ferrous Crossarm Gains for Overhead Line Construction
ANSI O5.1	(1992) Specifications and Dimensions for Wood Poles

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36	(1991) Structural Steel
ASTM A 123	(1989a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153	(1982; R 1987) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 475	(1989) Zinc-Coated Steel Wire Strand
ASTM A 575	(1989) Steel Bars, Carbon, Merchant Quality, M-Grades
ASTM A 576	(1990b) Steel Bars, Carbon, Hot-Wrought, Special Quality
ASTM B 1	(1990) Hard-Drawn Copper Wire
ASTM B 8	(1990) Concentric-Lay-Stranded Copper

	Conductors, Hard, Medium-Hard, or Soft
ASTM B 117	(1990) Salt Spray (Fog) Testing
ASTM B 228	(1988) Concentric-Lay-Stranded Copper-Clad Steel Conductors
ASTM B 230	(1989) Aluminum 1350-H19 Wire for Electrical Purposes
ASTM B 231	(1990) Concentric-Lay-Stranded Aluminum 1350 Conductors
ASTM B 232	(1992) Concentric-Lay-Stranded Aluminum Conductors, Coated-Steel Reinforced (ACSR)
ASTM B 398	(1990) Aluminum-Alloy 6201-T81 Wire for Electrical Purposes
ASTM B 399	(1992) Concentric-Lay-Stranded Aluminum-Alloy 6201-T81 Conductors
ASTM B 416	(1988) Concentric-Lay-Stranded Aluminum-Clad Steel Conductors
ASTM D 923	(1991) Sampling Electrical Insulating Liquids
ASTM D 1654	(1979a; R 1984) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environment
ASTM D 4059	(1991) Analysis of Polychlorinated Biphenyls in Insulating Liquids by Gas Chromatography.
ASTM F 883	(1990) Padlocks

AMERICAN WOOD-PRESERVERS' ASSOCIATION (AWPA)

AWPA C4	(1992) Poles - Preservative Treatment by Pressure Processes
AWPA C25	(1992) Sawn Crossarms - Preservative Treatment by Pressure Processes
AWPA P1/13	(1991) Coal Tar Creosote for Land and Fresh Water and Marine (Coastal Water) Use
AWPA P5	(1992) Waterborne Preservatives
AWPA P8	(1991) Oil-Borne Preservatives
AWPA P9	(1992) Solvents and Formulations for Organic Preservative Systems

INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS (IEEE)

IEEE C37.34	(1971; R 1987; C37.34a; C37.34b; C37.34d;

	C37.34e) Test Code for High-Voltage Air Switches
IEEE C37.41	(1988; C37.41c) Design Tests for High-Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches, and Accessories
IEEE C37.60	(1981; R 1988) IEEE Requirements for Overhead, Pad-Mounted Dry Vault and Submersible Automatic Circuit Reclosers and Fault Interrupters for AC Systems
IEEE C57.12.00	(1987) Liquid-Immersed Distribution, Power, and Regulating Transformers
IEEE C57.13.2	(1991) Conformance Test Procedures for Instrument Transformers
IEEE C57.15	(1986) Requirements, Terminology, and Test Code for Step-Voltage and Induction-Voltage Regulators
IEEE C57.19.00	(1991) IEEE Standard General Requirements and Test Procedures for Outdoor Power Apparatus Bushings
IEEE C57.19.01	(1991) IEEE Standard Performance Characteristics and Dimensions for Outdoor Apparatus Bushings
IEEE C57.98	(1986) Guide for Transformer Impulse Tests - Appendix to C57.12.90
IEEE C62.1	(1989) Surge Arresters for ac Power Circuits
IEEE C62.2	(1987) Guide for the Application of Gapped Silicon-Carbide Surge Arresters for Alternating Current Systems
IEEE C62.11	(1987) Metal-Oxide Surge Arresters for AC Power Circuits
IEEE Std 18	(1980) Shunt Power Capacitors
IEEE Std 81	(1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
IEEE Std 100	(1988) IEEE Standard Dictionary of Electrical and Electronics Terms
IEEE Std 404	(1986) Cable Joints for Use with Extruded Dielectric Cable Rated 5000 V Through 46 000 V and Cable Joints for Use with Laminated Dielectric Cable Rated 2500 V Through 500 000 V

INSULATED CABLE ENGINEERING ASSOCIATION (ICEA)

ICEA S-70-547	(1992) Weather Resistant Polyolefin - Covered Wire and Cable

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA HV 2	(1991) Application Guide for Ceramic Suspension Insulator
NEMA LA 1	(1986) Surge Arresters
NEMA SG 2	(1986) High-Voltage Fuses
NEMA WC 5	(1992) Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
NEMA WC 7	(1988) Cross-Linked-Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
NEMA WC 8	(1988) Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1993) National Electrical Code

RURAL ELECTRIFICATION ADMINISTRATION (REA)

REA DT-5B	(1987) Wood Crossarms (Solid and Laminated), Transmission Timbers and Pole Keys

UNDERWRITERS LABORATORIES (UL)

UL 467	(1984; Rev thru Nov 1986) Grounding and Bonding Equipment
UL 486A	(1991; Rev Oct 1991) Wire Connectors and Soldering Lugs for Use with Copper Conductors
UL 486B	(1991; Rev thru Apr 1992) Wire Connectors for Use with Aluminum Conductors

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.

b. Altitude 1700 feet

b. Ambient Temperature 100 degrees F

c. Frequency

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL DESCRIPTIONS:

SD-01 Data

Manufacturer's Catalog; GA.

Submit 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; GA.

A complete itemized listing of equipment and materials proposed for incorporation into the work shall be submitted. Each entry shall include an item number, the quantity of items proposed, and the name of the manufacturer of each such item.

Installation Procedures; FIO.

As a minimum, the Contractor shall submit installation procedures for regulators, transformers and reclosers.

Procedures shall include diagrams, instructions, and precautions required to install, adjust, calibrate, and test the devices and equipment.

SD-04 Drawings

Electrical Distribution System; FIO.

Detail drawings consisting of equipment drawings, illustrations, schedules, instructions, diagrams and other information necessary to define the installation and enable the Government to check conformity with the requirements of the contract drawings. Detail drawings shall as a minimum include:

a. Poles.

b. Crossarms.

c. Conductors.

d. Insulators.

e. Surge arresters.

If departures from the contract drawings are deemed necessary by the Contractor, complete details of such departures shall be submitted 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.

As-Built Drawings; FIO.

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 as well as all 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, modifications, and changes. The as-built drawing 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.

SD-09 Reports

Factory Test; FIO.

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 specified in applicable publications or in these specifications.

Field Testing; FIO.

A proposed field test plan 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.

Test Reports; GA.

Six copies of the information described below in 8 1/2 by 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 all equipment used, with calibration certifications.

b. A copy of all 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 all adjustments made.

SD-13 Certificates

Materials and Equipment; FIO.

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 Electronic Engineers (IEEE), or the National Electrical Manufacturers Association (NEMA), the Contractor shall submit proof that the items provided under this section of the specifications conform to such requirements. The label of, or listing by, UL will be acceptable as evidence that the items conform thereto. 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 thereto. 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 thereto. 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.

SD-19 Operation and Maintenance Manuals

Electrical Distribution System; FIO.

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 within 30 calendar days following the approval of 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 two 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 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 GENERAL REQUIREMENTS

Products shall conform to the following requirements. Items of the same classification shall be identical including equipment, assemblies, parts, and components.

2.2 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.

2.3 NAMEPLATES

2.3.1 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. Equipment containing liquid-dielectrics shall have the type of dielectric on the nameplate. Nameplates shall be made of noncorrosive metal. As a minimum, nameplates shall be provided for transformers, regulators, circuit breakers, capacitors, meters and switches.

2.4 CORROSION PROTECTION

2.4.1 Aluminum Materials

Aluminum shall not be used.

2.4.2 Ferrous Metal Materials

2.4.2.1 Hardware

Ferrous metal hardware shall be hot-dip galvanized in accordance with ASTM A 153 and ASTM A 123.

2.4.2.2 Equipment

Equipment and component items, including but not limited to transformers and ferrous metal luminaires 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 described 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.

2.4.3 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 PAINTING, GENERAL.

2.5 CONDUCTORS, CONNECTORS, AND SPLICES

2.5.1 Copper Conductors

Hard-drawn-copper conductors shall comply with ASTM B 1 and ASTM B 8 as appropriate for the conductor size.

2.5.2 Connectors and Splices

Connectors and splices shall be of copper alloys for copper conductors, aluminum alloys for aluminum-composition conductors, and a type designed to minimize galvanic corrosion for copper to aluminum-composition conductors. Aluminum-composition and aluminum-composition to copper shall comply with UL 486B, and copper to copper shall comply with UL 486A.

2.6 LOW-VOLTAGE LINES

Low-voltage line conductors shall be of the neutral-supported secondary and service drop type with cross-linked thermosetting polyethylene (XLP) insulation in accordance with NEMA WC 7. Neutral-supported secondary and service drop conductors shall be insulated aluminum with bare 1350 alloy aluminum or ACSR neutrals. Conductors on secondary racks may be provided in lieu of neutral-supported cable for pole line circuits where necessary clearances are available.

2.7 POLES AND HARDWARE

2.8.1 Wood Poles

Installation shall comply with the requirements of ANSI C2 for Grade B construction. The loading district will be that applying to the location of the installation. Joint-use electric/roadway-lighting poles for overhead electric and communication lines shall be wood poles utilizing crossarm construction. Crossarm construction shall be provided for support of other equipment, except where direct-pole mounting is indicated. Provision for communication services is required on pole-line construction, except where specifically noted otherwise. A vertical pole space of not less than 2 feet shall be reserved at indicated locations. Poles shall be of lengths and classes indicated.

Wood poles shall comply with ANSI O5.1, and shall be pressure treated in accordance with AWPA C4, with creosote conforming to AWPA P1/13 or with oil-borne preservatives and petroleum conforming to AWPA P8 and AWPA P9, respectively, and waterborne preservatives conforming to AWPA P5. Waterborne preservatives shall be either chromated or ammoniacal copper arsenate. Any species listed in ANSI O5.1 for which a preservative treatment is not specified in AWPA C4, shall not be used; northern white cedar, if treated as specified for western red cedar, and western fir, if treated as specified for Douglas fir, may be used. Wood poles shall have pole markings located approximately 10 feet from pole butts for poles 50 feet or less in length, and 14 feet from the pole butts for poles longer than 55 feet in length. Poles shall be machine trimmed by turning smooth full length, and shall be roofed, gained, and bored prior to pressure treatment. Where poles are not provided with factory-cut gains, metal gain plates shall be provided.

2.7.1 Pole Line Hardware

Zinc-coated hardware shall comply with ANSI C135.1, ANSI C135.2, ANSI C135.4, ANSI C135.14, ANSI C135.17, ANSI C135.22, and ANSI C135.33. Steel hardware shall comply with ASTM A 575 and ASTM A 576. All hardware shall be hot-dip galvanized in accordance with ASTM A 153. Pole-line hardware shall be hot-dip galvanized steel. Suitable washers shall be installed under boltheads and nuts on wood surfaces and elsewhere as required. Washers used on through-bolts and double-arming bolts shall be approximately 2-1/4 inches square and 3/16 inch thick. The diameter of holes in washers shall be the correct standard size for the bolt on which a washer is used. Washers for use under heads of carriage-bolts shall be of the proper size to fit over square shanks of bolts. Eye bolts, bolt eyes, eyenuts, strain-load plates, lag screws, guy clamps, fasteners, hooks, shims, and clevises shall be used wherever required to support and to protect poles, brackets, crossarms, guy wires, and insulators.

2.7.2 Guy Assemblies

Guy assemblies shall be zinc-coated steel in accordance with ASTM A 475. Guy assemblies, including insulators and attachments, shall provide a strength exceeding the required guy strength. Three-eye thimbles shall be provided on all anchor rods to permit attachment of individual primary, secondary, and communication down guys. Anchors shall provide adequate strength to support all loads. Guy strand shall be 7 strand. Guy material shall be high-strength grade aluminum-clad-steel-strand, with a minimum breaking strength not less than 6000 pounds, except where two or more guys are used to provide the required strength. Guy rods shall be not less than 8 feet in length by 3/4 inch in diameter.

2.8 INSULATORS

Insulators shall comply with NEMA HV 2 for general requirements. Suspension insulators shall be used at corners, angles, dead-ends, other areas where line insulators do not provide adequate strength, and as indicated. Mechanical strength of suspension insulators and hardware shall exceed the rated breaking strength of the attached conductors.

2.8.1 Medium-Voltage Line Insulators

Medium-voltage line insulators shall comply with ANSI C29.2, ANSI C29.5, ANSI C29.6, and ANSI C29.7 as applicable. Ratings shall not be lower than the ANSI classes indicated in TABLE I. Horizontal line-post insulators shall be used for armless construction and shall have the same mechanical and electrical ratings as vertical line-post insulators for the ANSI class indicated, but shall be modified to be suitable for horizontal installation. Pin insulators may be used for crossarm construction. Pin insulators for use on voltages in excess of 6 kV phase-to-phase shall be radio interference-freed or else line-post insulators shall be used.

TABLE I. MINIMUM ANSI RATING OF MEDIUM-VOLTAGE INSULATORS BY CLASS

Voltage Level	Line-Post	Pin	Suspension
Up to 5 kV	57-1 or 11	55-3	One 52-1
	57-1 or 11	55-5	Two 52-1
6 kV to 15 kV	57-1 or 11	55-5	Two 52-2
	57-2 or 12	56-3	Two 52-3 or 4
16 kV to 25 kV	57-2 or 12	56-3	Two 52-3 or 4
	57-3 or 13	56-4	Three 52-3 or 4
26 kV to 35 kV	57-3 or 13	56-4	Three 52-3 or 4
	57-4 or 14	56-5	Four 52-3 or 4

2.8.2 Low-Voltage Line Insulators

Low-voltage line insulators shall comply with ANSI C29.2 and ANSI C29.3 as applicable. Spool insulators for use on low-voltage lines shall be mounted on clevis attachments or secondary racks and shall be not smaller than Class 53-3. For No. 4/0 AWG and larger conductors, Class 53-5 shall be used. Suspension insulators on clevis attachments used at dead-ends shall be not smaller than Class 52-1.

2.8.3 Strain Insulators for Guy Wires

Strain insulators for use in insulated guy assemblies shall comply with ANSI C29.4 for porcelain or equivalent fiberglass, and shall have a mechanical strength exceeding the rated breaking strength of the attached guy wire. Insulators shall be not smaller than Class 54-1 or 54-2 for lines up to 5 kV, not smaller than Class 54-3 for lines of 6 kV to 15 kV.

2.8.4 Apparatus Insulators

Apparatus insulators shall comply with IEEE C57.19.00, IEEE C57.19.01, ANSI C29.8, and ANSI C29.9 as applicable.

2.9 CROSSARM ASSEMBLIES

2.9.1 Crossarms

Crossarms shall comply with REA DT-5B and be solid wood, distribution type, except cross-sectional area with pressure treatment conforming to AWPA C25, and a 1/4 inch, 45 degree chamfer on all top edges. Cross-sectional area minimum dimensions shall be 4-1/4 inches in height by 3-1/4 inches in depth in accordance with ANSI C2 for Grade B construction. Crossarms shall be 8 feet in length, except that 10-foot crossarms shall be used for crossarm-mounted banked single-phase transformers or elsewhere as indicated. Crossarms shall be machined, chamfered, trimmed, and bored for stud and bolt holes before pressure treatment. Factory drilling shall be provided for pole and brace mounting, for four pin or four vertical line-post insulators, and for four suspension insulators, except where otherwise indicated or required. Drilling shall provide required climbing space and wire clearances. Crossarms shall be straight and free of twists to within 1/10 inch per foot of length. Bend or twist shall be in one direction only.

2.9.2 Crossarm Gains

Crossarm gains shall comply with ANSI C135.33.

2.10 FUSES AND SWITCHES, MEDIUM-VOLTAGE

2.10.1 Fused Cutouts

Medium-voltage fuses and cutouts shall comply with NEMA SG 2 and shall be of the loadbreak open type construction rated 15 kV and of the heavy duty type. Open-link cut-outs are not acceptable. Fuses shall be either indicating or dropout type. Fuse ratings shall be as indicated. Fuse cutouts shall be equipped with mounting brackets suitable for the indicated installations.

2.10.2 Fused Switches

Fused switches shall be single-pole, manual devices with integral power fuses of the dropout type. Fuse ratings shall be as indicated. Each switch shall have a continuous current rating of 600 amperes rms, a momentary asymmetrical current rating of 20 kA rms, and shall be rated for the voltage of the system in which it is installed.

2.11 ILLUMINATION

2.11.1 General Lighting

Luminaires, ballasts, lamps, and control devices required for general area, including floodlighting shall be in accordance with Standard Detail No. 40-06-04, attached to these specifications.

2.11.2 Brackets

Brackets for area lighting shall be of the indicated types. Brackets for floodlights shall have the number of tenons indicated. Slip-fitter brackets shall be coordinated with the luminaires provided, and brackets used with one type of luminaire shall be identical. On metal poles, brackets shall be of the same metal. Flood lights shall be installed on wooden poles as shown on drawings.

2.12 SURGE ARRESTERS

Surge arresters shall comply with NEMA LA 1 and IEEE C62.1, IEEE C62.2, and IEEE C62.11, and shall be provided for protection of aerial-to-underground transitions, automatic circuit reclosers, capacitor equipment, group-operated load interrupter switches, transformers and other indicated equipment. Arresters shall be intermediate class, rated as shown. Arresters shall be equipped with mounting brackets suitable for the indicated installations. Arresters shall be of the combination valve-metal-oxide varistor type suitable for outdoor installations.

2.13 GROUNDING AND BONDING

2.13.1 Driven Ground Rods

Ground rods shall be of copper-clad steel conforming to UL 467 not less than 5/8 inch in diameter by 10 feet in length.

2.13.2 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 the 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.

2.14 PADLOCKS

Padlocks shall comply with ASTM F 883, Type EPC, size 2.

2.15 WARNING SIGNS

Warning signs shall be porcelain enameled steel or approved equal. Voltage warning signs shall comply with ANSI C2.

2.16 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 tetrachlorobenzene 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.

2.17 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.

a. High-Voltage Air Switches: Manufacturer's standard tests in accordance with IEEE C37.34 and IEEE C37.41.

b. High-Voltage Fuses: Manufacturer's standard tests in accordance with IEEE C37.41.

c. Electric Power Insulators: Manufacturer's standard tests in accordance with ANSI C29.1.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Equipment and devices shall be installed and energized in accordance with the manufacturer's published instructions. Circuits installed in conduits or underground and splices and terminations for medium-voltage cable shall conform to the requirements of Section 16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND. Secondary circuits installed in conduit on poles shall conform to the requirements of Section 16415 ELECTRICAL WORK, INTERIOR.

3.1.1 Conformance to Codes

The installation shall comply with the requirements and recommendations of NFPA 70 and ANSI C2 for heavy loading districts, Grade B construction. No reduction in clearance shall be made.

3.1.2 Verification of Dimensions

The Contractor shall become familiar with details of the work, shall verify dimensions in the field, and shall notify the Contracting Officer of any discrepancy before performing any work.

3.2 POLE INSTALLATION

3.2.1 Wood Pole Setting

Wood poles shall be set straight and firm. Pole setting depths shall be as shown. In rocky or swampy ground, pole-setting depths shall be decreased or increased as shown. In swampy or soft ground, a bog shoe shall be used where support for a pole is required. Poles in straight runs shall be in a straight line. Curved poles shall be placed with curvatures in the direction of the pole line. Poles shall be set to maintain as even a grade as practicable. When the average ground run is level, consecutive poles shall not vary more than 5 feet in height. When the ground is uneven, poles differing in length shall be kept to a minimum by locating poles at points other than the highest and lowest ground points. If it becomes

necessary to shorten a pole, a piece shall be sawed off the top end and roofed. If any pole is shortened after treatment, the shortened end of the pole shall be given an application of hot preservative. Where poles are set on hilly terrain, along edges of cuts or embankments, or where soil may be washed out, special precautions shall be taken to ensure durable pole foundations, and the setting depth shall be measured from the lower side of the terrain. Holes shall be dug large enough to permit proper use of tampers to the full depth of a hole. Earth shall be placed into a hole in 6 inch maximum layers, then thoroughly tamped before the next layer is placed. Surplus earth shall be placed around a pole in a conical shape and packed tightly to drain water away from poles.

3.3 CROSSARM MOUNTING

Crossarms shall be bolted to poles with 5/8 inch through-bolts with square washers at each end. Bolts shall extend not less than 1/8 inch nor more than 2 inches beyond nuts. On single crossarm construction, the bolt head shall be installed on the crossarm side of the pole. Wood crossarm braces shall be provided on crossarms. Flat braces may be provided for 8-foot crossarms and shall be 1/4 inch by 1-1/4 inches, not less than 28 inches in length. Flat braces shall be bolted to arms with 3/8 inch carriage bolts with round or square washers between boltheads and crossarms, and secured to poles with 1/2 inch by 4 inch lag screws after crossarms are leveled and aligned. Angle braces are required for 10-foot crossarms and shall be 60 inch span by 18 inch drop formed in one piece from 1-1/2 inch by 1-1/2 inch by 3/16 inch angle. Angle braces shall be bolted to crossarms with 1/2 inch bolts with round or square washers between boltheads and crossarms, and secured to poles with 5/8 inch through-bolts. Double crossarms shall be securely held in position by means of 5/8 inch double-arming bolts. Each double-arming bolt shall be equipped with four nuts and four square washers.

3.3.1 Line Arms and Buck Arms

Line arms and buck arms shall be set at right angles to lines for straight runs and for angles 45 degrees and greater; and line arms shall bisect angles of turns of less than 45 degrees. Dead-end assemblies shall be used for turns where shown. Buckarms shall be installed, as shown, at corners and junction poles. Double crossarms shall be provided at ends of joint use or conflict sections, at dead-ends, and at angles and corners to provide adequate vertical and longitudinal strength. Double crossarms shall be provided at each line-crossing structure and where lines not attached to the same pole cross each other.

3.3.2 Equipment Arms

Equipment arms shall be set parallel or at right angles to lines as required to provide climbing space. Equipment arms shall be located below line construction to provide necessary wire and equipment clearances.

3.4 GUY INSTALLATION

Guys shall be provided where shown, with loads and strengths as indicated, and wherever conductor tensions are not balanced, such as at angles, corners, and dead-ends. Where a single guy will not provide the required strength, two or more guys shall be provided. Where guys are wrapped around poles, at least two guy hooks shall be provided and pole shims shall be provided where guy tension exceeds 6000 pounds. Guy clamps 6 inches in length with three 5/8 inch bolts, or offset-type guy clamps, or

approved guy grips shall be provided at each guy terminal. Guy-strain insulators shall be provided in each guy for wood poles. Multiple-helix screw anchors shall be provided in marshy ground; rock anchors shall be installed in rock at right angles to guys, elsewhere anchors shall be of an expanding type, except that power installed screw anchors of equivalent holding power are acceptable. A half-round yellow polyvinyl, fiberglass, or other suitable plastic guy marker, not less than eight feet in length, shall be provided at the anchor end of each guy shown, securely clamped to the guy or anchor at the bottom and top of the marker. Holding capacities for down guys shall be based on a lead angle of 45 degrees.

3.5 CONDUCTOR INSTALLATION

3.5.1 Line Conductors

Unless otherwise indicated, conductors shall be installed in accordance with manufacturer's approved tables of sags and tensions. Proper care shall be taken in handling and stringing conductors to avoid abrasions, sharp bends, cuts, kinks, or any possibility of damage to insulation or conductors. Conductors shall be paid out with the free end of conductors fixed and cable reels portable, except where terrain or obstructions make this method unfeasible. Bend radius for any insulated conductor shall be at no time less than the applicable NEMA specification recommendation. Conductors shall not be drawn over rough or rocky ground, nor around sharp bends. When installed by machine power, conductors shall be drawn from a mounted reel through stringing sheaves in straight lines clear of obstructions. Initial sag and tension shall be checked by the Contractor, in accordance with the manufacturer's approved sag and tension charts, within an elapsed time after installation, recommended by the manufacturer.

3.5.2 Connectors and Splices

Connectors and splices shall be mechanically and electrically secure under tension and shall be of the nonbolted compression type. The tensile strength of any splice shall be not less than the rated breaking strength of the conductor. Splice materials, sleeves, fittings, and connectors shall be noncorrosive and shall not adversely affect conductors. Aluminum-composition conductors shall be wire brushed and an oxide inhibiter applied before making a compression connection. Connectors which are factory-filled with an inhibiter are acceptable. Inhibiters and compression tools shall be of types recommended by the connector manufacturer. Primary line apparatus taps shall be by means of hot line clamps attached to compression type bail clamps (stirrups). Low-voltage connectors for copper conductors shall be of the solderless pressure type. Noninsulated connectors shall be smoothly taped to provide a waterproof insulation equivalent to the original insulation, when installed on insulated conductors. On overhead connections of aluminum and copper, the aluminum shall be installed above the copper.

3.5.3 Conductor-To-Insulator Attachments

Conductors shall be properly attached to insulators. For insulators requiring conductor tie-wire attachments, tie-wire sizes shall be as indicated in TABLE II.

TABLE II. TIE-WIRE REQUIREMENTS

CONDUCTOR Copper (AWG)	TIE WIRE Soft-Drawn Copper (AWG)
6	8
4 and 2	6
1 through 3/0	4
4/0 and larger	2

AAC, AAAC, or ACSR (AWG)	AAAC OR AAC (AWG)
Any size	6 or 4

3.5.4 Low-Voltage Cables

Low-voltage cables shall be supported on clevis fittings using spool insulators. Dead-end clevis fittings and suspension insulators shall be provided where required for adequate strength. Dead-end construction shall provide a strength exceeding the rated breaking strength of the neutral messenger. Clevis attachments shall be provided with not less than 5/8 inch through-bolts.

3.6 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 wood poles by two-hole galvanized steel pipe straps spaced not more than 10 feet apart and with one strap not more than 12 inches from any bend or termination. Cables shall be supported by devices separate from the conduit or guard, near their point of exit from the riser conduit ac guard. Cables guards shall be secured in accordance with the manufacturers published procedure. Conduits shall be equipped with bushings to protect cables and minimize water entry.

3.7 CONNECTIONS TO BUILDINGS

3.7.1 Underground Services

Connections to buildings shall be made at the point indicated and shall be terminated at the service entrance equipment terminals. Cable pulling shall be in accordance with Section 16375, ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND. Service entrance conduits with termination fittings and conductors within the building shall conform to the requirements of Section 16415 ELECTRICAL WORK, INTERIOR.

3.8 GROUNDING

Noncurrent-carrying metal parts of equipment and conductor assemblies, such as luminaires, medium-voltage cable terminations and messengers, metal poles, operating mechanisms of pole top switches, panel enclosures, transformers, capacitors, recloser frames (cases) and other noncurrent-carrying metal items shall be grounded. Additional grounding of equipment,

neutral, and surge arrester grounding systems shall be installed at poles where indicated.

3.8.1 Grounding Electrodes

Grounding electrodes shall be installed as follows:

a. Driven rod electrodes - Unless otherwise indicated, ground rods shall be located approximately three feet out from base of the pole and shall be driven into the earth until the tops of the rods are approximately one foot below finished grade. Multiple rods shall be evenly spaced at least 10 feet apart and connected together two feet below grade with a minimum No. 6 bare copper conductor.

b. Additional electrodes - Whenever the required ground resistance is not met, provide additional electrodes interconnected with grounding conductors, to achieve the specified ground resistance. The additional electrodes will be up to three, 10 feet rods spaced a minimum of ten feet apart, a single extension-type rod, 5/8 inch diameter, up to 30 feet long, driven perpendicular to grade.

3.8.2 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.

3.8.3 Grounding Electrode Conductors

A single continuous vertical grounding electrode conductor shall be installed on each pole and connected directly to the grounding electrodes indicated on the drawings or required by these specifications. All equipment, neutrals, surge arresters, and other items required to be grounded shall be connected directly to this vertical conductor. The grounding electrode conductor shall be sized as shown. Secondary system neutral conductors shall be connected directly to the transformer neutral bushings, then connected with a neutral bonding jumper between the transformer neutral bushing and the vertical grounding electrode conductor, as shown. Grounding electrode conductors shall be stapled to wood poles at intervals not exceeding 2 feet. On metal poles, a preformed galvanized steel strap, 5/8 inch wide by 22-gauge minimum by length, secured by a preformed locking method standard with the manufacturer, shall be used to support a grounding electrode conductor installation on the pole and spaced at intervals not exceeding 5 feet with one band not more than 3 inches from each end of the vertical grounding electrode conductor. Bends greater than 45 degrees in grounding electrode conductor are not permitted.

3.8.4 Lighting Pole Grounding

Bases of lighting poles shall be connected to a driven grounding electrode by means of a bare copper conductor sized in accordance with NFPA 70. An equipment grounding conductor shall be provided in accordance with NFPA 70.

3.9 FIELD TESTING

3.9.1 General

Field testing shall be performed in the presence of the Contracting Officer. The Contractor shall notify the Contracting Officer 20 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. All field reports will be signed and dated by the Contractor.

3.9.2 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.

3.9.3 Ground-Resistance Tests

The resistance of each grounding electrode system 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 electrode - 25 ohms.

b. Multiple electrodes - 15 ohms.

