STANDARD FORM 20
JANUARY 1961 EDITION
GENERAL SERVICES ADMINISTRATION
FED. PROG. REG. (4) CFR) 1-16.401

INVITATION FOR BIDS

(CCHSTRUCTION CONTRACT)

REFERENCE

IFB N62470-81-B-1478 Specification No. 05-81-1478

DATE

16 December 1983

MAME AND LOCATION OF PROJECT

Utilities Improvements Marine Corps Base, Courthouse Bay Area, Camp Lejeune, NC DEPARTMENT OR AGENCY

Department of the Navy Naval Facilities Engineering Command

BY (Issuing Office)
Atlantic Division
Naval Facilities Engineering Command
Norfolk, Virginia 23511

Contract to be awarded as a result of this solicitation shall be assigned a DO-C2 rating in accordance with the provisions of BDSA Reg 2 and/or DMS Reg 1.

Sealed bids in duplicate for the work described herein will be received until 2:00 p.m., 07 FEBRUARY 1984, by the Commander, Atlantic Division, Naval Facilities Engineering Command, Building N-21, Room 105, Naval Station, Norfolk, Virginia 23511

and at that time publicly opened.

PLANS AND SPECIFICATIONS WILL BE AVAILABLE ON OR AFTER 29 DECEMBER 1983

Information regarding bidding material, bid guarantee, bonds and drawings:

SPECIFICATION NO. 05-81-1478 and other bidding data and information may be obtained or examined on application to the Commander, Atlantic Division, Naval Facilities Engineering Command (Code No. 04), Room 361, Bldg. N-26, Naval Station, Norfolk, Virginia 23511

NOTE: If the <u>BID</u> is \$25,000 or greater, failure to submit <u>BID</u> GUARANTY at the time of Bid Opening is cause for rejection of <u>THE BID</u>

PLANS/SPECIFICATIONS REQUEST: Refer to LANTDIV FORM 4250/20 **TO ORDER PLANS AND SPECS, CALL: AREA CODE 804-444-3595**
For information concerning this contract:

PRIOR to bid opening date — Telephone 444-9900
AFTER bid opening date — Telephone 444-9511

NOTE: Full-size drawings for this project are available to bidders at the bidder's expense. If full-size drawings are desired, the Officer in Charge of Construction should be contacted for the procedure to obtain them. Full-size drawings may be inspected during regular working hours at the office of the Officer in Charge of Construction.

NOTE: When published in commercial periodicals, this is for NEWS RELEASE only.

NOT A PAID ADVERTISEMENT

Description of work: The work includes providing a new well, renovations to two existing wells, renovations and additions to the existing water plant, renovations to two wastewater pumping stations, new sewer line, renovations and modifications to the existing wastewater treatment plant, and sewer system rehabilitation and incidental related work at the Marine Corps Base, Courthouse Bay Area, Camp Lejeune, NC.

D. L. CONNER, RADM, CEC, USN Commander, Atlantic Division Naval Facilities Engineering Command

Estimated Cost Range: Between \$ 2,500,000 and \$5,000,000 16 December 1983

NOTICE OF TOTAL SMALL BUSINESS SET-ASIDE (1972 JUL)

- (a) Restriction. Offers under this procurement are solicited from small business concerns only and this procurement is to be awarded only to one or more small business concerns. This action is based on a determination by the Contracting Officer, alone or in conjunction with a representative of the Small Business Administration that it is in the interest of maintaining or mobilizing the Nation's full productive capacity, in the interest of war or national defense programs, or in the interest of assuring that a fair proportion of Government procurement is placed with small business concerns. Offers received from firms which are not small business concerns shall be considered nonresponsive and shall be rejected.
- (b) Definition. A "small business concern" is a concern, including its affiliates, which is independently owned and operated, is not dominant in the field of operation in which it is offering on Government contracts, and can further qualify under the criteria set forth in regulations of the Small Business Administration (Code of Federal Regulations, Title 13, Section 121.3-8). In addition to meeting these criteria, a manufacturer or a regular dealer submitting offers in his own name must agree to furnish in the performance of the contract end items manufactured or produced by small business concerns: Provided, That this additional requirement does not apply in connection with construction or service contracts.

Bid or proposals received from firms which are not small business concerns shall be considered nonresponsive.

Standard Industrial Classification No. 1629 applies and the applicable size standard for this procurement is \$12,000,000

"Notice of Requirement for Affirmative Action to Ensure Equal Employment Opportunity (Feb 1982) is attached hereto as Appendix "A" and hereby made a part hereof."

APPENDIX "A"

NOTICE OF REQUIREMENT FOR AFFIRMATIVE ACTION TO ENSURE EQUAL EMPLOYMENT OPPORTUNITY (1982 FEB)

- (a) The Offeror's or Bidder's attention is called to the "Equal Opportunity" and the "Affirmative Action Compliance Requirements for Construction" clauses set forth herein.
- (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 in each trade

23.5

6.9

These goals are applicable to all the Contractor's construction work (whether or not it is Federal or federally assisted) performed in the covered area.

If the contractor performs construction work (whether or not it is Federal or Federally assisted) in a geographical area located outside of the covered area, it shall apply the goals established for the geographical area where such work is actually performed.

Goals are published periodically in the Federal Register in notice form, and such notices may be obtained from any Office of Federal Contract

Compliance Programs (OFCCP) office.

The Contractor's compliance with the Executive Order and the regulations in 41 CFR Part 60-4 shall be based on its implementation of the Equal Opportunity clause, specific affirmative action obligations required by the clause entitled "Affirmative Action Compliance Requirements for Construction" and its efforts to meet prescribed goals. The hours of minority and female employment and training must be substantially uniform throughout the length of the contract, and in each trade, and 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, the Executive Order and the regulations in 41 CFR Part 60-4. Compliance with the goals will be measured against the total work hours performed.

- (c) The Contractor shall provide written notification to the Director, OFCCP within 10 working days of 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 name, address and telephone number of the subcontractor; employer identification number of the subcontractor; estimated dollar amount of the subcontract; estimated starting and completion dates of the subcontract; and the geographical area in which the subcontract is to be performed.
- (d) As used in this Notice, and in the contract resulting from this solicitation, the "covered area" is the counties of Columbus, Duplin, Onslow, and Pender, North Carolina.

SECTION 00101

BIDDING INFORMATION

- 1. CONTENTS: This Invitation for Bids, IFB No. N62470-81-B-1478, consists of the following documents:
 - (a) Bid Instruction Documents
 - (i) Invitation for Bids (Standard Form 20, Jan 1961, Ed).
 - (ii) Bidding Information.
 - (iii) Instructions to Bidders, dated March 1979.
 - (b) Bid Submittal Documents
 - (i) Bid Form (Standard Form 21, Dec 1965 Ed).
 - (ii) Representations and Certifications (Standard Form 19-B, Jun 1976 Ed.)(Rev. 1982 Dec).
 - (iii) Bid Guaranty (Standard Form 24, Jun 1964 Ed.) (See Instructions to Bidders.)
 - (c) Contract Documents
 - (i) Construction Contract (Standard Form 23, Jan 1961 Ed.)
 - (ii) Performance Bond (Standard Form 25, Jun 1967 Ed.) (See Instructions to Bidders.)
 - (iii) Payment Bond (Standard Form 25A, Jun 1964 Ed.) (See Instructions to Bidders.)
 - (iv) Labor Standards Provisions, dated November 1979.
 - (v) General Provisions dated March 1981 (Rev. 12-81).
 - a. Clause 43. ACCIDENT PREVENTION (1977 JUN): Change the date of the Corps of Engineers Manual, EM 385-1-1 from "1 June 1977" to "1 April 1981".
 - b. Clause 63. VALUE ENGINEERING INCENTIVE (1977
 AUG): Delete this clause and substitute the
 following therefor:
 "63. VALUE ENGINEERING INCENTIVE--CONSTRUCTION
 (1980 DEC)

(a) Applicability. This clause applie to any Contractor developed, prepared, and submitted. Value Engineering Change Proposal (VECP).

> Definitions. (b)

- (1) "Contractor's development and implementation costs" means those costs incurred on a VECP Government acceptance and those costs the Contractor incurs specifically to make the changes required by Government acceptance of a
- "Government costs" means those agency costs that result directly from developing and implementing the VECP and any net increases in the cost of testing, operations, maintenance, and logistic support. They do not include the normal administrative costs of processing the VECP.
- (3) "Instant contract savings" means the estimated reduction in Contractor cost of performance resulting from acceptance of the VECP, minus allowable Contractor's development and implementation costs (including subcontractors' development and implementation costs). (See paragraph (g).)

(4) "Value Engineering Change Proposal

(VECP)" means a proposal that:

requires a change to this, (i) the instant contract, to implement; and

- results in reducing the (ii) contract price or estimated cost without impairing . essential functions or characteristics, provided that it does not involve a change in deliverable end-item quantities only.
- (c) VECP Preparation. As a minimum, the Contractor shall include the information described in (1) through (6) in each VECP. If the proposed change affects contractually required configuration management procedures, the instructions in the procedures relating to format, identification, and priority assignment shall govern VECP preparation. The VECP shall include the following:
- (1) A description of the difference between the existing contract requirement and that proposed, the comparative advantages and disadvantages of each, a justification when an item's function or characteristics are being altered, and the effect of the change on the end item's performance.

- (2) A list of the contract requirements that must be changed if the VECP is accepted, including any suggested specification revisions.
- (3) A separate, detailed cost estimate for both the affected portions of the existing contract requirement and the VECP. The cost reduction associated with the VECP shall take into account the Contractor's allowable development and implementation costs, including any amount attributable to subcontracts under paragraph (g). The Contractor shall also include a description and estimate of costs the Government may incur in implementing the VECP, such as test and evaluation and operating and support costs.
- (4) A projection of any effects the proposed change would have on collateral costs to the agency.
- (5) A statement of the time by which a contract modification accepting the VECP must be issued in order to achieve the maximum cost reduction, noting any effect on the contract completion time or delivery schedule.
- (6) Identification of any previous submissions of the VECP, including the dates submitted, the agencies and contract numbers involved, and previous Government actions, if known.
 - (d) Submissions.
- (1) The Contractor shall submit VECPs to the Resident Engineer at the worksite, with a copy to the Contracting Officer. The Contracting Officer shall notify the Contractor of the status of the VECP within 45 calendar days after the contracting office receives it. If additional time is required because of extenuating circumstances, the Contractor shall be notified within the 45-day period and provided the reason for the delay and the expected date of the Contracting Officer's decision. VECPs shall be processed expeditiously; however, the Government shall not be liable for any delay in acting upon a VECP.

- (2) If the VECP is not accepted, the Contracting Officer shall provide the Contractor written notification fully explaining the reasons for rejection. The Contractor may withdraw, in whole or in part, any VECP not accepted by the Government within the period specified in the VECP. The Contracting Officer may require that the Contractor provide written notification before undertaking significant expenditures for VECP effort.
- (e) Acceptance. Any VECP may be accepted in whole or in part by the Contracting Officer's award of a modification to this contract citing this clause. The Contracting Officer may accept the VECP, even though an agreement on price reduction has not been reached, by issuing the Contractor a notice to proceed with the change. Until a notice to proceed is issued or a contract modification applies a VECP to this contract, the Contractor shall perform in accordance with the existing contract. The Contracting Officer's decision to accept all or part of any VECP shall be final and not subject to the Disputes clause.

(f) Sharing.

- (1) Rates. The Contractor's share of savings is determined by subtracting Government costs from instant contract savings and multiplying the result by 55 percent for fixed-price contracts and 25 percent for cost-reimbursement contracts.
- (2) Payment. Payment of any share due the Contractor for use of a VECP on this contract shall be authorized by a modification to this contract to:

(i) accept the VECP;

- (ii) reduce the contract price or estimated cost by the amount of instant contract savings; and
- (iii) provide the Contractor's share of savings by adding the amount calculated in (f)(1) to the contract price or fee.

- include appropriate VE clauses in any subcontract of \$50,000 or more and may include them in subcontracts of lesser value. To compute any adjustment in the contract price under paragraph (f), the Contractor's VECP development and implementation costs shall include any subcontractor's development and implementation costs that clearly result from the VECP, but shall exclude any VE incentive payments to subcontractors. The Contractor may choose any arrangement for subcontractor VE incentive payments, provided that these payments are not made from the Government's share of the savings resulting from the VECP.
- (h) Data. The Contractor may restrict the Government's right to use any part of a VECP or the supporting data by marking the following legend on the affected parts:

"These data, furnished under the Value Engineering Incentive--Construction clause of Contract ______, shall not be disclosed outside the Government or duplicated, used, or disclosed, in whole or in part, for any purpose other than to evaluate a VECP submitted under the clause. This restriction does not limit the Government's right to use information containted in these data if it has been obtained or is otherwise available from the Contractor or from another source without limitations."

If a VECP is accepted, the Contractor hereby grants the Government unlimited rights in the VECP and supporting data, except that, with respect to data qualifying and submitted as limited rights technical data, the Government shall have the rights specified in the contract modification implementing the VECP and shall appropriately mark the data."

- c. Clause 97. AFFIRMATIVE ACTION COMPLIANCE REQUIRE-MENTS FOR CONSTRUCTION (1982 FEB).
- (vi) NAVFAC Specification No. 05-81-1478.
- (vii) Drawings identified in Section 01011, Division 1 of the Specifications.
- (viii) Wage Determination Decision, Secretary of Labor Decision No. NC81-1148, with Modification No. 1.

2. BIDS:

2.1 Instruction to Bidders: Instructions to Bidders, and Invitation for Bids, Standard Form 20, January 1961 edition, shall be observed in the preparation of bids. Bidders shall affix their names and return addresses in the upper left corner of bid envelope. Envelopes containing bids must be sealed.

- 2.2 Bid Guaranty: For bids of \$25,000 or greater a bid guaranty will be required as stipulated in the Instructions to Bidders.
- 2.3 Items of Bids: Bids shall be submitted, in duplicate, on Standard Form 21, Bid Form, and shall be accompanied by Standard Form 19B, Representations and Certifications, and by Bid Guaranty, all in accordance with the Bid Instruction Documents listed in paragraph 1(a) hereinbefore upon the following item(s):

Base Bid

- a. Price for the entire work, complete in accordance with the drawings and specifications, but excluding the price for providing chemical grouting of sewer line joints, initial and subsequent testing of all sewer line joints.
- b. Price for providing initial testing of all sewer line joints, complete in accordance with the drawings and specifications, and in accordance with the following schedule:

ITEM	UNIT	UNIT PRICE	NO. UNITS	EXTENSION	
6-inch diameter pipe	EA		194	\$	
8-inch diameter pipe	EA	1.5000000	1,524	\$	
10-inch diameter pipe	EA	A STATE OF THE STA	515	\$	
12-inch diameter pipe	EA		95	\$	

c. Price for providing chemical grouting of sewer line joints and subsequent testing of grouted joints, complete in accordance with the drawings and specifications, and in accordance with the following schedule:

ITEM	UNIT	UNIT PRICE	NO. UNITS	EXTENSION
6-inch diameter pipe	EA		155	\$
8-inch diameter pipe	EA	7 887330	1,215	\$
10-inch diameter pipe	EA		410	\$
12-inch diameter pipe	EA		75	\$

NOTES: 1. The unit and lump sum prices for various items in the schedule above shall be deemed to include all costs required for the specified work, complete in accordance with the drawings and specifications, including all materials, labor, equipment, tools, supervision, and related items.

- The bid amount for the Base Bid will be determined by the sum of the lump sums bid under Base Bid (a) and the sum of the extensions under Base Bid (b) and (c). For Base Bid (b) and (c), bidders shall enter the unit prices and the extended totals in the spaces provided. Should there be a discrepancy between the unit prices and the extended totals, the unit prices shall govern.
- 2.4 Telegraphic Modifications of Bids: Telegraphic modifications of bids may be made in accordance with the Instructions to Bidders. Two signed copies of the telegram in a sealed envelope marked "Copies of telegraphic modification of bid for Utilities Improvements, Specification No. 05-81-1478," should be forwarded immediately to the office to which the written bids were submitted.
- 2.5 Telegraphic Modifications or Withdrawal of Bids: Telegraphic modifications or withdrawal of bids will be considered as specified herein. TELEPHONIC RECEIPT OF TELEGRAPHIC MODIFICATIONS OR WITHDRAWAL OF BIDS WILL NOT QUALIFY THE TELEGRAM AS TIMELY. The telegram must be received at the place specified for receipt of bids prior to the exact time set for receipt of bids.
- 2.6 Hand Delivered Bids: All hand delivered bids must be deposited in the bid box at the Atlantic Division, Naval Facilities Engineering Command, Contract Division, Room No. 105, Building N-21, Naval Station, Norfolk, Virginia, prior to the time and date set for bid opening. Any bids submitted by hand after the time set for receipt will not be accepted.
- 3. PRE-BID SITE VISITATION: To inspect the site of the work prior to bid opening, prior appointment must be made with the Assistant Resident Officer in Charge of Construction, Marine Corps Base, Camp Lejeune, North Carolina 28542, telephone 919-451-1833. Bidders are urged and expected to inspect the site where services are to be performed and to satisfy themselves as to all general and local conditions that may affect the cost of performance of the contract to the extent such information is reasonably obtainable. In no event will a failure to inspect the site constitute grounds for withdrawal of a bid after opening or for a claim after award of the contract.
- 4. CONTROLLED MATERIALS DATA: The Contracting Officer will issue a DO-C2 priority rating for procurement of critical materials. See provision entitled, "Priorities, Allocations and Allotments" of the General Provisions.
- 5. INQUIRIES: All questions concerning the bidding or any other phase of the plans and specifications occurring prior to bid opening shall be presented to the Design Division, Atlantic Division, Naval Facilities Engineering Command, Building N-26, Room 307, Naval Station, Norfolk, Virginia 23511, telephone 444-9900, area code 804. Questions requiring interpretation of drawings and specifications must be submitted at least 10 days before bid opening. Interpretations or modifications to

specifications made as a result of questions will be made by amendment only, and unless so done, all bidders should base their bids on the plans and specifications as issued.

- 6. AVAILABILITY OF SPECIFICATIONS, STANDARDS AND DESCRIPTIONS (1977 JUN): Specifications, standards and descriptions cited in this solicitation are available as indicated below:
- (a) Unclassified Federal, Military and Other Specifications and Standards (Excluding Commercial), and Data Item Descriptions. Submit request on DD Form 1425 (Specifications and Standards Requisition) to:

Commanding Officer
U. S. Naval Publications and Forms Center
5801 Tabor Avenue -- Philadelphia, PA 19120

The Acquisition Management Systems and Data Requirements Control List, DoD Directive 5000.19-L, Volume II, may be ordered on the DD Form 1425. The Department of Defense Index of Specifications and Standards (DODISS) may be purchased from the Superintendent of Documents, U. S. Government Printing Office, Washington, D.C. 20402. When requesting a specification or standard, the request shall indicate the title, number, date and any applicable amendment thereto by number and date. When requesting a data item description, the request shall cite the solicitation. When DD Form 1425 is not available, the request may be submitted in letter form giving the same information as listed above, and the solicitation or contract number involved. Such request may also be made to the activity by Telex No. 834295, Western Union No. 710-670-1685, or telephone (area code 215, 697-3321) in case of urgency.

- (b) Commercial Specifications, Standards and Descriptions: These specifications, standards and descriptions are not available from Government sources. They may be obtained from the publishers.
- (c) Availability for Examination of Specifications, Standards, Plans, Drawings, and Other Pertinent Documents: The specifications, standards, plans, drawings, and other pertinent documents cited in this solicitation may be examined at the following location:

Atlantic Division, Naval Facilities Engineering Command Design Division, Specifications Branch Code 406, Room 396, Building N-26 Naval Station, Norfolk, Virginia 23511

- 7. RECOVERED MATERIAL: The Contractor certifies by signing this bid/proposal/quotation that recovered materials, as defined in DAR 1-2500.4 will be used as required by the applicable specifications.
- 8. CERTIFICATE OF CURRENT COST OR PRICING DATA: (This paragraph applies to negotiated contracts of \$500,000 or more except where the price is based on adequate competition, and to change orders of \$500,000 or more, to any contract.) The Contractor shall submit to the Contracting

Officer a certificate in the form set forth below as soon as practicable after agreement is reached on the contract price:

This is to certify that, to the best or pricing data as defined in DAR 3-807.1(a)(1) st	bmitted, eith	er actually
or by specific identification in writing (tracting Officer or his representative in	see DAR	3-80/.3(a) to of	the Con-
are accurate, complete, and current as of	M 1128		.**
	day	month	year

This certification includes the cost or pricing data supporting any advance agreement(s) and forward pricing rate agreements between the offeror and the Government which are part of the proposal.

Firm	
Name	
Title	

Date of Execution

*Describe the proposal, quotation, request for price adjustment or other submission involved, giving appropriate identifying number (e.g. RFP No.).

**The effective date shall be the date when price negotiations were concluded and the contract price was agreed to. The responsibility of the Contractor is not limited by the personal knowledge of the Contractor's negotiator if the Contractor had information reasonably available at the time of agreement, showing that the negotiated price is not based on accurate, complete and current data.

***This date should be as close as practicable to the date when the price negotiations were concluded and the contract price was agreed to.

- 9. NORTH CAROLINA STATE AND LOCAL SALES AND USE TAX (1977 JAN):
- (a) As used throughout this clause, the term "materials" means building materials, supplies, fixtures and equipment which become a part of or are annexed to any building or structure erected, altered, or repaired under this contract.
- (b) If this is a fixed-price type contract as defined in the Defense Acquisition Regulation, the contract price includes North Carolina state and local sales and use taxes to be paid with respect to materials, notwithstanding any other provision of this contract. If this is a cost-reimbursement type contract as defined in such regulation, any North Carolina state and local sales and use taxes paid by the Contractor with respect to materials shall consitute an allowable cost under this contract.

- (c) At the time specified in paragraph (d) below):
- (i) The Contractor shall furnish the Contracting Officer certified statements setting forth the cost of the materials purchased from each vendor and the amount of North Carolina state and local sales and use taxes paid thereon. In the event the Contractor makes several purchases from the same vendor, such certified statement shall indicate the invoice numbers, the inclusive dates of the invoices, the total amount of the invoices and the North Carolina state and local sales and use taxes paid thereon. Such statement shall also include the cost of any tangible personal property withdrawn from the Contractor's warehouse stock and the amount of North Carolina state and local sales or use tax paid thereon by the Contractor. Any local sales or use taxes included in the Contractor's statements must be shown separately from the state sales or use tax. The Contractor shall furnish such additional information as the Commissioner of Revenue of the State of North Carolina may require to substantiate a refund claim for sales or use taxes.
- (ii) The Contractor shall obtain and furnish to the Contracting Officer similar certified statements by its subcontractors.
- (d) If this contract is completed before the next October 1, the certified statements to be furnished pursuant to paragraph (c) above shall be submitted within 60 days after completion. If this contract is not completed before the next October 1, such certified statements shall be submitted on or before the 30th day of November of each year and shall cover taxes paid during the twelve month period which ended the preceding September 30.
- (e) The certified statements to be furnished pursuant to paragraph(c) above shall be in the following form:
- 10. REFERENCE TO AMENDMENTS: Each bidder shall refer in his bid to all amendments to this specification; failure to do so may constitute an informality in the bid.

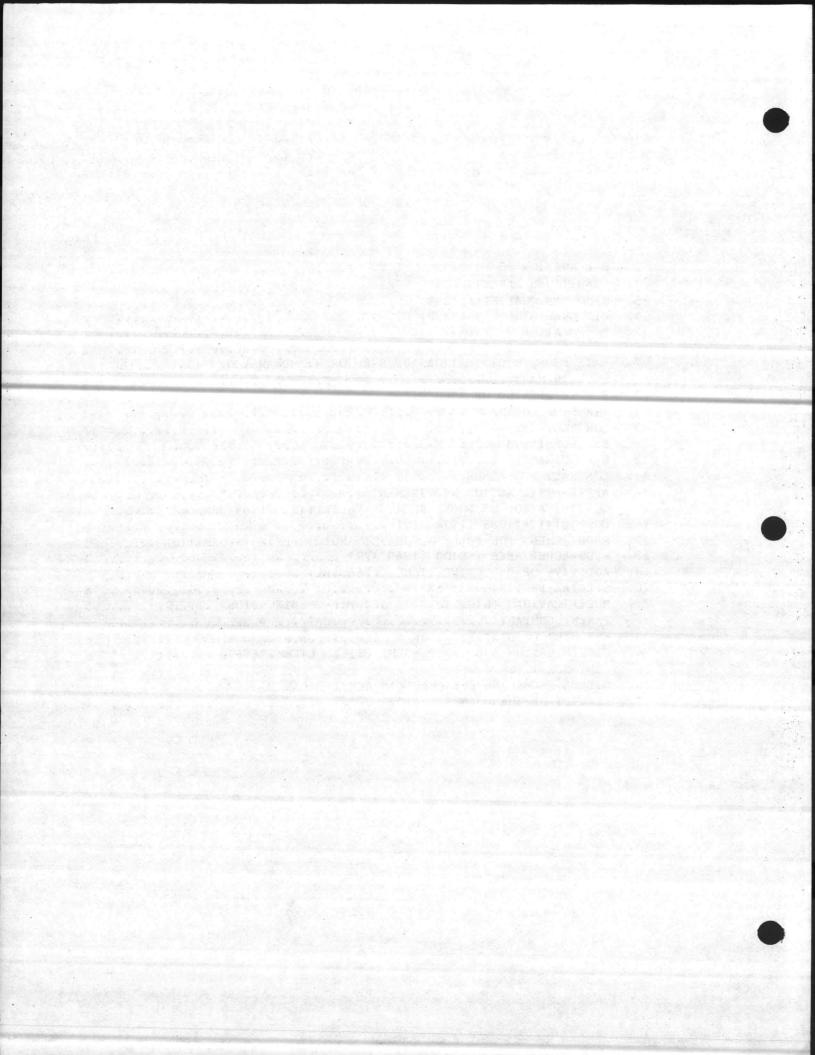
*** END OF SECTION ***

INSTRUCTIONS TO BIDDERS (Construction Contract)

(Instructions 1 through 11 are those prescribed by the General Services Administration in Standard Form 22, February 1978 Edition, as amended pursuant to the latest revisions of the Defense Acquisition Regulation).

TABLE OF CONTENTS

		Page
1.	EXPLANATION TO BIDDERS	1
2.	CONDITIONS AFFECTING THE WORK	1
3.	BIDDER'S QUALIFICATIONS	1
4.	BID GUARANTEE (1964 JUN)	1.
5.	PREPARATION OF BIDS	
6.	SUBMISSION OF BIDS	
7.	LATE BIDS, MODIFICATIONS OF BIDS OR WITHDRAWAL OF BIDS	
	(1979 MAR)	2
8.	PUBLIC OPENING OF BIDS	3
9.	AWARD OF CONTRACT	3
10.	CONTRACT AND BONDS	3
11.	BID SUBMISSION	3
12.	BID GUARANTY	4
13.	CONTRACT AND BONDS	4
14.	AFFIRMATIVE ACTION REQUIREMENT	
15.	CERTIFICATION OF NONSEGREGATED FACILITIES (1969 JAN)	
16.	COST LIMITATIONS (1974 APR)	
17.	REQUIREMENT FOR FULL, ACCURATE, AND COMPLETE INFORMATION	5
18.	BIDS-ACCEPTANCE PERIOD (1960 APR)	
9.	ADDITIVE OR DEDUCTIVE ITEMS (1968 APR)	5
20.	SPECIAL PROVISIONS - SF 19	5
21.	MODIFICATIONS PRIOR TO DATE SET FOR OPENING BIDS	5
22.	PARENT COMPANY	6
23.	EMPLOYER'S IDENTIFICATION NUMBER	6
24.	CERTIFICATION AND INDEPENDENT PRICE DETERMINATION	6
25.	CONTINGENT FEE	6
6.	NOTICE REGARDING BUY AMERICAN ACT (1970 SEP)	7
7.	RECEIPT OF AMENDMENTS	7



INSTRUCTIONS TO BIDDERS (Construction Contract)

(Instructions 1 through 11 are those prescribed by the General Services Administration in Standard Form 22, February 1978 Edition, as amended pursuant to the latest revisions of the Defense Acquisition Regulation).

- 1. EXPLANATIONS TO BIDDERS Any explanation desired by a bidder regarding the meaning or interpretation of the invitation for bids, drawings, specifications, etc., must be requested in writing and with sufficient time allowed for a reply to reach bidders before the submission of their bids. Any interpretation made will be in the form of an amendment of the invitation for bids, drawings, specifications, etc., and will be furnished to all prospective bidders. Its receipt by the bidder must be acknowledged in the space provided on the Bid Form (Standard Form 21) or by letter or telegram received before the time set for opening of bids. Oral explanations or instructions given before the award of the contract will not be binding.
- 2. CONDITIONS AFFECTING THE WORK -Bidders should visit the site and take such other steps as may be reasonably necessary to ascertain the nature and location of the work, and the general and local conditions which can affect the work or the cost thereof. Failure to do so will not relieve bidders from responsibility for estimating properly the difficulty or cost of successfully performing the work. The Government will assume no responsibility for any understanding or representations concerning conditions made by any of its officers or agents prior to the execution of the contract, unless included in the invitation for bids, the specifications, or related documents.
- 3. BIDDER'S QUALIFICATIONS Before a bid is considered for award, the bidder may be requested by the Government to submit a statement re-

garding his previous experience in performing comparable work, his business and technical organization, financial resources, and plant available to be used in performing the work.

4. BID GUARANTEE - Where a bid guarantee is required by the invitation for bids, 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.

A bid guarantee shall be in the form of a firm commitment, such as a bid bond, postal money order, certified check, cashier's check, irrevorcable letter of credit or, in accordance with Treasury Department regulations, certain bonds or notes of the United States. guarantees, other than bid bonds, will be returned (a) to unsuccessful bidders soon as practicable after the opening of bids, and (b) to the successful bidder upon execution of such further contractual documents and bonds (including any necessary coinsurance or reinsurance agreements) as may be required by the bid as accepted.

If the successful bidder, upon acceptance of his bid by the Government within the period specified therein for acceptance (sixty days if no period is specified) fails to execute such further contractual documents, if any, and give such bond(s) (including any necessary coinsurance or reinsurance agreements) as may be required by the terms of the bid as accepted within the time specified (ten days if no period is specified) after receipt of the

forms by him, his contract may be terminated for default. In such event he shall be liable for any cost of procuring the work which exceeds the amount of his bid, and the bid guarantee shall be available toward off-setting such difference. (1964 JUN)

- 5. PREPARATION OF BIDS (a) Bids shall be submitted on the forms furnished, or copies thereof, and must be manually signed. If erasures or other changes appear on the forms, each erasure or change must be initialed by the person signing the bid. Unless specifically authorized in the invitation for bids, telegraphic bids will not be considered.
- (b) The bid form may provide for submission of a price or prices for one or more items, which may be lump sum bids, alternate prices, scheduled items resulting in a bid on a unit of construction or a combination thereof, etc. Where the bid form explicitly requires that the bidder bid on all items, failure to do so will disqualify the bid. When submission of a price on all items is not required, bidders should insert the words "no bid" in the space provided for any item on which no price is submitted.
- (c) Unless called for, alternate bids will not be considered.
- (d) Modification of bids already submitted will be considered if received at the office designated in the invitation for bids by the time set for opening of bids. Telegraphic modifications will be considered, but should not reveal the amount of the original or revised bid.
- 6. SUBMISSION OF BIDS Bids must be sealed, marked, and addressed as directed in the invitation for bids. Failure to do so may result in a premature opening of, or a failure to open, such bid.

- 7. LATE BIDS, MODIFICATIONS OF BIDS OR WITHDRAWAL OF BIDS (1979 Mar)
- (a) Any bid received at the office designated in the solicitation after the exact time specified for receipt will not be considered unless it is received before award is made and either;
 - (i) it was sent by registered or certified mail not later than the fifth calendar day prior to the date specified for the receipt of bids (e.g., a bid submitted in response to a solicitation requiring receipt of bids by the 20th of the month must have been mailed by the 15th or earlier); or
 - (ii) it was sent by mail (or telegram if authorized) and it is determined by the Government that the late receipt was due solely to mishandling by the Government after receipt at the Government installation.
- (b) Any modification or withdrawal of bid is subject to the same conditions as in (a) above except that withdrawal of bids by telegram is authorized. A bid may also be withdrawn in person by a bidder or his authorized representative, provided his identity is made known and he signs a receipt for the bid, but only if the withdrawal is made prior to the exact time set for receipt of bids.
- (c) The only acceptable evidence to establish;
 - (i) the date of mailing of a late bid, modification or withdrawal sent either by registered or certified mail is the U.S. or Canadian Postal

Service postmark on the wrapper or on the original receipt from the U.S. or Canadian Postal Service. If neither postmark shows legible date, the modification or withdrawal shall be deemed to have been mailed late. (The "postmark" means a printed, stamped, or otherwise placed impression (exclusive of a postage meter machine impression) that is readily identifiable without further action as having been supplied and affixed on the date of mailing by employees of the U.S. or Canadian Postal Service. Therefore, offerors, should request the postal clerk to place a hand cancellation bull's-eye "postmark" on both the receipt and the envelope or wrapper.)