3.9.4 Medium-Voltage Preassembled Cable Test

After installation, prior to connection to an existing system, and before the operating test, the medium-voltage preassembled 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 at one terminal and connecting grounds or metallic shieldings or sheaths of the cable at the other terminal for each test. Prior to the test, the cables shall be isolated by opening applicable protective devices and disconnecting equipment. 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, and shall not exceed the recommendations of IEEE Std 404 for cable joints 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.

3.9.5 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 of conductors in the same trench, duct, or cable, with all other conductors in the same trench, duct, or cable grounded. The Minimum value of insulation shall be:

$$R \text{ in megohms} = \frac{(\text{rated voltage in kV} + 1) \times 1000}{\text{length of cable in feet}}$$

Each cable failing this test shall be repaired or replaced. The repaired cable system shall then be retested until failures have been eliminated.

3.9.6 Pre-Energization Services

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 insure 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 and that 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:

Switches.

3.9.7 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 requirements herein. An operating test report shall be submitted in accordance with paragraph SUBMITTALS.

3.10 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 --

SECTION 16375

ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND
11/92

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.

FEDERAL SPECIFICATIONS (FS)

FS RR-F-621	(Rev E) Frames, Covers, Gratings, Steps, Sump and Catch Basin, Manhole

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C2	(1993) National Electrical Safety Code
ANSI C12.1	(1988) Code for Electricity Metering
ANSI C12.4	(1984; R 1990) Mechanical Demand Registers
ANSI C12.10	(1987) Electromechanical Watthour Meters
ANSI C12.11	(1987) Instrument Transformers for Revenue Metering, 10 kV BIL through 350 kV BIL (0.6 kV NSV through 69 kV NSV)
ANSI C29.1	(1988) Electrical Power Insulators - Test Methods
ANSI C37.50	(1989) Low-Voltage AC Power Circuit Breakers Used in Enclosures - Test Procedures
ANSI C37.121	(1989) Unit Substations
ANSI C57.12.13	(1982) Conformance Requirements for Liquid-Filled Transformers Used in Unit Installations, Including Unit Substations
ANSI C57.12.21	(1980) Requirements for Pad-Mounted Compartmental-Type, Self-Cooled, Single-Phase Distribution Transformers with High-Voltage Bushings; High-Voltage, 34 500 GrdY/19 920 Volts and Below; Low-Voltage, 240/120 Volts; 167 kVA and Smaller
ANSI C57.12.22	(1989) Transformers - Pad-Mounted Compartmental-Type, Self-Cooled,

	Three-Phase Distribution Transformers with High-Voltage Bushings, 2500 kVA and Smaller: High-Voltage, 34 500 GrdY/19 920 Volts and Below; Low Voltage, 480 Volts and Below
ANSI C57.12.27	(1982) Liquid-Filled Distribution Transformers Used in Pad-Mounted Installations, Including Unit Substations
ANSI C80.1	(1990) Rigid Steel Conduit - Zinc Coated
ANSI C119.1	(1986) Sealed Insulated Underground Connector Systems Rated 600 Volts
ANSI C135.30	(1988) Zinc-Coated Ferrous Ground Rods for Overhead or Underground Line Construction
ANSI O5.1	(1992) Specifications and Dimensions for Wood Poles

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 48	(1983; R 1990) Gray Iron Castings
ASTM A 123	(1989a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153	(1982; R 1987) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM B 8	(1990) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM B 117	(1990) Salt Spray (Fog) Testing
ASTM C 478	(1990b) Precast Reinforced Concrete Manhole Sections
ASTM D 923	(1991) Sampling Electrical Insulating Liquids
ASTM D 1654	(1979a; R 1984) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D 4059	(1991) Analysis of Polychlorinated Biphenyls in Insulating Liquids by Gas Chromatography
ASTM F 883	(1990) Padlocks

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

AEIC CS5	(1987) Thermoplastic and Cross-linked Polyethylene Insulated Shielded Power Cables Rated 5 Through 35 kV
AEIC CS6	(1987; Rev Mar 1989) Ethylene Propylene

	Rubber Insulated Shielded Power Cables Rated 5 Through 69 kV

FACTORY MUTUAL ENGINEERING AND RESEARCH CORPORATION (FM)

FM P7825	(1992; Supple I, II, and III) Approval Guide

FEDERAL SPECIFICATIONS (FS)

FS HH-I-595	(Rev C) Insulation Tape, Electrical, Pressure-Sensitive Adhesive, Plastic
FS W-F-1814/GEN	(Rev A; Supple 1, Notice 1) Fuses, Cartridge, High-Interrupting Capacity
FS W-S-610	(Rev E) Splice Connectors

INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS (IEEE)

IEEE C37.20.1	(1987) Metal-Enclosed Low-Voltage Power Circuit-Breaker Switchgear
IEEE C37.20.2	(1987) Metal-Clad and Station-Type Cubicle Switchgear
IEEE C37.20.3	(1987) Metal-Enclosed Interrupter Switchgear
IEEE C37.23	(1987; R 1991) Guide for Metal-Enclosed Bus and Calculating Losses in Isolated - Phase Bus
IEEE C37.30	(1971; C37.30c; C37.30e; C37.30g; C37.30h; R 1987) Definitions and Requirements for High-Voltage Air Switches, Insulators, and Bus Supports
IEEE C37.34	(1971; R 1987; C37.34a; C37.34b; C37.34d; C37.34e) Test Code for High-Voltage Air Switches
IEEE C37.41	(1988; 37.41c) Design Tests for High-Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches, and Accessories
IEEE C37.63	(1984) Requirements for Overhead, Pad-Mounted, Dry-Vault, and Submersible Automatic Line Sectionalizers for AC Systems
IEEE C37.90.1	(1989; R 1991) 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	(1987) Liquid-Immersed Distribution,

	Power, and Regulating Transformers
IEEE C57.13	(1978; R 1986) Instrument Transformers
IEEE C57.98	(1986) Guide for Transformer Impulse Tests - Appendix to C57.12.90
IEEE C62.1	(1989) Standard for Gapped Silicon-Carbide Surge Arresters for AC Power Circuits
IEEE C62.2	(1987) Guide for the Application of Gapped Silicon-Carbide Surge Arresters for Alternating Current Systems
IEEE C62.11	(1987) Metal-Oxide Surge Arresters for AC Power Circuits
IEEE Std 48	(1990) Standard Test Procedures and Requirements for High-Voltage Alternating-Current Cable Terminations
IEEE Std 81	(1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
IEEE Std 100	(1988) IEEE Standard Dictionary of Electrical and Electronics Terms
IEEE Std 344	(1987) Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations
IEEE Std 386	(1985; R 1991) Separable Insulated Connector Systems for Power Distribution Systems Above 600V
IEEE Std 404	(1986) Cable Joints for Use with Extruded Dielectric Cable Rated 5000 V through 46 000 V and Cable Joints for Use with Laminated Dielectric Cable Rated 2500 V Through 500 000 V
IEEE Std 590	(1977; R 1991) Cable Plowing Guide
IEEE Std 592	(1990) Exposed Semiconducting Shields on High Voltage Joints and Separable Insulated Connectors

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA AB 1	(1986; Rev 1) Molded Case Circuit Breakers and Molded Case Switches
NEMA BU 1	(1988; BU 1.1-1986) Busways
NEMA FB 1	(1988) Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies

NEMA LA 1	(1986) Surge Arresters
NEMA PB 1	(1990; PB 1.1) Panelboards
NEMA PB 2	(1989; PB 2.1) Deadfront Distribution Switchboards
NEMA SG 2	(1986) High-Voltage Fuses
NEMA SG 3	(1990) Low-Voltage Power Circuit Breakers
NEMA SG 5	(1990) Power Switchgear Assemblies
NEMA TC 5	(1990) Corrugated Polyolefin Coilable Plastic Utilities Duct
NEMA TC 6	(1990) PVC and ABS Plastic Utilities Duct for Underground Installation
NEMA TC 7	(1990) Smooth-Wall Coilable Polyethylene Electrical Plastic Duct
NEMA WC 7	(1988) Cross-Linked-Thermosetting - Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
NEMA WC 8	(1988) Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1993) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 6	(1981; Rev thru Dec 1992) Rigid Metal Conduit
UL 198E	(1988; Rev Jul 1988) Class R Fuses
UL 467	(1984; Rev thru Nov 1986) Grounding and Bonding Equipment
UL 486A	(1991; Rev Oct 1991) Wire Connectors and Soldering Lugs for Use with Copper Conductors
UL 486B	(1991; Rev thru Apr 1992) Wire Connectors for Use with Aluminum Conductors
UL 489	(1991; Rev thru May 1992) Molded-Case Circuit Breakers and Circuit-Breaker Enclosures
UL 514A	(1991) Metallic Outlet Boxes
UL 543	(1982) Impregnated-Fiber Electrical Conduit

UL 651	(1989; Rev thru Dec 1989) Schedule 40 and 80 Rigid PVC Conduit
UL 854	(1991; Rev Dec 1992) Service-Entrance Cables
UL 857	(1990; Errata Apr 1990) Busways and Associated Fittings
UL 1242	(1983; Rev thru Jan 1993) Intermediate Metal 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:

a. Ambient Temperature 86 degrees F

b. Frequency 60 Hz

c. Corrosive Areas Class I and II, Div 1 and 2, Groups C, D, E, F, G.

1.3 SUBMITTALS

Governmental approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL DESCRIPTIONS:

SD-01 Data

Short-Circuit and Protective Devices Coordination Studies; GA.

Studies which demonstrate that the equipment selected and system constructed meet the contract requirements for equipment ratings, coordination, and protection. The studies shall include a complete single-line diagram of the power system covered by this specification; a short circuit study including the maximum and minimum values of short circuit currents at major buses extended down to system buses where currents are equal to 10,000 amperes symmetrical; existing power system data including time-current characteristic curves and protective device ratings and settings; fully coordinated composite time-current characteristic curves including recommended ratings and settings of all protective devices in tabulated form; and associated calculations to demonstrate that the power system protection will be selectively coordinated by the use of devices or equipment submitted. Situations where system coordination is not achievable due to device limitations shall be noted. 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.

Manufacturer's Catalog Data; GA.

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; GA.

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.

Installation Procedures; FIO.

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-04 Drawings

Electrical Distribution System; FIO.

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.

c. Substations.

d. Switchgear.

e. Pad-mounted loadbreak switches.

f. Busways.

g. Surge arresters.

As-Built Drawings; FIO.

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 as well as all 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 all 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 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.

SD-09 Reports

Factory Test; FIO.

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 specified in applicable publications or in these specifications. The manufacturer's pass-fail criteria for tests specified in paragraph FIELD TESTING shall be included.

Field Testing; GA.

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.

Test Reports; GA.

Six copies of the information described below in 8 1/2 by 11 inch binders having a minimum of 5 rings from which material may readily be moved and replaced, including a separate section for each test. Sections shall be separated by heavy plastic dividers with tabs.

a. A list of all equipment used, with calibration certifications.

b. A copy of all 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 all adjustments made.

Cable Installation Reports; GA.

Six copies of the information described below in 8 1/2 by 11 inch binders having a minimum of 5 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 all cable pulls numerically identified.

b. A list of all equipment used, with calibration certifications. The manufacturer of 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-13 Certificates

Materials and Equipment; FIO.

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 under this section of the specifications 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 Splicer Qualification; GA.

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; GA.

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-19 Operation and Maintenance Manuals

Electrical Distribution System; GA.

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, within 30 calendar days following the approval of 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.

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

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 dielectric 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 Aluminum Materials

Aluminum shall not be used in contact with earth or concrete. Where aluminum conductors are connected to dissimilar metal, fittings conforming to UL 486B shall be used.

2.3.2 Ferrous Metal Materials

2.3.2.1 Hardware

Ferrous metal hardware shall be hot-dip galvanized in accordance with ASTM A 153 and ASTM A 123.

2.3.2.2 Equipment

Equipment and component items, including but not limited to transformer stations and ferrous metal luminaires not hot-dip galvanized or porcelain enamel finished, shall be provided with corrosion-resistant finishes which shall withstand 480 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.

2.3.3 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 PAINTING, GENERAL.

2.4 CABLES

Cables shall be single conductor type unless otherwise indicated.

2.4.1 Conductor Material

Underground cables shall be of soft drawn copper or aluminum alloy AA-8000 conductor material.

2.4.2 Medium-Voltage Cables

2.4.2.1 General

Medium voltage cables shall conform to the requirements of NEMA WC 7 for cables utilizing cross-linked thermosetting polyethylene insulation and NEMA WC 8 for cables utilizing ethylene-propylene-rubber (EPR) insulation. Cables shall be in accordance with the requirements of NFPA 70. Single conductor cables shall be provided except as otherwise indicated.

2.4.2.2 Insulation

Cables shall utilize ethylene-propylene-rubber (EPR) insulation. Cables shall be provided with 133 percent insulation level.

2.4.2.3 Jackets

Cables shall be provided with a nonmetallic jacket. Concentric neutral cables for direct buried applications shall have a moisture-resistant, nonmetallic jacket rated for direct burial. Cables do not require termite-resistant nylon jacket.

2.4.2.4 Neutrals

Neutral conductors of grounded neutral systems except for concentric neutral cables shall be of the same insulation material as phase conductors, except that a 600-volt insulation rating is acceptable. Cables employing a concentric neutral shall have 1/3 concentric neutral with an insulating jacket over the concentric neutral.

2.4.2.5 Shielding

Cables rated for above 2 kV shall have both conductor and insulation shielding for each phase.

2.4.2.6 Ratings

Medium-voltage cables shall be rated for a circuit voltage of 15 kV or as indicated.

2.4.3 Low-Voltage Cables

Cables shall be rated 600 volts and shall conform to the requirements of NFPA 70. Cables shall be as indicated on the Cable Schedules.

2.4.3.1 In Duct

Cables shall be single-conductor cable, Type RHW, THW, THWN, TW, USE, or XHHW 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. All 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. 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. Connectors shall be of the loadbreak type, of suitable construction for the application and the type of cable connected, and 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, Type I, Class 1, Grade B, Style G, or Type II, Class 1 of FS W-S-610 and 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, Type II, Class 2 of FS W-S-610, 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.

2.6 CONDUIT AND DUCTS

Ducts shall be single, round-bore type, with wall thickness and fittings suitable for the application. Duct lines shall be concrete-encased, thin-wall type for duct lines between manholes and for other medium-voltage lines. Low-voltage lines or Communication lines run elsewhere may be direct-burial, thick-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 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 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. Precast-concrete manholes shall have the required strength established by ASTM C 478. 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. In paved areas, frames and covers in vehicular traffic areas shall be rated for wheel loads in accordance with FS RR-F-621. Cast iron shall comply with ASTM A 48, Class 30B, minimum. Handholes for low voltage cables installed lots, sidewalks, and turfed areas shall be 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 least 5,000 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 POLES AND HARDWARE

Poles and hardware shall be in accordance with Section 16370 ELECTRICAL DISTRIBUTION SYSTEM, AERIAL.

2.9 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.

2.9.1 Secondary Unit Substation

Secondary unit substations shall comply with ANSI C37.121 and shall be of the radial type. Substations shall be subassembled and coordinated by one manufacturer and shall be shipped in complete sections ready for connection

at the site. Complete sections shall include incoming, transformer, and outgoing sections and, where practicable, shall be shipped as one unit.

2.9.1.1 Incoming Section

Metal-enclosed interrupter switchgear of the fused load-interrupter air type shall be provided for protection of incoming circuits. Metal-enclosed interrupter switchgear shall comply with IEEE C37.20.3 and IEEE C37.30 for load-interrupter switches, NEMA SG 2 for power fuses, and shall be of the outdoor no-aisle type that meets or exceeds the requirements of applicable publications listed. Switch construction shall be of the manually-operated, "OPEN-CLOSED," air load interrupter type equipped with a stored energy operator for quick-make quick-break to make operating speeds independent of manual switch operations. Where indicated, suitable bus or lug connections shall be provided to mount field-installed, slip-on, medium-voltage cable terminations for cable entering via conduit from below and a flanged throat suitable for direct connection to the associated transformer. Surge protection shall be provided in accordance with paragraph SURGE ARRESTERS. Switches shall be of the 2-position type, open-closed.

a. Ratings. Fuse continuous current ratings shall be as indicated for the transformer for an incoming line unit and for the line tie unit. Unless otherwise indicated, fuses shall be of the current limiting type. Switch ratings at 60 Hz shall be:

Nominal voltage.....12.47 kV

Rated maximum voltage.....15 kV

Maximum symmetrical interrupting capacity.....40 kA

Maximum asymmetrical interrupting capacity.....40 kA

3-Second short time current carrying capacity.....25 kA

Rated continuous current.....600

BIL.....60 kV

Switches shall have an operating life expectancy of full-load close/open operations in accordance with the requirements of IEEE C37.30.

b. Basic Requirements. The electrical devices listed below shall be rated for the application and voltage and current indicated. Unless otherwise noted, manufacturer's standard devices shall be provided and shall include the following:

(1) A switch-operating handle with provisions for locking in either the open or closed position.

(2) A switch mechanical position indicator.

(3) A heater continuously energized to prevent condensation over an ambient temperature range of minus 20 to 104 degrees F and wired in series with a cabinet door-actuated switch, so the heater is de-energized when doors are open. High-temperature thermal protection shall be included.

(4) One-pole or 2-pole thermal-magnetic, molded-case circuit breakers suitable for the operating voltage for heater circuits.

(5) Safety devices as necessary to ensure that the load interrupter switch is in the open position whenever unit doors are in the open position.

(6) An interface terminal block wired for required exterior connections.

2.9.1.2 Transformer Section

Transformers shall have two separate windings per phase and shall be of the less-flammable, liquid-insulated type with dimethyl silicone liquid. Transformers shall be suitable for outdoor use. Liquid-insulated transformers shall comply with IEEE C57.12.00, ANSI C57.12.13, and ANSI C57.12.27, and shall have two 2-1/2 percent full capacity taps above and two 2-1/2 percent full capacity taps below rated voltage. Transformers shall be of the sealed tank type construction with welded-on cover. High-voltage terminals shall be provided for direct connection to the incoming line section. Low-voltage terminals shall be provided for direct connection to the outgoing switchgear section as shown on the drawings. Low-voltage terminals shall be on the right as shown on the drawings when facing the front, accessory side of the transformer. Provision shall be made for the future addition of forced air cooling equipment to give 650 kVA capacity. The transformer bushings, leads, and other components shall be designed to carry the increased load. A top liquid thermometer for control of future fans shall be furnished. Provision for future mounting of fans, conduit, and terminal box shall be provided. Transformer accessories and ratings at 60 Hz shall be as follows:

Three-phase capacity, self-cooled.....500 kVA
Three-phase capacity, (future) forced-cooled.....650 kVA
Impedance...5.75 percent, standard
Temperature rise.....65 degrees C
High-voltage winding.....12.47 volts
High-voltage winding connection.....Delta
Low-voltage winding.....480 volts
Low-voltage winding connection.....WYE
Accessories:

a. drain and filter connection

b. filling and top filter press connection

c. pressure-vacuum gauge

d. dial type thermometer with alarm contacts

e. magnetic liquid level indicator with high and low level alarm contacts

f. pressure relief device with alarm contacts

g. ground connection pad

h. provision for jacking, lifting, and towing

i. diagram and rating nameplate

2.9.1.3 Integral Outgoing Section

Integral outgoing section shall be of the dead-front distribution switchboard type. Each circuit breaker and auxiliary compartment shall have a suitable metal or laminated plastic nameplate with white cut letters at least 1/4 inch high on contrasting backgrounds identifying the breaker unit and/or circuit number as shown on the drawings.

a. Dead-Front Distribution Switchboard Type: Outgoing section shall be of the switchboard type mounted integrally with the transformer and shall consist of metering devices and main and branch circuit breakers mounted in switchboard enclosures. Switchboards shall comply with NEMA PB 2. Molded-case circuit breakers shall comply with NEMA AB 1. Low-voltage power circuit breakers shall comply with NEMA SG 3 and ANSI C37.50. Plug-in type circuit breakers are not acceptable. Directories to indicate loads served by each circuit shall be typed and mounted in holders provided on switchboard doors behind protective coverings.

b. Metering: The main secondary bus of each outgoing section assembly shall include a watthour demand meter with the necessary instrument transformers, and VT and CT test blocks. Metering shall be as specified in paragraph METERING AND PROTECTIVE DEVICES.

2.9.2 Sectionalizing Switches

Pad-mounted sectionalizing switches shall comply with IEEE C37.63. Sectionalizing terminals with loadbreak elbows and junctions shall not be used. Ratings at 60 Hz shall be:

Nominal voltage.....12.47 kV

Rated maximum voltage.....15 kV

Rated continuous current.....600A

Maximum symmetrical interrupting capacity.....40 kA

Maximum asymmetrical interrupting capacity.....40 kA

Three-second short-time current-carrying capacity.....25 kA

BIL.....60 kV

2.9.3 High Resistance Grounding System

The equipment shall be designed to operate on a 480V, 3-phase, 4-wire Wye connected system. It shall be provided in a NEMA 3R outdoor enclosure. It shall be shipped complete with the following items and features:

Line isolator, 3 phase, interlocked with door

Line fuses, 600 volt, 10 amp, interrupting capacity of 200,000 amps RMS symmetrical

Control power transformer

Meter relay-double set point

Pulsing contactor, set to produce approximately 40 current pulses per minute

Neutral grounding resistor, continuous rated

Relay for pulsing contactor

Control relay with interlocks for remote alarm

"Ground Fault" red indicating light

"Normal" green indicating light

"Normal-Pulse" selector switch

TEST resistor

TEST pushbutton-momentary type

Outdoor pad-mounted enclosure

Portable ground-current detector with carrying case.

Bottom cable entry

Green rotating beacon mounted on top of the enclosure as shown on the drawings.

2.10 METERING AND PROTECTIVE DEVICES

2.10.1 Circuit Breakers, Low-Voltage

Low-voltage circuit breakers shall comply with NEMA SG 3 for power, and NEMA AB 1 and UL 489 for molded-case.

2.10.2 Fuses, Medium-Voltage, Including Current-Limiting

Medium-voltage fuses, including current-limiting, shall comply with NEMA SG 2.

2.10.3 Fuses, Low-Voltage, Current-Limiting

Low-voltage, current-limiting fuses shall comply with FS W-F-1814/GEN for Class L or UL 198E for Class R.

2.10.4 Instrument Transformers

Instrument transformers shall comply with ANSI C12.11 for 0.6 kV insulation class with a primary rating suitable for the rated voltage and current of the secondary main bus of the transformer station on which the instrument transformer is installed.

2.10.5 Watthour Meters

Watthour meters shall comply with ANSI C12.1 and ANSI C12.10, except that numbered terminal wiring sequence and case size may be the manufacturer's standard. Watthour meters shall be of the drawout switchboard type having a 15 minute, cumulative form, demand register meeting ANSI C12.4 and

provided with not less than 2-1/2 stators. Watthour demand meters shall have factory-installed electronic pulse initiators meeting the requirements of ANSI C12.1. Pulse initiators shall be solid-state devices incorporating light-emitting diodes, phototransistors, and power transistors, except that mercury-wetted output contacts are acceptable. Initiators shall be totally contained within watthour demand meter enclosures. They shall be capable of operating at speeds up to 500 pulses per minute with no false pulses, and they shall be factory calibrated with no field adjustments being required. Initiators shall be calibrated for a pulse rate output of 1 pulse per 1/4 disc revolution of the associated meter and shall be compatible with the indicated equipment.

2.11 SURGE ARRESTERS

Surge arresters shall comply with NEMA LA 1, IEEE C62.1, IEEE C62.2, and IEEE C62.11 and shall be provided where indicated. Arresters shall be distribution class, rated 9 kV. 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 combination valve-metal-oxide varistor type.

2.12 GROUNDING AND BONDING

2.12.1 Driven Ground Rods

Ground rods shall be copper-clad steel conforming to UL 467 not less than 5/8 inch in diameter by 10 feet in length. Sectional type rods may be used.

2.12.2 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.

2.13 CONCRETE AND REINFORCEMENT

Concrete shall be a minimum of 2500 psi at 28 days. All other requirements shall be as specified in Section 03300 CONCRETE FOR BUILDING CONSTRUCTION. Concrete reinforcing shall be as specified in Section 03200 CONCRETE REINFORCEMENT.

2.14 PADLOCKS

Padlocks shall conform to ASTM F 883, Type EPC, size 2.

2.15 CABLE FIREPROOFING SYSTEMS

Cable fireproofing systems shall be listed in FM P7825 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.

2.15.1 Plastic Tape

Preapplication plastic tape shall be pressure sensitive, 10-mil thick, conforming to FS HH-I-595.

2.16 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.

2.17 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 routine 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. Instrument Current Transformers: Manufacturer's standard tests in accordance with IEEE C57.13.

e. Factory Preformed Terminations: Wet withstand voltage tests in accordance with IEEE Std 48 for the next higher BIL level.

f. Outdoor Switchgear: Manufacturer's standard tests in accordance with IEEE C37.20.1, IEEE C37.20.2, and IEEE C37.20.3.

g. Electrical Power Insulators: Manufacturer's standard tests in accordance with ANSI C29.1.

2.18 FENCING

Fencing shall conform to the requirements of Section 02831 FENCE, CHAIN-LINK.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Equipment and devices shall be installed and energized in accordance with the manufacturer's published instructions. Circuits installed aerially

shall conform to the requirements of Section 16370 ELECTRICAL DISTRIBUTION SYSTEM, AERIAL. Steel conduits installed underground shall be installed and protected from corrosion in conformance with the requirements of Section 16415 ELECTRICAL WORK, INTERIOR. Except as covered herein, excavation, trenching, and backfilling shall conform to the requirements of Section 02222 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS. Concrete work shall conform to the requirements of Section 03300 CONCRETE FOR BUILDING CONSTRUCTION.

3.1.1 Conformance to Codes

The installation shall comply with the requirements and recommendations of NFPA 70 and ANSI 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 AND BUSWAY 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 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.

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. 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 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

Cables shall be installed in duct lines where indicated. Cable splices in low-voltage cables shall be made in manholes and handholes only. Neutral and grounding conductors shall be installed in the same duct with their associated phase conductors.

3.2.2.1 Trenching

Trenches for direct-burial cables shall be excavated to depths required to provide the minimum necessary cable cover. Bottoms of trenches shall be smooth and free of stones and sharp objects. Where bottoms of trenches comprise materials other than sand, a 3-inch layer of sand shall be laid first and compacted to approximate densities of surrounding firm soil.

3.2.2.2 Cable Burial

Cables shall be unreeled along the sides of or in trenches and carefully placed on sand or earth bottoms. Pulling cables into direct-burial trenches from a fixed reel position will not be permitted, except as required to pull cables through conduits under paving or railroad tracks. Where cables cross, a separation of at least 3 inches shall be provided, unless each cable circuit is protected by a nonmetallic conduit sleeve at the crossing. Where single-conductor cable is installed, all 3 phases and the neutral shall be installed in the same sleeve. Bend radius of any cable shall be not less than 12 times the diameter of the cable. In no case shall cables be left under longitudinal tension. The first 6-inch layer of backfill shall be of sand. Machine compaction shall not be used within 6 inches of the cable.

3.2.2.3 Other Requirements

Where direct-burial cables cross under roads or other paving exceeding 5 feet in width, such cables shall be installed in concrete-encased ducts. Where direct-burial cables cross under railroad tracks, such cables shall be installed in reinforced concrete-encased ducts. Ducts shall extend at least 1 foot beyond each edge of any paving and at least 5 feet beyond each side of any railroad tracks. Cables may be pulled into duct from a fixed reel where suitable rollers are provided in the trench. Where direct burial cable transitions to duct-enclosed cable, direct-burial cables shall be centered in duct entrances, and a waterproof nonhardening mastic compound shall be used to facilitate such centering. If paving or railroad tracks are in place where cables are to be installed, coated rigid steel conduits driven under the paving or railroad tracks may be used in lieu of concrete-encased ducts. Damage to conduit coatings shall be prevented by providing ferrous pipe jackets or by predrilling. Where cuts are made in any paving, the paving and subbase shall be restored to their original condition.

3.2.2.4 Medium-Voltage Cable Joints or Low-Voltage Cable Splices

Cable joints or splices in direct-burial cables are not permitted in runs of 1000 feet or less, nor at intervals of less than 1000 feet in longer runs, except as required for taps. Locations of cable joints or splices in shorter intervals, where required to avoid obstructions or damage to cables, shall be approved. Cable joints or splices in direct burial installations shall be installed in above-ground junction boxes or in cast metal splice boxes suitable for direct burial use. Cable joints or splices in duct banks shall be made only in manholes, handholes, or pullboxes.

3.2.2.5 Cable Markers

Markers shall be located near the ends of cable runs, at each cable joint or splice, at approximately every 500 feet along cable runs, and at changes in direction of cable runs. 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, or other approved dig-in warning indication, shall be placed approximately 12 inches below finished grade levels of trenches.

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 ANSI 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.

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. Fire-stops shall be installed in each conduit entering or leaving a manhole.

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 P7825. 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

Each single duct requiring concrete encasement shall be completely encased in concrete with a minimum of 3 inches of concrete around each duct, except that only 2 inches of concrete are required between adjacent electric power or adjacent communication ducts, and 4 inches of concrete shall be provided between adjacent electric power and communication ducts. 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. 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. 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 Nonencased Direct-Burial

Top of duct lines shall be below the frost line depth of 24 inches, but not less than 24 inches below finished grade and shall be installed with a minimum of 3 inches of earth around each duct, except that between adjacent electric power and communication ducts, 12 inches of earth is

required. Bottoms of trenches shall be graded toward manholes or handholes and shall be smooth and free of stones, soft spots, and sharp objects. Where bottoms of trenches comprise materials other than sand, a 3 inch layer of sand shall be laid first and compacted to approximate densities of surrounding firm soil before installing ducts. Joints in adjacent tiers of duct shall be vertically staggered at least 6 inches. The first 6-inch layer of backfill cover shall be sand compacted as previously specified. The rest of the excavation shall be backfilled and compacted in 3-to 6-inch layers. Duct banks may be held in alignment with earth. However, high-tiered banks shall use a wooden frame or equivalent form to hold ducts in alignment prior to backfilling.