- (ii) the time of receipt at the Government installation is the time/date stamp of such installation on the bid wrapper or other documentary evidence of receipt maintained by the installation.
- (d) Notwithstanding the above, a late modification of an otherwise successful bid which makes its terms more favorable to the Government will be considered at any time it is received and may be accepted.

NOTE: The term "telegram" includes mailgrams.

8. PUBLIC OPENING OF BIDS - Bids will be publicly opened at the time set for opening in the invitation for bids. Their content will be made public for the information of bidders and others interested, who may be present either in person or by representative.

- 9. AWARD OF CONTRACT (a) award of contract will be made to that responsible bidder whose bid, conforming to the invitation for bids is most advantageous to the Government, price and other factors considered.
- (b) The Government may, when in its interest, reject any or all bids or waive any informality in bids received.
- (c) The Government may accept any item or combination of items of a bid, unless precluded by the invitation for bids or the bidder includes in his bid a restrictive limitation.
- 10. CONTRACT AND BONDS The bidder whose bid is accepted will, within the time established in the bid, enter into a written contract with the Government and, if required, furnish performance and payment bonds on Government standard forms in the amounts indicated in the invitation for bids or the specifications. (1979 MAR)
- 11. BID SUBMISSION Bids shall be submitted only upon the items of bids stated in the specifications; bids upon other bases will not be considered unless specifically requested by the Government. Bids that do not reference all amendments or that are not submitted on the prescribed forms may be considered nonconforming. The Officer whose duty it is to open the bids will decide when the specified time has arrived, and no bids (or modification or withdrawal of bid) will be considered if received by the Navy after the reading of the bids has begun except as provided in the "Late Bids and Modifications or Withdrawals" provisions of invitation. Discrepancies, this ambiguities, errors, or omissions to the bidding data should be reported promptly to the office from which the data were obtained.

12. BID GUARANTY

(Applicable only to bids of \$25,000 or more.) To assure the execution of the contract and the performance and payment bonds, each bidder shall submit with its bid a guaranty bond (Standard Form 24) executed by a surety company holding a certificate of authority from the Secretary of the Treasury as an acceptable surety, or other security as provided in paragraph 4 of Instructions to Bidders. Security shall be in the sum of 20 percent of the largest amount for which award can be made under the bid submitted, but in no case to exceed \$3,000,000. The bid guaranty bond shall be accompanied by a verifax or other facsimile copy of the agent's authority to sign bonds for the surety company.

13. CONTRACT AND BONDS

(Applicable only to bids of \$25,000 or more.) Within 10 days after the prescribed forms are presented to him for signature, the bidder to whom award is made shall enter into a written contract on the form prescribed by the specification and shall furnish two bonds, each with satisfactory security; namely, a performance bond (Standard Form 25) and a payment bond (Standard Form 25A). The performance bond shall be in a penal sum equal to 100 percent of the contract price. The payment bond shall be equal to 50 percent of the contract price, except that it shall be 40 percent of the contract price if that price is more than \$1,000,000 and not more \$5,000,000, and in the fixed sum of \$2,500,000 if the contract price is more than \$5,000,000. The bond of any surety company holding a certificate of authority from the Secretary of the Treasury as an acceptable surety on Federal bonds will be accepted. Individual sureties will be accepted if

each such surety deposits with the Contracting Officer cash, bonds, or notes of the United States, or certified check drawn to the order of the Treasurer of the United States, or such other security as the Contracting Officer may deem necessary for the required amount of the guaranty, under the agreement that the collateral so deposited shall remain in the possession and control of the Treasurer of the United States for at least one year after the completion of the contract. The contract time for purposes of fixing the completion date, default, and liquidated damages shall begin to run 15 days from the mailing of acceptance, regardless of when the formal contract and bonds are executed.

- 14. NOTE THE AFFIRMATIVE ACTION REQUIREMENT OF THE EQUAL OPPORTUNITY CLAUSE WHICH MAY APPLY TO THE CONTRACT RESULTING FROM THIS SOLICITATION
- 15. NOTE THE CERTIFICATION OF NONSEGREGATED FACILITIES IN THIS SOLICITATION

Bidders, offerors and applicants are cautioned to note the "Certification of Nonsegregated Facilities" in the solicitation. Failure of a bidder or offeror to agree to the certification will render his bid or offer nonresponsive to the terms of solicitations involving awards of contracts exceeding \$10,000 which are not exempt from the provisions of the Equal Opportunity clause (1978 SEP)

16. COST LIMITATIONS

A bid which does not contain separate bid prices for the items identified as subject to a cost limitation may be considered nonresponsive. A bidder by signing his bid certifies that each price bid on items subject to a cost limitation include an approp-

riate apportionment of all applicable estimated costs, direct and indirect, as well as overhead and profit. Bids may be rejected which (i) have been materially unbalanced for the purpose of bringing affected items within cost limitations or (ii) exceed the cost limitations unless such limitations have been waived by the Assistant Secretary of Defense (installations and Logistics) prior to award. (1974 APR)

17. BIDS MUST SET FORTH FULL, ACCURATE, AND COMPLETE INFORMATION AS REQUIRED BY THIS INVITATION FOR BIDS (INCLUDING ATTACHMENTS). THE PENALTY FOR MAKING FALSE STATEMENTS IN BIDS IS PRESCRIBED IN 18 U.S.C. 1001

18. BIDS - ACCEPTANCE PERIOD (1960 APR)

Bids offering less than the period of days specified for acceptance by the Government from the date set for opening of bids will be considered nonresponsive and will be rejected.

19. ADDITIVE OR DEDUCTIVE ITEMS (1968 APR)

If this invitation includes more than one bid item, the following clause applies.

The low bidder for purposes of award shall be the conforming responsible bidder offering the low aggregate amount for the first or base bid item, plus or minus (in the order of priority listed in the schedule) those additive or deductive bid items providing the most features of the work within the funds determined by the Government to be available before bids are opened. If addition of another bid item in the listed order of priority would make the award exceed such funds for all bidders, it shall be skipped and the next subsequent additive bid item in a lower

amount shall be added if award thereon can be made within such funds. For example, when the amount available is \$100,000, and a bidder's base bid and four successive additives are \$85,000, \$10,000, \$8,000, \$6,000, and \$4,000, the aggregate amount of the bid for purposes of award would be \$99,000 for the base bid plus the first and fourth additives, the second and third additives being skipped because each of them would cause the aggregate bid to exceed \$100,000. In any case all bids shall be evaluated on the basis of the same additive or deductive bid items, determined as above provided. listed order of priority need be followed only for determining the low bidder. After determination of the low bidder as stated, award in the best interests of the Government may be made to him on his base bid and any combination of his additive or deductive bid for which funds are determined to be available at the time of the award, provided that award on such combination of bid items does not exceed the amount offered by any other conforming responsible bidder for the same combination of bid items.

20. SPECIAL PROVISIONS - SF 19

If the successful bid exceeds \$10,000 and the contract is to be executed on Standard Form 19, the clauses set forth in the current Defense Acquistion Regulation, paragraphs 11-401.1(b) (Federal, State, and Local Taxes) and 12-804(a)(Equal Opportunity) apply.

21. MODIFICATIONS PRIOR TO DATE
SET FOR OPENING BIDS

The right is reserved, as the interest of the Government may require, to revise or amend the specifications or drawings or both prior to the date set for opening bids. Such revisions

and amendments, if any, will be announced by an amendment or amendments to this Invitation for Bids. If the revisions and amendments are of a nature which requires material changes in quantities or prices to be bid or both, the date set for opening bids may be postponed by such number of days as in the opinion of the issuing officer will enable bidders to revise their bids. In such cases, the amendment will include an announcement of the new date for opening bids.

22. PARENT COMPANY

A parent company for the purpose of this offer is a company which either owns or controls the activities and basic business policies of the offeror. To own another company means the parent company must own at least a majority (more than 50 percent) of the voting rights in that company. To control another company, such ownership is not required; if another company is able to formulate, determine, or veto basic business policy decisions of the offeror; such other company is considered the parent company of the offeror. This control may be exercised through the use of dominating minority voting rights, use of proxy voting, contractual arrangements or otherwise.

23. EMPLOYER'S IDENTIFICATION NUMBER

(Applicable only to advertised solicitations). The offeror shall insert in the applicable space on the offer form, if he has no parent company, his own Employer's Identification Number (E.I. No.) (Federal Social Security Number used on Employer's Quarterly Federal Tax Return, U.S. Treasury Department Form 941), or, if he has a parent company, the Employer's Identification Number of his parent company.

24. CERTIFICATION OF INDEPENDENT PRICE DETERMINATION

- (a) This certification on the offer form is not applicable to a foreign offeror submitting an offer for a contract which requires performance of delivery outside the United States, its possessions, and Puerto Rico.
- (b) An offer will not be considered for award where (a)(1), (a)(3), or (b) of the certification has been deleted or modified. Where (a)(2) of the certification has been deleted or modified, the offer will not be considered for award unless the offeror furnishes with the offer a signed statement which sets forth in detail the circumstances of the disclosure and the head of the agency, or his designee, determines that such disclosure was not made for the purpose of restricting competition.

25. CONTINGENT FEE

If the offeror, by checking the appropriate box provided therefor, has represented that he has employed or retained a company or person (other than a full-time bone fide employee working solely for the offeror) to solicit or secure this contract, or that he has paid or agreed to pay any fee, commission, percentage, or brokerage fee to any company or person contingent upon or resulting from the award of this contract, he shall furnish, in duplicate, a complete Standard Form 119, Contractor's Statement of Contingent or Other Fees. If offeror has previously furnished a completed Standard Form 119 to the office issuing solicitation, he may accompany his offer with a signed statement (a) indicating when such completed form was previously furnished, (b) identifying by number the previous solicitation of contract, if any, in connection with

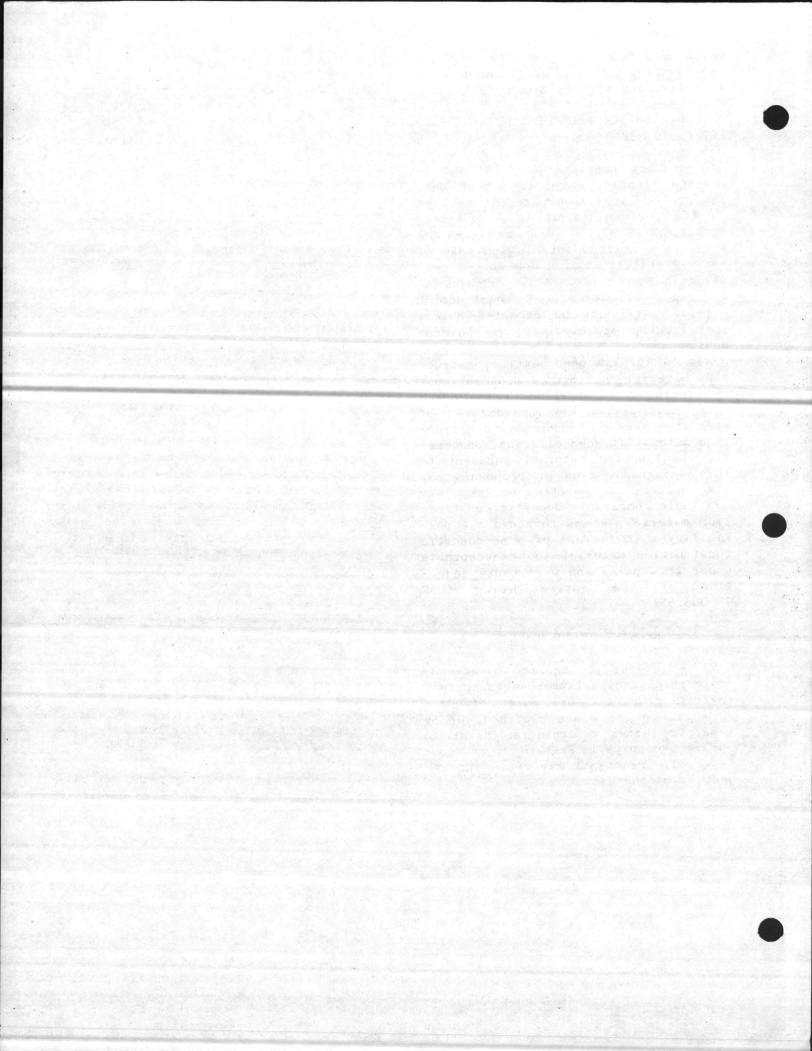
which such form was submitted, and (c) representing that the statement in such form is applicable to this offer.

26. NOTICE REGARDING BUY AMERICAN ACT (1970 SEP)

The Buy American Act (41 U.S.C. 10a-10d) generally requires that only domestic construction material be used in the performance of this contract. Exception from the Buy American Act shall be permitted only in the case of nonavailability of domestic construction materials. A bid or proposal offering nondomestic construction material will not be accepted unless specifically approved by the Government. When a bidder or offeror proposes to furnish nondomestic construction material, his bid or proposal must set forth an itemization of the quantity, unit price, and intended use of each item of such nondomestic construction material. When offering nondomestic construction material pursuant to this paragraph, bids or proposals may also offer, at stated prices, any available comparable domestic construction material, so as to avoid the possibility that farture of a nondomestic construction material to be acceptable under this paragraph will cause rejection of the entire bid. (DAR 7-2003.65)

27. RECEIPT OF AMENDMENTS

Each bidder is required to acknowledge receipt of all amendments to this invitation on the Bid Form, Standard Form 21, in the space provided, or by separate letter or telegram prior to opening of bids. Failure to acknowledge all amendments may cause the rejection of the bid.



REPRESENTATIONS AND CERTIFICATIONS	REFERENCE (Enter Same No.(s) as on SF		
(Construction and Architect-	19, 21 and 252)		
Engineer Contract) (REV. 1982 DEC)			
(For use with Standard Forms 19, 21 and 252)			
NAME AND ADDRESS OF BIDDER (No., Street,	DATE OF BID		
City, State and ZIP Code)	그는 사람들은 사람들이 가는 바람들이 살아 나가면 얼마나 나를 다 먹었다.		
어린 가는 가는 아이들은 아이들은 그래를 들었다. 그는 이렇게 그는 그녀들이 하는 그가 그리고 그렇게 하는데 그는데 그래요?	shall be construed to mean "offer" and "offeror." stations and certifications as a part of the bid		
Tuentified above. Toneek appropriate boxes,			
1. SMALL BUSINESS			
He is, is not, a small business co	ncern. (A small business concern for the purpose of		
Government procurement is a concern, including	ng its affiliates, which is independently owned and		
operated, is not dominant in the field of	operations in which it is bidding on Government		
	e criteria concerning number of employees, average		

2. CONTINGENT FEE

1217).

(a) He has, has not, employed or retained any company or person (other than a full-time bona fide employee working solely for the bidder) to solicit or secure this contract, and (b) he has, has not, paid or agreed to pay any company or person (other than a full-time bona fide employee working solely for the bidder) any fee, commission, percentage or brokerage fee, contingent upon or resulting from the award of this contract; and agrees to furnish information relating to (a) and (b) above as requested by the Contracting Officer. (For interpretation of the representation, including the term "bona fide employee," see Code of Federal Regulations, Title 41, Subpart 1-1.5.)

annual receipts, or other criteria as prescribed by the Small Business Administration. For additional information see governing regulations of the Small Business Administration [13 CFR Part

3.	TYPE	OF	ORGANIZATION	

He operates as an ___ individual, ___ partnership, ___ joint venture, ___ corporation, incorporated in State of ____

4. INDEPENDENT PRICE DETERMINATION

- (a) By submission of this bid, each bidder certifies, and in the case of a joint bid each party thereto certifies as to his own organization, that in connection with this procurement:
 - (1) The prices in this bid have been arrived at independently, without consultation, communication, or agreement, for the purpose of restricting competition, as to any matter relating to such prices with any other bidder or with any competitor;
- NOTE Bids must set forth full, accurate, and complete information as required by this invitation for bids (including attachments). The penalty for making false statements in bids is prescribed in 18 U.S.C. 1001.