3.5.5 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.

3.5.5.1 Bituminized-Fiber Ducts

Bituminized-fiber ducts shall be used to interface with existing bituminized-fiber duct as shown. To ensure a watertight joint, tapered ends or joints of the same material as the ducts shall be swabbed with bituminous or joint-sealing compound before couplings are applied. Plastic or nonmetallic couplings shall be tightly driven onto unswabbed ducts. Due to the brittleness of plastic couplings at low temperatures, such couplings shall not be installed when temperatures are below 0 degrees F. Couplings shall be warmed in hot water or by another approved method when installed at temperatures below 32 degrees F.

3.5.5.2 Plastic Duct

Duct joints shall be made by brushing a plastic solvent cement on insides of plastic coupling fittings and on outsides of duct ends. Each duct and fitting shall then be slipped together with a quick 1/4-turn twist to set the joint tightly.

3.5.6 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. Frames and covers shall be delivered on the job unpainted and, after approval, shall be given 2 coats of asphalt paint. 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.

Where duct lines enter manholes, the sections of duct may be either cast in the concrete or may enter the manhole through a square or rectangular opening of suitable dimensions provided in the manhole walls. Where openings are provided for the entrance of duct lines, the space between ducts and between ducts and manhole walls shall be caulked tight with lead wool or approved equal. 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 inch above 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 tinned 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 manufacturers published, standard installation drawings and procedures, except that they shall be modified to meet the requirements of this document. Units shall be carefully installed so as not to 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. Three phase transformer installations shall be installed with abc phase sequence.

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 comply with the requirements of Section 03300 CONCRETE FOR BUILDING CONSTRUCTION. Concrete pad reinforcement shall be in accordance with Section 03200 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. Padlocks shall comply with ASTM F 883, Type EPC, Size 2.

3.7.3 Fencing

Fencing shall conform to the requirement of and be installed in accordance with Section 02831 FENCE, CHAIN-LINK. Fences shall provide working clearances for operation and maintenance in accordance with ANSI C2. The entire space between fences and concrete pads shall be excavated to a minimum depth of 4 inches below finished gradelines, shall be graded to

reasonably level surfaces, and filled with well-compacted clean coarse gravel or crushed stone of 1/2 inch to 1-1/2 inches graded size up to finished gradelines. Space between fences and concrete pads shall be excavated to a minimum depth of 4 inches below finished gradelines, shall be graded to reasonably level surfaces, and filled with well-compacted clean coarse gravel or crushed stone of 1/2 inch to 1-1/2 inches graded size up to finished gradelines.

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.

3.8.1 Pole Installation

Pole installation shall be in accordance with Section 16370 ELECTRICAL DISTRIBUTION SYSTEM, AERIAL.

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 2 feet below finished grade as specified and provided under Section 16415 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 and a switchgear ground bus to the ground ring.

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 sized as shown.

c. Additional electrodes - Whenever the required ground resistance is not met, provide additional electrodes interconnected with grounding conductors, to achieve the specified ground resistance. The additional electrodes will be up to 3, 10-foot rods spaced a minimum of 10 feet apart.

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 all 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 electrical-distribution-system 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.

3.10.7 Riser Pole Grounding

A single continuous vertical grounding electrode conductor shall be installed on each riser pole and connected directly to the grounding electrodes indicated on the drawings or required by these specifications. All equipment, neutrals, surge arresters, and items required to be grounded shall be connected directly to this vertical conductor. The grounding electrode conductor shall be sized as shown. Grounding electrode conductors shall be stapled to wood poles at intervals not exceeding 2 feet.

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 2 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. All 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 the ground ring 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.

d. Ground ring - 5 ohms.

3.11.4 Ground-Ring Connection Inspection

All below-grade ground-ring 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.

3.11.5 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.

3.11.6 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 cable grounded. The minimum value of insulation shall be:

$$R \text{ in megohms} = \frac{(\text{rated voltage in kV} + 1) \times 1000}{\text{length of cable in feet}}$$

Each cable failing this test shall be repaired or replaced. The repaired cable system shall be retested until failures have been eliminated.

3.11.7 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.

3.11.8 Circuit Breaker Tests

The following field tests shall be performed on circuit breakers. Pass-fail criteria shall be in accordance with the circuit breaker manufacturer's specifications.

a. Insulation resistance test phase-to-phase.

b. Insulation resistance test phase-to-ground.

3.11.9 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. Secondary unit substation

b. Panelboards

c. Switchboards

d. Metal-enclosed switchgear

e. Switches

3.11.10 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 SUBMITTALS Test Reports.

3.12 MANUFACTURER'S FIELD SERVICE

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 --

SECTION 16415

ELECTRICAL WORK, INTERIOR
12/91

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.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C12.1	(1988) Code for Electricity Metering
ANSI C12.4	(1984; R 1990) Mechanical Demand Registers
ANSI C12.10	(1987) Electromechanical Watthour Meters
ANSI C12.11	(1987) Instrument Transformers for Revenue Metering, 10 kV BIL through 350 kV (0.6 kV NSV through 69 kV NSV)
ANSI C37.16	(1988) Switchgear - Low-Voltage Power Circuit Breakers and AC Power Circuit Protectors - Preferred Ratings, Related Requirements, and Application Recommendations
ANSI C39.1	(1981) Electrical Analog Indicating Instruments
ANSI C57.12.10	(1988) Transformers - 230 kV and Below 833/958 through 8333/10 417 kVA, Single-Phase, and 750/862 through 60 000/80 000/100 000 kVA, Three-Phase without Load Tap Changing; and 3750/4687 through 60 000/80 000/100 000 kVA with Load Tap Changing - Safety Requirements
ANSI C57.12.13	(1982) Conformance Requirements for Liquid-Filled Transformers Used in Unit Installations, Including Unit Substations
ANSI C57.12.27	(1982) Conformance Requirements for Liquid-Filled Distribution Transformers Used in Pad-Mounted Installations, Including Unit Substations
ANSI C57.12.50	(1981; R 1989) Ventilated Dry-Type Distribution Transformers, 1 to 500 kVA, Single-Phase, and 15 to 500 kVA, Three-Phase, with High-Voltage 601 to 34 500 Volts, Low-Voltage 120 to 600 Volts

ANSI C57.12.51	(1981; R 1989) Ventilated Dry-Type Power Transformers, 501 kVA and Larger, Three-Phase, with High-Voltage 601 to 34 500 Volts, Low-Voltage 208Y/120 to 4160 Volts
ANSI C57.12.52	(1981; R 1989) Sealed Dry-Type Power Transformers, 501 kVA and Larger, Three-Phase, with High-Voltage 601 to 34 500 Volts, Low-Voltage 208Y/120 to 4160 Volts
ANSI C57.12.70	(1978; R 1987) Terminal Markings and Connections for Distribution and Power Transformers
ANSI C80.5	(1990) Rigid Aluminum Conduit
ANSI C82.1	(1985; C82.1a; C82.1b; C82.1c) Ballasts for Fluorescent Lamps
ANSI C82.4	(1985; C82.4a) Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type)
ANSI C135.30	(1988) Zinc-Coated Ferrous Ground Rods for Overhead or Underground Line Construction

CODE OF FEDERAL REGULATIONS (CFR)

47 CFR 18	Rules and Regulations: Industrial, Scientific, and Medical Equipment
47 CFR 68	Connection of Terminal Equipment to the Telephone Network

FEDERAL SPECIFICATIONS (FS)

FS L-C-530	(Rev C) Coating, Pipe, Thermoplastic Resin
FS L-P-387	(Rev A; Am 1, Int Am 2) Plastic Sheet, Laminated, Thermosetting (for Designation Plates)

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C37.13	(1990) Low-Voltage AC Power Circuit Breakers Used in Enclosures
IEEE C37.20.1	(1987) Metal-Enclosed Low-Voltage Power Circuit-Breaker Switchgear
IEEE C57.12.00	(1993) Liquid-Immersed Distribution, Power, and Regulating Transformers
IEEE C57.12.01	(1989) Dry-Type Distribution and Power Transformers Including Those With Solid Cast and/or Resin - Encapsulated Windings

IEEE C57.12.80	(1978; R 1992) Terminology for Power and Distribution Transformers
IEEE C57.12.90	(1993) Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers and Guide for Short-Circuit Testing of Distribution and Power Transformers
IEEE C57.12.91	(1979) Test Code for Dry Type Distribution and Power Transformers
IEEE C57.13	(1993) Instrument Transformers
IEEE C57.94	(1982; R 1987) Installation, Application, Operation and Maintenance of Dry-Type General Purpose Distribution and Power Transformers
IEEE C57.98	(1986) Guide for Transformer Impulse Tests - Appendix to C57.12.90
IEEE C57.100	(1986) Test Procedure for Thermal Evaluation of Oil-Immersed Distribution Transformers
IEEE C57.105	(1978; R 1987) Transformers Connections in Three Phase Distribution Systems
IEEE C62.41	(1991) Surge Voltages in Low-Voltage AC Power Circuits
IEEE Std 81	(1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)

ICEA S-80-576	(1988) Communications Wire and Cable for Wiring of Premises

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(1991) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA AB 1	(1986; Rev 1) Molded Case Circuit Breakers and Molded Case Switches
NEMA BU 1	(1988; BU 1.1-1986) Busways
NEMA FU 1	(1986) Low Voltage Cartridge Fuses
NEMA ICS 1	(1988; Rev 1, 2 & 3) Industrial Controls and Systems
NEMA ICS 2	(1988; Rev 1) Industrial Control Devices, Controllers and Assemblies

NEMA ICS 3	(1988; Rev 1) Industrial Systems
NEMA ICS 6	(1988; Rev 1) Enclosures for Industrial Control and Systems
NEMA LE 4	(1987) Recessed Luminaires, Ceiling Compatibility
NEMA MG 1	(1993) Motors and Generators
NEMA MG 10	(1983; R 1988) Energy Management Guide for Selection and Use of Polyphase Motors
NEMA OS 1	(1989) Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports
NEMA OS 2	(1986; Errata 1986; R 1991) Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports
NEMA PB 1	(1990) Panelboards
NEMA PB 2	(1989) Deadfront Distribution Switchboards
NEMA PE 5	(1985; R 1991) Utility Type Battery Chargers
NEMA PE 7	(1985; R 1991) Communication Type Battery Chargers
NEMA RN 1	(1989) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA ST 20	(1992) Dry-Type Transformers for General Applications
NEMA TC 2	(1990) Electrical Polyvinyl Chloride (PVC) Tubing (EPT) and Conduit (EPC-40 and EPC-80)
NEMA TC 13	(1986) Electrical Nonmetallic Tubing (ENT)
NEMA WD 1	(1983; R 1989) General Requirements for Wiring Devices
NEMA WD 6	(1988) Wiring Devices - Dimensional Requirements

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1993) National Electrical Code
NFPA 101	(1994) Safety to Life from Fire in Buildings and Structures

RURAL ELECTRIFICATION ADMINISTRATION (REA)

REA TE&CM 823	(1980) Electrical Protection by Use of Gas Tube Arresters

UNDERWRITERS LABORATORIES (UL)

UL-03	(1993; Supple) Electrical Construction Materials Directory
UL 1	(1985; Rev thru Aug 1993) Flexible Metal Conduit
UL 5	(1985; Rev thru Sep 1990) Surface Metal Raceways and Fittings
UL 6	(1993) Rigid Metal Conduit
UL 20	(1986; Rev thru Jul 1993) General-Use Snap Switches
UL 44	(1991; Rev thru Feb 1994) Rubber-Insulated Wires and Cables
UL 50	(1992; Rev thru Feb 1994) Enclosures for Electrical Equipment
UL 67	(1988; Rev thru Feb 1993) Panelboards
UL 83	(1991; Rev thru Jul 1993) Thermoplastic-Insulated Wires and Cables
UL 94	(1991; Rev May 1993) Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
UL 98	(1987; Rev thru Apr 1990) Enclosed and Dead-Front Switches
UL 198B	(1988; Rev Jan 1988) Class H Fuses
UL 198C	(1986; Rev thru Jun 1993) High-Interrupting-Capacity Fuses, Current-Limiting Types
UL 198D	(1988; Rev Jul 1988) Class K Fuses
UL 198E	(1988; Rev Jul 1988) Class R Fuses
UL 198F	(1988) Plug Fuses
UL 198G	(1988; Rev May 1988) Fuses for Supplementary Overcurrent Protection
UL 198H	(1988; Rev thru Nov 1993) Class T Fuses
UL 198L	(1988; Rev Mar 1988) D-C Fuses for Industrial Use
UL 360	(1986; Rev thru Jan 1993) Liquid-Tight Flexible Steel Conduit
UL 467	(1984; Rev thru Nov 1986) Grounding and

	Bonding Equipment
UL 486A	(1991; Rev Oct 1991) Wire Connectors and Soldering Lugs for Use with Copper Conductors
UL 486B	(1991; Rev thru Apr 1992) Wire Connectors for Use with Aluminum Conductors
UL 486C	(1991; Rev thru Sep 1992) Splicing Wire Connectors
UL 489	(1991; Rev thru Aug 1993) Molded-Case Circuit Breakers and Circuit-Breaker Enclosures
UL 497	(1991; Rev Sep 1992) Protectors for Paired Conductor Communication Circuits
UL 498	(1991; Rev thru Dec 1993) Attachment Plugs and Receptacles
UL 506	(1989; Rev Sep 1993) Specialty Transformers
UL 508	(1993) Industrial Control Equipment
UL 510	(1986; Rev Oct 1986) Insulating Tape
UL 512	(1993) Fuseholders
UL 514A	(1991) Metallic Outlet Boxes
UL 514B	(1992; Rev thru Mar 1993) Fittings for Conduit and Outlet Boxes
UL 514C	(1988; Rev Jun 1989) Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL 542	(1985; Rev thru Oct 1993) Lampholders, Starters, and Starter Holders for Fluorescent Lamps
UL 651	(1989; Rev thru Dec 1989) Schedule 40 and 80 Rigid PVC Conduit
UL 651A	(1989; Rev thru Dec 1989) Type EB and A Rigid PVC Conduit and HDPE Conduit
UL 674	(1989) Electric Motors and Generators for Use in Hazardous (Classified) Locations
UL 698	(1991; Rev thru May 1993) Industrial Control Equipment for Use in Hazardous (Classified) Locations
UL 719	(1985; Rev thru Apr 1993) Nonmetallic-Sheathed Cables
UL 797	(1993) Electrical Metallic Tubing

UL 817	(1986; Rev thru Jul 1993) Cord Sets and Power-Supply Cords
UL 844	(1990; Rev thru Dec 1993) Electric Lighting Fixtures for Use in Hazardous (Classified) Locations
UL 845	(1988; Rev thru Jul 1993) Motor Control Centers
UL 857	(1990; Errata Apr 1990; Rev thru Jan 1994) Busways and Associated Fittings
UL 869A	(1993) Reference Standard for Service Equipment
UL 877	(1993) Circuit Breakers and Circuit-Breaker Enclosures for Use in Hazardous (Classified) Locations
UL 886	(1994; Rev thru Feb 1994) Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations
UL 891	(1994) Dead-Front Switchboards
UL 924	(1990; Rev thru Nov 1993) Emergency Lighting and Power Equipment
UL 935	(1993; Rev Feb 1993) Fluorescent-Lamp Ballasts
UL 943	(1993) Ground-Fault Circuit Interrupters
UL 1004	(1989; Rev thru Mar 1993) Electric Motors
UL 1010	(1991; Rev thru Feb 1994) Receptical-Plug Combinations for Use in Hazardous (Classified) Locations
UL 1022	(1979; Rev thru Jun 1984, Errata Nov 1985) Line Isolation Monitors
UL 1029	(1986; Rev thru Jul 1993) High-Intensity-Discharge Lamp Ballasts
UL 1047	(1990; Errata May 1991) Isolated Power Systems Equipment
UL 1236	(1992; Rev thru Mar 1994) Battery Chargers for Charging Engine-Starter Batteries
UL 1242	(1983; Rev thru Jul 1993) Intermediate Metal Conduit
UL 1561	(1986; Rev thru Jul 1992) Dry-Type General Purpose and Power Transformers

UL 1564	(1993) Industrial Battery Chargers
UL 1570	(1988; Rev thru Mar 1994) Fluorescent Lighting Fixtures
UL 1571	(1991; Rev thru Mar 1994) Incandescent Lighting Fixtures
UL 1572	(1991; Rev thru Mar 1994) High Intensity Discharge Lighting Fixtures
UL 1660	(1987) Liquid-Tight Flexible Nonmetallic Conduit

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 herein 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 located to avoid interference with mechanical or structural features; 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 Electrical Contractor shall coordinate the electrical work with HVAC and electrical drawings and provide all power related wiring even if they are not shown on electrical drawings.

1.2.3 Hazardous Locations

Wiring in locations indicated shall conform to the NFPA 70 for Class I and II, Division 2 hazardous locations. Equipment shall be suitable for Group C, D, E, F, and G. Wiring and equipment in locations indicated shall be of the classes, groups, divisions, and suitable for the operating temperature; all as indicated.

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 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, all identification nameplates shall be made of laminated plastic in accordance with FS L-P-387 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." See drawings for nameplate schedule.

1.2.6 As Built Drawings

Following the project completion or turnover, within 30 days the Contractor shall furnish two sets of as built drawings to the Contracting Officer.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL DESCRIPTIONS:

SD-04 Drawings

Electrical Work; GA.

Detail drawings for all materials and equipment specified. Detail drawings shall consist of a complete list of equipment and materials, including manufacturer's descriptive and technical data; catalog cuts; and any special installation instructions that may be required. Drawings shall show applicable schematic diagrams; and equipment layout and anchorage; and conduit and cable tray runs, anchorage, and support. Telephone system drawings showing actual layout, including locations, type any gauge of cables, and terminal assignment of wiring, after installation.

SD-09 Reports

Materials and Equipment; GA.

The label or listing of the Underwriters Laboratories, Inc., shall 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. Materials and equipment shall 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 Federal Specification, or standard of the American Society for Testing and Materials, National Electrical Manufacturers Association, or other commercial standard, is acceptable.

SD-13 Certificates

Telephone Installer; GA.

Qualifications of the telephone installer.

1.4 WORKMANSHIP

Materials and equipment shall be installed in accordance with recommendations of the manufacturer and as shown.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Materials and equipment 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.

2.1.1 Cables and Wires

Conductors in cables shall be annealed copper, except that AA-8000 series aluminum conductors may be used as an equivalent for copper conductors of No. 6 AWG or larger. Intermixing of copper and aluminum conductors in these sizes is not permitted. Design is based on copper conductors and aluminum conductors shall have an ampacity not less than that of the indicated copper conductors. Cables shall be single-conductor type, unless otherwise indicated. Cables and wires shall conform to UL 44 for

rubber-insulated type; UL 83 for the thermoplastic-insulated type; and UL 719 for the nonmetallic-sheathed cables. The following types shall be provided.

2.1.1.1 Metallic Armored Cable

Type ACHH or ACT.

2.1.1.2 Service Entrance Cable

Type USE.

2.1.1.3 Grounding Cables

Grounding cables shall be bare or shall have green low-voltage insulation.

2.1.1.4 Cord Sets and Power-Supply Cords

UL 817.

2.1.1.5 Telephone Cables

ICEA S-80-576

2.1.1.6 Ladder

Ladder-type cable trays shall be of nominal 24 inch width. Rung spacing shall be on 9 inch maximum centers as indicated.

2.1.1.7 Cantilever

Cantilever-type, center-hung cable trays may be provided at the Contractor's option in lieu of other cable tray types specified.

2.1.2 Cabinets for Communications

UL 50. Cabinets shall have boxes constructed of zinc-coated sheet steel. Cabinets shall be constructed with interior dimensions not less than those indicated. Trim shall be fitted with hinged door and flush catch. Doors shall provide maximum-size openings to the box interiors. Boxes shall be provided with a 5/8 inch plywood back board having a two-coat insulating varnish finish.

2.1.3 Connector Blocks

Connector blocks shall be type 66 equipped with punch down clips.

2.1.4 Protector Modules

The protector modules shall be of the three-electrode gas tube type. Protection modules shall be medium duty as specified in REA TE&CM 823. The gas modules shall be fail-short and shall shunt high voltage to ground in less than 10 nanoseconds, shall have an external spark gap, and shall comply with UL 497.

2.1.5 Circuit Breakers

Circuit breakers shall have voltage, current and interrupting ratings as indicated. Fully rated circuit breakers or series rated circuit breakers

in combinations approved for series applications by UL shall be provided as indicated, for specific pieces of distribution equipment, to obtain the specified interrupting rating. The fully rated circuit breakers will be acceptable where the series rated is specified. Panelboards or individual enclosures containing series rated circuit breakers shall be appropriately marked for use with the specified breakers at the designated short circuit level.

2.1.5.1 Molded-Case and Insulated-Case Circuit Breakers

NEMA AB 1 and UL 489 for circuit breakers.

a. Molded-Case Circuit Breakers: Single-pole breakers shall be full module size; two poles shall not be installed in a single module. Multipole breakers shall be of the common-trip type having a single operating handle, but for sizes of 100 amperes or less may consist of single-pole breakers permanently factory assembled into a multipole unit having an internal, mechanical, nontamperable common-trip mechanism and external handle ties. Breakers coordinated with current-limiting fuses shall have a combined interrupting capacity of 100,000 symmetrical amperes. All poles of associated breakers shall open if any fuse blows.

2.1.6 Conduit and Tubing

2.1.6.1 Electrical, Zinc-Coated Steel Metallic Tubing (EMT)

UL 797.

2.1.6.2 Electrical Plastic Tubing and Conduit

NEMA TC 2.

2.1.6.3 Flexible Conduit, Steel and Plastic

General-purpose type, UL 1; liquid tight, UL 360, and UL 1660

2.1.6.4 Intermediate Metal Conduit

UL 1242.

2.1.6.5 PVC Coated Rigid Steel Conduit

NEMA RN 1.

2.1.6.6 Rigid Aluminum Conduit

ANSI C80.5 and UL 6.

2.1.6.7 Rigid Metal Conduit

UL 6.

2.1.6.8 Rigid Plastic

NEMA TC 2, UL 651 and UL 651A.

2.1.7 Conduit and Device Boxes and Fittings

2.1.7.1 Boxes, Metallic Outlet

NEMA OS 1 and UL 514A.

2.1.7.2 Boxes, Nonmetallic, Outlet and Flush-Device Boxes and Covers

NEMA OS 2 and UL 514C.

2.1.7.3 Boxes, Outlet for Use in Hazardous (Classified) Locations

UL 886.

2.1.7.4 Boxes, Switch (Enclosed), Surface-Mounted

UL 98.

2.1.7.5 Fittings for Conduit and Outlet Boxes

UL 514B.

2.1.7.6 Fittings for Use in Hazardous (Classified) Locations

UL 886.

2.1.7.7 Fittings, PVC, for Use with Rigid PVC Conduit and Tubing

UL 514B.

2.1.8 Conduit Coatings Plastic Resin System

FS L-C-530 or NEMA RN 1, Type A-40.

2.1.9 Connectors, Wire Pressure

2.1.9.1 Copper Conductors

UL 486A.

2.1.9.2 Aluminum Conductors

UL 486B.

2.1.10 Electrical Grounding and Bonding Equipment

UL 467.

2.1.10.1 Ground Rods

Ground rods shall be of copper-clad steel conforming to UL 467 not less than 5/8 inch in diameter by 10 feet in length of the sectional type driven full length into the earth.

2.1.11 Enclosures

NEMA ICS 6 or NEMA 250 or UL 698 for use in hazardous (classified) locations, unless otherwise specified.

2.1.11.1 Cabinets and Boxes

UL 50.

2.1.11.2 Circuit Breaker

UL 489.

2.1.12 Fixtures, Lighting and Fixture Accessories/Components

Standard Drawing 40-06-04 sheets referenced hereinafter and enclosed as an integral part of these specifications, additional fixtures shown on contract drawings, if any and UL 844 for fixtures to be installed in hazardous (classified) locations. Fixtures, accessories and components, including ballasts, lampholders, lamps, starters and starter holders, shall conform to industry standards specified below.

2.1.12.1 Fixture, Auxiliary or Emergency

UL 924.

2.1.12.2 Incandescent Fixture

NEMA LE 4 for ceiling compatibility of recessed fixtures and UL 1571.

2.1.12.3 Fluorescent

a. Fixture: NEMA LE 4 for ceiling compatibility of recessed fixtures and UL 1570. 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.

b. Ballasts:

(1) Magnetic Ballast, Energy-Saving, High Power Factor, Class P, Automatic-Resetting Type, approved for the application by the Certified Ballast Manufacturers: ANSI C82.1 and UL 935. Two-lamp ballasts shall be used for each pair of lamps within a fixture or within continuous mounted fixtures. Single-lamp ballasts shall be used for individually mounted single-lamp fixtures and where an odd single-lamp fixture occurs at the end of a continuous group. Magnetic fluorescent lamp ballasts shall have a Ballast Efficacy Factor (BEF) not less than shown in the following table:

MAGNETIC FLUORESCENT BALLAST EFFICACY FACTORS*

Design starting temperature above 40 degrees F with 60 HZ input frequency

NUMBER OF LAMPS	LAMP TYPE	NOMINAL OPERATIONAL INPUT VOLTAGE	MAX. LAMP OPERATING CURRENT	MIN. BALLAST EFFICACY FACTOR
1	4 ft rapid start	120 or 277	less than 1000 m amp	1.805

MAGNETIC FLUORESCENT BALLAST EFFICACY FACTORS*

Design starting temperature above 40 degrees F with 60 HZ input frequency

NUMBER OF LAMPS	LAMP TYPE	NOMINAL OPERATIONAL INPUT VOLTAGE	MAX. LAMP OPERATING CURRENT	MIN. BALLAST EFFICACY FACTOR
2	4 ft rapid start	120	less than 1000 m amp	1.060
2	4 ft rapid start	277	less than 1000 m amp	1.050
2	8 ft slim-line	120 - 277	less than 1000 m amp	0.570
2	8 ft high output, rapid start	120 - 277	less than 1000 m amp	0.390

* For ballasts not specifically designed for use with dimming controls

The BEF is calculated using the formula:

BEF = Ballast Factor, (in percent) / Power Input

Where Power Input = Total Wattage of Combined Lamps and Ballasts.

(2) Electronic Ballast. Electronic ballasts shall consist of a rectifier, high frequency inverter, and power control and regulation circuitry. The ballasts shall be UL listed, Class P, with a Class A sound rating and shall contain no PCBs. Ballasts shall meet 47 CFR 18 for electromagnetic interference and shall not interfere with the operation of other electrical equipment. Design shall withstand line transients per IEEE C62.41, Category A. Unless otherwise indicated, the minimum number of ballasts shall be used to serve each individual fixture, using one, two, three or four lamp ballasts. A single ballast may be used to serve multiple fixtures if they are continuous mounted, factory manufactured for that installation with an integral wireway and are identically controlled.

(a) Light output regulation shall be +/- 10%.
(b) Voltage input regulation shall be +/- 10%.
(c) Lamp current crest factor shall be no more than 1.7.
(d) Ballast factor shall be not less than 85% nor more than 100%, unless otherwise indicated.
(e) A 60 Hz filter shall be provided. Flicker shall be no more than

15% with any lamp suitable for the ballast.
(f) Ballast case temperature shall not exceed 25 degree celsius rise above 40 degree celsius ambient, when tested in accordance with UL 935.
(g) Input current third harmonic shall not exceed 32 percent total harmonic distortion or 27.5 percent of the third triplens.
(h) Power factor shall not be less than 0.9.
(i) Ballasts shall operate at a frequency of 20 KHz or more.
(j) Operating filament voltage shall be 2.5 to 4.5 volts.
(k) Warranty. Three year full warranty including a $10 labor allowance.
(l) Ballast Efficacy Factor (BEF) shall be in accordance with the following table. Ballasts and lamps shall be matching rapid start or instant start as indicated on the following table. If 32W-F32-T8 lamps and ballasts are used, they must be either all rapid start or all instant start.

ELECTRONIC FLUORESCENT BALLAST EFFICACY FACTORS

LAMP TYPE	TYPE OF STARTER & LAMP	NOMINAL OPERATIONAL INPUT VOLTAGE	NUMBER OF LAMPS	MIN. BALLAST EFFICACY FACTOR
40W F40 T12	rapid start	120 or 277 V	1	2.3
			2	1.2
			3	0.8
			4	0.6
34W F40 T12	rapid start	120 or 277 V	1	2.6
			2	1.3
			3	1.0
			4	0.7
40W F40 T10	rapid start	120 or 277 V	1	2.2
			2	1.1
			3	0.8
32W F32 T8	rapid or instant start	120 or 277 V	1	2.4
			2	1.4
			3	1.0
			4	0.8

*For ballasts not specifically designed for use with dimming controls

The BEF is calculated using the formula:

BEF = Ballast Factor (in percent) / Power Input

Where Power Input = Total Wattage of Combined Lamps and Ballasts.

c. Lampholders, Starters, and Starter Holders: UL 542.

2.1.12.4 High-Intensity-Discharge

a. Fixture: NEMA LE 4 for ceiling compatibility of recessed fixtures and UL 1572.

b. Ballasts: ANSI C82.4 for multiple supply types and UL 1029.

2.1.13 Fuses and Fuseholders

2.1.13.1 Fuses, Low Voltage Cartridge Type

NEMA FU 1.

2.1.13.2 Fuses, High-Interrupting-Capacity, Current-Limiting Type

UL 198C.

2.1.13.3 Fuses, Class K, High-Interrrupting-Capacity Type

UL 198D.

2.1.13.4 Fuses, Class H

UL 198B.

2.1.13.5 Fuses, Class T

UL 198H.

2.1.13.6 Fuses, Plug Type

UL 198F.

2.1.13.7 Fuses for Supplementary Overcurrent Protection

UL 198G.

2.1.13.8 Fuses, D-C for Industrial Use

UL 198L.

2.1.13.9 Fuseholders

UL 512.

2.1.14 Instruments, Electrical Indicating

ANSI C39.1.

2.1.15 Motors, ac, Fractional and Integral Horsepower

Motors, ac, fractional and integral horsepower, 500 hp and smaller shall conform to NEMA MG 1 and UL 1004 for motors; NEMA MG 10 for energy management selection of polyphase motors; and UL 674 for use of motors in hazardous (classified) locations.

2.1.15.1 Horsepower 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.

2.1.15.2 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, dripproof or totally enclosed fan cooled enclosures shall be high efficiency type, unless otherwise indicated. 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 Motor Efficiencies

HP	Std. Efficiency	High Efficiency
1	77.0	85.5
1.5	78.5	85.5
2	78.5	85.5
3	78.5	88.5
5	82.5	88.5
7.5	84.0	90.0
10	85.5	90.0
15	85.5	91.0
20	87.5	92.0
25	88.5	92.0
30	88.5	92.0
40	88.5	92.0
50	89.0	92.5
60	89.0	92.5
75	89.0	95.5
100	90.0	93.5
125	91.0	94.5
150	91.0	94.5
200	91.0	94.5
250	91.0	94.5
300	91.0	94.5
350	91.0	94.5
400	91.0	94.5
500	91.0	94.5

2.1.16 Motor Controls and Motor Control Centers

NEMA ICS 1, NEMA ICS 2, NEMA ICS 3 and NEMA ICS 6, and UL 508 and UL 845.

2.1.17 Panelboards

Dead-front construction, NEMA PB 1 and UL 67.

2.1.18 Receptacles

2.1.18.1 General Grade

NEMA WD 1.

2.1.18.2 Ground Fault Interrupters

UL 943, Class A or B.

2.1.18.3 Hazardous (Classified) Locations

UL 1010.

2.1.19 Service Equipment

UL 869A.

2.1.20 Splice, Conductor

UL 486C.

2.1.21 Snap Switches

UL 20.

2.1.22 Tapes

2.1.22.1 Plastic Tape

UL 510.

2.1.22.2 Rubber Tape

UL 510.

2.1.23 Transformers

2.1.23.1 Conventional Dry-Type

IEEE C57.12.01, ANSI C57.12.10, IEEE C57.12.80, IEEE C57.12.91, IEEE C57.94, IEEE C57.98, IEEE C57.105 and UL 1561 in addition to the specific standards referenced below.

a. Distribution: Ventilated, 1 to 500 kVA, single-phase, and 15 to 500 kVA, three-phase with high-voltage 601 to 34500 volts, low-voltage 120-600 volts: ANSI C57.12.50.

b. Instrument: ANSI C12.11 and IEEE C57.13 with current ratio or voltage ratings shown or specified.

2.1.23.2 Liquid Filled and Liquid Immersed

IEEE C57.12.00, ANSI C57.12.10, ANSI C57.12.13, ANSI C57.12.27, ANSI C57.12.70, IEEE C57.12.80, IEEE C57.12.90, IEEE C57.98, IEEE C57.100, and IEEE C57.105, including transformers having mineral oil, silicone or high molecular weight hydrocarbon dielectrics to be installed in an interior vault as shown.

2.1.24 Digital Metering Systems

The system shall be self contained and recessed mounted in the Motor Control Center. It shall be of a standard design regularly manufactured by the factory. The following values shall be available for viewing on the front of the unit:

Phase-Phase Voltage

Current on any Phase
Frequency
Real Power (kW)
Apperant Power (kVA)
Reactive Power (kVAR)
Power Factor

Accuracy shall be 2% or better. Display shall be LED or LCD.

2.1.25 Wiring Devices

NEMA WD 1 for general-purpose wiring devices, and NEMA WD 6 for dimensional requirements of wiring devices.

2.1.26 Telephone Jacks

47 CFR 68, plastic shall be class VO in accordance with UL 94.

PART 3 EXECUTION

3.1 GROUNDING

Grounding shall be in conformance with NFPA 70, the contract drawings, and the following specifications.

3.1.1 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.

3.1.2 Ground Bus

Ground bus shall be provided in the electrical equipment rooms as indicated. Noncurrent-carrying metal parts of transformer neutrals and other electrical equipment shall be effectively grounded by bonding to the 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. Connections shall be bolted type in lieu of thermoweld, so they can be changed as required by additions and/or alterations.

3.1.3 Grounding Conductors

A green ground wire shall be furnished regardless of the type of conduit. 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 boxes for receptacles, 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.

3.2 WIRING METHODS

3.2.1 General Requirements

Unless otherwise indicated, wiring shall consist of insulated conductors installed in or rigid zinc-coated steel conduit, rigid plastic conduit, electrical metallic tubing, or intermediate metal conduit.

3.2.2 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 may be installed only within buildings. Electrical metallic tubing may be installed in concrete and grout in dry locations. Electrical metallic tubing installed in concrete or grout shall be provided with concrete tight fittings. 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 not be used. 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 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. Wiring installed in underfloor raceway system shall be suitable for installation in wet locations.

3.2.2.1 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.

3.2.2.2 Installing in Slabs Including Slabs on Grade

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.

3.2.2.3 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.

3.2.2.4 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. Care shall be taken to prevent the lodgment of plaster, dirt, or trash in raceways, boxes, fittings and equipment during the course of construction. Clogged raceways shall be entirely freed of obstructions or shall be replaced.

3.2.2.5 Supports

Metallic conduits and tubing shall be securely and rigidly fastened in place 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, or ceiling trapeze. C-clamps or beam clamps shall have strap or rod-type retainers. Rigid plastic conduits (if permitted as a wiring method) shall be supported as indicated above, except that they will be supported at intervals as indicated in NFPA 70. Loads and supports shall be coordinated with supporting structure to prevent damage or deformation to the structures, but no load shall be applied to joist bridging. Fastenings 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. Holes cut to a depth of more than 1-1/2 inches in reinforced concrete beams or to a depth of more than 3/4 inch in concrete joists shall avoid cutting the main reinforcing bars. Holes not used shall be filled. In partitions of light steel construction, sheet-metal screws may be used. Conduit shall not be supported using wire or nylon ties. Raceways shall be installed as a complete system and be independently supported from the structure. Upper raceways shall not be the support of lower raceways. Supporting means will not be shared between electrical raceways and mechanical piping or ducts and shall not be fastened to hung ceiling supports. Conduits shall be fastened to all sheet-metal boxes and cabinets with two locknuts where required by the 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. A pull wire shall be inserted in each empty raceway in which wiring is to be installed by others 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 pound per square inch tensile strength. Not less than 10 inches of slack shall be left at each end of the pull wire. Additional support for horizontal runs is not required when EMT rests on steel stud cutouts.

3.2.2.6 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.

3.2.2.7 Communications Raceways

Communications raceways indicated shall be installed in accordance with the previous requirements for conduit and tubing and with the additional requirements 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 be not less than ten times the nominal diameter.

3.2.3 Cable Systems

Cables shall be installed concealed behind ceiling or wall finish where practicable. Cables shall be threaded through holes bored on the approximate centerline of wood members; notching of surfaces will not be permitted. Sleeves shall be provided through bond beams of masonry-block walls for threading cables through hollow spaces. Exposed cables shall be installed parallel or at right angles to walls or structural members. In rooms or areas not provided with ceiling or wall finish, cables and outlets shall be installed so that a room finish may be applied in the future without disturbing the cables or resetting the boxes. Cables less than 4 feet above floors shall be protected from mechanical injury by installation in conduit or tubing. Cables shall be protected from mechanical injury by installation in conduit or tubing.

3.2.4 Cables and Conductors

Aluminum conductors shall have ampacity of not less than the copper conductors. Wire connectors of insulating material or solderless pressure connectors properly taped shall be utilized for all splices. Pressure connectors for aluminum conductors shall have tinned aluminum bodies. Aluminum contact surfaces of conductors and connectors shall be cleaned and covered with antioxidant compound prior to making of connections.

3.2.4.1 Sizes

All sizes are based on copper conductors, unless otherwise 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.

The conductor sizes are based on the use of TW insulation for conductors smaller than No. 1/0 AWG and THW insulation for conductors No. 1/0 and

larger, except where otherwise indicated.

Higher temperature rated conductors will be permitted to be used, if the UL tested temperature ratings for which the equipment in the circuit is marked are not exceeded.

Conductor sizes for nonlinear loads shall be based on the use of minimum 75 degrees C insulated conductors for branch circuits and feeders.

3.2.4.2 Power Conductor Identification

Phase conductors shall be identified by color coding. The color of the insulation on phases A, B, and C respectively (for three phase) or phases A and B respectively (for single phase) of different voltage systems shall be as follows:

120/208 volt, 3-phase: Black, red, and blue.

277/480 volt, 3-phase: Brown, orange, and yellow.

120/240 volt, single/phase: Black and red.

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. Conductor identification shall be provided within each enclosure where a tap, splice, or termination is made. Phase identification by a particular color shall be maintained continuously for the length of a circuit, including junctions.

3.2.4.3 Control Conductor Identification

Control 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.

3.3 BOXES AND SUPPORTS

Boxes shall be provided in the wiring or raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures. Boxes for metallic raceways, 4 inch by 4 inch nominal size and smaller, shall be of the cast-metal hub type when located in normally wet locations, when flush and surface mounted on outside of exterior surfaces, or when located in hazardous areas. Large size boxes shall be NEMA 1, 3R, 12, or 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. In partitions of light steel construction bar hangers with 1 inch long studs, mounted between metal wall studs or metal stud "C" brackets snapped on and tab-locked to metal wall studs, shall be used to secure boxes to the building structure. When "C" brackets are used, additional box support shall be provided on the

side of the box opposite the brackets. The edges of boxes for electrical devices shall be flush with the finished surfaces in gypsum and plasterboard installations. Boxes for mounting lighting fixtures shall be not less than 4 inches square except smaller boxes may be installed as required by fixture configuration, as approved. 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 flush with the top of a block to minimize cutting of blocks, and boxes shall be located horizontally to avoid cutting webs of block. 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 on opposite sides of fire rated walls shall be separated by a minimum horizontal distance of 24 inches. Cast-metal boxes installed in wet locations and boxes installed flush with the outside of exterior surfaces shall be gasketed. 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. 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 screws 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. 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. Cast-metal boxes with 3/32 inch wall thickness are acceptable. 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. 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.

3.3.1 Boxes for Use with Raceway Systems

Boxes for use with raceway systems shall be not less than 1-1/2 inches deep except where shallower boxes required by structural conditions are approved. Sheetmetal boxes for other than lighting fixtures shall be not less than 4 inches square except that 4 by 2 inch boxes may be used where only one raceway enters the outlet. Contractor shall size the telephone outlet boxes as required by the number, size and type of outlets specified and as required by the outlets furnished by the Contractor.

3.3.2 Boxes for Use with Cable Systems

Boxes for use with cable systems shall be not less than 3 by 2 inch sectional boxes, 2 inches deep.

3.3.3 Pull Boxes

Pull boxes of not less than the minimum size required by NFPA 70 shall be constructed of aluminum or galvanized sheet steel, except where cast-metal boxes are required in locations specified above. Boxes shall be furnished with screw-fastened covers. 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.

3.3.4 Conduit Stub-Ups

Conduits stubbed up through concrete floors for connections to freestanding equipment shall be provided with a short elbow and an adjustable top or coupling threaded inside for plugs, set 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. Screwdriver-operated threaded flush plugs shall be installed in conduits from which no equipment connections are made to suit the devices installed.

3.4 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 steel with baked enamel finish or impact-resistant plastic and shall be ivory. 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.

3.5 RECEPTACLES

3.5.1 Single and Duplex

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 brown or ivory 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. Receptacles with ground fault circuit interrupters shall have the current rating of 20A, 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 WALL SWITCHES

Wall switches shall be of the totally enclosed tumbler type. The wall switch handle and switch plate color shall harmonize with the color of the respective wall. 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 120-volt for use on alternating current only.

3.7 SERVICE EQUIPMENT

Service-disconnecting means shall be of the enclosed molded-case circuit breaker type as indicated with external handle for manual operation. When service disconnecting means is a part of an assembly, the assembly shall be listed as suitable for service entrance equipment. Enclosures shall be sheet metal with hinged cover for surface mounting unless otherwise indicated.

3.8 PANELBOARDS

Circuit breakers and switches used as a motor disconnecting means, and not in sight of the motor and the driven machinery location, 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 or aluminum.

3.8.1 Panelboards

Panelboards shall be circuit breaker or fusible switch equipped as indicated on the drawings.

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.

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. Cartridge fuses shall be used for circuits rated in excess of 30 amperes, 125 volts, except where current-limiting fuses are indicated.

3.10 UNDERGROUND-SERVICE CONDUITS

Empty conduits for underground electric-service cable and telephone cable shall be installed as indicated. Except where otherwise indicated, conduits shall terminate approximately 5 feet beyond the building wall and 2 feet below finished grade, with the outside ends bushed and plugged or capped.

3.11 MOTORS

Motors shall be as specified in paragraph Motors, ac, Fractional and Integral Horsepower, whether or not motors are separately provided or included in equipment assemblies specified in other sections of these specifications. 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.

3.12 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.

3.12.1 Reduced-Voltage Controllers

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.

3.12.2 Motor Control Centers

Control centers shall be indoor type and shall contain combination starters and other equipment as indicated. Control centers shall be NEMA ICS 2, Class B, Type 1. Each control center shall be mounted on floor sills or mounting channels. Each circuit shall have a suitable metal or laminated plastic nameplate with white cut letters. Combination starters shall be provided with circuit breakers. Motor control centers shall be provided with a full-length ground bus bar.

3.12.3 Contacts

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.

3.12.4 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.

3.13 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.

3.14 TRANSFORMERS

Only single- and three-phase transformers having two windings per phase will be approved. Full-capacity standard NEMA taps shall be provided in the primary windings of transformers having a primary rating in excess of 600 volts. Three-phase transformers shall be connected only in a delta-wye or wye-delta configuration, as indicated "T" connections may be used for transformers rated at 15 kVA or below. The insulation on transformer windings may be the manufacturer's standard for transformers rated for operation in a 40-degree Celsius ambient temperature unless a higher-temperature insulation is shown, specified or required by the application indicated. Single kVA ratings shown are based on self-cooled operation. The basic impulse level (BIL) of individual transformers shall be as stated in the following paragraphs. The conventional dry-type transformer 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 a 40-degree Celsius ambient temperature, unless otherwise specified or shown. The average sound level in decibels (dB) of transformers shall not exceed the following dB level for the applicable kVA rating range listed:

kVA RANGE	dB SOUND LEVEL
1-50	50
51-150	55
151-300	58
301-500	60
501-700	62
701-1000	64
1001-1500	65
1501 & above	70

3.14.1 Conventional Dry-Type Transformers

Transformers having the primary or higher-voltage winding rated at 600 volts or less and a secondary or lower-voltage winding rated at 240 volts or less may be manufacturer's standard ventilated or enclosed, self-cooled type of transformer unless otherwise shown, specified or required for proper and safe application. Transformers shown with primary ratings in excess of 600 volts shall have the NEMA 220 degree C insulation and shall be rated for a temperature rise of 80 degrees C above ambient. Similarly, transformers having primary windings rated at 480 volts or less and a kVA rating of 150 or larger shall have Class H insulation and be suitable for an 80 degree C temperature rise above ambient. The percent voltage impedance for the transformer shown to supply all facility power demands shall be 5.75. These distribution transformers shall have a basic impulse level (BIL) rating not less than the ANSI standard BIL rating for the mineral-oil insulated type of transformer having the same voltage classification or rating as the dry-type of transformer proposed for installation.

3.14.2 Liquid-Insulated Transformers

Transformers may be the mineral-oil insulated, silicone, or the high molecular-weight hydrocarbon (HMWH) type. Each of these liquid-insulated or dielectric types of transformers shall be installed in the fire-resistant vault shown, which shall be equipped with fire detection, suppression and associated control circuits. These types of transformers shall have the VA and voltage ratings shown, and shall be provided with pressure-relief devices and relays required for safe application in an interior environment. The type of transformer proposed for supplying the peak power demands of the facility shall be suitable for operation in an ambient temperature of 40 degrees Celsius without exceeding a temperature rise of 80 degrees Celsius under full-load operation. The type or types of transformers proposed shall have a percent voltage impedance of 5.75. The basic impulse level (BIL) rating of primary transformer windings shall comply with the ANSI standard requirement for the mineral-oil insulated type of transformer having a voltage rating the same as the voltage rating of the distribution voltage shown to supply the facility power transformer.

3.15 LAMPS AND LIGHTING FIXTURES

Ballasted fixtures shall have ballasts which are compatible with the specific type and rating of lamps indicated and shall comply with the applicable provisions of the publications referenced.

3.15.1 Lamps

Lamps of the type, wattage, and voltage rating indicated shall be delivered

to the project in the original cartons and installed in the fixtures just prior to the completion of the project.

3.15.1.1 Incandescent

Incandescent lamps shall be for 125-volt operation unless otherwise indicated.

3.15.1.2 Fluorescent

Fluorescent lamps for magnetic ballasts shall have standard cool-white color characteristics and shall be of a type that will not require starter switches. Lamps shall be of the rapid-start type unless otherwise shown or approved. Fluorescent lamps for electronic ballasts shall be as indicated.

3.15.1.3 High-Intensity-Discharge

High-intensity-discharge lamps shall be the high-pressure sodium type unless otherwise indicated, shown, or approved.

3.15.2 Fixtures

Fixtures shall be as shown and shall conform to the following specifications and shall be as detailed on Standard Drawing No. 40-06-04, Sheet Nos. 20, 31, 56, 69, 74, 75, and 76, which accompany and form a part of this specification for the types indicated. Illustrations shown on these sheets 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.

3.15.2.1 Accessories

Accessories such as straps, mounting plates, nipples, or brackets shall be provided for proper installation. Open type fluorescent fixtures with exposed lamps shall have a wire-basket type guard.

3.15.2.2 Suspended Fixtures

Suspended fixtures shall be provided with swivel hangers in order to ensure a plumb installation. Pendants, rods, or chains 4 feet or longer excluding fixture, shall be braced to limit swinging. Bracing shall be 3 directional, 120 degrees apart. Single unit suspended fluorescent fixtures shall have twin-stem hangers. Multiple unit or continuous-row fluorescent units shall have a tubing or stem for wiring at one point, and a tubing or rod suspension provided for each length of chassis including one at each end. Maximum distance between adjacent tubing or stems shall be 10 feet. Rods shall be of not less than 3/16 inch diameter. Flexible raceway shall be installed to each fixture from an overhead junction box. Fixture to fixture wiring installation is allowed only when fixtures are installed end to end in a continuous run.

3.15.2.3 Ceiling Fixtures

Ceiling fixtures shall be coordinated with and suitable for installation in, on, or from the suspended ceiling provided under other sections of

these specifications. Installation and support of fixtures shall be in accordance with the 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 type of suspended 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 panels, in conformance with UL-03. Surface-mounted fixtures shall be suitable for fastening to the structural support for ceiling panels.

3.15.2.4 Sockets

Sockets of industrial, strip, and other open type fluorescent fixtures shall be of the type requiring a forced movement along the longitudinal axis of the lamp for insertion and removal of the lamp.

3.16 EQUIPMENT CONNECTIONS

All 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

Control equipment furnished under this section of the specifications, and shown on the drawings, shall be connected under this section of the specifications unless shown or specified otherwise. Except as otherwise specifically noted, automatic-control wiring, signaling, and protective devices are not included in this section of the specifications, but shall be furnished and installed under other sections of the specifications. Control wiring not shown on the drawings shall be furnished under the other sections of the specifications.

3.16.2 Installation of Government-Furnished Equipment

Wiring shall be extended to the equipment, and proper connections made thereto.

3.17 COORDINATED POWER SYSTEM PROTECTION

A fault-impedance diagram, a load flow analysis or study, a short-circuit analysis or study, and a power system coordination study shall be prepared to demonstrate that protective system after devices have been properly calibrated, adjusted, set and tested. These data, including complete descriptive and technical data of all protective devices, diagrams, and studies as required to ensure complete coordination, shall be prepared in conformance with industry practices, standards, or with other technical data approved by the Contracting Officer, and shall be submitted for approval of the Contracting Officer in accordance with submittal SD-04, Drawings.

3.17.1 Fault-Impedance Diagram

The diagram shall be prepared to reflect the system impedance of power sources available to supply the building or facility, and the impedance of the new power system components for the facility.

3.17.2 Fault Locations and Short-Circuit Current Availability (SCCA)

The fault-impedance diagram shall, as a minimum, show fault locations for each voltage transformation and at each power distribution bus. The SCCA available at each fault location shall be shown in tabular form on the diagram for a bolted line-to-line fault and a line-to-ground fault.

3.17.3 Protective Devices

The time-current characteristics, features, and nameplate data for each existing protective device, including fuses, circuit breakers, and protective relays shall be determined and documented when necessary to ensure coordination between existing and new protective devices. New protective devices proposed, including devices with fixed or adjustable time-current characteristics and features, shall demonstrate proper coordination with existing devices and new and related devices required to:

a. Minimize the extent of power outages by the operation of the primary protective device nearest the load-side fault location.

b. Provide back-up protection on the supply-side of the primary protective device if the primary protective device fails to operate.

c. To ensure a minimum of a 0.2-second delay between the operation of the primary and the back-up, or secondary, protective device unless otherwise approved to prevent nuisance tripping.

3.17.4 Power System Coordination Study

The study shall include all data related to existing and new protective devices proposed as such data relates to the nameplate data, time-current characteristics, and the fixed or adjustable features of the existing or new protective devices. These data shall include:

a. The time-current characteristic curves published by the manufacturer of the protective devices or equipment having adjustable time-current characteristics.

b. Data published by the manufacturer of circuit breakers or protective relays which contain installation, operation and maintenance instructions for calibration, adjustment, setting, and testing of the specific protective device.

c. Composite time-current characteristic curves for primary, secondary and other related devices, as required to ensure coordinated power system protection between existing and new protective devices or equipment.

3.17.5 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 TELEPHONE WIRING SYSTEM

The telephone wiring system shall be complete and functional.

3.18.1 Telephone Cables

Each telephone outlet will be serviced with 24-gauge solid copper station-type color coded cable, vinyl insulated with an overall vinyl jacket. Cable shall be continuous from each telephone outlet to cabinet indicated on the drawings. Splicing of individual cables shall not be permitted. At each outlet, four-pair cable shall be terminated on the modular jack assembly, using color code provided by the Contracting Officer. At the backboard, terminate the cable on cross-connect terminal blocks and mark with the appropriate outlet number.

3.18.2 Telephone Outlets

Modular telephone outlets shall comply with FCC Rules and Regulations, Part 68, Subpart F. Each modular outlet shall have a single modular jack. Each eight-position jack in the modular outlet shall contain screw terminals or approved quick connect terminals for each conductor in the cable. The flush mounted cover shall be ivory. Each outlet shall be numbered for easy identification of type and location.

3.18.3 Crossconnect Blocks

Punch down 66 type connecting blocks shall be provided to terminate all subscriber lines. The blocks shall be attached to right side of the plywood telephone backboard in vertical rows.

3.18.4 Telephone Backboards

Telephone backboards shall be installed at locations shown on the drawings. The backboards shall be 3/4 inch plywood having a two-coat insulating varnish finish and shall be sized as shown on the drawings.

3.18.5 Building Entry Protection Modules

Building Entry Protection Modules shall be provided to terminate the building feeder cable. The modules shall be attached to the left side of the telephone backboard.

3.18.6 Auxiliary Devices

All auxiliary devices such as tie bars, cable rings, etc. which are not shown but are required for a high grade installation shall be provided.

3.18.7 Qualifications of Installer

The system shall be installed by an experienced installer regularly engaged in the installation of telephone systems. The Contracting Officer may reject any proposed installer who can not show evidence of such qualifications.

3.19 PAINTING AND FINISHING

Field-applied paint on exposed surfaces shall be provided under Section 09900 PAINTING, GENERAL.

3.20 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.

3.21 TESTS

After the interior-wiring-system installation is completed, and at such time as the Contracting Officer may direct, the Contractor shall conduct an operating test for approval. The equipment shall be demonstrated to operate in accordance with the requirements of this specification. Continuity test shall be conducted on the telephone wiring system. The test shall be performed in the presence of the Contracting Officer. The Contractor shall furnish all instruments and personnel required for the tests, and the Government will furnish the necessary electric power. No part of the electrical distribution system shall be energized prior to the resistance testing of that system's ground rods and submission of test results to the Contracting Officer. Test reports shall indicate the location of the rod and the resistance and the soil conditions at the time the test was performed.

3.22 ONE-LINE DIAGRAM

A one-line diagram with main transformer, building disconnect means, and feeder breakers/switches to building panels located at the building disconnect shall be provided. Diagram shall be mounted under glass or shall be plastic laminated. The breaker/switch identification on the diagram shall match nameplate on the installed equipment.

-- End of Section --

SECTION 16670

LIGHTNING PROTECTION SYSTEM
12/88

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 C135.30	(1988) Zinc-Coated Ferrous Ground Rods for Overhead or Underground Line Construction

FEDERAL SPECIFICATION (FS)

FS W-S-610	(Rev E) Splice Connectors

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1990) National Electrical Code
NFPA 780	(1992) Lightning Protection Code

UNDERWRITERS LABORATORIES (UL)

UL-03	(1992) Electrical Construction Materials Directory
UL 96	(1985; Rev thru Dec 1988) Lightning Protection Components
UL 96A	(1982; Rev thru Jul 1990) Installation Requirements for Lightning Protection Systems
UL 467	(1984; Rev thru Nov 1986) Grounding and Bonding Equipment

1.2 GENERAL REQUIREMENTS

1.2.1 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. No departures shall be made without the prior approval of the Contracting Officer.

1.2.2 System Requirements

The system furnished under this specification shall consist of the standard products of a manufacturer regularly engaged in the production of lightning protection systems and shall be the manufacturer's latest UL approved

design. The lightning protection system shall conform to NFPA 70 and NFPA 780, UL 96 and UL 96A, except where requirements in excess thereof are specified herein.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL DESCRIPTIONS:

SD-04 Drawings

Lightning Protection System; GA.

Contractor shall submit LP System plan indicating ground connection and interconnection of metallic bodies inclding railings, walkways, light fixtures, underground metal pipes, etc. to be connected to the LP system and eliminating metallic items that are not connected (e.g., doors, windows, roof conductors, etc). Detail drawings consisting of a complete list of material, including manufacturer's descriptive and technical literature, catalog cuts, drawings, and installation instructions. Detail drawings shall demonstrate that the system has been coordinated and will function as a unit. Drawings shall show proposed layout and mounting and relationship to other parts of the work.

SD-13 Certificates

Materials and Equipment; GA.

Where material or equipment is specified to comply with requirements of UL, proof of such compliance. The label of or listing in UL-03 will 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 Underwriters Laboratories may be submitted. A letter of findings shall be submitted certifying UL inspection of lightning protection systems provided on the following facilities: Radford Army Ammunition Plant, Radford, Virginia.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 General Requirements

No combination of materials shall be used that form an electrolytic couple of such nature that corrosion is accelerated in the presence of moisture unless moisture is permanently excluded from the junction of such metals. Where unusual conditions exist which would cause corrosion of conductors, conductors with protective coatings or oversize conductors shall be used. Where a mechanical hazard is involved, the conductor size shall be increased to compensate for the hazard or the conductors shall be protected by covering them with molding or tubing made of wood or nonmagnetic material. When metallic conduit or tubing is used, the conductor shall be electrically connected at the upper and lower ends.

2.1.2 Main and Secondary Conductors

Conductors shall be in accordance with NFPA 780 and UL 96 for Class I, Class II, or Class II modified materials as applicable.

2.1.2.1 Copper

Copper conductors mounted on poles shall weigh not less than 375 pounds per thousand feet, and the size of any wire in the cable shall be not less than No. 15 AWG. The thickness of any web or ribbon used on stacks shall be not less than No. 12 AWG. Counterpoise shall be copper conductors not smaller than No. 1/0 AWG.

2.1.2.2 Aluminum

Aluminum shall not contact the earth nor shall it be used in any other manner that will contribute to rapid deterioration of the metal. Appropriate precautions shall be observed at connections with dissimilar metals. Aluminum conductors for bonding and interconnecting metallic bodies to the main cable shall be at least equivalent to strength and cross-sectional area of a No. 4 AWG aluminum wire. If perforated strips are used, the strips shall be as much wider than solid strips, as the diameter of the perforations. Aluminum strip for connecting exposed water pipes shall be not less than No. 12 AWG in thickness and at least 1-1/2 inches wide.