STANDARD FORM 19-B, JUNE 1976 EDITION GENERAL SERVICES ADMINISTRATION FED. PROC. REG. (41CFR)1-16.401 AND 1-16.701

- (2) Unless otherwise required by law, the prices which have been quoted in this bid have not been knowingly disclosed by the bidder and will not knowingly be disclosed by the bidder prior to opening, in the case of a bid, or prior to award, in the case of a proposal, directly or indirectly to any other bidder or to any competitor; and
- (3) No attempt has been made or will be made by the bidder to induce any other person or firm to submit or not to submit a bid for the purpose of restricting competition.
- (b) Each person signing this bid certifies that:
 - (1) He is the person in the bidder's organization responsible within that organization for the decision as to the prices being bid herein and that he has not participated, and will not participate, in any action contrary to (a)(1) through (a)(3) above; or
 - (2) (a) He is not the person in the bidder's organization responsible within that organization for the decision as to the prices being bid herein but that he has been authorized in writing to act as agent for the persons responsible for such decision in certifying that such persons have not participated, and will not participate, in any action contrary to (a)(1) through (a)(3)above, and as their agent does hereby so certify; and (b) he has not participated, and will not participate, in any action contrary to (a)(1) through (a)(3) above.
- (c) This certification is not applicable to a foreign bidder submitting a bid for a contract which requires performance or delivery outside the United States, its possessions, and Puerto Rico.
- (d) A bid will not be considered for award where (a)(1), (a)(3), or (b) above, has been deleted or modified. Where (a)(2) above has been deleted or modified, the bid will not be considered for award unless the bidder furnishes with the bid a signed statement which sets forth in detail the circumstances of the disclosure and unless it is determined that such disclosure was not made for the purpose of restricting competition.

THE FOLLOWING NEED BE CHECKED ONLY IF BID EXCEEDS \$10,000 IN AMOUNT.

5. EQUAL OPPORTUNITY

He has, has not, participated in a previous contract or subcontract subject to the Equal Opportunity Clause herein, the clause originally contained in Section 301 of Executive Order No. 10925, or the clause contained in Section 201 of Executive Order No. 11114; he has, has not, filed all required compliance reports; and representations indicating submission of required compliance reports, signed by proposed subcontractors, will be obtained prior to subcontract awards.

(The above representations need not be submitted in connection with contracts or subcontracts which are exempt from the equal opportunity clause.)

6. PARENT COMPANY AND EMPLOYER IDENTIFICATION NUMBER

Each bidder shall furnish the following information by filling in the appropriate blanks:

(a) Is the bidder owned or controlled by a parent company as described below? Yes No. (For the purpose of this bid, a parent company is defined as one which either owns or controls the activities and basic business policies of the bidder. To own another company means the parent company must own at least a majority (more than 50 percent) of the voting rights in that company. To control another company, such ownership is not required; if another company is able to formulate, determine, or veto basic business policy decisions of the bidder, such other company is considered the parent company of the bidder. This control may be excerised through the use of dominant minority voting rights, use of proxy voting, contractual arrangements, or otherwise.)

(b) If the answer to (a) above is "Yes," bidder shall insert in the space below the name and main office address of the parent company.

NAME OF PARENT COMPANY

MAIN OFFICE ADDRESS (No., Street, City, State, and ZIP CODE)

(c) Bidder shall insert in the applicable space below, if he has no parent company, his own Employer's Identification Number (E.I. No.) (Federal Social Security Number used on Employer's Quarterly Federal Tax Return, U.S. Treasury Department Form 941), or, if he has a parent company, the E.I. No. of his parent company.

EMPLOYER PARENT COMPANY BIDDER

IDENTIFICATION NUMBER OF

7. CERTIFICATION OF NONSEGREGATED FACILITIES (1979 AUG)

(Applicable to contracts, subcontracts, and agreements with applicants who are themselves performing Federally assisted construction contracts, exceeding \$10,000 which are not exempt from the provisions of the Equal Opportunity Clause.)

By the submission of this bid, the bidder, offeror, applicant, or subcontractor certifies that he does not maintain or provide for his employees any segregated facilities at any of his establishments, and that he does not permit employees to perform their services at any location, under his control, where segregated facilities are maintained. He certifies further that he will not maintain or provide for his employees any segregated facilities at any of his establishments, and that he will not permit his employees to perform their services at any location, under his control, where segregated facilities are maintained. The bidder, offeror, applicant, or subcontractor agrees that a breach of this certification is a violation of Equal Opportunity Clause in this contract. As used in this certification, the term "segregated facilities" 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 which are segregated by explicit directive or are in fact segregated on the basis of race, color, religion, or national origin, because of habit, local custom, or otherwise. He further agrees that (except where he has obtained identical certifications from proposed subcontractors for specific time periods) he will obtain identical certifications from proposed subcontractors prior to the award of subcontractors exceeding \$10,000 which are not exempt from the provisions of the Equal Opportunity Clause; that he will retain such certifications in his files; and that he will forward the following notice to such proposed subcontractors (except where the proposed subcontractors have submitted identical certifications for specific time periods):

NOTICE TO PROSPECTIVE SUBCONTRACTORS OF REQUIREMENT FOR CERTIFICATIONS OF NONSEGREGATED FACILITIES

A Certification of Nonsegregated Facilities must be submitted prior to the award of a subcontract exceeding \$10,000 which is not exempt from the provisions of the Equal Opportunity Clause. The certification may be submitted either for each subcontract or for all subcontracts during a period (i.e., quarterly, semiannually or annually).

NOTE: The penalty for making false statements in offers is prescribed in 18 U.S.C. 1001.

8. CLEAN AIR AND WATER CERTIFICATION (1977 JUN)

(Applicable if the bid or offer exceeds \$100,000 or the Contracting Officer has determined that orders under an indefinite quantity contract in any year will exceed \$100,000, or a facility to be used has been the subject of a conviction under the Clean Air Act (42 U.S.C. 1857c-8(c)(1)) or the Federal Water Pollution Control Act (33 U.S.C. 1319(c)) and is listed by EPA, or is not otherwise exempt.)

The bidder or offeror certifies as follows:

(a) Any facility to be utilized in the performance of this proposed contract is ____, is not ____, listed on the Environmental Protection Agency List Law of Violating Facilities.

REPRESENTATIONS AND CERTIFICATIONS
(Construction and Architect-Engineer Contract)

- (b) He will promptly notify the Contracting Officer, prior to award, of the receipt of any communication from the Director, Office of Federal Activities, U. S. Environmental Protection Agency, indicating that any facility which he proposes to use for the performance of the contract is under consideration to be listed on the EPA List of Violating Facilities.
- (c) He will include substantially this certification, including this paragraph (c), in every nonexempt subcontract.

9. WOMAN OWNED BUSINESS (1978 SEP)

The offeror represents that the firm submitting this offer () is, () is not, a woman owned business. A woman-owned business is a business which is, at least, 51 percent owned, controlled and operaterd by a woman or women. Controlled is defined as exercising the power to make policy decisions. Operated is defined as actively involved in the day-to-day management. For the purposes of this definition, businesses which are publicly owned, joint stock associations and business trusts are exempted. Exempted business may voluntarily represent that they are or are not, women-owned if this information is available.

10. PERCENT FOREIGN CONTENT (1978 SEP)

Approximately____ percent of the proposed contract price represents foreign content or effort.

11. SMALL DISADVANTAGED BUSINESS CONCERN (1980 AUG)

- (a) The offeror represents that he () is, () is not, a small business concern owned and controlled by socially and economically disadvantaged individuals. The term "small business concern" means a small business as defined pursuant to Section 3 of the Small Business Act and relevant regulations promulgated pursuant thereto. The term "small business concern owned and controlled by socially and economically disadvantaged individuals" means a small business concern-
 - (1) that is at least 51 per centum owned by one or more socially and economically disadvantaged individuals; or, in the case of any publicly owned business, at least 51 per centum of the stock of which is owned by one or more socially and economically disadvantaged individuals; and
 - (2) whose management and daily business operations are controlled by one or more such individuals.
- (b) The offeror shall presume that socially and economically disadvantaged individuals include Black Americans, Hispanic Americans, Native Americans (i.e. American Indians, Eskimos, Aleuts, and Native Hawaiians), Asian-Pacific Americans (i.e. U.S. citizens whose origins are from Japan, China, the Philippines, Vietnam, Korea, Samoa, Guam, the U.S. Trust Territories of the Pacific, Northern Marianas, Laos, Cambidia, and Taiwan), and other minorities or any other individuals found to be disadvantaged by the Small Business Administration pursuant to Section 8(a) of the Small Business Act.

12. EQUAL EMPLOYMENT COMPLIANCE (1978 SEP)

By submission of this offer, the offeror represents that, to the best of his knowledge and belief, except as noted below, up to the date of this offer no written notice such as a show cause letter, a letter indicating probable cause, or any other written notification citing specific deficiencies, has been received by the offeror from any Federal Government agency or representative thereof that the offeror or any of its divisions or affiliates or known first-tier subcontractors is in violation of any of the provisions of Executive Order 11246 of September 24.

1965, as amended, or rules and regulations of the Secretary of Labor (41 CFR, Chapter 60) and specifically as to not having an acceptable affirmative action compliance program or being in noncompliance with any other aspect of the Equal Employment Opportunity Program. It is further agreed that should there be any change (i) in the offeror's status or circumstances between this date and the date of expiration of this offer or any extension thereof or (ii) during any contract or extension resulting from this solicitation, the Contracting Officer will be notified promptly.

The bidder's Dun and Bradstreet, Incorporated Data Universal Numbering System No.

s _____.

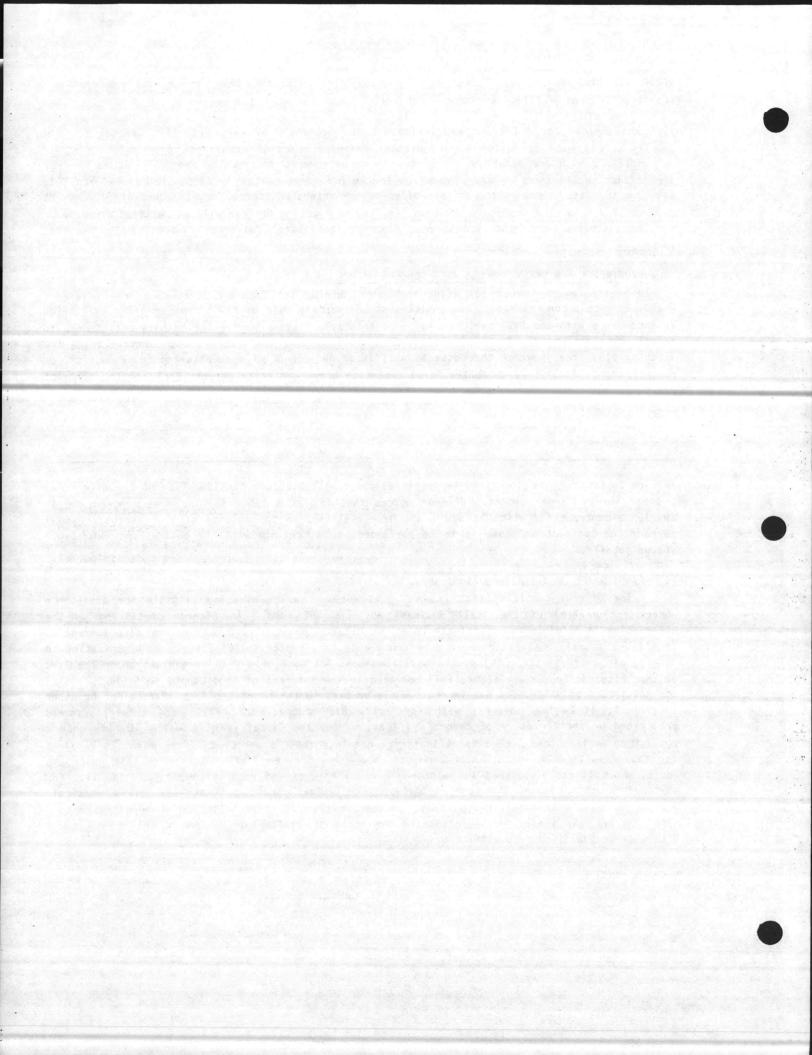
13. PREFERENCE FOR LABOR SURPLUS AREA CONCERNS (1978 JUN)

This procurement is not set aside for labor surplus area concerns. However, the offeror's status as such a concern may affect entitlement to award in case of tie offers or offer evaluation in accordance with the Buy American clause of this solicitation. In order to have entitlement to a preference determined if those circumstances should apply, the offeror must identify below the labor surplus area in which the costs he will incur on account of manufacturing or production (by himself or his first-tier subcontractors) amount to more than fifty percent (50%) of the contract price.

Failure to identify the locations as specified above will preclude consideration of the offeror as a labor surplus area concern. Offeror agrees that if, as a labor surplus area concern, he is awarded a contract for which he would not have qualified in the absence of such status, he will perform the contract or cause it to be performed, in accordance with the obligations which such status entails.

14. HANDICAPPED ORGANIZATIONS (1981 SEP)

The Offeror certifies that it is ___ is not ___ an organization eligible for assistance under section 7(h) of the Small Business Act (15 USC 636). An Offeror certifying in the affirmative is eligible to participate in any resultant contracts hereunder or any part thereof as if he were a small business concern as elsewhere defined in the solicitation. An organization to be eligible under section 7(h) of the Small Business Act must be one (i) organized under the laws of the United States or any state; (ii) operated in the interest of handicapped individuals; (iii) the net income of which does not inure in whole or part to the benefit of any shareholder or other individual; (iv) that complies with any applicable occupational health and safety standard prescribed by the Secretary of Labor; (v) that, during the fiscal year in which it bids upon a set-aside, employs handicapped individuals for not less than 75 per cent of the manhours required for the production or provision of commodities or services; and (vi) that can qualify under the additional criteria prescribed in Section 118.11, SBA Rules and Regulations, 13 CFR 118.11. For purposes of this clause, the term "handicapped individual" means a person who has a physical, mental, or emotional impairment, defect, ailment, disease, or disability of a permanent nature which in any way limits the selection of any type of employment for which the person would otherwise be qualified or qualifiable.



REPRESENTATIONS AND CERTIFICATIONS	REFERENCE (Enter Same No.(s) as on SF
(Construction and Architect-	19, 21 and 252)
Engineer Contract) (REV. 1982 DEC)	
(For use with Standard Forms 19, 21 and 252)	
NAME AND ADDRESS OF BIDDER (No., Street,	DATE OF BID
City, State and ZIP Code)	
The bidder makes the following represent	shall be construed to mean "offer" and "offeror." tations and certifications as a part of the bid
identified above. (Check appropriate boxes.)	
1. SMALL BUSINESS	
	ncern. (A small business concern for the purpose of
	g its affiliates, which is independently owned and
P	operations in which it is bidding on Government
20. [2] 사용하기 경기 가입니다. "C. "A. 12 (14 H. 14 H. 16 H. 1	e criteria concerning number of employees, average ribed by the Small Business Administration. For
네 그렇게 하는 사람들이 하는 것이 많아 많아 있다면 하는데	ns of the Small Business Administration. For
121]).	12 Of the 2mail pastness wall intertaction [12 ct k rate
2. CONTINGENT FEE	
	or retained any company or person (other than a
	or the bidder) to solicit or secure this contract,
	greed to pay any company or person (other than a
	for the bidder) any fee, commission, percentage or
	om the award of this contract; and agrees to furnish as requested by the Contracting Officer. (For
interpretation of the representation including	the term "bona fide employee," see Code of Federal
Regulations, Title 41, Subpart 1-1.5.)	
3. TYPE OF ORGANIZATION	
	partnership, joint venture, corporation,
incorporated in State of	

4. INDEPENDENT PRICE DETERMINATION

- (a) By submission of this bid, each bidder certifies, and in the case of a joint bid each party thereto certifies as to his own organization, that in connection with this procurement:
 - (1) The prices in this bid have been arrived at independently, without consultation, communication, or agreement, for the purpose of restricting competition, as to any matter relating to such prices with any other bidder or with any competitor;
- NOTE Bids must set forth full, accurate, and complete information as required by this invitation for bids (including attachments). The penalty for making false statements in bids is prescribed in 18 U.S.C. 1001.

STANDARD FORM 19-B, JUNE 1976 EDITION GENERAL SERVICES ADMINISTRATION FED. PROC. REG.(41CFR)1-16.401 AND 1-16.701

(Construction and Architect-Engineer Contract)

- (2) Unless otherwise required by law, the prices which have been quoted in this bid have not been knowingly disclosed by the bidder and will not knowingly be disclosed by the bidder prior to opening, in the case of a bid, or prior to award, in the case of a proposal, directly or indirectly to any other bidder or to any competitor; and
- (3) No attempt has been made or will be made by the bidder to induce any other person or firm to submit or not to submit a bid for the purpose of restricting competition.
- (b) Each person signing this bid certifies that:
 - (1) He is the person in the bidder's organization responsible within that organization for the decision as to the prices being bid herein and that he has not participated, and will not participate, in any action contrary to (a)(1) through (a)(3) above; or
 - (2) (a) He is not the person in the bidder's organization responsible within that organization for the decision as to the prices being bid herein but that he has been authorized in writing to act as agent for the persons responsible for such decision in certifying that such persons have not participated, and will not participate, in any action contrary to (a)(1) through (a)(3)above, and as their agent does hereby so certify; and (b) he has not participated, and will not participate, in any action contrary to (a)(1) through (a)(3) above.
- (c) This certification is not applicable to a foreign bidder submitting a bid for a contract which requires performance or delivery outside the United States, its possessions, and Puerto Rico.
- (d) A bid will not be considered for award where (a)(1), (a)(3), or (b) above, has been deleted or modified. Where (a)(2) above has been deleted or modified, the bid will not be considered for award unless the bidder furnishes with the bid a signed statement which sets forth in detail the circumstances of the disclosure and unless it is determined that such disclosure was not made for the purpose of restricting competition.