2.1.3 Air Terminals

Terminals shall be in accordance with UL 96 and NFPA 780. The tip of air terminals on buildings used for manufacturing, processing, handling, or storing explosives, ammunition, or explosive ingredients shall be a minimum of 2 feet above the ridge parapet, ventilator or perimeter. On open or hooded vents emitting explosive dusts or vapors under natural or forced draft, air terminals shall be a minimum of 5 feet above the opening. On open stacks emitting explosive dusts, gases, or vapor under forced draft, air terminals shall extend a minimum of 15 feet above vent opening. Air terminals more than 24 inches in length shall be supported by a suitable brace, with guides, not less than one-half the height of the terminal.

2.1.4 Ground Rods

Rods made of copper-clad steel shall conform to UL 467 and galvanized ferrous rods shall conform to ANSI C135.30. Ground rods shall be not less than 3/4 inch in diameter and 10 feet in length. Ground rods of copper-clad steel, stainless steel, galvanized ferrous, and solid copper shall not be mixed on the job.

2.1.5 Clamp-Type Connectors

Connectors for splicing conductors shall conform to UL 96, class as applicable, and FS W-S-610, Class 2, style and size as required for the installation.

2.1.6 Lightning Protection Components

Lightning protection components, such as bonding plates, air terminal supports, chimney bands, clips, and fasteners shall conform to UL 96, classes as applicable.

PART 3 EXECUTION

3.1 INTEGRAL SYSTEM

3.1.1 General Requirements

The lightning protection system shall consist of air terminals, roof conductors, down conductors, ground connections, and grounds, electrically interconnected to form the shortest distance to ground. Railings, walkways, light fixtures, and underground metal pipes are to be connected to the Lightning Protection system. All conductors on the structures shall be exposed except where conductors are in protective sleeves exposed on the outside walls. Secondary conductors shall interconnect with grounded metallic parts within the building. Interconnections made within side-flash distances shall be at or above the level of the grounded metallic parts.

3.1.1.1 Air Terminals

Air terminal design and support shall be in accordance with NFPA 780. Terminals shall be rigidly connected to, and made electrically continuous with, conductors by means of pressure connectors or crimped joints of T-shaped malleable metal and connected to the air terminal by a dowel or threaded fitting.

3.1.1.2 Down Conductors

Down conductors shall be electrically continuous from air terminals to grounding electrodes.

3.1.1.3 Interconnection of Metallic Parts

Gutters shall be connected directly to the grounds or down conductors using not smaller than No. 6 copper conductor, or equivalent. Conductors placed where there is probability of unusual wear, mechanical injury, or corrosion shall be of greater electrical capacity than would normally be used, or shall be protected.

3.1.1.4 Ground Connections

Ground connections comprising continuations of down conductors from the structure to the grounding electrode shall securely connect the down conductor and ground in a manner to ensure electrical continuity between the two. All connections shall be of the clamp type. There shall be a ground connection for each down conductor. Metal water pipes and other large underground metallic objects shall be bonded together with all grounding mediums. Ground connections shall be protected from mechanical injury. In making ground connections, advantage shall be taken of all permanently moist places where practicable, although such places shall be avoided if the area is wet with waste water that contains chemical substances, especially those corrosive to metal.

3.1.1.5 Grounding Electrodes

A grounding electrode shall be provided for each down conductor located as shown. A driven ground shall extend into the earth for a distance of not less than 10 feet. Ground rods shall be set not less than 3 feet, nor more than 8 feet, from the structures foundation. The complete installation shall have a total resistance to ground of not more than 10 ohms if a counterpoise is not used. Ground rods shall be tested individually prior to connection to the system and the system as a whole shall be tested not less than 48 hours after rainfall. When the resistance

of the complete installation exceeds the specified value or two ground rods individually exceed 50 ohms, the Contracting Officer will be notified immediately. A counterpoise, where required, shall be of No. 1/0 copper cable or equivalent material having suitable resistance to corrosion and shall be laid around the perimeter of the structure in a trench not less than 2 feet deep at a distance not less than 3 feet nor more than 8 feet from the nearest point of the structure. All connections between ground connectors and grounds or counterpoise, and between counterpoise and grounds shall be electrically continuous. Where so indicated on the drawings, an alternate method for grounding electrodes in shallow soil shall be provided by digging trenches radially from the building. The lower ends of the down conductors are then buried in the trenches.

3.1.2 Tanks and Towers

3.1.2.1 Metal or Reinforced-Concrete Tanks and Towers

The metal or reinforcing steel shall be made electrically continuous. Electrical continuity may be provided by bolting, riveting, or welding metal and tying or clipping reinforcing bars, unless a specific method is noted on the drawings. Air terminals and down conductors are required except on bolted, riveted, or welded 3/16-inch minimum, steel plate tanks. Ground connections and grounding electrodes are not required on metal tanks that are electrically continuous with a metallic underground pipe system. On other structures, two ground connections shall be provided approximately 180 degrees apart, at the base of the structure. Where buried metal pipes enter the tank or tower, one ground connection shall be connected to them, approximately 1 foot below finished grade. Metal guy wires on tanks and towers shall be grounded. Metal guy wires or cables attached to steel anchor rods set in earth will be considered as grounded. Metal guy wires or cables set in concrete or attached to buildings or nonconducting supports shall be grounded to a ground rod driven full length into the ground.

3.2 INTERCONNECTION OF METAL BODIES

Metal bodies of conductance shall be protected if not within the zone of protection of an air terminal. All metal bodies of conductance having an area of 400 square inches or greater or a volume of 1000 cubic inches or greater shall be bonded to the lightning protection system using main size conductors and a bonding plate having a surface contact area of not less than 3 square inches. Provisions shall be made to guard against the corrosive effect of bonding dissimilar metals. Metal bodies of inductance shall be bonded at their closest point to the lightning protection system using secondary bonding conductors and fittings. A metal body that exceeds 5 feet in any dimension, that is situated wholly within a building, and that does not at any point come within 6 feet of a lightning conductor or metal connected thereto shall be independently grounded.

3.3 FENCES

Except as indicated below, metal fences that are electrically continuous with metal posts extending at least 2 feet into the ground require no additional grounding. Other fences shall be grounded on each side of every gate. Fences shall be grounded by means of ground rods every 1000 to 1500 feet of length when fences are located in isolated places, and every 500 to 750 feet when in proximity (100 feet or less) to public roads, highways, and buildings. The connection to ground shall be made from the post where it is of metal and is electrically continuous with the fencing.

All metal fences shall be grounded at or near points crossed by overhead lines in excess of 600 volts and at distances not exceeding 150 feet on each side of line crossings.

3.4 SEPARATELY MOUNTED SHIELDING SYSTEM, MAST-TYPE

The mast-type protection shall consist of a pole, which, when of a nonconducting material, shall be provided with an air terminal mounted to the top, extending not less than 2 feet nor more than 5 feet above the top of the pole and a down conductor run down the side of the pole and connected to the ground rod. When a metal pole is used, the pole will act as a down conductor, and an air terminal need not be provided. Where the resistance of the pole to ground is 10 ohms or less, additional grounding is unnecessary. Where the resistance exceeds 10 ohms, additional grounding shall be provided, and the ground connection shall be fastened to the metal pole and the ground. When a ground rod is necessary, the rod shall be driven approximately 6 feet from the base of the pole. When the combined measured resistance to ground of the pole and ground rod exceeds 10 ohms, the Contracting Officer will be notified immediately. The grounding system at the base of the pole shall be interconnected with any grounding system provided for the protected structure.

3.5 SEPARATELY MOUNTED SHIELDING SYSTEM, OVERHEAD GROUND-WIRE TYPE

This type of protection shall consist of two or more poles electrically connected to each other by overhead conductors. Where the poles are made of a nonconducting material an air terminal shall be mounted to the top of each pole and shall extend not less than 2 nor more than 5 feet above the top of the pole. Down conductors shall be run down the side of the pole, or a guy wire may be used as a conductor. When the guy wire is used, the guy wire and the overhead ground wire shall be dead-ended at the pole. The overhead ground wire and the guy wire shall then be connected to each other by a separate cable using standard cable clamps in such manner that the discharge will not be reversed at any point. Guy wires used as down conductors shall be grounded by means of separate ground rods with cable connections clamped to the lower end of guy wire. Resistance to ground shall not exceed 25 ohms.

3.6 INSPECTION

The lightning protection system will be inspected by the Contracting Officer to determine conformance with the requirements of this specification. No part of the system shall be concealed until so authorized by the Contracting Officer.

-- End of Section --

SECTION 16721

FIRE DETECTION AND ALARM SYSTEM
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.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C135.30	(1988) Zinc-Coated Ferrous Ground Rods for Overhead or Underground Line Construction

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P7825	(1994; Supple 1) Approval Guide

FEDERAL STANDARDS (FED-STD)

FED-STD 595	(Rev B) Colors Used in Government Procurement

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41	(1991) Surge Voltages in Low-Voltage AC Power Circuits

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1993) National Electrical Code
NFPA 72	(1993) National Fire Alarm Code
NFPA 90A	(1993) Installation of Air Conditioning and Ventilating Systems

UNDERWRITERS LABORATORIES (UL)

UL-04	(1994) Fire Protection Equipment Directory
UL 6	(1993) Rigid Metal Conduit
UL 38	(1994; Rev Jan 1994) Manually Actuated Signaling Boxes for Use with Fire-Protective Signaling Systems
UL 228	(1993) Door Closers-Holders, with or without Integral Smoke Detectors
UL 268	(1989; Rev May 1989) Smoke Detectors for Fire Protective Signaling Systems

UL 464	(1990) Audible Signal Appliances
UL 467	(1993) Grounding and Bonding Equipment
UL 521	(1993) Heat Detectors for Fire Protective Signaling Systems
UL 797	(1993) Electrical Metallic Tubing
UL 864	(1991; Rev thru May 1994) Control Units for Fire-Protective Signaling Systems
UL 1242	(1983; Rev thru Jul 1993) Intermediate Metal Conduit

1.2 GENERAL REQUIREMENTS

1.2.1 Standard Products

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall be items that have been in satisfactory use for at least 5 years prior to bid opening. Equipment shall be supported by a service organization that can provide service within 24 hours.

1.2.2 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.

1.2.3 Keys and Locks

Locks shall be keyed alike.

1.2.4 Tags

Tags with stamped identification number shall be furnished for keys and locks.

1.2.5 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.

1.2.6 Compliance

The fire detection and internal alarm system and the central reporting system shall be configured in accordance with NFPA 72. The equipment furnished shall be compatible and be UL listed or FM approved or approved or listed by a nationally recognized testing laboratory in accordance with the applicable NFPA standards.

1.2.7 Manufacturer's Services

Services of a manufacturer's representative who is experienced in the installation, adjustment, testing, and operation of the equipment specified

shall be provided. The representative shall supervise the installation, adjustment, and testing of the equipment.

1.3 SYSTEM DESIGN

1.3.1 Operation

The fire alarm and detection system shall be a complete, supervised fire alarm 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 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, in accordance with NFPA 72. Alarm indicating appliances shall be connected to indicating appliance circuits (IAC), Style Z in accordance with NFPA 72. A two-loop conduit system shall be provided so that if any one conduit and all conductors contained in that conduit are severed all IDC or IAC on that circuit shall remain functional. A two-loop system is not applicable to the central fire alarm communication center from the local panels. All textual, audible, and visual appliances and systems shall comply with NFPA 72.

1.3.2 Operational Features

The system shall have the following operating features:

a. Electrical supervision of alarm IDC and IAC. Smoke detectors shall have combined alarm initiating and power circuits.

b. 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. Trouble buzzer and trouble lamp (light emitting diode or neon light) 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 lamp. 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. 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. Evacuation alarm silencing switch or switches which, when activated, will silence alarm devices, but will not affect the zone indicating lamp nor the operation of the transmitter. This switch shall be over-ridden upon activation of a subsequent alarm from an unalarmed zone and the alarm devices will be activated.

f. Electrical supervision of circuits used for supervisory signal services. Supervision shall detect any open, short, or ground.

g. Confirmation or verification modules used on smoke detection initiating circuits. The modules shall interrupt the transmission of an alarm signal to the system control panel for a factory set 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. All fire alarm devices other than smoke detectors shall be prohibited on circuits controlled by confirmation or verification modules.

h. Zones for alarm IDC shall be arranged as indicated on the contract drawings.

1.3.3 Alarm Functions

An alarm condition on a circuit shall automatically initiate the following functions:

a. Transmission of a signal over the station radio fire reporting system. The signal shall be common for all zones.

b. Visual indications of the alarmed zones on the fire alarm control panel annunciator.

c. Continuous sounding of alarm notification appliances throughout the building.

1.3.4 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.

1.3.5 Battery Backup Power

Battery backup power shall be through use of rechargeable, sealed-type storage batteries and battery charger.

1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FI0" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL DESCRIPTIONS:

SD-01 Data

Battery; FIO.

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; FIO.

Voltage drop calculations for signaling appliance circuits to indicate that sufficient voltage is available for proper appliance operation.

Spare Parts; FIO.

Spare parts data for each different item of material and equipment specified, not later than 1 month 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.

Qualifications; FIO.

Qualifications, with verification of experience and license number, of a Registered Professional Engineer with at least 4 years of current experience in the design of the fire protection and detection systems. This engineer must perform the various specification items required by this section to be performed by a registered Professional Engineer.

SD-04 Drawings

Fire Alarm Reporting System; GA.

Detail drawings, signed by the Registered Professional Engineer, 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, signed by the Registered Professional Engineer, showing all points of connection. Diagram shall include connections between system devices, appliances, control panels, supervised devices, and all equipment that is activated or controlled by the panel.

SD-06 Instructions

Fire Alarm Reporting System; GA.

Six copies of operating instructions outlining step-by-step procedures required for system startup, operation, and shutdown. 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. Six copies of maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guide. The instructions shall include conduit layout, equipment layout and simplified wiring, and control diagrams of the system as installed. Instructions shall be approved prior to training.

SD-08 Statements

Test Procedures; FIO.

Detailed test procedures, signed by the Registered Professional Engineer,

for the fire detection and alarm system 60 days prior to performing system tests.

SD-09 Reports

Testing; FIO.

Test reports in booklet form showing all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall document all readings, test results and indicate the final position of controls.

SD-13 Certificates

Equipment; FIO.

Certified copies of current approvals or listings issued by UL, FM or other nationally recognized testing laboratory, showing compliance with specified NFPA standards.

Installer; FIO.

The Contractor shall provide documentation demonstrating that its fire detection and alarm system installer has been regularly engaged in the installation of fire detection and alarm systems meeting NFPA standards for a minimum of three years immediately preceding commencement of this contract. Such documentation shall specifically include proof of satisfactory performance on at least three projects similar to that required by these specifications, including the names and telephone numbers of using agency points of contact for each of these projects. Documentation shall indicate the type of each system installed and include a written certificate that each system has performed satisfactorily in the manner specified for a period of not less than 12 months following completion. All such data shall be submitted 30 days prior to commencement of installation for approval of the Contracting Officer. Listing of the installer under "Protective Signaling Services - Local, Auxiliary, Remote Station Proprietary (UUJS)" of UL-04 shall be accepted as equivalent proof of compliance with the foregoing experience requirements.

1.5 DELIVERY AND STORAGE

All equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variation, dirt and dust, and any other contaminants.

PART 2 PRODUCTS

2.1 CONTROL PANEL

Control Panel shall comply with all 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 all 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 all lamps, zones, controls, meters, fuses, and switches. Nameplates for fuses shall also include ampere rating. Separate alarm and trouble lamp shall be provided for each zone alarm located on exterior of cabinet door or be visible through the

cabinet door. Control panel switches shall be within the locked cabinet. A suitable means shall be provided for testing the control panel visual indicating devices (meters or lamps). Meters and lamps shall be plainly visible when the cabinet door is closed. Signals shall be provided to indicate by zone any alarm, supervisory or trouble condition on the system.

Each IDC initiating circuit shall be powered and supervised so that a signal on one zone does not prevent the receipt of signals from other zones. Loss of power, including any or all batteries, shall not require the 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 annunciators shall be provided for each active zone and spare zone. Spare zones shall be provided as shown on the drawing. Each lamp shall provide specific identification of the zone by means of a permanently attached rigid plastic, phenolic or metal sign with either raised or engraved letters. Zone identification shall consist of word description of the zone.

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 all units. All shall be painted red similar to FED-STD 595 color, number 11105.

2.1.1 Circuit Connections

Circuit conductors entering or leaving the panel shall be connected to screw-type terminals with each terminal marked for identification.

2.2 STORAGE BATTERIES

Storage Batteries shall be provided and shall be the 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 48 hours. Following this period of operation via batteries, 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 sized to deliver 50 percent more ampere/hours based on a 48 hour discharged rate than required for the calculated capacities. Battery cabinet shall be a separate compartment within the control panel. Batteries in the control panel shall be located at the bottom of the panel. Battery shall be provided with overcurrent protection in accordance with NFPA 72.

2.3 BATTERY CHARGER

Battery charger shall be completely automatic, with high/low charging rate, capable of restoring the batteries from full discharge to full charge within 12 hours. A separate ammeter shall be provided for indicating rate of charge. A separate voltmeter shall be provided to indicate the state of the battery charge. 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.

2.4 MANUAL FIRE ALARM STATIONS

Manual fire alarm stations shall conform to the applicable requirements of UL 38. Manual stations shall be connected into alarm-initiating circuits. Stations shall be installed on surface mounted outlet boxes. Stations shall be single 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. Stations shall have a separate screw terminal for each conductor. Surface mounted boxes shall be 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, 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 shall be connected into alarm initiating circuits. Detectors located in concealed locations (above ceiling, etc.) shall have a remote visible indicator lamp. Installed devices shall conform to the classification of the area.

2.5.1 Smoke Detectors

Detectors shall be designed for detection of abnormal smoke densities. Smoke detectors shall be photoelectric type. Detectors shall contain a visible indicator lamp 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 all wiring connections. Detectors that are in concealed (above false ceilings, etc.) locations shall have a remote visible indicator lamp.

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 between 1.9 and 2.4 percent per foot when tested in accordance with UL 268.

2.6 NOTIFICATION APPLIANCES

Audible appliances shall be heavy duty and conform to the applicable requirements of UL 464. Devices shall be connected into alarm indicating circuits. All devices shall have a separate screw terminal for each conductor. All shall be painted red similar to FED-STD 595 color, number 11105.

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.

2.7 FIRE DETECTION AND ALARM SYSTEM PERIPHERAL EQUIPMENT

2.7.1 Grounding

Fire Alarm system shall be grounded to the building grounding system via a #6 bare solid copper wire.

2.7.2 Conduit

Conduit and fittings shall comply with UL 6, UL 1242 and UL 797.

2.7.3 Wiring

Wiring for 120V ac power shall be No. 12 AWG minimum. Wiring for low voltage dc circuits shall be No. 14 AWG minimum. Power wiring (over 28 volts) and control wiring shall be isolated. All wiring shall conform to NFPA 70. System field wiring shall be solid copper and installed in metallic conduit or electrical metallic tubing, except rigid plastic conduit may be used under slab-on-grade. All 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 alarm initiating, supervisory circuits, and alarm indicating circuits are prohibited. T-tapping using screw terminal blocks is allowed for addressable systems.

2.7.4 Special Tools and Spare Parts

Special tools necessary for the maintenance of the equipment shall be furnished. Two spare fuses of each type and size required and five spare lamps and LED's of each type shall be furnished. Two percent of the total number of each different type of detector, but no less than two each, shall be furnished. Fuses and lamps shall be mounted in the fire alarm panel.

PART 3 EXECUTION

3.1 INSTALLATION

All work shall be installed as shown and in accordance with the manufacturer's diagrams and recommendations, unless otherwise specified. Smoke detectors shall not be installed until the building has been thoroughly cleaned.

3.1.1 Power Supply for the System

A single dedicated circuit connection for supplying power to each building fire alarm system shall be provided. The primary power shall be supplied as shown on the drawings. The power supply shall be equipped with a locking mechanism and marked "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. No more than one conductor shall be installed under any screw terminal. All circuit conductors entering or leaving any mounting box, outlet box enclosure or cabinet shall be connected to screw terminals with each terminal marked in accordance with the wiring diagram. Connections and

splices shall be made using screw terminal blocks. The use of wire nut type connectors are prohibited in the system. 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. All manually operable controls shall be between 36 inches to 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 installed in accordance with NFPA 72. 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 free 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.

3.1.5 Notification Appliances

Notification appliances shall be mounted a minimum of 8 feet above the finished floor unless limited by ceiling height or otherwise indicated.

3.1.6 Annunciator Equipment

Annunciator equipment provided shall be mounted where indicated.

3.2 OVERVOLTAGE AND SURGE PROTECTION

All equipment connected to alternating current circuits shall be protected from surges per IEEE C62.41 and NFPA 70. All cables and conductors which serve as communications links, except fiber optics, shall have surge protection circuits installed at each end. Fuses shall not be used for surge protection.

3.3 GROUNDING

Grounding shall be provided to building ground. Maximum impedance to ground shall be 25 ohms.

3.4 TESTING

The Contractor shall notify the Contracting Officer 30 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 all tests. The Contractor shall furnish all 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. Tests shall include the meggering of all 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.

3.4.2 Acceptance Test

Testing shall be in accordance with NFPA 72. The recommended tests in NFPA 72 shall be considered mandatory and shall verify that all previous deficiencies have been corrected. The test shall include 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 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 all 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 shall consist of 1 training day (2 hours per day) and shall start after the system is functionally completed but prior to final acceptance tests. The instructions shall cover all of the items contained in the operating and maintenance instructions.

-- End of Section --

SECTION 16900

INSTRUMENT INSTALLATION
08/95

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 SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A-269	(1990) Seamless and Welded Authentic Stainless Steel Tubing for General Service

INSTRUMENT SOCIETY OF AMERICA (ISA)

ISA RP 7.1	(1956) Pneumatic Control Circuit Pressure Test
ISA RP 60.9	(1981) Piping Guide for Control Centers

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1993) National Electric Code

1.2 GENERAL REQUIREMENTS

This specification together with Technical Data Sheets (Appendix A), Instrument Lists, Location and Routing drawings, Installation Details and related drawings, provides the requirements for installation, inspection and testing of field instrumentation, air supply piping, transmission and control tubing, and instrument process piping, for an industrial plant.

Quantities of materials required for installation shall be determined from instrument drawings, specifications, standards, and field observation.

1.2.1 Hazardous Environment

System components located in fire or explosion hazard areas shall be rated and installed according to Chapter 5 of NFPA 70 and as shown.

1.2.2 Electrical Requirements

The equipment shall operate from a voltage source as shown, plus or minus 10%, and 60 Hz, plus or minus 2%.

1.2.3 Instrument Tags

Each instrument will be identified with a 316 SS instrument tag. Tags should be firmly attached with stainless steel wire. Tags to be labeled with 1/8" high lettering shwoing designated instrument tag number.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL DESCRIPTIONS:

SD-06 Instructions

Manufacturers' Recommendations; GA.

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 shall be submitted prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received and approved.

Operation and Maintenance Instructions; GA.

Instructions shall include the manufacturer's name, service manual, parts list, and a brief description of equipment, components, and their basic operating features. A copy of the maintenance instructions listing regular maintenance procedures, possible system failures, a troubleshooting guide for repairs, and simplified diagrams for the system as installed shall be provided where applicable.

SD-19 Operation and Maintenance Manuals and Verification Testing

Components with Technical Data Sheets (Appendix A); GA.

Manufacturer's O&M manuals and Verification Testing where applicable.

1.4 DELIVERY, HANDLING, AND STORAGE

The instruments and accessories shall be adequately and securely packed for shipment to the installation site.

Instruments and accessories shall be stored in the original shipping containers, above ground level, in bins or racks free from rain or water contact, in a clean dry sheltered area where ambient temperatures remain between 32F and 120F.

All identification tags shall be left securely attached to the instrument and shall not be removed during installation. Care shall be taken to assure that the miscellaneous accessories are stored with the instrument with which they are associated.

Control valves, relief valves, rotameters, level devices, and other instruments that will be installed in pipe lines or vessels are to be protected such that foreign matter cannot enter the end fittings, diaphragms, tubes or other internal parts of the instrument.

Tubing, pipe, fittings, and valves used in the installation of pneumatic instruments shall be kept free of moisture and foreign matter. All ends shall be kept sealed during storage to assure that moisture and foreign matter do not enter.

PART 2 PRODUCTS

2.1 COMPONENTS

The Technical Data Sheets (Appendix A) cover the technical requirements for engineering, design, manufacture, and performance of various instruments.

The equipment furnished according to this specification shall conform to the requirements contained herein and as specified in the Technical Data Sheets.

2.2 CONDUIT, FITTINGS AND ENCLOSURES

Conduit shall be as specified in Section 16415 ELECTRICAL WORK, INTERIOR and Section 16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND and as shown on the Instrument Installation Details.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Installation of Instruments

Instruments shall be mounted at the locations and elevations shown on the Piping Layout and Instrument Location or Electrical Drawings, giving easy access for maintenance and calibration so that test jacks, adjustments, and the like are reached from the top, front, or side and not from the bottom of the instrument.

Should the designated location or elevation of an instrument be found impractical or to result in interference with other equipment, Contractor shall select an alternate arrangement with Purchaser's approval.

Instruments and primary instrument lines shall be installed from the root valve as shown on the Instrument Installation Details. These details shall be used as a guide for modifying, revising, or developing new details for instruments and installations not included as part of these specifications.

Should the designated instrument connections on the piping layout drawings differ from those on the instrument, as furnished, the Contractor shall revise the connections to conform to the intent of the Instrument Installation Details.

Instruments shall be mounted plumb and level and in upright position unless otherwise indicated on the drawings. Impulse piping or electrical conduits shall not be used for support of instruments or accessories.

Field mounted instruments shall be mounted on racks, floor stands, structural steel, or masonry structures. Instruments shall be grouped together by systems wherever possible. Tubing runs greater than 50 feet should be avoided. Instruments shall not be mounted on vibrating equipment. Where instruments are to be mounted on fire-proofed members, the installer shall assure that the mounting hardware is in place prior to fire proofing. Mounting hardware attached to masonry shall be painted prior to mounting, to eliminate rust discoloration of the masonry.

Instrument cases shall be positioned such that doors may be fully opened, covers are fully removable, vent holes are not blocked, and adjustment screws, valves, wiring, and piping connections are accessible.

Instruments shall not be mounted adjacent to hot or vibrating equipment (except where directly attached to vessels) and shall not be mounted under

drain points nor immediately above vent points.

Pressure gages, meters, transmitters, etc. shall be mounted for operating, calibration, and maintenance convenience near the equipment they serve. Pressure gages shall have a shut-off valve between the gage and the line as detailed in the Instrument Installation Details. Gages on steam lines shall have a syphon installed ahead of the gage.

Pressure gages, switches, transmitters, etc. shall be installed as close as possible to the process connection with suitable block and bleed valves between the instrument and process tap. Pressure gages furnished with syphons or "pigtail" condensate seals, used for steam or other hot condensible vapors, shall be mounted above the process connection to allow for condensate drainage to the process. Pressure transmitters used in liquid or steam service shall be mounted below the process connection with all lines sloping towards the instrument to permit self venting. Transmitters that are remotely mounted from the process tap shall be provided with a block valve at the tap and another close to the instrument.

Orifice plates, control valves, and other in-line instruments shall not be installed until pipe lines have been pressure tested, flushed, and cleaned. Orifice plates shall be accurately centered in the pipe and installed with the sharp flat edge on the upstream side.

Control valve handwheels shall be positioned so that they are located on the accessible side of the valve. Positioners shall be mechanically free to operate with the instrument air turned on and the bypass closed.

Temperature sensor assemblies shall be readily accessible and adaptable to each type of application in such a manner as to allow for quick, easy replacement and servicing without special tools or skills.

3.1.2 Instrument Racks

Transmitters, current-pneumatic transducers, and other instruments located in close proximity to one another may be mounted on an instrument rack instead of separate supports. The rack shall be rigid and self supporting, framed with angle iron, primed, and painted with rust inhibitive paint. All instruments shall be piped to air supply manifolds and wired to terminal strips, as required. The rack shall be installed as close as possible to the process area so as to minimize the primary tube runs.

Instruments that require an air supply shall be supplied from a common manifold. The manifold shall be one inch with 1/2 inch takeoff to each user. Each takeoff shall have a 1/2 inch packless shut-off valve to isolate the instrument for service.

Wiring for electronic instruments shall be run in conduit or cable tray, and terminated at barrier type terminal strips. The barrier strips shall have screw terminals for No. 12 AWG wire minimum. Instrument wiring shall be cable tray rated No. 16 AWG twisted shielded pairs rated at 300 volts with PVC insulation. 120VAC control wiring shall be cable tray rated No. 14 AWG twisted pair, rated at 600 volts with PVC insulation.

3.1.3 Installation of Pneumatic Piping and Tubing

Instrument air piping shall include takeoff valves, filter regulators, and pressure indicators as required on projected drawings.

Piping for pneumatic primary measuring instruments and controls shall be arranged, routed, and installed in accordance with best engineering, efficient, functioning, and pleasing appearance without obstructing access for operation and maintenance. Where feasible, instrumentation and control piping shall be grouped and run together.

The installation of pneumatic piping and tubing shall conform to ISA RP 60.9 and the following requirements.

Lines in the air supply distribution system should be sized such that the maximum pressure drop from the air dryer to the most remote air user does not exceed 5 psi with 100 psig supply, when all users are taking air at approximately 2 to 5 SCFM. Branch piping to individual instrument shall be a minimum of 1/2 inch NPS. Air supply to individual instrument supplied from a common manifold or header may be either 1/4 or 3/8 OD stainless-steel tubing.

Header, branch, and sub-branch piping material for the Instrument Air System shall be in accordance with the applicable piping specification. Continuations from the sub-branch to the instrument shall be in accordance with the Instrument Installation Details.

Threaded fittings shall be made up using Teflon tape. Care shall be taken to assure that the tape is applied to the male thread only and does not enter the inside wall of the pipe.

Prior to connecting instrument air piping to the instrument or accessory, the lines shall be pneumatically blown free of moisture, loose scale, and foreign matter.

3.1.4 Installation of Transmission and Control Tubing

Instrument tubing shall be adequately supported with Unistrut type supports. Adequate support shall consist of supporting the tubing at the following spacings:

Vertical: Maximum 36" centers
Horizontal: Maximum 24" centers

Tubing shall be installed with sufficient flexibility to prevent undue stresses in tubing and at end connections caused by thermal expansion or vibration. Tubing shall not be fastened directly to concrete.

Where tubing requires bending, bends shall be made using a bender sized for the tubing being bent, and according to tubing manufacturer's instructions. Care shall be taken to assure that a reasonable bending radius is maintained and tubing is not flattened or pinched.

Cutting of tubing shall be done with a commercial tubing cutter. Ends shall be cut 90 to the wall of the tubing and shall be reamed to the original inside diameter of the tube. All chips or shavings shall be removed.

Tubing fittings for transmission and control tubing shall be as specified herein. Tubing fittings shall be made up using teflon tape. Thread compound shall not be used. Fittings shall be made up and checked according to fitting manufacturer's instructions.

Prior to tightening the tubing collar to the fitting, care shall be taken

to assure that the tubing end is square, inserted fully through the ferrule into the tube fitting, and is properly aligned with the fitting. Tightening of the collar shall be done with the proper sized wrench.

Wherever possible, single tubes shall be grouped and run together in small carrier channels. Coiled tubing shall be fully straightened before installation.

Routing of single tubes and groups of single tubes shall be determined in the field. Care shall be taken in planning the installation that tubes are orderly grouped and their carrier channels are routed as directly as possible to the instruments.

Tubing bends shall be made with an approved tubing bender, and terminations shall be made as discussed under bundled tubing installations above.

Carrier channels shall be rigidly mounted to permanent structural members and shall not be bracketed to equipment, which may be removed for maintenance purposes.

Tubing shall be securely clamped to the carrier assuring that the tube is not pinched or damaged when clamped in place.

Where cutting of the carrier channel is required, raw edges shall be painted or coated with a material equal to the original finish.

3.1.5 Installation of Instrument Process and Sampling Piping (or Tubing)

The extent and arrangement of process piping or tubing beyond the primary block valve shall be as indicated on the Instrument Installation Details. Materials of construction for impulse piping or tubing and associated valves and fittings are indicated on the Instrument Installation Details and specified herein.

All process connecting lines shall be pneumatically blown free of moisture, loose scale, and foreign matter prior to connecting to the primary side of the instrument.

Where process connecting lines are indicated to be of rigid pipe construction, care shall be taken to assure that no stresses or strains are exerted on the instrument, due to improperly aligned or poorly supported piping. Impulse piping to remote located instruments shall be securely bracketed to existing members to relieve any vibration at the instrument.

Threaded fittings for impulse lines of rigid pipe or tubing shall be made up using Teflon tape. Where temperatures exceed 450F, thread compounds suitable for high temperature service shall be used.

Where tubing and tube fittings of the nonflare compression type are used, care shall be taken to assure that the tubing is inserted fully into the fitting prior to tightening.

Process connecting lines shall be sloped in accordance with the Instrument Installation Details.

Wherever thermal expansion movement is indicated, the primary line shall be installed so that this movement is taken into consideration. The usual procedure is to provide either a 6 in. "Vee" bend at the point of expansion, or a 3-ring loop (6 in. diam min) on the line at the point of

expansion.

Wherever vibration is indicated, a coil of two or three loops shall be provided in a horizontal plane in the primary line at the pressure source connection. Rubber inserts of 1/8 in. thick gasket material shall be placed between each tube clamp and tubing at all points affected by vibration.

3.1.6 Materials for Instrument Piping and Tubing

3.1.6.1 Primary Instrument and Sampling Tubing

All tubing for this service shall have a minimum outside diameter of «-inch (except where noted) and shall conform to the following requirements:

ASTM A-269 Grade TP316
Seamless Stainless Steel
Cold Drawn Fully Annealed
Dimensions:

Actual O.D. Inches	Wall Thickness Inches
3/8	0.065
1/2	0.065

The supplier of the tubing shall verify that all requirements of the material specifications have been complied with and that the tubing meets these requirements.

Weld repairs shall not be allowed on the tubing.

3.1.6.2 Instrument Air Supply and Pneumatic Control Tubing

All tubing for this service shall conform to the following requirements:

ASTM A-269, Grade TP316
Seamless Stainless Steel
Cold Drawn Fully Annealed
Dimensions:

Actual O.D. Inches	Wall Thickness Inches
1/4	0.035
3/8	0.035
1/2	0.049
5/8	0.049
3/4	0.065
1	0.065

The supplier of the tubing shall verify that requirements of the material specification have been complied with and that the tubing meets these requirements.

3.1.6.3 Stainless Steel Fittings

Compression Type Fittings: Fittings for those joints, where connection of a primary sensing line or a sampling line is made, shall be furnished in

accordance with the following specifications:

Tube Size, O.D. inches: 1/4, 3/8, 1/2, 3/4
Type: Compression
Rating: 5500 psi @ 72F; 3200 psi @ 1000F
Material: 316 Stainless Steel

The supplier of the compression type fittings shall certify that the fittings are suitable for use with 316 stainless-steel tubing that is fabricated per ASTM A-269 with a maximum Rockwell Hardness of Rb90.

3.1.6.4 Brass Fittings

Compression Type Fittings: Fittings for those joints, where connection of an air supply line or a pneumatic control line to an instrument, or an air supply regulator is made, shall be furnished in accordance with the following specifications:

Tube Size, O.D. inches: 1/4, 3/8, 1/2
Type: Compression
Material: Brass

3.1.6.5 Globe Valves

The valves applicable to this section are the instrument valve, the test valve, and the backup root valve (when specified). The valves for these applications shall be furnished in accordance with the following specifications:

Rating: 6,000 psi @ 100F, 3000 psi @ 1,000F
Body Design: Globe
Body Material: 316 Stainless Steel
Construction: Screwed Bonnet, 316 Stainless Steel
Plug and Stem: Stainless Steel
Seat: Stainless Steel
Packing: Grafoil or equal
End Connections: Threaded
Sizes in inches: 1/4, 3/8, 1/2, 5/8, 3/4

Weld repair of defects on the pressure boundaries of a valve body shall not be allowed.

3.1.6.6 Needle Valves

The valves applicable to this section are the sample regulating valves. These valves shall be furnished in accordance with the following specifications:

Rating: 4,000 psi @ 100F, 2,500 psi @ 700F
Body Design: Needle
Body Material: 316 Stainless Steel
Construction: Screwed bonnet, 316 stainless steel
Plug and Stem: Stainless Steel
Seat: Stainless Steel
Packing: Teflon
Sizes: 1/4, 3/8, 1/2
End Connections: Threaded

3.1.6.7 Brass Valves

Instrument Air Supply: The valves applicable to this section may be the individual instrument air supply shut-off valves where brass is specified, they shall be furnished in accordance with the following specifications:

Working Pressure: 3,500 psi @ 72F
Body Material: Brass
Construction: Screwed Bonnet
Stem: Stainless Steel
Sizes: 1/4, 3/8, 1/2 inch
End Connections: Pipe to Pipe, Pipe to Tube, Tube to Tube

3.2 FIELD QUALITY CONTROL

3.2.1 Flushing, Purging, and Testing

Pneumatic piping and tubing shall be cleaned of all foreign material by pressurizing one end with clean, dry, oil free 20 psig air. The air shall flow freely out of the other end to indicate that the line is not plugged. Lines showing evidence of grease or oil shall be solvent cleaned.

Piping and tubing for instrument pressure leads to process mains and headers shall be cleaned of all foreign material by pressure flushing or by blowing with clean, dry, oil free compressed air.

Where required, piping and tubing for instrument air supply and process sensing lines shall be tested in accordance with ISA RP 7.1. Signal air lines shall be pressure tested with clean, dry, oil free air and checked for leaks by applying a soap and water solution to all joints. There shall be no leaks. Lines shall be further tested for leaks by blocking in the system under pressure for a 15-minute period. The line will be considered satisfactory if the drop in pressure at the conclusion of the test period does not exceed 10%. Instruments shall not be directly connected to lines under test.

Piping and tubing for instrument pressure leads to process mains and headers shall be tested in accordance with requirements for pressure testing the line to which they are connected. If testing procedures would subject the instruments to pressures exceeding the range of the instruments, the instruments shall be isolated from the line under test.

Where instrument impulse lines are connected to process and utility piping, the impulse line shall be disconnected from the instrument and capped prior to system pressure testing. Pressure testing of instrument impulse lines shall be in accordance with the applicable piping test procedures.

Fragile devices such as pH electrodes, conductivity probes, or other highly sensitive components shall be removed from the lines or vessels prior to systems pressure testing.

Where instruments are connected to vessels such as level gage glasses, ball floats, or displacement level units, care shall be taken to assure that the design pressure rating of the instrument is above the proposed test pressures.

All control valves and damper operators shall be cleared of dirt and debris and exercised/stroked for satisfactory operation. This includes checkout for rigid and correct mounting of limit switches, position transmitters, solenoid valves, air supply regulators, current-to-pneumatic converters,

positioners, air cylinders, motor drives, and connecting linkage.

3.2.2 Preoperational Tests and Calibration

Preoperational tests and calibration shall be performed on all instruments, control loops, and systems. All loop components, pneumatic drives, control valves, piping, tubing, and wiring shall have been permanently mounted and testing shall have been completed before the preoperational tests and calibration of instrument installations are initiated. All electrical wiring shall have been rung out and tested for continuity and integrity of connections and subjected to all other tests specified for that wiring. The tests and calibration shall be performed by the Contractor.

The calibrating equipment used shall be NIST traceable, calibrated prior to and after use, and the reports furnished to the buyer so to validate the test equipment. All instruments calibrated using a piece of test equipment found to be defective at the post-use NIST calibration shall be re-calibrated.

3.2.2.1 Preoperational/Loop Tests

For purposes of preoperational checkout, all instrumentation shall be considered to fall into one of two groups:

1. Single-Element Installations--Such as pressure gages, thermometers, self-contained control valves, etc.

2. Instrument Loops--Consisting of two or more separate devices. There are two kinds of instrument loops:

<SPR>a. Functionally Closed Loops--Loops without inputs to, or outputs from, other loops or devices. Such loops normally consist of one or more primary measuring devices, such as process-sensing transmitters, switches, etc., operating one or more final elements such as valves, indicators, recorders, etc. Between these primary and final elements there may be one or more intermediate devices such as power supplies, controllers, signal-actuated switches, air solenoid valves, electrical relays, and the like.</SPR>

<SPR>b. Functionally Open Loops--Loops with inputs to, or outputs from, other control loops which must, for practical reasons, be checked out as separate control entities.</SPR>

Each loop shall be checked as needed to verify that each and every component, mechanical and electrical, is undamaged and functional, and to verify loop integrity with respect to signal ranges and directions, as well as direction of action of final control elements; this shall be done without calibrating devices or making quantitative settings. The final loop checks shall include the following:

1. Functionally closed loops should be checked by manipulating the primary sensing device(s) and observing response to the final control element(s). Where this is not practical, the loop shall be divided into two or more overlapping sections, and all devices of each section operated in concert to verify integrity of control action within that section.

2. Functionally open loops vary so widely in character that no single procedure can be specified for all cases, but the following

criteria shall be followed as applicable:

<SPR>a. Inputs from thermocouples shall be checked for reasonable "ball-park" magnitudes while warming or cooling the sensor to positively identify the correct leads. Other analog inputs shall be similarly checked while manipulating their source devices.</SPR>

<SPR>b. Switching devices shall be checked by manipulating that device and verifying that it actuates the correct relay in the correct direction.</SPR>

<SPR>c. Alarm circuits shall be checked by manipulating the switching device to sound the alarm and light up the correct display window through whatever circuitry and/or relays have been provided in the permanent installation.</SPR>

<SPR>d. Analog or on-off inputs from, or outputs to other loops shall be checked by manipulating the sending device and verifying correct action by the receiving device, preferably while operating all loop components in concert.</SPR>

The foregoing loop tests shall generally be made with increasing and decreasing signal inputs at approximately 0%, 10%, 30%, 50%, 80%, and 100% of the full process variable range (head, level, pressure, etc.).

These procedures shall be supplemented with the Manufacturer's instruction manual information covering functional testing of individual instruments and integrated instrument systems and services of manufacturers specialist engineers as required.

When the instrument or instrument loop has been checked out and readied for calibration, the event shall be recorded on a document bearing the date of verification and the signature(s) of the Contractor's representative who performed the inspection.

No instrument shall be calibrated to function at any range other than manufacturer's recommended range, nor shall it be subjected to loads of pressure, voltage, etc., beyond those for which the manufacturer has rated it.

All switching devices actuated by process variables, electrical variables, or analog signals shall be set to open and close at the specified values of increase or decrease and then cycled repeatedly over full range to verify repeatability.

All control loop instruments shall be adjusted for zero, linerity, and span across full range. Their smooth performance shall be verified by cycling across full range a minimum of three times. All instruments shall be adjusted to their full design accuracy.

Every instrument shall be individually calibrated by applying measured inputs and measuring the outputs. In no case shall two or more instruments be gang calibrated, e.g., by feeding measured pressure into a transmitter and then adjusting the receiver gage to agree. This verification shall be known as the calibrated loop check.

After several instruments of a loop have been individually calibrated, they shall be cycled repeatedly in concert by applying a series of measured dummy inputs to the primary device(s), and all loop elements shall be thus verified for quantitative agreement, correct action, and prompt response.

Final control elements such as control valves, damper drives, motor-operated valves, and other power movers, shall be timed while stroking them full cycle at the fastest rate attainable through their permanent control systems, from shut to wide open and from wide open to shut. The stroking times shall be logged as part of the permanent record of calibration.

After an instrument has been calibrated, all pertinent valves and switches shall be positioned and tagged as needed for protection, and a distinctive tag or label shall be affixed to the instrument to indicate that it has been calibrated.

All instruments shall be calibrated in place with all mounting fasteners, piping, and wiring permanently attached and with all supports, ties, and fasteners for both piping and wiring permanently installed and fully tightened. Devices which have been shop-calibrated prior to erection shall be subjected to full recheck after installation as needed to verify that installation and handling have not upset accuracy or functional integrity. No instrument shall be released as calibrated until it has been either calibrated in place or fully rechecked in place.

All calibrated loop checks shall be performed in place with all loop elements permanently mounted, piped, and wired. No loop component shall be considered finally calibrated until this loop check has been completed and the satisfactory interaction of all loop components has been thus verified.

Purchaser shall have full access to all calibrating equipment and records for purposes of inspection; shall be free to fully witness all calibrating equipment and records for purposes of inspection; and shall be free to fully witness all calibrating procedures at any time and without previous notice or application.

Every instrument calibration shall be logged in writing at the time the calibration work is performed on a printed form developed by the Contractor for the purpose. The information thus logged shall include all applicable portions of the following:

1. Instrument tag number, service, and input/output range

2. Date of final calibration and/or calibrated loop check

3. Description of the procedure used

4. Shop numbers of all calibrating equipment used

5. All figures needed to describe settings, input/output values, and the points of range which have been checked.

6. Any appropriate notes and remarks

7. Signature of the technician performing the work, and the name(s) of all personnel assisting him.

If an instrument or loop has been calibrated and checked, but is subsequently recalled for repairs or changes, the Contractor shall amend all pertinent calibration records to record the event.

Upon completion of the preoperational tests and calibration work, the Contractor shall submit a complete report of that work (including calibration data logs for each instrument/loop) to Purchaser. The Contractor shall also submit progress reports to Purchaser during the installation work at regular intervals.

-- End of Section --

Appendix A

Technical Data Sheets

Line C . . . . . Pages A-12 thru A-34

ALL REFERENCES TO 3056 NIC

PRESSURE INDICATOR

HAZARDOUS WASTE TANKS - LINE C TANKS

RADFORD ARMY AMMUNITION PLANT

STONE & WEBSTER ENGINEERING CORP.

PRESSURE GAGES

NO	BY	DATE	REVISION

SHEET A-12 OF 54

SPEC. NO.	REV.
16900	0
CONTRACT 5962896	DATE 4-15-95
REQ. P.O.	
BY / CHK'D	APPR.

1. Type: Direct Rdg ■ 3-15 lb Receiver ☐ Other ____
2. Mounting: Surface ☐ Local ■ Flush ☐
3. Dial: Diameter 4-6 IN. Color MFR. STD
4. Case: Cast Iron ☐ Aluminum ☐ Phenol ☐ Other MFR. STD
5. Ring: Screwed ☐ Hinged ☐ Slip ☐ Std ■ Other ____
6. Blow-out Protection None ☐ Back ■ Disc ☐ Solid Front ☐ Other ____
7. Lens: Glass ☐ Plastic ☐ MFR. STD ■
8. Options: Syphon ☐ Material Snubber ☐ ____ Pressure Limit Valve ☐ ____ Movement Damping ☐ ____
9. Nominal Accuracy Required ± 0.5 % OF SPAN
10. MFR. & Model No. ____
11. Press. Element: Bourdon ■ Bellows ☐ Other ____
12. Element Mtl: Bronze ☐ Steel ■ 316 SS Other ____
13. Socket Mtl: Bronze ☐ Steel ■ 316 SS Other ____
14. Connection-NPT: ¼ in. ☐ ½ in. ■ Other ____ Bottom ■ Back ☐
15. Movement: Bronze ☐ SS ☐ Nylon ☐ Other MFR. STD
16. Diaphragm Seal MFG. ____ Type ____ Wetted Part Mtl. ____ Other Mtl. ____ Fill Fluid ____ Process Conn. ____ Gage Conn. ____

Rev. Quan.	Tag No.	Range	Operating Pressure	Service
	PI 201	0 - 100 psi	60 psi	SETTLING PIT 3056 PUMP SEAL FILTERED WATER SUPPLY

Notes:

ISA FORM S20.41a

PRESSURE INDICATOR WITH DIAPHRAGM SEAL
HAZARDOUS WASTE TANKS - LINE C TANKS
RADFORD ARMY AMMUNITION PLANT
STONE & WEBSTER ENGINEERING CORP.

PRESSURE GAGES

NO	BY	DATE	REVISION

SHEET A-13 OF 54

SPEC. NO.	REV.
16900	0
CONTRACT	DATE
5962896	4-15-95
REQ.	P.O.
BY	CHK'D	APPR.

1. Type: Direct Rdg ■ 3-15 lb Receiver ☐ Other
2. Mounting: Surface ☐ Local ■ Flush ☐
3. Dial: Diameter 4-6 IN. Color MFR. STD
4. Case: Cast Iron ☐ Aluminum ☐ Phenol ☐ Other MFR. STD
5. Ring: Screwed ☐ Hinged ☐ Slip ☐ Std ■ Other
6. Blow-out Protection None ☐ Back ■ Disc ☐ Solid Front ☐ Other
7. Lens: Glass ☐ Plastic ☐ MFR. STD ■
8. Options: Sylphon ☐ Material Snubber ☐ Pressure Limit Valve ☐ Movement Damping ☐
9. Nominal Accuracy Required ±0.5% OF SPAN
10. MFR. & Model No.
11. Press. Element: Bourdon ■ Bellows ☐ Other
12. Element Mtl: Bronze ☐ Steel ■ 316 SS Other
13. Socket Mtl: Bronze ☐ Steel ■ 316 SS Other
14. Connection-NPT: ¼ in. ☐ ½ in. ■ Other Bottom ■ Back ☐
15. Movement: Bronze ☐ SS ☐ Nylon ☐ Other MFR. STD
16. Diaphragm Seal MFG. Type Wetted Part Mtl. 316 SS Other Mtl. 316 SS Fill Fluid MFR. STD Process Conn. 1/2 IN. Gage Conn. 1/2 IN.

Rev. Quan.	Tag No.	Range	Operating Pressure	Service
	PI206	0-160 psi	77 psi	SETTLING PIT PUMP 3056-P3 DISCHARGE
	PI210	0-100 psi	77 psi	SETTLING PIT PUMP 3056-P4 DISCHARGE
	PI213	0-60 psi	43 psi	SETTLING PIT PUMP 3056-P1 DISCHARGE
	PI215	0-60 psi	43 psi	SETTLING PIT PUMP 3056-P2 DISCHARGE
	PI216	0-60 psi	43 psi	SETTLING PIT PUMP 3056-P1 & P2 DISCHARGE
	PI218	0-30 psi	23 psi	SETTLING PIT PUMP 3056-P5 DISCHARGE
	PI224	0-100 psi	77 psi	FORCE MAIN TO BLDG 3057
	PI313	0-30 psi	21 psi	PUMP TANK PUMP 3058-P1 DISCHARGE
	PI316	0-30 psi	21 psi	PUMP TANK PUMP 3058-P2 DISCHARGE
	PI318	0-100 psi	62 psi	PUMP TANK INLINE BOOSTER PUMP 3058-P3 DISCHARGE

Notes: 1. GAGES SHALL BE FURNISHED WITH SEAL AND FILL FLUID.

ISA FORM S20.41a

D

FLOW SWITCH

HAZARDOUS WASTE TANKS - LINE C TANKS
RADFORD ARMY AMMUNITION PLANT
STONE & WEBSTER ENGINEERING CORP.

FLOW SWITCHES

NO	BY	DATE	REVISION

SHEET A-14 OF 54	
SPEC. NO. 16900	REV. 0
CONTRACT 5962896	DATE 4-15-95
REQ. · P.O.	
BY / CHK'D	APPR.

GENERAL

1. Type: Press ☐ Vacuum ☐ FLOW ■ Comp. ☐ Diff. Press. ☐
2. Setting: Set in Field ☐ Factory Set ■ Internal ☐ External ☐ Dial ☐
3. Dead Band: Fixed ■ Adj. ☐ Min. ☐

ELEMENT

4. Type: Diaphragm ☐ Bourdon ☐ Bellows ☐ Other PISTON
5. Material: Bronze ☐ 316 SS ■ Alloy St. ☐ Other
6. Connection: MFR STD ☐ Other Size 1/4 IN. NPT Bottom ☐ Back ☐ INLINE ■
7. Mounting: Local ■ Surface ☐ Flush ☐

SWITCH

8. Type: Mercury ☐ Snap ☐ Other MFR. STD
9. Quantity: Single ■ Dual ☐
10. Form: SPST ☐ SPDT ■ DPDT ☐ Other
11. Rating: 2 Amps ___ V ___ Hz Other
12. Load: Inductive ☐ Non-Inductive ☐
13. Enclosure: General Purpose ☐ Weather proof ■ None ☐ Explosion proof ■ Class SEE NOTE 2
14. Conduit Connection: MFR STD ☐ Other 1/2 IN. NPT

Manufacturer & Model No.

Rev.	Tag. No.	Process Condition	Adj. Range	Set Point Process	Set Point Signal	Operating Temp.	Operating Press.	Service	Notes
	FSL205	LOW FLOW		0.5 GPM		AMB	60 psi	3056-P3 SEAL WATER	1
	FSL 209	LOW FLOW		0.5 GPM		AMB	60 psi	3056-P4 SEAL WATER	1
	FSL 212	LOW FLOW		0.5 GPM		AMB	60 psi	3056-P1 SEAL WATER	1
	FSL214	LOW FLOW		0.5 GPM		AMB	60 psi	3056-P2 SEAL WATER	1
	FSL217	LOW FLOW		0.5 GPM		AMB	60 psi	3056-P5 SEAL WATER	1
	FSL311	LOW FLOW		0.5 GPM		AMB	60 psi	3058-P1 SEAL WATER	1
	FSL314	LOW FLOW		0.5 GPM		AMB	60 psi	3058-P2 SEAL WATER	1
	FSL317B	LOW FLOW		0.5 GPM		AMB	60 psi	3058-P3 SEAL WATER	1

Notes: 1. SETPOINT ACCURACY ± 10%

2. Explosion Proof requirements are Class I & II, Groups C, D, E, F, & G

ISA FORM S20-42a

FLOW SWITCH
HAZARDOUS WASTE TANKS - LINE C TANKS
RADFORD ARMY AMMUNITION PLANT
STONE & WEBSTER ENGINEERING CORP.

FLOW SWITCHES

NO	BY	DATE	REVISION

SHEET A-15 OF 54

SPEC. NO.	REV.
16900	0
CONTRACT	DATE
REQ. · P.O.	
BY / CHK'D	APPR.

GENERAL

1. Type: Press ☐ Vacuum ☐ FLOW ■ Comp. ☐ Diff. Press. ☐
2. Setting: Set in Field ☐ Factory Set ■ Internal ■ External ☐ Dial ☐
3. Dead Band: Fixed ■ Adj. ☐ Min. ☐

ELEMENT

4. Type: Diaphragm ☐ Bourdon ☐ Bellows ☐ Other VANE ACTUATED
5. Material: Bronze ☐ 316 SS ■ Alloy St. ☐ Other
6. Connection: MFR STD ☐ Other Size 2 IN. NPT Bottom ■ Back ☐
7. Mounting: Local ■ Surface ☐ Flush ☐

SWITCH

8. Type: Mercury ☐ Snap ☐ Other MFR-STD
9. Quantity: Single ■ Dual ☐
10. Form: SPST ☐ SPDT ☐ DPDT ■ Other
11. Rating: 2 Amps ___ V ___ Hz Other
12. Load: Inductive ☐ Non-Inductive ☐
13. Enclosure: General Purpose ☐ Weather proof ■ None ☐ Explosion proof ■ Class SEE NOTE 2
14. Conduit Connection: MFR STD ☐ Other 3/4 IN. NPT

Manufacturer & Model No.

Rev.	Tag. No.	Process Condition	Adj. Range	Set Point Process	Set Point Signal	Operating Temp.	Operating Press.	Service	Notes
	FSL317A	LOW FLOW		300 GPM		AMB		PUMP TANK 3058	1

Notes: 1. SWITCH TO BE INSTALLED IN 8 INCH LINE.
2. Explosion Proof requirements are Class I & II, Groups C, D, E, F, & G

ISA FORM S20-42a

TEMPERATURE INDICATOR
HAZARDOUS WASTE TANKS - LINE C TANKS
RADFORD ARMY AMMUNITION PLANT
STONE & WEBSTER ENGINEERING CORP.

TEMPERATURE INSTRUMENTS (FILLED SYSTEM)

NO	BY	DATE	REVISION

SHEET A-16 OF 54
SPEC. NO. 5962896 REV. 4-15-95
CONTRACT DATE
REQ. · P.O.
BY CHK'D APPR.

	1	Tag No. SEE NOTE 1	Service SEE NOTE 1
GENERAL	2	Function	Record ☐ Indicate ■ Control ☐ Blind ☐ Trans ☐ Other
	3	Case	MFR STD ■ Nom Size 4 1/2 IN. Color: MFR STD ■ Other
	4	Mounting	Flush ☐ Surface ■ Yoke ☐ Other
	5	Enclosure Class	General Purpose ☐ Weather proof ■ Explosion proof ☐ Class; For Use in Intrinsically Safe System ☐ Other
	6	Power Supply	117 V 60Hz ☐ Other ac ____ dc ☐ ____ Volts
	7	Chart	Strip ☐ ____ Roll ☐ ____ Fold ☐ ____ Circular ____ Time Marks ____
	8	Chart Drive	Speed ____ Power ____
	9	Scales	Type DIAL; Range 1 20-240 °F 2 ____ 3 ____ 4 ____
XMTR	10	Transmitter Output	4-20 mA ☐ 10-50 mA ☐ 21-103 kPa (3-15 psig) ☐ Other; For Receiver See Spec. Sheet
CONTROLLER	11	Control Modes	P=Prop (Gain), I=Integral (Auto Reset), D=Derivative (Rate), Sub: s = Slow f = Fast; P ☐ PI ☐ PD ☐ PID ☐ If ☐ Df ☐ Is ☐ Ds ☐ Other
	12	Action	On Meas. Increase Output: Increases ☐ Decreases ☐
	13	Auto-Man Switch	None ☐ MFR STD ☐ Other
	14	Set Point Adj.	Manual ☐ External ☐ Remote ☐ Other
	15	Manual Reg.	None ☐ MFR STD ☐ Other
	16	Output	4-20 mA ☐ 10-50 mA ☐ 21-103 kPa (3-15 psig) ☐ Other
ELEMENT	17	Fill	SAMA Class III A Compensation FULL
	18	Process Data	Temp: Normal 140 °F Max 200 °F Max. Press.
	19	Range	Fixed ☐ Adj. Range ____ Set At; Overrange Protection to
	20	Bulb	Type FIXED UNION Mtl. 316SS Extension: Length ____ Type; Size: Diameter MFR. STD Length 3 IN Insertion; Conn: 1/2 IN. NPT Location ____ Ft. Above ☐ Below ☐ Instr.
	21	Capillary	MFR STD ■ Length 15 FT Mtl. 316SS Armor
	22	Well	Mtl. ____ Insertion ____ Lag Ext. ____ Conn; Const: Drilled ☐ Built-Up ☐ Other
	23	Alarm Switches	Quantity ____ Form ____ Rating
	24	Function	Temp ☐ Deviation ☐ Contacts To ____ On Temp. Increase
	25	Options	Filt-Reg. ☐ Sup. Gage ☐ Output Gage ☐ ____ Charts; Other
	26	Mfr. & Model No.	