THE FOLLOWING NEED BE CHECKED ONLY IF BID EXCEEDS \$10,000 IN AMOUNT.

5. EQUAL OPPORTUNITY

He has, has not, participated in a previous contract or subcontract subject to the Equal Opportunity Clause herein, the clause originally contained in Section 301 of Executive Order No. 10925, or the clause contained in Section 201 of Executive Order No. 11114; he has, has not, filed all required compliance reports; and representations indicating submission of required compliance reports, signed by proposed subcontractors, will be obtained prior to subcontract awards.

(The above representations need not be submitted in connection with contracts or subcontracts which are exempt from the equal opportunity clause.)

6. PARENT COMPANY AND EMPLOYER IDENTIFICATION NUMBER

Each bidder shall furnish the following information by filling in the appropriate blanks:

(a) Is the bidder owned or controlled by a parent company as described below? Yes No. (For the purpose of this bid, a parent company is defined as one which either owns or controls the activities and basic business policies of the bidder. To own another company means the parent company must own at least a majority (more than 50 percent) of the voting rights in that company. To control another company, such ownership is not required; if another company is able to formulate, determine, or veto basic business policy decisions of the bidder, such other company is considered the parent company of the bidder. This control may be excerised through the use of dominant minority voting rights, use of proxy voting, contractual arrangements, or otherwise.)

(b) If the answer to (a) above is "Yes," bidder shall insert in the space below the name and main office address of the parent company.

NAME OF PARENT COMPANY

MAIN OFFICE ADDRESS (No., Street, City, State, and ZIP CODE)

(c) Bidder shall insert in the applicable space below, if he has no parent company, his own Employer's Identification Number (E.I. No.) (Federal Social Security Number used on Employer's Quarterly Federal Tax Return, U.S. Treasury Department Form 941), or, if he has a parent company, the E.I. No. of his parent company.

EMPLOYER PARENT COMPANY BIDDER

IDENTIFICATION NUMBER OF

7. CERTIFICATION OF NONSEGREGATED FACILITIES (1979 AUG)

(Applicable to contracts, subcontracts, and agreements with applicants who are themselves performing Federally assisted construction contracts, exceeding \$10,000 which are not exempt from the provisions of the Equal Opportunity Clause.)

By the submission of this bid, the bidder, offeror, applicant, or subcontractor certifies that he does not maintain or provide for his employees any segregated facilities at any of his establishments, and that he does not permit employees to perform their services at any location. under his control, where segregated facilities are maintained. He certifies further that he will not maintain or provide for his employees any segregated facilities at any of his establishments, and that he will not permit his employees to perform their services at any location, under his control, where segregated facilities are maintained. The bidder, offeror, applicant, or subcontractor agrees that a breach of this certification is a violation of Equal Opportunity Clause in this contract. As used in this certification, the term "segregated facilities" 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 which are segregated by explicit directive or are in fact segregated on the basis of race, color, religion, or national origin, because of habit, local custom, or otherwise. He further agrees that (except where he has obtained identical certifications from proposed subcontractors for specific time periods) he will obtain identical certifications from proposed subcontractors prior to the award of subcontractors exceeding \$10,000 which are not exempt from the provisions of the Equal Opportunity Clause; that he will retain such certifications in his files; and that he will forward the following notice to such proposed subcontractors (except where the proposed subcontractors have submitted identical certifications for specific time periods):

NOTICE TO PROSPECTIVE SUBCONTRACTORS OF REQUIREMENT FOR CERTIFICATIONS OF NONSEGREGATED FACILITIES

A Certification of Nonsegregated Facilities must be submitted prior to the award of a subcontract exceeding \$10,000 which is not exempt from the provisions of the Equal Opportunity Clause. The certification may be submitted either for each subcontract or for all subcontracts during a period (i.e., quarterly, semiannually).

NOTE: The penalty for making false statements in offers is prescribed in 18 U.S.C. 1001.

8. CLEAN AIR AND WATER CERTIFICATION (1977 JUN)

(Applicable if the bid or offer exceeds \$100,000 or the Contracting Officer has determined that orders under an indefinite quantity contract in any year will exceed \$100,000, or a facility to be used has been the subject of a conviction under the Clean Air Act (42 U.S.C. 1857c-8(c)(1)) or the Federal Water Pollution Control Act (33 U.S.C. 1319(c)) and is listed by EPA, or is not otherwise exempt.)

The bidder or offeror certifies as follows:

(a) Any facility to be utilized in the performance of this proposed contract is ______, is not _____, listed on the Environmental Protection Agency List law of Violating Facilities.

REPRESENTATIONS AND CERTIFICATIONS
(Construction and Architect-Engineer Contract)

- (b) He will promptly notify the Contracting Officer, prior to award, of the receipt of any communication from the Director, Office of Federal Activities, U. S. Environmental Protection Agency, indicating that any facility which he proposes to use for the performance of the contract is under consideration to be listed on the EPA List of Violating Facilities.
- (c) He will include substantially this certification, including this paragraph (c), in every nonexempt subcontract.

9. WOMAN OWNED BUSINESS (1978 SEP)

The offeror represents that the firm submitting this offer () is, () is not, a woman owned business. A woman-owned business is a business which is, at least, 51 percent owned, controlled and operaterd by a woman or women. Controlled is defined as exercising the power to make policy decisions. Operated is defined as actively involved in the day-to-day management. For the purposes of this definition, businesses which are publicly owned, joint stock associations and business trusts are exempted. Exempted business may voluntarily represent that they are or are not, women-owned if this information is available.

10. PERCENT FOREIGN CONTENT (1978 SEP)

Approximately_____ percent of the proposed contract price represents foreign content or effort.

11. SMALL DISADVANTAGED BUSINESS CONCERN (1980 AUG)

- (a) The offeror represents that he () is, () is not, a small business concern owned and controlled by socially and economically disadvantaged individuals. The term "small business concern" means a small business as defined pursuant to Section 3 of the Small Business Act and relevant regulations promulgated pursuant thereto. The term "small business concern owned and controlled by socially and economically disadvantaged individuals" means a small business concern-
 - (1) that is at least 51 per centum owned by one or more socially and economically disadvantaged individuals; or, in the case of any publicly owned business, at least 51 per centum of the stock of which is owned by one or more socially and economically disadvantaged individuals; and
 - (2) whose management and daily business operations are controlled by one or more such individuals.
- (b) The offeror shall presume that socially and economically disadvantaged individuals include Black Americans, Hispanic Americans, Native Americans (i.e. American Indians, Eskimos, Aleuts, and Native Hawaiians), Asian-Pacific Americans (i.e. U.S. citizens whose origins are from Japan, China, the Philippines, Vietnam, Korea, Samoa, Guam, the U.S. Trust Territories of the Pacific, Northern Marianas, Laos, Cambodia, and Taiwan), and other minorities or any other individuals found to be disadvantaged by the Small Business Administration pursuant to Section 8(a) of the Small Business Act.

12. EQUAL EMPLOYMENT COMPLIANCE (1978 SEP)

By submission of this offer, the offeror represents that, to the best of his knowledge and belief, except as noted below, up to the date of this offer no written notice such as a show cause letter, a letter indicating probable cause, or any other written notification citing specific deficiencies, has been received by the offeror from any Federal Government agency or representative thereof that the offeror or any of its divisions or affiliates or known first-tier subcontractors is in violation of any of the provisions of Executive Order 11246 of September 24,

REPRESENTATIONS AND CERTIFICATIONS
(Construction and Architect-Engineer Contract)

1965, as amended, or rules and regulations of the Secretary of Labor (41 CFR, Chapter 60) and specifically as to not having an acceptable affirmative action compliance program or being in noncompliance with any other aspect of the Equal Employment Opportunity Program. It is further agreed that should there be any change (i) in the offeror's status or circumstances between this date and the date of expiration of this offer or any extension thereof or (ii) during any contract or extension resulting from this solicitation, the Contracting Officer will be notified promptly.

The bidder's Dun and Bradstreet, Incorporated Data Universal Numbering System No.

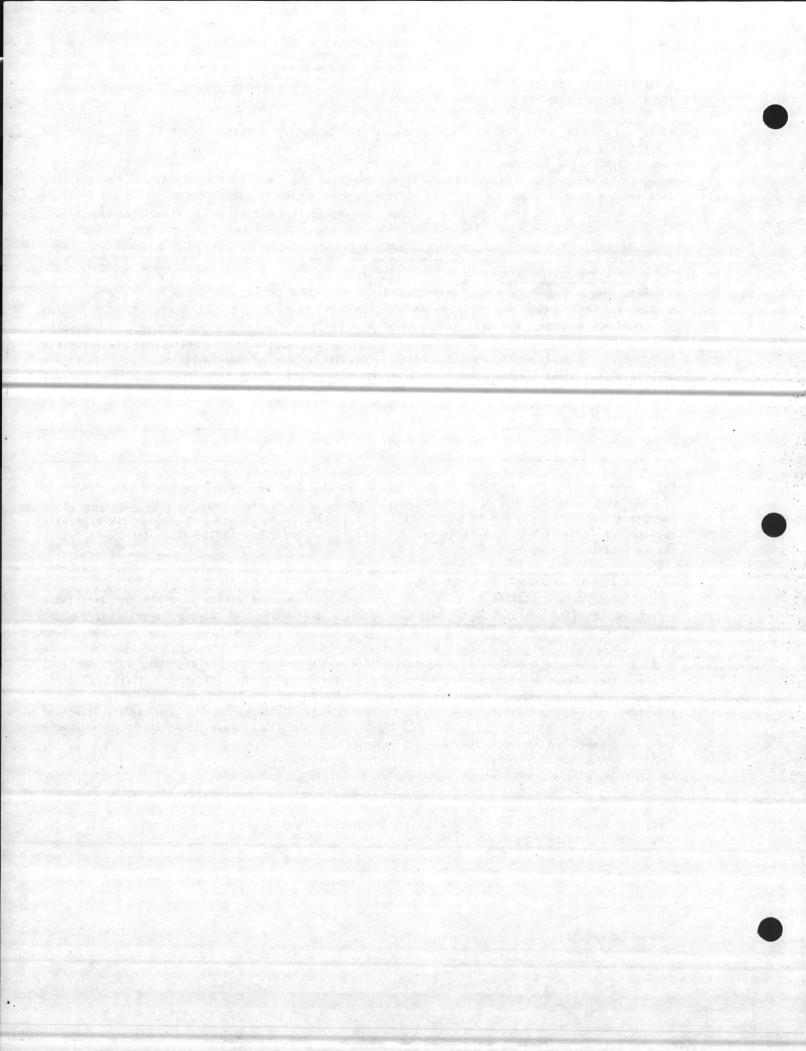
13. PREFERENCE FOR LABOR SURPLUS AREA CONCERNS (1978 JUN)

This procurement is not set aside for labor surplus area concerns. However, the offeror's status as such a concern may affect entitlement to award in case of tie offers or offer evaluation in accordance with the Buy American clause of this solicitation. In order to have entitlement to a preference determined if those circumstances should apply, the offeror must identify below the labor surplus area in which the costs he will incur on account of manufacturing or production (by himself or his first-tier subcontractors) amount to more than fifty percent (50%) of the contract price.

Failure to identify the locations as specified above will preclude consideration of the offeror as a labor surplus area concern. Offeror agrees that if, as a labor surplus area concern, he is awarded a contract for which he would not have qualified in the absence of such status, he will perform the contract or cause it to be performed, in accordance with the obligations which such status entails.

14. HANDICAPPED ORGANIZATIONS (1981 SEP)

The Offeror certifies that it is ___ is not ___ an organization eligible for assistance under section 7(h) of the Small Business Act (15 USC 636). An Offeror certifying in the affirmative is eligible to participate in any resultant contracts hereunder or any part thereof as if he were a small business concern as elsewhere defined in the solicitation. An organization to be eligible under section 7(h) of the Small Business Act must be one (i) organized under the laws of the United States or any state; (ii) operated in the interest of handicapped individuals; (iii) the net income of which does not inure in whole or part to the benefit of any shareholder or other individual; (iv) that complies with any applicable occupational health and safety standard prescribed by the Secretary of Labor; (v) that, during the fiscal year in which it bids upon a set-aside, employs handicapped individuals for not less than 75 per cent of the manhours required for the production or provision of commodities or services; and (vi) that can qualify under the additional criteria prescribed in Section 118.11, SBA Rules and Regulations, 13 CFR 118.11. For purposes of this clause, the term "handicapped individual" means a person who has a physical, mental, or emotional impairment, defect, ailment, disease, or disability of a permanent nature which in any way limits the selection of any type of employment for which the person would otherwise be qualified or qualifiable.



REPRESENTATIONS AND CERTIFICATIONS	REFERENCE (Enter Same No.(s) as on SF
(Construction and Architect-	19, 21 and 252)
Engineer Contract) (REV. 1982 DEC)	
(For use with Standard Forms 19, 21 and 252)	
NAME AND ADDRESS OF BIDDER (No., Street,	DATE OF BID
City, State and ZIP Code)	[사용기 기계
	man file of the first state of the second state of the second state of the second state of the second state of
In negotiated procurements, "bid" and "bidder" sl	hall be construed to mean "offer" and "offeror."
	tions and certifications as a part of the bid
identified above. (Check appropriate boxes.)	
1. SMALL BUSINESS	The second secon
	ern. (A small business concern for the purpose of
	its affiliates, which is independently owned and
	perations in which it is bidding on Government
	criteria concerning number of employees, average
annual receipts, or other criteria as prescri	bed by the Small Business Administration. For
additional information see governing regulations	of the Small Business Administration [13 CFR Part
121]).	Carlotte and the state of the state of the state of
2. CONTINGENT FEE	
게 하다면 있다	retained any company or person (other than a
	the bidder) to solicit or secure this contract,
	eed to pay any company or person (other than a
HOSE CHINES, IN THE TOTAL CONTROL OF THE PROPERTY OF THE PROP	r the bidder) any fee, commission, percentage or
brokerage fee, contingent upon or resulting from	the award of this contract; and agrees to furnish
	as requested by the Contracting Officer. (For
interpretation of the representation, including	the term "bona fide employee," see Code of Federal
Regulations, Title 41, Subpart 1-1.5.)	
3. TYPE OF ORGANIZATION	
	eartnership, joint venture, corporation,
incorporated in State of	
4. INDEPENDENT PRICE DETERMINATION	
	certifies, and in the case of a joint bid each
party thereto certifies as to his own organization	
그렇게 가는 사람이 하는데 가는데 가는데 가는데 가는데 하는데 하는데 하는데 하는데 하는데 하는데 하는데 하는데 하는데 하	arrived at independently, without consultation,
	pose of restricting competition, as to any matter
relating to such prices with any other bi	

STANDARD FORM 19-B, JUNE 1976 EDITION GENERAL SERVICES ADMINISTRATION FED. PROC. REG.(41CFR)1-16.401 AND 1-16.701

NOTE - Bids must set forth full, accurate, and complete information as required by this invitation

prescribed in 18 U.S.C. 1001.

for bids (including attachments). The penalty for making false statements in bids is

- (2) Unless otherwise required by law, the prices which have been quoted in this bid have not been knowingly disclosed by the bidder and will not knowingly be disclosed by the bidder prior to opening, in the case of a bid, or prior to award, in the case of a proposal, directly or indirectly to any other bidder or to any competitor; and
- (3) No attempt has been made or will be made by the bidder to induce any other person or firm to submit or not to submit a bid for the purpose of restricting competition.
- (b) Each person signing this bid certifies that:
 - (1) He is the person in the bidder's organization responsible within that organization for the decision as to the prices being bid herein and that he has not participated, and will not participate, in any action contrary to (a)(1) through (a)(3) above; or
 - (2) (a) He is not the person in the bidder's organization responsible within that organization for the decision as to the prices being bid herein but that he has been authorized in writing to act as agent for the persons responsible for such decision in certifying that such persons have not participated, and will not participate, in any action contrary to (a)(1) through (a)(3)above, and as their agent does hereby so certify; and (b) he has not participated, and will not participate, in any action contrary to (a)(1) through (a)(3) above.
- (c) This certification is not applicable to a foreign bidder submitting a bid for a contract which requires performance or delivery outside the United States, its possessions, and Puerto Rico.
- (d) A bid will not be considered for award where (a)(1), (a)(3), or (b) above, has been deleted or modified. Where (a)(2) above has been deleted or modified, the bid will not be considered for award unless the bidder furnishes with the bid a signed statement which sets forth in detail the circumstances of the disclosure and unless it is determined that such disclosure was not made for the purpose of restricting competition.