Notes: 1. TI208 - SETTLING PIT 3056
TI301 - PUMP TANK 3058-A
TI302 - PUMP TANK 3058-B

ISA FORM S20.11a

RED WARNING BEACON AND HORN HARARDOUS WASTE TANKS - LINE & TANKS RADFORD ARMY AMMUNITION PLANT STONE & WEBSTER ENGINEERING CORP.	RED WARNING BEACON AND HORN				SHEET A-17 OF 54	
	NO	BY	DATE	REVISION	SPEC. NO. 16900	REV. 0
					CONTRACT 5962896	DATE 6/30/95
					REQ. - P.O.	
					BY / CHK'D	APPR.

TAG NUMBER: UA207

RED WARNING BEACON:
- 120VAC OPERATION
- MINIMUM 75 WATT LAMP
- LAMP ON CONTINUOUSLY (ROTATING IS NOT ACCEPTABLE)
- ELECTRICAL CONNECTION 1/2" NPT
- NEMA 4 ENCLOSURE

HORN:
- 120VAC OPERATION
- MINIMUM DECIBAL OUTPUT IS 95DB @ 10 FT.
- ELECTRICAL CONNECTION 1/2" NPT
- NEMA 4 ENCLOSURE

ISA Form S20.3b

PUSH BUTTON SWITCH HAZARDOUS WASTE TANKS - LINE C TANKS RADFORD ARMY AMMUNITION PLANT STONE & WEBSTER ENGINEERING CORP.	PUSH BUTTON SWITCHES			SHEET A-18 OF 54	
	NO	BY	DATE	REVISION	SPEC. NO. 16900	REV. 0
					CONTRACT 5962896	DATE 4-15-95
					REQ. · P.O.	
					BY / CHK'D	APPR.

- MAINTAINED CONTACT WITH MANUAL RESET, RATED AT 5 AMPS, 120 VAC
- WITH SINGLE GANG BOX, 3/4 IN. NPT
- REFERENCE E2400 DRAWING SERIES FOR LEGEND AND CONTACT FUNCTION

TAG NO.	EXPLOSION PROOF Class I & II, Groups C, D, E, F & G	CONTACTS
HS205B	YES	1-NO
HS209B	YES	1-NO
HS217B	YES	1-NO
HS311B	YES	1-NO
HS314B	YES	1-NO
HS317B	YES	1-NO

ISA Form S20.3b

(A) START/STOP
PUSH BUTTON STATION
HAZARDOUS WASTE TANKS - LINE C TANKS
RADFORD ARMY AMMUNITION PLANT
STONE & WEBSTER ENGINEERING CORP.

PUSHBUTTON STATION

NO	BY	DATE	REVISION

SHEET A-19 OF 54	
SPEC. NO. 16900	REV. 0
CONTRACT 5962896	DATE 4-15-95
REQ. · P.O.	
BY / CHK'D	APPR.

- CONTACTS, RATED AT 5 AMPS, 120VAC
- WITH SINGLE GANG BOX, 3/4 IN. NPT
- REFERENCE E2400 DRAWING SERIES FOR LEGEND AND CONTACT FUNCTION

TAG NO.	PUSHBUTTONS	EXPLOSION PROOF Class I & II, Groups C,D,E,F&G	CONTACTS
HS 212	1- START, 1-STOP	YES	SPDT PER P.B.
HS 214	1- START, 1-STOP	YES	SPDT PER P.B.

ISA Form S20.3b

DUAL DISPLACER TYPE LEVEL SWITCH
HAZARDOUS WASTE TANKS - LINE C TANKS
RADFORD ARMY AMMUNITION PLANT
STONE & WEBSTER ENGINEERING CORP.

LEVEL INSTRUMENTS (DISPLACER or FLOAT)

NO	BY	DATE	REVISION

SHEET A-21 OF 54

SPEC. NO.	REV.
16900	0
CONTRACT 5962896	DATE 4-15-95
REQ. - P.O.	
BY / CHK'D	APPR.

	1	Tag Number		LSHL 203		LSHL 309		LSHL 310	
	2	Service		SETTLING PIT 3056		PUMP TANK 3058-A		PUMP TANK 3058-B	
	3	Line No./Vessel No.		PIT 3056		TANK 3058-A		TANK 3058-B	
BODY/CAGE	4	Body or Cage Mtl		SS		SS		SS	
		Rating							
	5	Conn Size & Location Upper		2 1/2 IN. NPT		2 1/2 IN. NPT		2 1/2 IN. NPT	
		Type		TOP		TOP		TOP	
	6	Conn Size & Location Lower							
		Type							
	7	Case Mounting		TOP		TOP		TOP	
		Type							
	8	Rotatable Head							
	9								
	10	Orientation							
	11	Cooling Extension							
	12								
DISPLACER OR FLOAT	13	Dimensions		MFR. STD		MFR. STD		MFR. STD	
	14	Insertion Depth							
	15	Displacer Extension		12 FT		12 FT		12 FT	
	16	Disp. or Float Material		SS		SS		SS	
	17	Displacer Spring/Tube Mtl		SS		SS		SS	
	18								
	19								
XMTR/CONT.	20	Function		SWITCH		SWITCH		SWITCH	
	21	Output							
	22	Control Modes							
	23	Differential							
	24	Output Action: Level Rise							
	25	Mounting		INTEGRAL		INTEGRAL		INTEGRAL	
	26	Enclosure Class		NEMA 4		NEMA 7/9, *		NEMA 7/9, *	*EXPLOSION PROOF
	27	Elec. Power or Air Supply		N/A		N/A		N/A	
	28								
SERVICE	29	Upper Liquid							
	30	Lower Liquid		WATER		WATER		WATER	
	31	sp. gr.: Upper	Lower		1.00		1.00		1.00
	32	Press. Max.	Normal	AMB	AMB	AMB	AMB	AMB	AMB
	33	Temp. Max.	Normal	120°F	AMB	120°F	AMB	120°F	AMB
	34								
	35								
OPTIONS	36	Airset / Supply Gage							
	37	Gage Glass Connections							
	38	Gage Glass Model No.							
	39	Contacts: No.	Form	2	DPDT	2	DPDT	2	DPDT
	40	Contact Rating		24VDC @ 2A		24VDC @ 2A		24VDC @ 2A	
	41	Action of Contacts		SEE NOTE 1		SEE NOTE 1		SEE NOTE 1	
	42								
	43								
	44								
	45								
	46	Manufacturer							
	47	Model Number							
	48								

Notes: 1. INSTRUMENT REQUIRES TWO SWITCH MECHANISMS AND TWO SEPARATE DISPLACERS.
SW1 - CC INC LEVEL
SW2 - CC DEC LEVEL

ISA FORM S20.26

DISPLACER TYPE LEVEL SWITCH
HAZARDOUS WASTE TANKS - LINE C TANKS
RADFORD ARMY AMMUNITION PLANT
STONE & WEBSTER ENGINEERING CORP.

LEVEL INSTRUMENTS (DISPLACER or FLOAT)

NO	BY	DATE	REVISION

SHEET A-22 OF 54

SPEC. NO.	REV.
16900	0
CONTRACT 5962896	DATE 4-15-95
REQ. · P.O.	
BY	CHK'D	APPR.

	1	Tag Number	LSHH 303	LSHH 304		
	2	Service	PUMP TANK 3058-A	PUMP TANK 3058-B		
	3	Line No./Vessel No.	TANK 3058-A	TANK 3058-B		
BODY/CAGE	4	Body or Cage Mtl	SS	SS		
		Rating				
	5	Conn Size & Location Upper	2 1/2 IN NPT	2 1/2 IN NPT		
		Type	TOP	TOP		
	6	Conn Size & Location Lower				
		Type				
	7	Case Mounting	TOP	TOP		
		Type				
	8	Rotatable Head				
	9					
	10	Orientation				
	11	Cooling Extension				
	12					
DISPLACER OR FLOAT	13	Dimensions	MFR STD	MFR. STD		
	14	Insertion Depth				
	15	Displacer Extension	6 FT	6 FT		
	16	Disp. or Float Material	SS	SS		
	17	Displacer Spring/Tube Mtl	SS	SS		
	18					
	19					
XMTR/CONT.	20	Function	SWITCH	SWITCH		
	21	Output				
	22	Control Modes				
	23	Differential				
	24	Output Action: Level Rise				
	25	Mounting	INTEGRAL	INTEGRAL		
	26	Enclosure Class	NEMA 4	NEMA 4		
	27	Elec. Power or Air Supply	N/A	N/A		
	28					
SERVICE	29	Upper Liquid				
	30	Lower Liquid	WATER	WATER		
	31	Sp. gr.: Upper / Lower	1.00	1.00		
	32	Press. Max. / Normal	AMB / AMB	AMB / AMB		
	33	Temp. Max. / Normal	120°F / AMB	120°F / AMB		
	34					
	35					
OPTIONS	36	Airset / Supply Gage				
	37	Gage Glass Connections				
	38	Gage Glass Model No.				
	39	Contacts: No. / Form	1 / DPDT	1 / DPDT		
	40	Contact Rating	24VDC @ 2A	24VDC @ 2A		
	41	Action of Contacts	CC INC LEVEL	CC INC LEVEL		
	42					
	43					
	44					
	45					
	46	Manufacturer				
	47	Model Number				
	48					

Notes:

ISA FORM S20.26

pH INDICATING TRANSMITTER AND ELECTRODE

HAZARDOUS WASTE TANKS - LINE C TANKS

RADFORD ARMY AMMUNITION PLANT

STONE & WEBSTER ENGINEERING CORP.

pH INSTRUMENTS

NO	BY	DATE	REVISION

SHEET A-23 OF 54

SPEC. NO. 16900 REV. 0

CONTRACT 5962896 DATE 4-15-95

REQ. P.O.

BY CHK'D APPR.

	1	Tag No.	SEE NOTE 1 — Service SEE NOTE 1
GENERAL	2	Function	Record ☐ Indicate ■ Control ☐ Blind ☐ Trans ■ Other
	3	Case	MFR STD ■ Nom Size ____ Color: MFR STD ■ Other
	4	Mounting	Flush ☐ Surface ☐ Yoke ☐ Other PIPE MOUNT
	5	Enclosure Class	General Purpose ☐ Weather proof ■ Explosion proof ☐ Class ____ For Use In Intrin. Safe System ■ Other
	6	Power Supply (NOTE 2)	117V 60Hz ☐ Other ac ____ dc ____ Volts
	7	Chart	____ Strip ☐ ____ Roll ☐ ____ Fold ☐ Circular ____ Time Marks ____ Range ____ Number ____
	8	Chart Drive	Speed ____ Power ____
	9	Scales	Type DIAL OR DIGITAL (MIN 3½ DIGITS) Range 1 0-14 pH 2 ____ 3 ____ 4 ____
XMTR	10	Transmitter Output (NOTE 3)	4-20 mA ■ 10-50 mA ☐ 21-103 kPa (3-15 psig) ☐ Other ____ For Receiver See Spec Sheet ____
CONTROLLER	11	Control Modes	P=Prop (Gain) I=Integral (Auto-Reset) D=Derivative (Rate) Sub: s=Slow f=Fast P ☐ PI ☐ PD ☐ PID ☐ If ☐ Df ☐ Is ☐ Ds ☐ Other
	12	Action	On Meas. Increase Output: Increases ☐ Decreases ☐
	13	Auto-Man Switch	None ☐ MFR STD ☐ Other
	14	Set Point Adj.	Manual ☐ External ☐ Remote ☐ Other
	15	Manual Reg.	None ☐ MFR STD ☐ Other
	16	Output	4-20mA ☐ 10-50mA ☐ 21-103 kPa (3-15 psig) ☐ Other
ELEMENT	17	Service	Gage Press. ☐ Vacuum ☐ Absolute ☐ Compound ☐ pH ■
	18	Element Type	Diaphragm ☐ Helix ☐ Bourdon ☐ Bellows ☐ Other ELECTRODE
	19	Material	316 SS ☐ Ber. Copper ☐ Other SEE NOTE 4
	20	Range	Fixed ■ Adj. Range ____ Set at ____ Overrange protection to ____
	21	Process Data	Press/Temp: Normal AMB / AMB Max AMB / 120°F Element Range 0-14 pH
	22	Process Conn.	¼ in. NPT ☐ ½ in. NPT ☐ Other ____ Location: Bottom ☐ Back ☐ Other
	23	Alarm Switches	Quantity ____ Form ____ Rating ____
	24	Function	Press ☐ Deviation ☐ Contacts To ____ on Inc Press.
OPTIONS	25	Options	Filt-Reg. ☐ Sup Gage ☐ Output Gage ☐ ____ Charts Diaph Seal ☐ Type ____ Diaph ____ Bot Bowl ____ Conn ____ Capillary: Length ____ Mtl. ____ Other ELEMENT FURNISHED WITH PVC ELECTRODE PROTECTIVE SLEEVE, CABLE END SUBMERSION ADAPTER, MINIMUM 40 FT. INTEGRAL CABLE
	26	MFR & Model No.	

Notes:

1. AIT306/AE306 - PUMP TANK 3058-A
   AIT307/AE307 - PUMP TANK 3058-B
2. LOOP POWERED 28VDC SUPPLY.
3. ACCURACY: ±0.1% OF SPAN, ELECTRICAL CONNECTION: ½ IN. NPT
4. CONSULT SELECTED VENDOR FOR VARIOUS ELEMENT MATERIALS.
5. ELEMENT SHALL BE FURNISHED WITH AUTOMATIC TEMPERATURE COMPENSATION.

ISA Form S20.40a

pH INDICATING RECORDER/ALARM
HAZARDOUS WASTE TANKS - LINE C TANKS
RADFORD ARMY AMMUNITION PLANT
STONE & WEBSTER ENGINEERING CORP.

RECEIVER INSTRUMENTS

NO	BY	DATE	REVISION

SHEET A-24 OF 54

SPEC. NO.	REV.
16900	0
CONTRACT 5962896	DATE 4-15-95
REQ. P.O.	
BY / CHK'D / APPR.	

	1	Tag No. AIR308/ASH308	Service PUMP TANK 3058
GENERAL	2	Function	Record ■ Indicate ■ Control ☐ Blind ☐ Integ ☐ DIGITAL ■ Deviation ☐ Other
	3	Case	MFR STD ■ Nom Size ____ Color: MFR STD ■ Other
	4	Mounting	Flush ■ Surface ☐ Rack ☐ Multi-Case ☐ Other PANEL MOUNT For Multiple Case, See Spec. Sheet
	5	Enclosure Class	General Purpose ■ Weather Proof ☐ Explosion-Proof ☐ Class ____ For Use in Intrinsically Safe System. ☐ Other
	6	Power Supply	117 V 60Hz ■ Other ac ____ dc ☐ ____ Volts
	7	Chart MFR. STD ■	____ Strip ☐ ____ Roll ☐ ____ Fold ☐ Circular ____ Time Marks ____ Range MFR. STD Number MFR. STD
	8	Chart Drive	Speed MFR. STD Power
	9	Scales	Type MIN 4½ DIGITS MIN 4½ DIGITS Range 1 0-14 pH 2 0-14 pH 3 ____ 4 ____
CONTROLLER	10	Control Modes	P = Prop (Gain), I = Integral (Auto Reset), D = Derivative (Rate), Sub: s = Slow, f = Fast P ☐ PI ☐ PD ☐ PID ☐ If ☐ Df ☐ Is ☐ Ds ☐ Other
	11	Action	On Meas. Increase Output: Increases ☐ Decreases ☐
	12	Auto-Man Switch	None ☐ MFR STD ☐ Other
	13	Set Point Adj.	Manual ☐ External ☐ Remote ☐ Other
	14	Manual Reg	None ☐ MFR STD ☐ Other
	15	Output	4-20 mA ☐ 10-50 mA ☐ 21-103 kPa (3-15 psig) ☐ Other
INPUTS	16	Input Signals	4-20 mA ■ 10-50 mA ☐ 21-103 kPa (3-15 psig) ☐ Other
	17	No. of Inputs	1 ☐ 2 ■ 3 ☐ 4 ☐
	18	Power for XMTRS	External ☐ This Inst ☐ No. of Independent Supplies ____ For Transmitters, See Spec Sheet.
ALARMS	19	Alarm Switches	Quantity 2 Form SPDT Rating 2A
	20	Function	Meas. Var. ■ Deviation ☐ Contacts To ____ On Meas ____ Other SEE NOTE 1
	21	Options	Filter-Reg ☐ Supply Gage ☐ Charts ☐ Int. Illumination ☐ Other
	22	MFR & Model No.	

Notes: 1. ALARM CONTACTS REQUIRED TO MONITOR HIGH/LOW pH INPUTS 1 & 2.

ISA Form S20.1a

SWITCH TYPE INTRINSIC BARRIER HAZARDOUS WASTE TANKS - LINE C TANKS RADFORD ARMY AMMUNITION PLANT STONE & WEBSTER ENGINEERING CORP.	INTRINSIC BARRIER				SHEET A-25 OF 54		
	NO	BY	DATE	REVISION	SPEC. NO. 16900		REV. 0
					CONTRACT 5962896		DATE 4-15-95
					REQ. · P.O.		
					BY	CHK'D	APPR.

TAG NUMBER: IB3, IB4, IB6

A 2-CHANNEL SHUNT-DIODE SAFETY BARRIER WITH BUILT-IN ELECTRONIC OVERVOLT PROTECTION. INTENDED FOR SAFEGUARDING A HAZARDOUS-AREA SWITCH CONTROLLING A SAFE-AREA LOAD FROM AN UNREGULATED DC SUPPLY IN THE SAFE AREA.

CIRCUIT SUPPLY VOLTAGE: 28 VDC
SUPPLY CURRENT LIMIT: 50 mA

ISA Form S20.3b

CONTROLLER TYPE INTRINSIC BARRIER HAZARDOUS WASTE TANKS - LINE C TANKS RADFORD ARMY AMMUNITION PLANT STONE & WEBSTER ENGINEERING CORP.	INTRINSIC BARRIER				SHEET A-26 OF 54		
	NO	BY	DATE	REVISION	SPEC. NO. 16900		REV. 0
					CONTRACT 5962896		DATE 4-15-95
					REQ. · P.O.		
					BY	CHK'D	APPR.

TAG NUMBER: IB2, IB5

A SAFETY BARRIER WHERE THE OUTPUT CURRENT OF A CONTROLLER FLOWS DIRECTLY TO ITS "0V" RAIL AND THE RAIL CAN BE EARTHED AT THE BUSBAR.

CIRCUIT SUPPLY VOLTAGE: 28 VDC
HAZARDOUS AREA LOAD: I/P CONVERTER, MINIMUM 500 OHMS
MAXIMUM END TO END RESISTANCE: 400 OHMS

ISA Form S20.3b

TRANSMITTER TYPE INTRINSIC BARRIER
HAZARDOUS WASTE TANKS - LINE C TANKS
RADFORD ARMY AMMUNITION PLANT
STONE & WEBSTER ENGINEERING CORP.

INTRINSIC BARRIER

NO	BY	DATE	REVISION

SHEET A-27 OF 54

SPEC. NO.	REV.
16900	0
CONTRACT 5962896	DATE 4-15-95
REQ. P.O.	
BY / CHK'D	APPR.

TAG NUMBER: IB1, IB7, IB8

A 1-CHANNEL SHUNT-DIODE SAFETY BARRIER, WITH BUILT-IN ELECTRONIC OVERVOLT PROTECTION, FOR ENERGISING A 2-WIRE 4/20 mA TRANSMITTER IN A HAZARDOUS AREA. POWERED FROM A POSITIVE SUPPLY OF 28 VDC AND DELIVERS A 4/20 mA SIGNAL INTO AN EARTHED LOAD IN THE SAFE AREA.

CIRCUIT SUPPLY VOLTAGE: 28 VDC
TRANSMITTER CURRENT: 4-20 mA
SAFE AREA LOAD RESISTANCE: 600 OHMS MAXIMUM
OUTPUT IMPEDANCE TO LOAD: > 1 MEGAOHM
CALIBRATED ACCURACY: 0.05% OF MAXIMUM OUTPUT
ZERO TEMPERATURE DRIFT: < 0.005% OF MAXIMUM OUTPUT PER °C
SPAN TEMPERATURE DRIFT: < 0.005% OF MAXIMUM OUTPUT PER °C

ISA Form S20.3b

(31) CURRENT-TO-CURRENT 'CONVERTER' HAZARDOUS WASTE TANKS-LINE C TANKS RADFORD ARMY AMMUNITION PLANT STONE & WEBSTER ENGINEERING CORP	CURRENT CONVERTER/ TRANSMITTER				SHEET A-28 OF 54		
	NO	BY	DATE	REVISION	SPEC. NO. 16900		REV. 0
					CONTRACT 5962896		DATE 4-18-95
					REQ. · P.O.		
					BY LDH	CHK'D	APPR.

TAG NUMBER: IY202

CURRENT-TO-CURRENT CONVERTER

INPUT POWER - 24VDC ±10%, 5 WATTS NOMINAL

INPUT SIGNAL - 4-20mA DC INTO 50Ω NOMINAL

OUTPUT SIGNAL - 4-20mA DC INTO 1200Ω LOAD

INSTRUMENT TO HAVE ZERO ADJUSTMENT AND SPAN ADJUSTMENT ON FRONT PANEL

NOTE: THIS DEVICE SERVES AS A BOOSTER ON THE LT202 CURRENT LOOP AS THE TRANSMITTER THROUGH THE INTRINSIC BARRIER CANNOT DRIVE THE LOOP IMPEDANCE WITH VALVES LV220 AND LV222 CONNECTED.

ISA Form S20.3b

(1) CURRENT SWITCH HAZARDOUS WASTE TANKS - LINE C TANKS RADFORD ARMY AMMUNITION PLANT STONE & WEBSTER ENGINEERING CORP	CURRENT SWITCH				SHEET A-29 OF 54	
	NO	BY	DATE	REVISION	SPEC. NO. 16900	REV. 0
					CONTRACT 5962896	DATE 4-18-95
					REQ. · P.O.	
					BY KDH	CHK'D / APPR.

TAG NUMBER: LSHL202

CURRENT SWITCH

POWER 24VDC ± 10%, 5 WATTS NOMINAL

INPUT 4-20 mADC @ 50 Ω

OUTPUT TWO SEPARATE, ADJUSTABLE SPDT ALARM CONTACTS RATED 5A @ 28VDC

TRIP POINT REPEATABILITY - ±0.1% FULL SPAN
DEADBAND - 1% OF SPAN

INPUT AND OUTPUT CIRCUITS TO BE FULLY ISOLATED

ISA Form S20.3b

HAZARDOUS WASTE TANKS - LINE C TANKS
RADFORD ARMY AMMUNITION PLANT
STONE & WEBSTER ENGINEERING CORP

SOLENOID VALVES

NO	BY	DATE	REVISION

SHEET A-30 OF 54

SPEC. NO.	REV.
16900	0
CONTRACT 5962896	DATE 4-18-95
REQ. P.O.	
BY LDH	CHK'D / APPR.

	1.	Tag Number	LY222A	
	2.	Service	AIR	
	3.	Line No./Vessel No.	VALVE LV222	
	4.	Quantity	1	
VALVE BODY	5.	Type	3 WAY	
	6.	Size – Body/Port	1/4"	
	7.	Rating & Type Conn.	200 PSI/SCREWED	
	8.	Material – Body	316 SS	
	9.	Material – Seat	MFR. STD.	
	10.	Material – Diaphragm	MFR. STD.	
	11.	Operation Direct/Pilot	DIRECT	
	12.	Packless or Type Packed		
	13.	Manual Re-Set	NO	
	14.	Manual Operator	NO	
	15.			
	16.			
WHEN DE-ENERGIZED	17.	2-Way Valve Opens/Close		
	18.	3-Way		
	19.	Vent Port Opens/Close	OPENS	
	20.	Press Port Opens/Close	CLOSES	
	21.	4-Way		
	22.	Press to Cyl. 1/Cyl 2		
	23.	Exh. from Cyl 1/Cyl 2		
	24.			
	25.			
SOLENOID	26.	Enclosure	WATERTIGHT	
	27.	Voltage/Hz	28 VDC	
	28.	Style of Coil	MFR. STD.	
	29.	Single or Double Coil	SINGLE	
	30.			
	31.			
SERVICE CONDITIONS	32.	Fluid	AIR	
	33.	Qty. Maximum	25 CFM	
	34.	Oper. Diff. Min/Max	20 PSI / 70 PSI	
	35.	Allow. Diff. Min/Max		
	36.	Temp. Norm/Max.	AMB. / AMB	
	37.	Oper. sp. gr.		
	38.	Oper. Viscosity		
	39.	Required Cv		
	40.	Valve Cv		
	41.			
	42.			
	43.			
	44.			
	45.	Manufacturer		
	46.	Model Number		

Notes:

Field to install this solenoid on value LV222 in field.

ISA Form S20.55

RELIEF VALVES
HAZARDOUS WASTE TANKS - LINE C TANKS
RADFORD ARMY AMMUNITION PLANT
STONE & WEBSTER ENGINEERING CORP.

PRESSURE RELIEF VALVES

NO	BY	DATE	REVISION

SHEET A-31 OF 54

SPEC. NO.	REV.
16900	0
CONTRACT 5962896	DATE 4-21-95
REQ. · P.O.	
BY / CHK'D	APPR.

GENERAL	1.	Tag Number		PSV225		PSV312		PSV315		PSV319	
	2.	Service		PUMP 3056-P4		PUMP 3058-P1		PUMP 3058-P2		PUMP 3058-P3	
	3.	Line No./Vessel No.		103		207		203		210	
	4.	Full Nozzle/Semi Nozzle		*		*		*		*	
	5.	Safety or Relief		RELIEF		RELIEF		RELIEF		RELIEF	
	6.	Conv., Bellows, Pilot Op.		CONV.		CONV.		CONV.		CONV.	
	7.	Bonnet Type		*		*		*		*	
CONN.	8.	Size: Inlet	Outlet	3 IN.	3 IN.	2 IN.	2 IN.	2 IN.	2 IN.	2 IN.	2 IN.
	9.	Flange Rating or Screwed		SCREWED	FNPT	SCREWED	FNPT	SCREWED	FNPT	SCREWED	FNPT
	10.	Type of Facing									
MATERIALS	11.	Body and Bonnet		*		*		*		*	
	12.	Seat and Disc		*		*		*		*	
	13.	Resilient Seat Seal		*		*		*		*	
	14.	Guide and Rings		*		*		*		*	
	15.	Spring		*		*		*		*	
	16.	Bellows		*		*		*		*	
	17.										
OPTIONS	18.	Cap: Screwed or Bolted		*		*		*		*	
	19.	Lever: Plain or Packed		PACKED		PACKED		PACKED		PACKED	
	20.	Test Gag									
	21.										
	22.										
	23.										
BASIS	24.	Code									
	25.	Fire									
	26.										
	27.										
FLUID DATA	28.	Fluid and State		ACIDIC WASTE STREAM		ACIDIC WASTE STREAM		ACIDIC WASTE STREAM		ACIDIC WASTE STREAM	
	29.	Required Capacity		* 700 GPM		* 250 GPM		* 250 GPM		* 300 GPM	
	30.	Mol. Wt.	Oper. sp. gr.								
	31.	Oper. Press.	Set Press.	70 PSIG	88 PSIG	15 PSIG	22 PSIG	15 PSIG	22 PSIG	70 PSIG	78 PSIG
	32.	Oper. Temp.	Rel. Temp.	100 °F	*	100 °F	*	100 °F	*	100 °F	PSIG
	33.	Back Pressure	Constant								
	34.		Variable								
	35.		Total								
	36.	% Allowable Overpressure									
	37.	Overpressure Factor									
	38.	Compressibility Factor									
	39.	Latent Heat of Vaporization									
	40.	Ratio of Specific Heats									
	41.	Operating Viscosity									
	42.	Barometric Pressure									
	43.										
	44.										
	45.	Calc. Area sq. in.		*		*		*		*	
	46.	Selected Area		*		*		*		*	
	47.	Orifice Designation		*		*		*		*	
	48.	Manufacturer									
	49.	Model No.									

Notes: * FINAL CONFIGURATION TO BE PER MANUFACTURERS RECOMMENDATIONS, WHICH SHALL BE OBTAINED ON DATA FROM THE SELECTED PUMP.
NOTE: WHERE SIZES/CAPACITIES ARE LISTED, THEY ARE FOR ESTIMATING ONLY, FINAL VALUES TO BE BASED ON SELECTED PUMP DATA.

ISA Form S20.53

RELIEF VALVES
HAZARDOUS WASTE TANKS - LINE C TANKS
RADFORD ARMY AMMUNITION PLANT
STONE & WEBSTER ENGINEERING CORP.

PRESSURE RELIEF VALVES

NO	BY	DATE	REVISION

SHEET A-32 OF 54

SPEC. NO.	REV.
16900	0
CONTRACT 5962896	DATE 4-21-95
REQ. - P.O.	
BY / CHK'D	APPR.

GENERAL	1.	Tag Number		PSV211		PSV219		PSV221		PSV223
	2.	Service		PUMP 3056-P1		PUMP 3056-P5		PUMP 3056-P2		PUMP 3056-P3
	3.	Line No./Vessel No.		108		102		105		107
	4.	Full Nozzle/Semi Nozzle		*		*		*		*
	5.	Safety or Relief		RELIEF		RELIEF		RELIEF		RELIEF
	6.	Conv., Bellows, Pilot Op.		CONV.		CONV.		CONV.		CONV.
	7.	Bonnet Type		*		*		*		*
CONN.	8.	Size: Inlet	Outlet	2 IN.	2 IN.	2 IN.	2 IN.	2 IN.	2 IN.	3 IN. 3 IN.
	9.	Flange Rating or Screwed		SCREWED	FNPT	SCREWED	FNPT	SCREWED	FNPT	SCREWED FNPT
	10.	Type of Facing								
MATERIALS	11.	Body and Bonnet		*		*		*		*
	12.	Seat and Disc		*		*		*		*
	13.	Resilient Seat Seal		*		*		*		*
	14.	Guide and Rings		*		*		*		*
	15.	Spring		*		*		*		*
	16.	Bellows		*		*		*		*
	17.									
OPTIONS	18.	Cap: Screwed or Bolted		*		*		*		*
	19.	Lever: Plain or Packed		PACKED		PACKED		PACKED		PACKED
	20.	Test Gag								
	21.									
	22.									
	23.									
BASIS	24.	Code								
	25.	Fire								
	26.									
	27.									
FLUID DATA	28.	Fluid and State		ACIDIC WASTE STREAM		ACIDIC WASTE STREAM		ACIDIC WASTE STREAM		ACIDIC WASTE STREAM
	29.	Required Capacity		* 300 GPM		* 300 GPM		* 300 GPM		* 700 GPM
	30.	Mol. Wt.	Oper. sp. gr.							
	31.	Oper. Press.	Set Press.	40 PSIG	60 PSIG	20 PSIG	28 PSIG	40 PSIG	60 PSIG	70 PSIG 88 PSIG
	32.	Oper. Temp.	Rel. Temp.	100 °F	*	100 °F	*	100 °F	*	100 °F *
	33.	Back Pressure	Constant							
	34.		Variable							
	35.		Total							
	36.	% Allowable Overpressure								
	37.	Overpressure Factor								
	38.	Compressibility Factor								
	39.	Latent Heat of Vaporization								
	40.	Ratio of Specific Heats								
	41.	Operating Viscosity								
	42.	Barometric Pressure								
	43.									
	44.									
	45.	Calc. Area sq. in.		*		*		*		*
	46.	Selected Area		*		*		*		*
	47.	Orifice Designation		*		*		*		*
	48.	Manufacturer								
	49.	Model No.								

Notes: * FINAL CONFIGURATION TO BE PER MANUFACTURERS RECOMMENDATIONS, WHICH SHALL BE OBTAINED ON DATA FROM THE SELECTED PUMP.
NOTE: WHERE SIZES/CAPACITIES ARE LISTED, THEY ARE FOR ESTIMATING ONLY, FINAL VALUES TO BE BASED ON SELECTED PUMP DATA.

ISA Form S20.53

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CONTROL VALVE DATA SHEET

Second Printing

PROJECT HAZARDOUS WASTE TANKS - LINE C TANKS
RADFORD ARMY AMMUNITION PLANT
STONE & WEBSTER ENGINEERING CORP.
ITEM
CONTRACT 5962896
•MFR. SERIAL

DATA SHEET A-33 of 54
SPEC 16900 REV. 0
TAG LV220
DWG
SERVICE SETTLING PIT 3056

1 Fluid ACIDIC WATER — Crit Press PC

SERVICE CONDITIONS	Units	Max Flow	Norm Flow	Min Flow	Shut-Off
2 Flow Rate	GPM	*	*	*	—
3 Inlet Pressure	PSI	*	*	*	*
4 Outlet Pressure	PSI	*	*	*	*
5 Inlet Temperature	°F	AMB	AMB	AMB	AMB
6 Spec Wt/Spec Grav/Mol Wt	-	1.00	1.00	1.00	—
7 Viscosity/Spec Heats Ratio	lbf-sec/ft²	2.05×10^{-5}	2.05×10^{-5}	2.05×10^{-5}	—
8 Vapor Pressure P_v	lbf/ft²	48.9	48.9	48.9	—
9 *Required C_v					—
10 *Travel	%				0
11 Allowable/*Predicted SPL	dBA	/	/	/	—
12					

LINE
13 Pipe Line Size & Schedule — In 8 IN. SCH-10 S.S.
14 Out 8 IN. SCH-10 S.S.
15 Pipe Line Insulation

VALVE BODY/BONNET
16 *Type BUTTERFLY
17 *Size 8" ANSI Class 150
18 Max Press/Temp 100 / 150 °F
19 *Mfr & Model VALTEK VALDISK 150
20 *Body/Bonnet Matl 316 SS
21 *Liner Material/ID N/A
22 End Connection — In *
23 Out *
24 Flg Face Finish ANSI B16.5-81
25 End Ext/Matl N/A
26 *Flow Direction SHAFT DOWNSTREAM
27 *Type of Bonnet STD
28 Lub & Iso Valve Lube
29 *Packing Material PTFE
30 *Packing Type V-RING SINGLE
31

TRIM
32 *Type ECCENTRIC-CAMMED DISK
33 *Size 8" Rated Travel 90 Deg
34 *Characteristic EQUAL PERCENT
35 *Balanced/Unbalanced N/A
36 *Rated C_v * F_L X_T
37 *Plug/Ball/Disk Material 316 SS
38 *Seat Material PFA VITON
39 *Cage/Guide Material N/A
40 *Stem Material 17 - 4 PH
41
42

SPECIALS/ACCESSORIES
43 NEC Class Group Div
44 TAG: LV220 Fail Open Valve
45 I/P TRANSDUCER
46
47 * TO BE DETERMINED AFTER
48 FINAL SETTLING PIT PUMPS
49 SELECTION
50
51
52

ACTUATOR
53 *Type SPRING - CYLINDER
54 *Mfr & Model VALTEK VR CYLINDER
55 *Size 50 STD Eff Area 50 SQ IN
56 On/Off Modulating X
57 Spring Action Open/Close OPEN
58 *Max Allowable Pressure 150 PSI
59 *Min Required Pressure 60 PSI
60 Available Air Supply Pressure:
61 Max Min
62 *Bench Range /
63 Actuator Orientation
64 Handwheel Type
65 Air Failure Valve OPENS Set at
66

POSITIONER
67 Input Signal 4-20 mA
68 *Type ELECTRO - PNEUMATIC
69 *Mfr & Model VALTEK XL I/P
70 *On Incr Signal Output Incr/Decr INCR.
71 Gauges YES By-pass N/A
72 *Cam Characteristic MODIFIED EP
73

SWITCHES
74 Type PROX Quantity 2
75 *Mfr & Model GO - SWITCH 75-13523-A
76 Contacts/Rating
77 Actuation Points OPEN / CLOSED
78

AIR SET
79 *Mfr & Model VALTEK COALESCING
80 *Set Pressure
81 Filter N/A Gauge N/A
82

TESTS
83 *Hydro Pressure
84 ANSI/FCI Leakage Class
85
86

Rev	Date	Revision	Orig	App

*Information supplied by manufacturer unless already specified.

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CONTROL VALVE DATA SHEET

Second Printing

PROJECT HAZARDOUS WASTE TANKS - LINE C TANKS
RADFORD ARMY AMMUNITION PLANT
STONE & WEBSTER ENGINEERING CORP.
ITEM
CONTRACT 5962896
•MFR. SERIAL

DATA SHEET A-34 of 54
SPEC 16900 REV. 0
TAG ~~LV220~~ 100
DWG
SERVICE SETTLING PIT ~~3056~~ 3020

1 Fluid ACIDIC WATER — Crit Press PC

SERVICE CONDITIONS	Units	Max Flow	Norm Flow	Min Flow	Shut-Off
2 Flow Rate	GPM	*	*	*	—
3 Inlet Pressure	PSI	*	*	*	*
4 Outlet Pressure	PSI	*	*	*	*
5 Inlet Temperature	°F	AMB	AMB	AMB	AMB
6 Spec Wt/Spec Grav/Mol Wt	-	1.00	1.00	1.00	—
7 Viscosity/Spec Heats Ratio	lbf-sec/ft²	2.05×10⁻⁵	2.05×10⁻⁵	2.05×10⁻⁵	—
8 Vapor Pressure P_v	lbf/ft²	48.9	48.9	48.9	—
9 *Required C_v					—
10 *Travel	%				0
11 Allowable/*Predicted SPL	dBA	/	/	/	—
12					

LINE
13 Pipe Line Size & Schedule — In 10 IN. SCH-10 S.S.
14 Out 10 IN. SCH-10 S.S.
15 Pipe Line Insulation

VALVE BODY/BONNET
16 *Type BUTTERFLY
17 *Size ____ ANSI Class 150
18 Max Press/Temp 100 / 150 °F
19 *Mfr & Model VALTEK VALDISK 150
20 *Body/Bonnet Matl 316 SS
21 *Liner Material/ID N/A
22 End Connection — In *
23 Out *
24 Flg Face Finish ANSI B16.5-81
25 End Ext/Matl N/A
26 *Flow Direction SHAFT DOWNSTREAM
27 *Type of Bonnet STD
28 Lub & Iso Valve ____ Lube ____
29 *Packing Material PTFE
30 *Packing Type V-RING SINGLE
31

TRIM
32 *Type ECCENTRIC-CAMMED DISK
33 *Size 10" Rated Travel 90 Deg
34 *Characteristic EQUAL PERCENT
35 *Balanced/Unbalanced N/A
36 *Rated C_v * F_L ____ X_T ____
37 *Plug/Ball/Disk Material 316 SS
38 *Seat Material PFA VITON
39 *Cage/Guide Material N/A
40 *Stem Material 17 - 4 PH
41
42

SPECIALS/ACCESSORIES
43 NEC Class ____ Group ____ Div ____
44 TAG: LY220 Fail Open Valve
45 I/P TRANSDUCER
46
47 * TO BE DETERMINED AFTER
48 FINAL SETTLING PIT PUMP
49 SELECTION
50
51
52

ACTUATOR
53 *Type SPRING - CYLINDER
54 *Mfr & Model VALTEK VR CYLINDER
55 *Size 50 EXT Eff Area ____
56 On/Off ____ Modulating X
57 Spring Action Open/Close OPEN
58 *Max Allowable Pressure 150 PSI
59 *Min Required Pressure 60 PSI
60 Available Air Supply Pressure:
61 Max ____ Min ____
62 *Bench Range ____ / ____
63 Actuator Orientation STD
64 Handwheel Type N/A
65 Air Failure Valve OPENS Set at ____
66

POSITIONER
67 Input Signal 4-20 mA
68 *Type ELECTRO - PNEUMATIC
69 *Mfr & Model VALTEK XL I/P
70 *On Incr Signal Output Incr/Decr INCR.
71 Gauges YES By-pass ____
72 *Cam Characteristic MODIFIED EP
73

SWITCHES
74 Type PROX Quantity 2
75 *Mfr & Model GO - SWITCH 75-13523-A
76 Contacts/Rating ____
77 Actuation Points OPEN / CLOSED
78

AIR SET
79 *Mfr & Model VALTEK COALESCING
80 *Set Pressure N/A
81 Filter YES Gauge N/A
82

TESTS
83 *Hydro Pressure ____
84 ANSI/FCI Leakage Class ____
85
86

Rev	Date	Revision	Orig	App

*Information supplied by manufacturer unless already specified.

ISA FORM S20.50, Rev. 1

Appendix B

Pump Operating Sequence

All References to 3056 NIC

C Line Hazardous Waste Tanks Pump Operating Sequence

A. 3056 P-1 and P-2 (500 GPM Slurry Pumps)

All power for controls off motor starter 480 V XFMR

These pumps are manually started and will run so long as the seal water flow switches and on delay relay contacts remain made. I presume that the intent of electrical schematic is to show maintained Start/Stop for these, making the seal-in contacts redundant. A maintained Start/Stop is the only way to ensure an automatic re-start after power loss. The auto re-start occurs after the power has been restored for 20 seconds.

B. 3056 P-5 (1000 GPM, 40 PSI) Controlled off LT 202

Controls dependent on 480 VAC XFMR and CP2 120 VAC, assorted flow switches, level transmitters, level switches and associated relays.

LT 202: 1 - 6.5 ft = 4-20 mA

Trip points: 5 mA (1.34 ft) - Stop P-5 on fall
5.5 mA (1.52 ft) - Start P-5 on rise
12 mA (3.75 ft) - Stop P-3 or P-4 on fall (15 sec delay), Start P-5
12.5 mA (3.9125 ft) - Activate P-3 or P-4 on Rise, Stop P-5 (15 sec delay)

Note: LV 220 is ranged 0% (Closed) to 100% (Open) for 4-12 mA
LV 222 is ranged 0% (Closed) to 100% (Open) for 8-20 mA

LS 203: LSL at 0.5 ft, LSH at 7.0 ft. Contacts open at trip points.

Trip points: At 0.5 ft stop P-3, P-4 and P-5 via AR 203B & CR 203
At 0.5 ft generate alarm at 3056, 3019, 3046
At 7.0 ft Initiate KY 202C to swap pumps
At 7.0 ft generate alarm at 3056, 3019, 3046

P-5 Manual operation: If everything is working as designed P- 5 can be run in Hand position so long as seal water flow switch FSL 217 is made, the Stop push button HS 217 B is not activated, and LSL 203 is satisfied (level > 0.5 ft).

P-5 Automatic operation: If everything is working as designed P-5 will start automatically at an increasing level of 1.52 ft in the tank so long as seal water flow switch FSL 217 is made, the Stop push button HS 217 B is not activated, and LSL 203 is satisfied (level > 0.5 ft).

If the tank level falls (outflow > inflow) the pump will continue to run until the level drops below 1.34 ft. Since the valve position is proportional to level the valve will be mostly closed off when the pump shuts off.

If the tank level rises (inflow > outflow) the pump will continue to run, and the control valve FV 220 will open in an attempt to maintain an equilibrium level. The valve position is controlled off

the level with a gain of 2.0. As the level rises due to increased flow the valve will open, as it falls the valve will close. This will result in a low level at low flows, a high level at high flows. (No set point control).

If the inflow exceeds the pump's capacity the level will exceed 3.9 ft (12.5 mA) and LS 202 will trip the HI alarm point which will start sequencer KY 202A & 202B, which starts either P-3 or P-4 will be started by lead/lag alternator GY 202. If the level stays above 3.9 ft for 15 sec P-5 will be stopped. If the level drops below 3.9 ft for over 15 sec the P-3 or P-4 will then stop.

C. P-3 and P-4 (3000 GPM, 77 PSI) Controlled off LT 202, LS 203

Controls dependent on 480 VAC XFMR and CP2 120 VAC, and various relays.

P-3 and P-4 Hand Operation: If everything is working as designed P-3 and P-4 may be run in Hand position so long as seal water flow switches FSL 205/209 are made, the Stop Pushbuttons HS 205/209 B are not activated, and LSL 203 is satisfied (level > 0.5 ft).

P-3/P-4 Automatic Operation: In Auto these pumps are alternated off sequencer GY 202. These will run so long as seal water flow switches FSL 205/209 are made, the Stop push buttons HS 205/209 B are not activated, and LSL 203 is satisfied (level > 0.5 ft). GY 202 is the pump alternator which should run one pump one cycle, the other pump the next, the cycles based on level in the tank being above 3.9 ft (12.5 mA).

If the tank level rises the pump will continue to run, and the control valve FV 222 will open in an attempt to maintain an equilibrium level. The valve position is controlled off the level with a gain of 2.0. As the level rises due to increased flow the valve will open, as it falls the valve will close. Since P-3 or P-4 has excess capacity, the tank level will eventually start to fall and LT 202 will drop below 12mA. At this point P-5 will be re-started and P-3 or P-4 will be stopped after 15 sec.

If the inflow exceeds pump/valve output the level will continue to rise.

At 7.0 ft level and P-3 or P-4 running, solenoid LY 222A is actuated which fully opens FV 222 (Vents actuator which is air to close).

D. 3058 P-1 and P-2 (500 GPM), Controlled off LS 309, LS 310.

Controls dependent on 480 VAC XFMR and CP2 120 VAC, and various relays

P-1 and P-2 Hand Operation: If everything is working as designed P-1 and P-2 may be run in Hand position so long as seal water flow switches FSL 311/314 are made, and the Stop push buttons HS 311/314 B are not activated.

P-1 and P-2 Auto Operation: In Auto mode the pumps are activated when the pit level reaches the 8 ft 4 in level in the selected pit. The selected pump remains on so long as seal water flow switches FSL 311/314 are made, and the Stop push buttons HS 311/314 B are not activated and until the level falls below 1 foot level.

E. 3058 P-3 (500 GPM), Controlled off FSL 317A.

Controls dependent on 480 VAC XFMR and CP2 120 VAC, and various relays

P-3 Hand Operation: If everything is working as designed P-3 may be run in Hand position so long as seal water flow switch FSL 317 is made, and the Stop Pushbutton HS 317B is not activated.

P-3 Auto Operation: In Auto mode the P-3 is activated only if P-1 or P-2 is running and the low flow switch FSL 317A detects low flow for 20 seconds. The pump remains on so long as seal water flow switch FSL 317 is made, and the Stop Pushbutton HS 317B is not activated and until P-1 and P-2 are both stopped.

SECTION 16902

CONTROL PANELS
08/95

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

This specification, together with the contract control panel drawings, covers the technical requirements for engineering, design, and fabrication of control panels.

The equipment furnished according to this specification shall conform exactly to the requirements contained herein, unless modified in writing by the Contractor.

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL DESCRIPTIONS:

SD-01 Precon Submittals

Documents to be Furnished with Proposal; GA.

Contractor's proposal shall include:

1. Catalogs, brochures, and/or data sheets for Contractor furnished equipment.

2. Total shipping weight and weight of each section.

Documents to be Furnished after Purchase; FIO.

The Contractor shall submit all drawings, sketches, and schematics prepared for the fabrication and wiring of the panels.

The drawings submitted shall include the following:

1. Instrument general arrangement and graphic display.

2. Fabrication and dimensional drawings for setting panels in place.

3. Wiring and schematic diagrams.

4. Point to point wiring drawings showing field and panel terminal connections.

5. Rear panel equipment arrangement.

1.3 DELIVERY, STORAGE, AND HANDLING

Panels quoted shall be F.O.B. jobsite. The control panel sections shall be crated using a heavy skid and shall be cushioned to protect the finish of

the instruments and panel face. Instruments mounted in cases or shelves shall be removed and boxed in their original shipping cartons with shipping stops in place prior to transporting the panel.

Panels shall be capable of being shipped upright in an "air ride" van. They shall be lifted using removable lugs without causing frame distortion when raised.

PART 2 PRODUCTS

2.1 WORK, MATERIALS, AND SERVICES PROVIDED BY THE CONTRACTOR

Design and fabrication of a complete control panel assembly.

Instruments and components as specified.

Install and wire supplied instruments and components.

Install and wire supplied panel inserts, if any.

Shop tests of the assembled panel.

Packaging and shipping panel to site.

Documentation and drawings.

Panel front layout drawings.

Panel inserts, layout, and wiring diagrams.

Receiving, unpacking, inspection, and storage of panel sections at site.

Installation of panel including mounting and connection of field wiring.

Control room arrangement.

Elementary and loop diagrams.

Instrument list of furnished instrument items.

Field testing of panel as installed.

2.1.1 ADDITIONAL PANELS FOR BLDGS 3002, 3019, and 3046

1. Contractor shall supply a new annunciator panel at Buildings 3002, 3019, and 3046 (total of 3) as specified as follows.

2. Contractor shall work with the contracting officer as to the location of the annunciator panel in each building and as to the location of the 120 V power supply for each panel.

3. Annunciators shall be solid state, integral architecture, powered from external 120 V AC with internal power supply providing 24 VDC for field contact interrogating voltage, dry contact input (field adjustable for normally open or normally closed) complete with horn, horn relay, TEST -ACKNOWLEDGE pushbuttons, and alarm windows all in a NEMA 4 surface mount enclosure.

4. Annunciator windows shall be in a 2 x 2 configuration, each window approximately 3 inches by 3 inches, with white background and black 114 inch lettering.

5. Annunciator sequence shall be ISA sequence A with the following features:

- Acknowledge and test pushbuttons
- Alarm audible device
- Lock-in of momentary alarms until acknowledged
- The audible device is silenced and the flashing stops when acknowledged
- Automatic reset of acknowledged alarm indication when process condition returns to normal
- Operational test

Annunciator engraving for Building 3002 shall be as follows:

- Master Nameplate: BUILDING 3002 ANNUNCIATOR
- Window 1-1: LAHH305B -PUMP TANKS 3058A or 3058B LEVEL HI HI
- Window 1-2: AHH308B -PUMP TANKS 3058A or 3058B pH HI HI
- Window 2-1: (Blank)
- Window 2-2 (Blank)

Annunciator engraving for Building 3019 shall be as follows:

- Master Nameplate: BUILDING 3019 ANNUNCIATOR
- Window 1-1: LAHH305C -PUMP TANK 3058A or 3058B LEVEL HI HI
- Window 1-2: AHH308C -PUMP T ANK 3058A or 3058B pH HI HI
- Window 2-1: LA204C -SETTLING PIT OVERFLOW CHAMBER 3056 LEVEL HI HI
- Window 2-2: (Blank)

Annunciator engraving for Building 3046 shall be as follows:

- Master Nameplate: BUILDING 3046 ANNUNCIATOR
- Window I-I: LAHH305D -PUMP TANK 3058A or 3058B LEVEL HI HI
- Window 1-2: AHH308D -PUMP TANK 3058A or 3058B pH: HI HI
- Window 2-1: LA204D - SETTLING PIT OVERFLOW CHAMBER 3056 LEVEL HI HI
- Window 2-2: (Blank)

2.2 CONSTRUCTION

The control panel front mounting surface shall be fabricated of hot rolled steel with a minimum thickness of 3/16 inch. All other panel sides shall be 11 gauge minimum. The panels shall be of NEMA 12 indoor construction suitably reinforced to provide sturdy, freestanding, rigid units. The panel shall be arranged for floor mounting with bottom or top cable entry, as specified.

Vibration dampeners shall be furnished, with a load capacity to limit the normal deflection to within 1/8 inch.

Internal fluorescent lighting and 120V, 20-amp utility receptacles shall be provided for each panel.

Panel dimensions shall conform to the overall dimensions shown on the contract control panel drawings. Multiple sections shall be furnished when the panel length exceeds 10 feet or when the overall length is excessive for shipping, handling, and installation.

Removable lifting lugs shall be provided on top of the panel to allow for four point lifting.

Rack mounted accessory items, relay cabinets, conduit, wireways, and other equipment mounted on the rear of the panel shall be supported by the rear steel framework. Panel face, removable panels, doors, etc. shall not be used to provide support structures. Panel structural steel or additional members shall not interfere with or otherwise hinder the accessibility of all instruments for maintenance or ease of removal.

2.3 PANEL WIRING

Panel wiring shall be provided to inter-connect electronic loop components, alarms, relays, annunciator, power supplies, switches, indicating lights, and other control devices within the control panel.

The wiring will consist of electronic signal (4 to 20 maDC), control (120V AC), low level signal (millivolt) and power supply (24V DC, 120V AC). Each type of wiring shall be run in separate conduit or wireways, grouped, and separated to eliminate electrical interference. Power or control wiring shall be separated from signal wiring by at least 6 inches. If the power wiring has to cross the signal wiring, the crossing shall be as close to right angles as possible.

Electrical wiring shall be arranged so that all conductors entering or leaving the control panel are terminated on barrier type terminal strips, located at the rear of individual panels. Separate terminal strips shall be provided for connecting electronic signal, low level signal, control AC and DC power supply wiring. Parallel terminal strips shall be separated by a minimum of 6 inches.

Instrument input/output, switches, contacts, indicating lights, and other components shall be individually wired to permit removal and testing without disconnecting other components in the same control loop or circuit. "Daisy chain" wiring between instruments, neutrals, or grounds between different control circuits is not permitted.

All wiring connections shall be terminated with lugs and not more than two wires shall be connected to one terminal.

Terminal strips shall be phenolic with screw terminals suitable for No. 12 AWG wire as a minimum. Twenty percent spare terminals shall be provided for each row of terminal strips. Terminal strips shall be furnished with fanning strips and termination designations. A sleeve type wire marker, engraved with wire number, shall be permanently affixed to each wire at both ends.

Wire and cables shall be routed through conduit or plastic covered wireways. Wiring ducts shall be provided for incoming cables. Branch wiring shall be grouped and tied with tie wraps for neatness. Sufficient lengths of wire and cable shall be provided to permit removal of instruments and accessories without disconnecting component from the board wiring.

Panel wiring shall have stranded conductors with type of insulation, wire gauge, and rating as follows:

Service	Wire Size	Rating	Insulation
Instrument and Low Level Signal	No. 16 AWG	600 volt	SIS
Control Circuit and Power	No. 14 AWG	600 volt	SIS
SIS Incoming Power (120VAC)	No. 12 AWG	600 volt	XHHW

2.4 GROUND AND NEUTRAL BUS

A copper isolated instrument ground bus, 1/4" by 1", shall be furnished to ground signal shields, signal common, and instrument power supply common. A solderless lug connector shall be furnished at the end of the panel for a 4/0 stranded cable.

A copper isolated neutral bus, 1/4" by 1", shall be furnished to terminate the common AC neutral wires.

2.5 COMPONENTS

2.5.1 Pushbuttons and Indicating Lights

Pushbuttons, switches, and indicating lights shall be heavy duty, oil tight type. The pushbuttons and selector switches may have momentary or maintained contacts depending on circuit design. Contacts shall be rated at 5 amperes, 120V AC or 5 ampere, and 24V DC, continuously.

Indicating lights shall be single lens low voltage type with built-in dropping resistor for 6 volt lamp.

Unless otherwise specified, the color lens shall indicate the following:

Red Motor Running
Device Energized
Valve or Damper Open (On-Off)
Normal Path (3-Way Valve)
Power - On

Blue Supervisory or automatic indication

Green System Ready indication
Circuit Breaker Open
Valve or Damper Closed (On-Off)
Branch Flow Path (3-Way Valve)

Amber Permissive

White Alarm indication

2.5.2 Relays

Relays used for interlocks and alarms shall be of the industrial type, rated at 600 volts. Contacts shall be convertible type, rated at 10 amperes, with molded coil to operate at the voltage specified on the applicable drawings. Contact form and quantity for each relay shall be as called for on the elementary and loop diagrams.

2.6 POWER SUPPLY DISTRIBUTION

Power supply circuits shall be furnished for each panel section as follows:

120V AC - From UPS for instrument power supply
120V AC - For miscellaneous AC control circuits and panel power
120V AC - Lighting and convenience receptacles

All instruments related to the same control loop shall be serviced from the same power supply circuit. Multi-loop and individual power supplies furnished with instruments shall be mounted and fused.

A fused circuit breaker shall be furnished for each power supply and individual control circuit.

24 volt DC instrument power supply wiring shall be run in wireways separate from AC power. A common wireway may be used if they are separated by a barrier.

2.7 PAINTING AND FINISHING

Panel shall be free of rust, scale, distortion, and warpage. Surface shall be sandblasted with No. 00 grit, and shall be painted with two coats of rustproof primer and two coats of semi-gloss air dried lacquer. Panel color shall be as specified. Panel interior shall be primed and painted white.

2.8 INSTRUMENT NAMEPLATES

A nameplate shall be furnished for each instrument located on the front of the panel. They shall measure in accordance with dimensions on panel drawings or nameplate list.

Nameplates shall be manufactured of 3/32 inch thick white laminate having a black core and engraved with the inscription listed on the panel drawings or nameplate list. The characters shall be arranged symmetrically about the plate's vertical center line and formed by cutting through the laminate into the black core.

PART 3 EXECUTION

3.1 PANEL INSPECTION

Test instrumentation, personnel, and facilities shall be provided for shop tests of the panel. Panel inspection shall consist of checking general appearance, workmanship, and conformance with the contract drawings. Nameplates, wire tags, and similar markings shall be checked for proper location and identification.

3.2 SHOP TESTS

The panel shall be completely tested and checked out to assure a trouble-free, working installation in the field. Contractor shall be responsible for all testing, repair, and re-testing as outlined in this specification.

Complete records shall be kept of all tests and test reports. These shall be made available for inspection and approval.

Shop demonstration may be witnessed. At least two (2) weeks notice prior to testing is required in order that representatives may witness such tests

at their discretion.

Point to point wiring continuity checks shall be performed prior to energizing the panel.

Shop tests shall consist of initial tests of all components and sub-assemblies along with, to the extent reasonably possible, a full functional test of the complete system and all auxiliary equipment. This test shall be performed with all equipment connected in the same manner as it will be in the field to permit verification of proper system operation. After complete assembly, each circuit shall be tested to ground, rung out, and functionally tested under simulated service conditions. All wiring shall be checked by actual operating tests for accurate conformity to wiring diagrams and for continuity. This scope is not intended to include internal PLC functions or software.

Contractor shall supply testing and calibration facilities along with all dummy inputs and outputs necessary to simulate field conditions.

Functional and operational tests shall be performed for all devices such as recorders, annunciators, indicators and lights. All indication, alarm, and interlock circuits shall be tested to ensure proper operation. Recorder pens shall be set at zero, half scale, and full scale using suitable test inputs. Alarm set points shall be adjusted to values provided and actuated to alarm their corresponding annunciator points.

Control packages, which are furnished as panel inserts, do not require calibration or functional testing.

Test procedures and type of test equipment shall be submitted for information.

Supplied components, which are found to be defective or damaged, shall be replaced without cost. If any furnished component is found to be faulty, the supplier shall be notified for disposition.

3.3 FIELD ACCEPTANCE

Field acceptance tests for the control panel and all the devices mounted thereon will be performed for installation and connection of all external wiring.

Services of an engineer may be required to provide technical direction for installation and field acceptance testing.

-- End of Section --