THE FOLLOWING NEED BE CHECKED ONLY IF BID EXCEEDS \$10,000 IN AMOUNT.

5. EQUAL OPPORTUNITY

He ___ has, ___ has not, participated in a previous contract or subcontract subject to the Equal Opportunity Clause herein, the clause originally contained in Section 301 of Executive Order No. 10925, or the clause contained in Section 201 of Executive Order No. 11114; he has, has not, filed all required compliance reports; and representations indicating submission of required compliance reports, signed by proposed subcontractors, will be obtained prior to subcontract awards.

(The above representations need not be submitted in connection with contracts or subcontracts which are exempt from the equal opportunity clause.)

6. PARENT COMPANY AND EMPLOYER IDENTIFICATION NUMBER

Each bidder shall furnish the following information by filling in the appropriate blanks:

- (a) Is the bidder owned or controlled by a parent company as described below? Yes

 No. (For the purpose of this bid, a parent company is defined as one which either owns or controls
 the activities and basic business policies of the bidder. To own another company means the parent
 company must own at least a majority (more than 50 percent) of the voting rights in that company.
 To control another company, such ownership is not required; if another company is able to
 formulate, determine, or veto basic business policy decisions of the bidder, such other company is
 considered the parent company of the bidder. This control may be excerised through the use of
 dominant minority voting rights, use of proxy voting, contractual arrangements, or otherwise.)
- (b) If the answer to (a) above is "Yes," bidder shall insert in the space below the name and main office address of the parent company.

NAME OF PARENT COMPANY

MAIN OFFICE ADDRESS (No., Street, City, State, and ZIP CODE)

(c) Bidder shall insert in the applicable space below, if he has no parent company, his own Employer's Identification Number (E.I. No.) (Federal Social Security Number used on Employer's Quarterly Federal Tax Return, U.S. Treasury Department Form 941), or, if he has a parent company, the F.I. No. of his parent company.

EMPLOYER	PARENT COMPANY	BIDDER	
IDENTIFICATION			
NUMBER OF			

7. CERTIFICATION OF NONSEGREGATED FACILITIES (1979 AUG)

(Applicable to contracts, subcontracts, and agreements with applicants who are themselves performing Federally assisted construction contracts, exceeding \$10,000 which are not exempt from the provisions of the Equal Opportunity Clause.)

By the submission of this bid, the bidder, offeror, applicant, or subcontractor certifies that he does not maintain or provide for his employees any segregated facilities at any of his establishments, and that he does not permit employees to perform their services at any location. under his control, where segregated facilities are maintained. He certifies further that he will not maintain or provide for his employees any segregated facilities at any of his establishments. and that he will not permit his employees to perform their services at any location, under his control, where segregated facilities are maintained. The bidder, offeror, applicant, or subcontractor agrees that a breach of this certification is a violation of Equal Opportunity Clause in this contract. As used in this certification, the term "segregated facilities" 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 which are segregated by explicit directive or are in fact segregated on the basis of race, color, religion, or national origin, because of habit, local custom, or otherwise. He further agrees that (except where he has obtained identical certifications from proposed subcontractors for specific time periods) he will obtain identical certifications from proposed subcontractors prior to the award of subcontractors exceeding \$10,000 which are not exempt from the provisions of the Equal Opportunity Clause; that he will retain such certifications in his files; and that he will forward the following notice to such proposed subcontractors (except where the proposed subcontractors have submitted identical certifications for specific time periods):

NOTICE TO PROSPECTIVE SUBCONTRACTORS OF REQUIREMENT FOR CERTIFICATIONS OF NONSEGREGATED FACILITIES

A Certification of Nonsegregated Facilities must be submitted prior to the award of a subcontract exceeding \$10,000 which is not exempt from the provisions of the Equal Opportunity Clause. The certification may be submitted either for each subcontract or for all subcontracts during a period (i.e., quarterly, semiannually or annually).

NOTE: The penalty for making false statements in offers is prescribed in 18 U.S.C. 1001.

8. CLEAN AIR AND WATER CERTIFICATION (1977 JUN)

(Applicable if the bid or offer exceeds \$100,000 or the Contracting Officer has determined that orders under an indefinite quantity contract in any year will exceed \$100,000, or a facility to be used has been the subject of a conviction under the Clean Air Act (42 U.S.C. 1857c-8(c)(1)) or the Federal Water Pollution Control Act (33 U.S.C. 1319(c)) and is listed by EPA, or is not otherwise exempt.)

The bidder or offeror certifies as follows:

(a) Any facility to be utilized in the performance of this proposed contract is ____, is not ____, listed on the Environmental Protection Agency List law of Violating Facilities.

REPRESENTATIONS AND CERTIFICATIONS
(Construction and Architect-Engineer Contract)

- (b) He will promptly notify the Contracting Officer, prior to award, of the receipt of any communication from the Director, Office of Federal Activities, U. S. Environmental Protection Agency, indicating that any facility which he proposes to use for the performance of the contract is under consideration to be listed on the EPA List of Violating Facilities.
- (c) He will include substantially this certification, including this paragraph (c), in every nonexempt subcontract.

9. WOMAN OWNED BUSINESS (1978 SEP)

The offeror represents that the firm submitting this offer () is, () is not, a woman owned business. A woman-owned business is a business which is, at least, 51 percent owned, controlled and operaterd by a woman or women. Controlled is defined as exercising the power to make policy decisions. Operated is defined as actively involved in the day-to-day management. For the purposes of this definition, businesses which are publicly owned, joint stock associations and business trusts are exempted. Exempted business may voluntarily represent that they are or are not, women-owned if this information is available.

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 - (1) that is at least 51 per centum owned by one or more socially and economically disadvantaged individuals; or, in the case of any publicly owned business, at least 51 per centum of the stock of which is owned by one or more socially and economically disadvantaged individuals; and
 - (2) whose management and daily business operations are controlled by one or more such individuals.
- (b) The offeror shall presume that socially and economically disadvantaged individuals include Black Americans, Hispanic Americans, Native Americans (i.e. American Indians, Eskimos, Aleuts, and Native Hawaiians), Asian-Pacific Americans (i.e. U.S. citizens whose origins are from Japan, China, the Philippines, Vietnam, Korea, Samoa, Guam, the U.S. Trust Territories of the Pacific, Northern Marianas, Laos, Cambodia, and Taiwan), and other minorities or any other individuals found to be disadvantaged by the Small Business Administration pursuant to Section 8(a) of the Small Business Act.

12. EQUAL EMPLOYMENT COMPLIANCE (1978 SEP)

By submission of this offer, the offeror represents that, to the best of his knowledge and belief, except as noted below, up to the date of this offer no written notice such as a show cause letter, a letter indicating probable cause, or any other written notification citing specific deficiencies, has been received by the offeror from any Federal Government agency or representative thereof that the offeror or any of its divisions or affiliates or known first-tier subcontractors is in violation of any of the provisions of Executive Order 11246 of September 24,

REPRESENTATIONS AND CERTIFICATIONS
(Construction and Architect-Engineer Contract)

1965, as amended, or rules and regulations of the Secretary of Labor (41 CFR, Chapter 60) and specifically as to not having an acceptable affirmative action compliance program or being in noncompliance with any other aspect of the Equal Employment Opportunity Program. It is further agreed that should there be any change (i) in the offeror's status or circumstances between this date and the date of expiration of this offer or any extension thereof or (ii) during any contract or extension resulting from this solicitation, the Contracting Officer will be notified promptly.

The bidder's Dun and Bradstreet, Incorporated Data Universal Numbering System No.

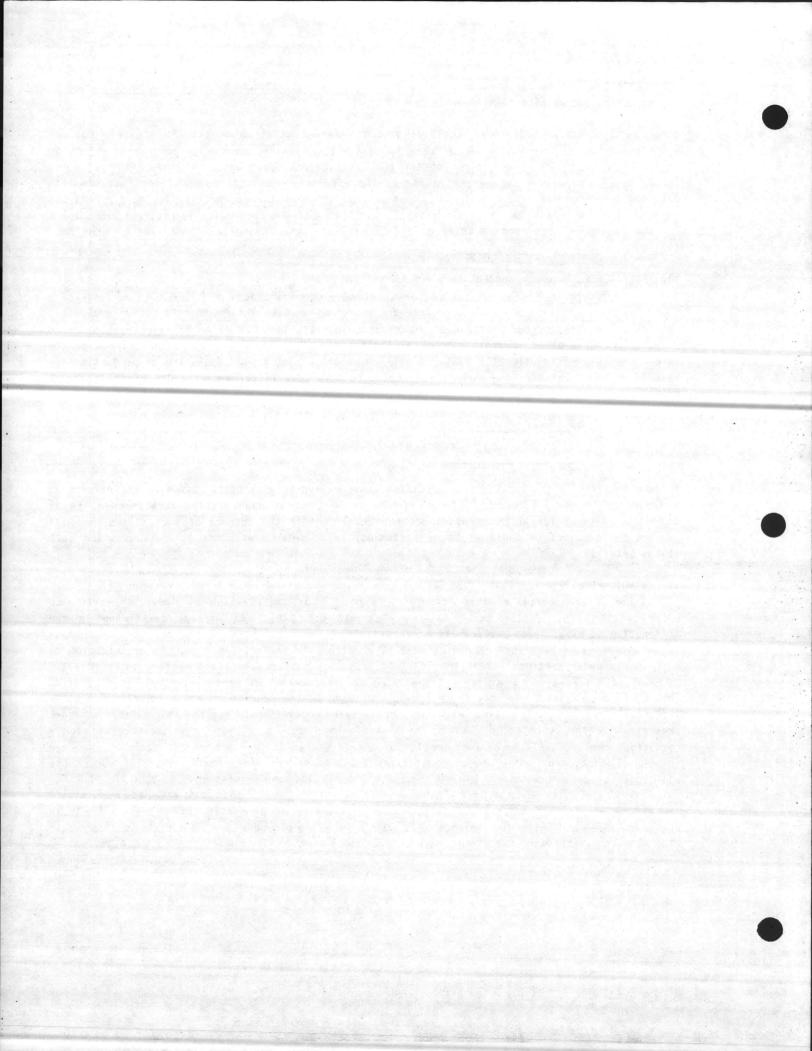
13. PREFERENCE FOR LABOR SURPLUS AREA CONCERNS (1978 JUN)

This procurement is not set aside for labor surplus area concerns. However, the offeror's status as such a concern may affect entitlement to award in case of tie offers or offer evaluation in accordance with the Buy American clause of this solicitation. In order to have entitlement to a preference determined if those circumstances should apply, the offeror must identify below the labor surplus area in which the costs he will incur on account of manufacturing or production (by himself or his first-tier subcontractors) amount to more than fifty percent (50%) of the contract price.

Failure to identify the locations as specified above will preclude consideration of the offeror as a labor surplus area concern. Offeror agrees that if, as a labor surplus area concern, he is awarded a contract for which he would not have qualified in the absence of such status, he will perform the contract or cause it to be performed, in accordance with the obligations which such status entails.

14. HANDICAPPED ORGANIZATIONS (1981 SEP)

The Offeror certifies that it is ___ is not ___ an organization eligible for assistance under section 7(h) of the Small Business Act (15 USC 636). An Offeror certifying in the affirmative is eligible to participate in any resultant contracts hereunder or any part thereof as if he were a small business concern as elsewhere defined in the solicitation. An organization to be eligible under section 7(h) of the Small Business Act must be one (i) organized under the laws of the United States or any state; (ii) operated in the interest of handicapped individuals; (iii) the net income of which does not inure in whole or part to the benefit of any shareholder or other individual; (iv) that complies with any applicable occupational health and safety standard prescribed by the Secretary of Labor; (v) that, during the fiscal year in which it bids upon a set-aside, employs handicapped individuals for not less than 75 per cent of the manhours required for the production or provision of commodities or services; and (vi) that can qualify under the additional criteria prescribed in Section 118.11, SBA Rules and Regulations, 13 CFR 118.11. For purposes of this clause, the term "handicapped individual" means a person who has a physical, mental, or emotional impairment, defect, ailment, disease, or disability of a permanent nature which in any way limits the selection of any type of employment for which the person would otherwise be qualified or qualifiable.



STA JI GENERAL FED. PROC	ANDARD FO UNE 1964 EI SERVICES AL	ORM 24 DITION DIMINISTRATION CFR) 1-16.801	(See		BOND	e)	24-10	DATE BOND EXECUTED (1 than bid opening date)	Must not be later
		ne and business	address)					C JOINT	"X" one) ARTNERSHIP ORPORATION
JRETY(IES	S) (Name a	nd business add	ress)						
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Signatur	re(s)				(Seal)			(Seal)	Corporate
Name(s) Title(s) (Type)				2.	- 10			Seal
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- 1. This form is authorized for use whenever a bid guaranty is required in connection with construction work or the furnishing of supplies or services. There shall be no deviation from this form without approval by the Administrator of General Services.
- 2. The full legal name and business address of the Principal shall be inserted in the space designated "Principal" on the face of this form. The bond shall be signed by an authorized person. Where such person is signing in a representative capacity (e.g., an attorney-infact), but is not a member of the firm, partnership, or joint venture, or an officer of the corporation involved, evidence of his authority must be furnished.
- 3. The penal sum of the bond may be expressed as a percentage of the bid price if desired. In such cases, a maximum dollar limitation may be stipulated (e.g., 20% of the bid price but the amount not to exceed dollars).
- 4. (a) Corporations executing the bond as sureties must be among those appearing on the Treasury Department's list of approved sureties and must be acting within

- the .limitations set forth therein. Where more than a single corporate surety is involved, their names and addresses (city and State) shall be inserted in the spaces (Surety A, Surety B, etc.) headed "CORPORATE SURETY (IES)", and in the space designated "SURETY (IES)" on the face of this form only the letter identification of the Sureties shall be inserted.
- (b) Where individual sureties execute the bond, they shall be two or more responsible persons. A completed Affidavit of Individual Surety (Standard Form 28), for each individual surety, shall accompany the bond. Such sureties may be required to furnish additional substantiating information concerning their assets and financial capability as the Government may require.
- 5. Corporations executing the bond shall affix their corporate seals. Individuals shall execute the bond opposite the word "Seal"; and, if executed in Maine or New Hampshire, shall also affix an adhesive seal.
- 6. The name of each person signing this bid bond should be typed in the space provided.

	ANDARD FOR IUNE 1964 EDIT SERVICES ADM C. REG. (41 CF		(See		BOND tions on reverse)	24-10	DATE BOND EXECUTED (M than bid opening date)	ust not be later
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	1	CORF	PORATE SURETY(I	ES) (Continued)				
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S	Name(s) & Title(s) (Typed)	1.	2.					
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GENERAL SERVICES ADMINISTRATION FED. PROC. REG. (41 CFR) 1-16.401	CONCEDUCTION CONTENCE	CONTRACT NO.
TED. PROC. REG. (41 CFR) 1-10.401	(See instructions on reverse)	DATE OF CONTRACT
NAME AND ADDRESS OF CONTRACTOR		CHECK APPROPRIATE BOX Individual Partnership Joint Venture Corporation, incorporated in the
DEPARTMENT OR AGENCY	And the second s	State of
and there is replied		
CONTRACT FOR (Work to be performed)		
PLACE		
CONTRACT PRICE (Express in words and fig.	(ures)	
ADMINISTRATIVE DATA (Optional)		
Officer executing this contract above (hereinafter called the (with the General Provisions (a (hereinafter called the Government), it, and the individual, partnership, joint Contractor), mutually agree to perform to Standard Form 23-A), Labor Standards Production of Form 19-A), and the following designation of the contract of th	venture, or corporation named his contract in strict accordance ovisions Applicable to Contracts
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Alterations. The following alterations were made in this contract before it was signed by the parties hereto: In witness whereof, the parties hereto have executed this contract as of the date entered on the first page hereof. THE UNITED STATES OF AMERICA CONTRACTOR (Name of Contractor) (Official title) (Signature) (Title)

- 1. The full name and business address of the Contractor must be inserted in the space provided on the face of the form. The Contractor shall sign in the space provided above with his usual signature and typewrite or print his name under the signature.
- 2. An officer of a corporation, a member of a partnership, or an agent signing for the Contractor shall place his signature and title after the word "By" under the name of the Contractor. A contract executed by an attorney or agent on behalf of the Contractor shall be accompanied by two authenticated copies of his power of attorney or other evidence of his authority to act on behalf of the Contractor.

PRINCIPAL (L	egal name and business add	ress)						
				TYPE	OF ORG	ANIZATION ("X	" one)	
					NDIVIDUA	L PARTN	HERSHIP	
					OINT ENTURE	CORP	ORATION	
				STATE	OF INC	ORPORATION		
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SU	Name(s) & Title(s) (Typed)		2	2			
-	Name & Address		STATE OF INC. LIABILITY LIMIT		LIABILITY LIMIT		
SUKETY	Signature(s)					Corporate Seal	
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	Name & Address			STATE OF INC	LIABILITY LIMIT		
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- 1. This form is authorized for use in connection with contracts for construction work or the furnishing of supplies or services. There shall be no deviation from this form without approval by the Administrator of General Services.
- 2. The full legal name and business address of the Principal shall be inserted in the space designated "Principal" on the face of this form. The bond shall be signed by an authorized person. Where such person is signing in a representative capacity (e.g., an attorney-infact), but is not a member of the firm, partnership, or joint venture, or an officer of the corporation involved, evidence of his authority must be furnished.
- 3. (a) Corporations executing the bond as sureties must be among those appearing on the Treasury Department's list of approved sureties and must be acting within the limitations set forth therein. Where more than a single corporate surety is involved, their names and addresses (city and State) shall be inserted in the spaces

- (Surety A, Surety B, etc.) headed "CORPORATE SURE-TY (1ES)", and in the space designated "SURETY (IES)" on the face of this form only the letter identification of the Sureties shall be inserted.
- (b) Where individual sureties execute the bond, they shall be two or more responsible persons. A completed Affidavit of Individual Surety (Standard Form 28), for each individual surety, shall accompany the bond. Such sureties may be required to furnish additional substantiating information concerning their assets and financial capability as the Government may require.
- 4. Corporations executing the bond shall affix their corporate seals. Individuals shall execute the bond opposite the word "Seal"; and, if executed in Maine or New Hampshire, shall also affix an adhesive seal.
- 5. The name of each person signing this performance bond should be typed in the space provided.

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- 1. This form, for the protection of persons supplying labor and material, shall be used whenever a payment bond is required under the act of August 24, 1935, 49 Stat. 793, as amended (40 U.S.C. 270a-270e). There shall be no deviation from this form without approval by the Administrator of General Services.
- 2. The full legal name and business address of the Principal shall be inserted in the space designated "Principal" on the face of the form. The bond shall be signed by an authorized person. Where such person is signing in a representative capacity (e.g., an attorney-in-fact), but is not a member of the firm, partnership, or joint venture, or an officer of the corporation involved, evidence of his authority must be furnished.
- 3. (a) Corporations executing the bond as sureties must be among those appearing on the Treasury Department's list of approved sureties and must be acting within the limitations set forth therein. Where more than a single corporate surety is involved, their names and addresses (city

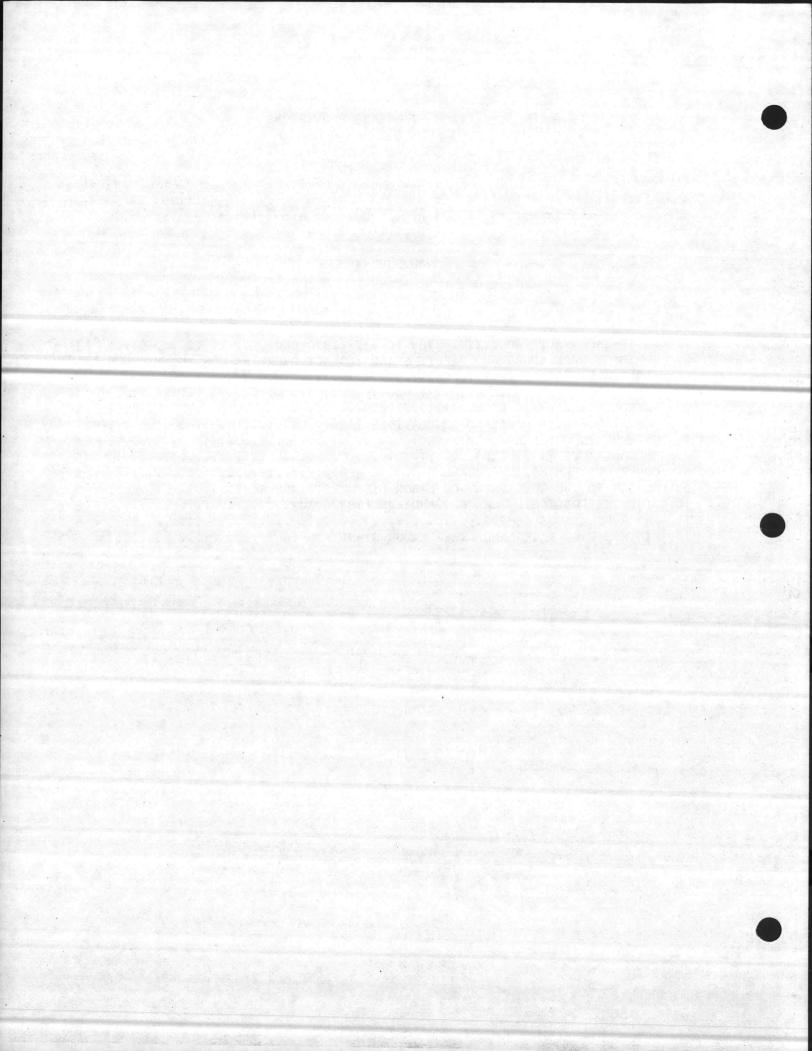
- and State) shall be inserted in the spaces (Surety A, Surety B, etc.) headed "CORPORATE SURETY (IES)", and in the space designated "SURETY (IES)" on the face of this form only the letter identification of the Sureties shall be inserted.
- (b) Where individual sureties execute the bond, they shall be two or more responsible persons. A completed Affidavit of Individual Surety (Standard Form 28), for each individual surety, shall accompany the bond. Such sureties may be required to furnish additional substantiating information concerning their assets and financial capability as the Government may require.
- 4. Corporations executing the bond shall affix their corporate seals. Individuals shall execute the bond opposite the word "Seal"; and, if executed in Maine or New Hampshire, shall also affix an adhesive seal.
- 5. The name of each person signing this payment bond should be typed in the space provided.

LABOR STANDARDS PROVISIONS (Construction Contract)

(Provisions 1 through 8 and 10 are those prescribed by the General Services Administration in Standard Form 19-A, November 1972 Edition as amended pursuant to the latest revisions of the Defense Acquisition Regulation.)

TABLE OF CONTENTS

		Page
1.	DAVIS-BACON ACT (40 U.S.C. 276a to a-7)(1977 DEC)	1
2.	CONTRACT WORK HOURS AND SAFETY STANDARDS ACT-OVERTIME COMPENSATION	
	(40 U.S.C. 327-333)(1977 DEC)	2
3.	APPRENTICES AND TRAINEES (1977 DEC)	3
4.	PAYROLLS AND BASIC RECORDS (1977 DEC)	.4
5.	COMPLIANCE WITH COPELAND REGULATIONS (1964 JUN)	5
6.	WITHHOLDING OF FUNDS (1977 DEC)	5
7.		5
8.	CONTRACT TERMINATION-DEBARMENT (1972 APR)	
9.	NOTICE TO THE GOVERNMENT OF LABOR DISPUTES (1958 SEP)	5
	DISPUTES CONCERNING LABOR STANDARDS (1977 DEC)	
11.	LABOR RELATIONS (6-72)	6
	MINIMUM WAGE RATES AND OTHER LABOR STANDARDS (6-72)	



LABOR STANDARDS PROVISIONS (Construction Contract)

(Provisions 1 through 8 and 10 are those prescribed by the General Services Administration in Standard Form 19-A, November 1972 Edition as amended pursuant to the latest revisions of the Defense Acquisition Regulation.)

- DAVIS-BACON ACT (40 U.S.C. 276a to a-7)(1977 DEC)
- (a) All mechanics and employed or working directly upon the site of the work shall 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 the Copeland Regulations (29 CFR, Part 3)), the full amounts due at time of payment computed at wage rates not less than the aggregate of the basic hourly rates and rates of payments, contributions, or costs for any fringe benefits contained in the wage determination decision of 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 or subcontractor and such laborers and mechanics. A copy of such wage determination decision shall be kept posted by the Contractor at the site of the work in a prominent place where it can be easily seen by the workers. The term mechanics and laborers shall be deemed to include apprentices and trainees not covered by an approved program as provided by the apprentice and trainee clause of the contract.
- (b) The Contractor may discharge his obligation under this clause to workers in any classification for which the wage determination decision contains:

- (1) Only a basic hourly rate of pay, by making payment at not less than such basic hourly rate, except as otherwise provided in the Copeland Regulations (29 CFR, Part 3); or
- (2) Both a basic hourly rate of pay and fringe benefits payments, by making payment in cash, by irrevocably making contributions pursuant to a fund, plan, or program for, and/or by assuming an enforceable commitment to bear the cost of, bona fide fringe benefits contemplated by the Davis-Bacon Act, or by any combination thereof. Contributions made, or costs assumed, on other than a weekly basis shall be considered as having been constructively made or assumed, during a weekly period to the extent that they apply to such period. Where a fringe benefit is expressed in a wage determination in any manner other than as an hourly rate and the Contractor pays a cash equivalent or provides an alternative fringe benefit, he shall furnish information with his payrolls showing how he determined that the cost incurred to make the cash payment or to provide the alternative fringe benefit is equal to the cost of the wage determination fringe benefit. any case where the Contractor provides a fringe benefit different from any contained in the wage determination, he shall similarly show how he arrived at the hourly rate shown therefor. In the event of disagreement between or among the interested parties as to an equivalent of any fringe benefit, the

Contracting Officer shall submit the question, together with his recommendation, to the Secretary of Labor for final determination.

- (c) The assumption of an enforceable commitment to bear the cost of fringe benefits, or the provision of any fringe benefits not expressly listed in section 1(b)(2) of the Davis-Bacon Act or in the wage determination decision forming a part of the contract, may be considered as payment of wages only with the approval of the Secretary of Labor pursuant to a written request by the Contractor. The Secretary of Labor may require the Contractor to set aside assets, in a separate account, to meet his obligations under any unfunded plan or program.
- (d) The Contracting Officer shall require that any class of laborers or mechanics, including apprentices and trainees, which is not listed in the wage determination decision and which is to be employed under the contract shall be classified or reclassified conformably to the wage determination decision and shall report the action to the Secretary of Labor. If the interested parties cannot agree on the proper classification or reclassification of a particular class of laborers or mechanics, including apprentices and trainees, to be used, the Contracting Officer shall submit the question, together with his recommendation, to the Secretary of Labor for final determination.
- (e) In the event it is found by the Contracting Officer that any laborer or mechanic, including all apprentices and trainees, employed by the Contractor or any subcontractor directly on the site of the work covered by this contract has been or is being paid at a rate of wages less that the rate of wages required by

paragraph (a) of this clause, or by the "Apprentices and Trainees" clause of this contract, the Contracting Officer may (i) by written notice to the Government prime Contractor terminate his right to proceed with the work, or such part of the work as to which there has been a failure to pay said required wages, and (ii) prosecute the work to completion by contract or otherwise, whereupon such Contractor and his sureties shall be liable to the Government for any excess occasioned the Government thereby.

- (f) Paragraphs (a) through (e) of the clause shall apply to this contract to the extent that it is (i) a prime contract with the Government subject to the Davis-Bacon Act or (ii) a subcontract also subject to the Davis-Bacon Act under such prime contract.
- 2. CONTRACT WORK HOURS AND SAFETY STANDARDS ACT-OVERTIME COMPENSATION (40 U.S.C. 327-333)(1977 DEC)

This contract is subject to the Contract Work Hours and Safety Standards Act and to the applicable rules, regulations, and interpretations of the Secretary of Labor.

(a) The Contractor shall require or permit any laborer mechanic, including apprentices, trainees, watchmen, and guards in any workweek in which he is employed on any work under this contract to work in excess of eight (8) hours in any calendar day or in excess of forty (40) hours in such workweek on work subject to the provisions of the Contract Work Hours and Safety Standards Act unless such laborer or mechanic, including apprentices, trainees, watchmen, and guards, receives compensation at a rate not less than one and one-half times his basic rate of pay for all

such hours worked in excess of eight (8) hours in any calendar day or in excess of forty (40) hours in such work week, whichever is the greater number of overtime hours. The "basic rate of pay," as used in this clause, shall be the amount paid per hour, exclusive of the Contractor's contribution or cost for fringe benefits and any cash payment made in lieu of providing fringe benefits, or the basic hourly rate contained in the wage determination, whichever is greater.

(b) In the event of any violation of the provisions of paragraph (a), the Contractor shall be liable to any affected employee for any amounts due, and to the United States for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including an apprentice, trainee, watchman, or guard, employed in violation of the provisions of paragraph (a) in the sum of \$10 for each calendar day on which such employee was required or permitted to be employed on such work in excess of eight (8) hours or in excess of the standard workweek of forty (40) hours without payment of the overtime wages required by paragraph (a).

3. APPRENTICES AND TRAINEES (1977 DEC)

(a) Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Bureau Apprenticeship and Training, or with a state apprenticeship agency recognized by the Bureau, or if a person is employed in his first ninety (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 in any craft classification employed on this contract shall not be greater than the ratio permitted to the Contractor as to his entire work force under the registered program. employee listed on a payroll at an apprentice wage rate, who is not a trainee as defined in paragraph (b) of this clause or is not registered or otherwise employed as stated above, shall be paid the wage rate determined by the Secretary of Labor for the classification of work he actually performed. The Contractor or subcontractor shall furnish to the Contracting Officer written evidence of the registration of his program and apprentices as well as the appropriate ratios and wage rates (expressed in percentages of the journeyman hourly rates), for the area of constructon prior to using apprentices on the contract work. The wage rate paid apprentices shall be not less than the appropriate percentage of the journeyman's rate contained in the applicable wage determination.

(b) Trainees will be permitted to work at less than the perdetermined rate for the work performed when 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, Bureau of Apprenticeship and Training. ratio of trainees to journeymen on this contract shall not be greater than permitted under the plan approved by the Bureau of Apprenticeship and Training. Every trainee must be paid at not less than the rate specified in the approved program for his level of

progress. Any employee listed on the payroll at a trainee rate who is not registered and not participating in a training plan approved by the Bureau of Apprenticeship and Training shall be paid not less than the wage rate determined by the Secretary of Labor for the classification of work he actually performed. The Contractor or subcontractor shall furnish the Contracting Officer written evidence of the certification of his program, the registration of the trainee, and the ratios and wage rates prescribed in that program. In the event the Bureau of Apprenticeship and Training withdraws the approval of a training program, the Contractor shall 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) The utilization of apprentices, trainees, and journeymen under this clause shall be in conformity with the equal opportunity requirements of this contract.
- 4. PAYROLLS AND BASIC RECORDS (1977 DEC)
- (a) The Contractor shall maintain payrolls and basic records relating thereto during the course of the work and shall preserve them for a period of three (3) years thereafter for all laborers and mechanics, including apprentices, trainees, watchmen, and guards, working at the site of the work. Such records shall contain the name and address of each such employee, his correct classification, rate of pay (including rates of contributions for, or costs assumed to provide, fringe benefits), daily and weekly number of hours worked, deductions made and actual wages paid. Watchmen and guards are reflected on payroll records for Contract Work Hours and Safety Standards

Act purposes only.) Whenever the Contractor has obtained approval from the Secretary of Labor as provided in paragraph (c) of the clause entitled "Davis-Bacon Act," he shall maintain records which show the commitment, its approval, written communication of the plan or program to the laborers or mechanics affected, and the costs anticipated or incurred under the plan or program.

- (b) The Contractor shall submit weekly a copy of all payrolls to the Contracting Officer. The Government Prime Contractor shall be responsible for the submission of copies of payrolls of all subcontractors. The copy shall be accompanied by a statement signed by the Contractor indicating that the payrolls are correct and complete, that the wage rates contained therein are not less than those determined by the Secretary of Labor, and that the classifications set forth for each laborer or mechanic, including apprentices and trainees, conform with the work he performed. Weekly submission of the "Statement of Compliance" required under this contract and the Copeland Regulations of the Secretary of Labor (29 CFR, Part 3) shall satisfy the requirement for submission of the above statement. The Contractor shall submit also a copy of any approval by the Secretary of Labor with respect to fringe benefits which is required by paragraph (c) of the clause entitled "Davis-Bacon Act."
- (c) The Contractor shall make the records required under this clause available for inspection by authorized representatives of the Contracting Officer and the Department of Labor, and shall permit such representatives to interview employees during working hours on the job.

5. COMPLIANCE WITH COPELAND REGULA-TIONS (1964 JUN)

The Contractor shall comply with the Copeland Regulations of the Secretary of Labor (29 CFR, Part 3) which are incorporated herein by reference. (DAR 7-602.23(a)(v))

6. WITHHOLDING OF FUNDS (1977 DEC)

- (a) The Contracting Officer may withhold or cause to be withheld from the Government Prime Contractor so much of the accrued payments or advances as may be considered necessary (i) to pay laborers and mechanics. including apprentices, trainees, watchmen, and guards, employed by the Contractor or any subcontractor on the work the full amount of wages required by the contract, and (ii) to satisfy any liability of the Contractor and any subcontractor for liquidated damages under paragraph (b) of the clause entitled "Contract Work Hours Safety Standards Act-Overtime Compensation."
- (b) If the Contractor or any subcontractor fails to pay any laborer,
 mechanic, apprentice, trainee, watchman, or guard employed or working on
 th site of the work, all or part of
 the wages required by the contract,
 the Contracting Officer may, after
 written notice to the Government Prime
 Contractor, take such action as may be
 necessary to cause suspension of any
 further payments or advances until
 such violations have ceased.

7. SUBCONTRACTS (1972 FEB)

The Contractor agrees to insert the clauses hereof entitled "Davis-Bacon Act," "Contract Work Hours and Safety Standards Act-Overtime Compensation," "Apprentices and Trainees," "Payrolls and Basic Records," "Compliance with Copeland Regulations," "With-

holding of Funds," "Subcontracts," and "Contract Termination-Debarment" in all subcontracts. The term "Contract" as used in such clauses in any subcontract shall be deemed to refer to the subcontractor except in the phrase "Government Prime Contractor." (DAR 7-602.23(a)(vii))

8. CONTRACT TERMINATION-DEBARMENT (1972 APR)

A breach of the clauses hereof entitled "Davis-Bacon Act," "Contract Work Hours and Safety Standards Act-Overtime Compensation," "Apprentices and Trainees," "Payrolls and Basic Records," "Compliance with Copeland Regulations," "Withholding of Funds," and "Subcontracts" may be grounds for termination of the contract, and for debarment as provided in 29 CFR 5.6 (DAR 7-602.23(a)(viii))

NOTICE TO THE GOVERNMENT OF LABOR DISPUTES (1958 SEP)

- (a) Whenever the Contractor has knowledge that any actual or potential labor dispute is delaying or threatens to delay the timely performance of this contract, the Contractor shall immediately give notice thereof, including all relevant information with respect thereto, to the Contracting Officer.
- (b) The Contractor agrees to insert the substance of this clause, including this paragraph (b), in any subcontract hereunder as to which a labor dispute may delay the timely performance of this contract; except that each such subcontract shall provide that in the event its timely performance is delayed or threatened by delay by actual or potential labor dispute, the subcontractor shall immediately notify his next higher tier subcontractor, or the prime contractor, as the case may be, of all relevant information with respect to such dispute (DAR 7-104.4)

10. DISPUTES CONCERNING LABOR STANDARDS (1977 DEC)

Disputes arising out of the labor standards provisions of this contract shall be subject to the Disputes clause except to the extent such disputes involve the meaning of classifications or wage rates contained in the wage determination decision of the Secretary of Labor or the applicability of the labor provisions of this contract which questions shall be referred to the Secretary of Labor in accordance with the procedures of the Department of Labor.

11. LABOR RELATIONS (6-72)

It is the Contractor's responsibility to maintain satisfactory labor relations with his employees. Representatives of the Contracting Officer will not participate in labor relations matters unless disputes develop that interfere with the proper performance of the contract, at which time the representative may endeavor to assist in settling the difficulty or may refer the matter to the Federal Mediation and Conciliation Service or the Commander, Naval Facilities Engineering Command for appropriate action.

12. MINIMUM WAGE RATES AND OTHER LABOR STANDARDS (6-72)

(a) The Contractor shall pay mechanics and laborers employed or working directly upon the site of the work wage rates not less than those determined as prevailing by the Secretary of Labor and contained in the wage determination decision that is attached to this specification or addendum thereto. In the event of any difference between the Contractor and the Government concerning the proper wage rates to be paid, the classification of employees to conform to prevailing practice, the amount of wages due employees, or any other

application or interpretation of the labor standards provisions in this contract, the differences shall be referred to the Contracting Officer who shall determine the matter with advice from the Secretary of Labor as required by Department of Labor regulations.

(b) Investigation of Labor Conditions. The wage determination decision of the Secretary of Labor attached hereto or included by amendment is made a part of this contract for the purpose of setting forth the minimum hourly wage rates required to be paid by the Davis-Bacon Act. the rates set forth in the wage determination are no warranty that labor will be available at these rates. Bidders are advised to make their own investigation to determine local labor conditions.

GENERAL PROVISIONS (Construction Contract)

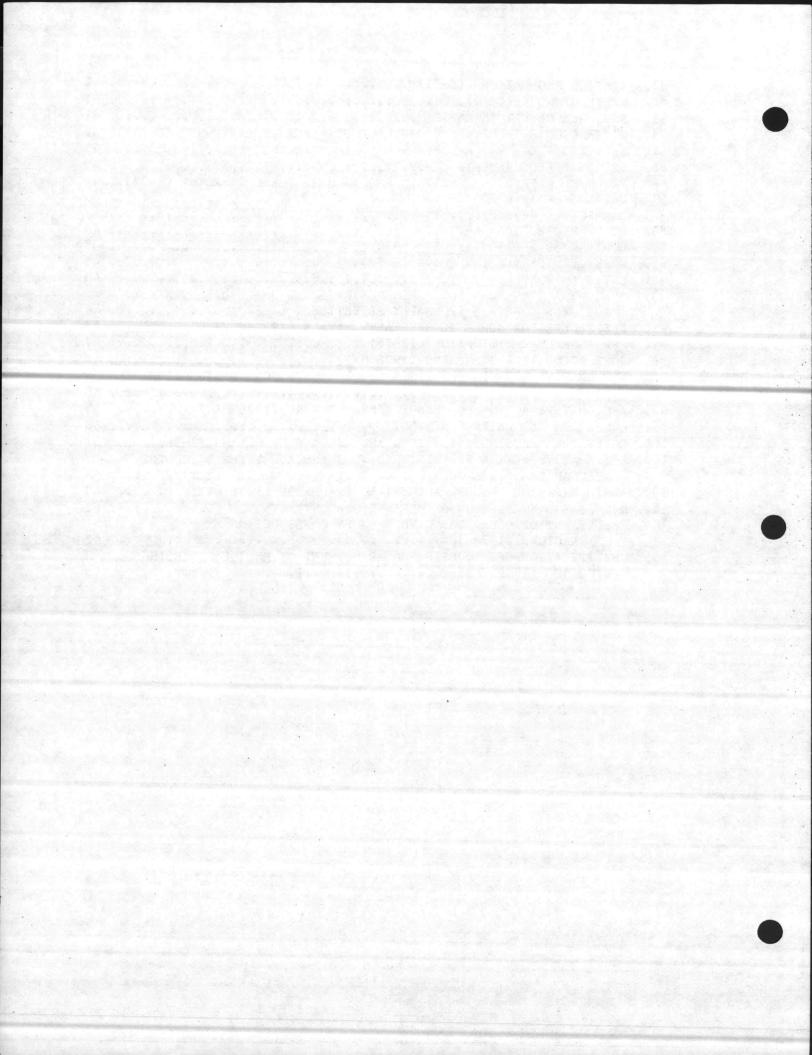
(Provisions 1 through 30 are those prescribed by the General Services Administration in Standard Form 23-A (Rev. 4-75), as amended pursuant to the latest revisions of the Defense Acquisition Regulation.)

TABLE OF CONTENTS

		Pag
	DEFINITIONS (1964 JUN)	
1.	DEFINITIONS (1964 JUN)	. 1
2.	SPECIFICATIONS AND DRAWINGS (1964 JUN)	
3.	CHANGES (1968 FEB)	. 1
4.	DIFFERING SITE CONDITIONS (1968 FEB)	. 2
5.	TERMINATION FOR DEFAULT-DAMAGES FOR DELAY-TIME EXTENSIONS	
	(1969 AUG)	. 3
6.	DISPUTES (1980 JUN)	. 4
7.	PAYMENTS TO CONTRACTOR (1979 MAR)	. 5
8.	ASSIGNMENT OF CLAIMS (1976 OCT)	. 6
9.	MATERIAL AND WORKMANSHIP (1964 JUN)	. 6
10.	INSPECTION AND ACCEPTANCE (1976 OCT)	. 7
11.	SUPERINTENDENCE BY CONTRACTOR (1976 OCT)	. 8
12.	PERMITS AND RESPONSIBILITIES (1964 JUN)	8
13.	CONDITIONS AFFECTING THE WORK (1964 JUN)	. 8
14.	OTHER CONTRACTS (1964 JUN)	. 9
15.	SHOP DRAWINGS (1976 OCT)	
16.	USE AND POSSESSION PRIOR TO COMPLETION (1976 OCT)	
17.	SUSPENSION OF WORK (1968 FEB)	
18.	TERMINATION FOR CONVENIENCE OF THE GOVERNMENT (1974 APR)	
20.	PRICING OF ADJUSTMENTS (1970 JUL)	14
21.		
22.	PATENT INDEMNITY (1964 JUN)	15
23.	EXAMINATION OF RECORDS BY COMPTROLLER GENERAL (1975 JUN)	15
24.	BUY AMERICAN (1966 OCT)	15
25.	EQUAL OPPORTUNITY (1978 SEP)	16
26.	CONVENANT AGAINST CONTINGENT FEES (1958 JAN)	18
27.	OFFICIALS NOT TO BENEFIT (1964 JUN)	18
28.	CONVICT LABOR (1975 OCT)	18
29.	UTILIZATION OF SMALL BUSINESS AND SMALL DISADVANTAGED	10
	BUSINESS CONCERNS (1980 AUG)	
30.	FEDERAL, STATE, AND LOCAL TAXES (1971 NOV)	
31.	CONTRACTOR INSPECTION SYSTEM (1964 NOV)	20
32.	GRATUITIES (1952 MAR)	20
33.	NOTICE AND ASSISTANCE REGARDING PATENT AND COPYRIGHT	20
	INFRINGEMENT (1965 JAN)	21
		- 4

34.	AUTHORIZATION AND CONSENT (1964 MAR)	01
35.		23
36.		21
37.	PROTECTION OF EXISTING VEGETATION, STRUCTURES, UTILITIES.	21
37.	AND IMPROVEMENTS (1965 JAN)	
38.	OPERATIONS AND STORAGE APPAG (1965 743)	22
		22
39.		23
40.		23
41.		23
42.		23
43.		24
44.	GOVERNMENT INSPECTORS (1965 JAN)	24
45.	RIGHTS IN SHOP DRAWINGS (1966 APR)	25
46.	PRIORITIES, ALLOCATIONS, AND ALLOTMENTS (1975 OCT)	25
47.	PRICE REDUCTION FOR DEFECTIVE COST OR PRICING DATA - PRICE	
	ADJUSTMENTS (1970 JAN)	25
48.	AUDIT BY DEPARTMENT OF DEFENSE (1978 AUG)	26
49.	SUBCONTRACTOR COST OR PRICING DATA - PRICE ADJUSTMENTS	0000
	(1970 JAN)	27
50.	GOVERNMENT-FURNISHED PROPERTY (SHORT FORM) (1964 NOV)	28
51.	VARIATIONS IN ESTIMATED QUANTITIES (1968 APR)	28
52.	SALVAGE MATERIALS AND EQUIPMENT (1965 JAN)	20
53.	AVAILABILITY AND USE OF UTILITY SERVICES (1967 APR)	20
54.	MISPLACED MATERIAL (1965 JAN)	29
55.	SIGNAL LIGHTS (1965 JAN)	29
56.	IDENTIFICATION OF EMPLOYEES (1965 JAN)	29
57.	TIME EXTENSIONS (1965 JAN)	30
58.	UTILIZATION OF WOMEN-OWNED BUSINESS CONCERNS (OVER \$10,000)	30
50.	(1980 AUG)	•
59.	PROGRESS CHARTS AND REQUIREMENTS FOR OVERTIME WORK (1965 JAN)	30
60.	DEDECRMANCE OF WORK BY CONTRACTION (1965 JAN)	30
61.	PERFORMANCE OF WORK BY CONTRACTOR (1965 JAN)	31
62.	LAYOUT OF WORK (1965 JAN)	31
63.	WARRANTY OF CONSTRUCTION (1974 APR)	32
	VALUE ENGINEERING INCENTIVE (1977 AUG)	33
64.	VALUE ENGINEERING COST COMPUTATION (1-75)	35
65.	REQUIRED INSURANCE (1977 JAN)	35
66.	GOVERNMENT REPRESENTATIVES (6-72)	36
67.	SPECIFICATIONS AND DRAWINGS (6-72)	36
68.	PRECEDENCE (6-72)	36
69.	ORAL MODIFICATIONS (6-72)	36
70.	NO WAIVER BY GOVERNMENT (6-72)	37
71.	SUPERSEDURE (6-72)	37
72.	SANITATION (6-72)	37
73.	TESTING FOUNDATIONS (6-72)	37
74.	PAYMENT TO CONTRACTOR (6-72)	37
75.	CHANGES BOARD AND ESTIMATES (2-81)	37
76.	CONTRACTOR QUALITY CONTROL (CQC) (4-77)	38
77.	DAMAGES FOR DELAY - DEFENSE MATERIALS SYSTEM AND PRIORITIES	
	(6-72)	40
78.	SPECIFICATIONS AND STANDARDS (6-72)	40
79.	AN OLIN THAT I WINCH THE THE TANK THE T	4.1

80.	STATION REGULATIONS (6-72)	41
81.	ORDER OF WORK (8-75)	41
82.	SCHEDULE OF PRICES (6-72)	41
83.	CONTRACTOR'S INVOICE AND CONTRACT PERFORMANCE STATEMENT (6-72)	42
84.	AS-BUILT RECORD OF MATERIALS USED IN BUILDINGS (6-72)	42
85.	OPTIONAL REQUIREMENTS (6-72)	42
86.	PROPOSED MATERIAL SUBMITTALS REQUIRED OF THE CONTRACTOR (6-72)	42
87.	CATALOG DATA (6-72)	43
88.	SAMPLES (6-72)	43
89.	STORM PROTECTION (6-72)	
90.	CONTRACTOR'S DAILY REPORT (6-72)	43
91.	WORK OUTSIDE REGULAR HOURS (6-72)	43
92.	EXISTING WORK (6-72)	43
93.	SUBCONTRACTING PLAN FOR SMALL BUSINESS AND SMALL DISADVANTAGED	
	BUSINESS CONCERNS (FORMALLY ADVERTISED) (1980 AUG)	
94.	PREFERENCE FOR DOMESTIC SPECIALTY METALS (1972 NOV)	
95.	ENVIRONMENTAL LITIGATION (12-74)	47
96.	COST ACCOUNTING STANDARDS (1978 MAY)	48
97.	AFFIRMATIVE ACTION COMPLIANCE REQUIREMENTS FOR CONSTRUCTION	
	(1978 SEP)	50
98.	AFFIRMATIVE ACTION FOR HANDICAPPED WORKERS (1976 MAY)	55
99.	CLEAN AIR AND WATER (1975 OCT)	56
100.	EQUITABLE ADJUSTMENTS: WAIVER AND RELEASE OF CLAIMS (7-76)	57
101.	AFFIRMATIVE ACTION FOR DISABLED VETERANS AND VETERANS OF THE	
	VIETNAM ERA (1976 JUL)	58
102.	ADMINISTRATION OF COST ACCOUNTING STANDARDS (1978 MAY)	60
	OVERSEAS DISTRIBUTION OF DEFENSE SUBCONTRACTS	
	EMPLOYMENT OF OCEAN GOING VESSELS BY CONSTRUCTION	
	CONTRACTORS (1979 JUL)	62
105.	CERTIFICATION OF REQUESTS FOR ADJUSTMENT OR RELIEF EXCEEDING	
	\$100,000 (1980 FEB)	63



GENERAL PROVISIONS (Construction Contract)

(Provisions 1 through 30 are those prescribed by the General Services Administration in Standard Form 23-A (Rev. 4-75), as amended pursuant to the latest revisions of the Defense Acquisition Regulation.)

1. DEFINITIONS (1964 JUN)

- (a) The term "head of the agency" or "Secretary" as used herein means the Secretary, the Under Secretary, any Assistant Secretary, or any other head or assistant head of the executive or military department or other Federal agency; and the term "his duly authorized representative" means any person or persons or board (other than the Contracting Officer) authorized to act for the head of the agency or the Secretary.
- (b) The term "Contracting Officer" as used herein means the person executing this contract on behalf of the Government and includes a duly appointed successor or authorized representative. (DAR 7-602.1)

2. SPECIFICATIONS AND DRAWINGS (1964 JUN)

The Contractor shall keep on the work 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 either in the figures, in the drawings, or in the specifications, the matter shall be promptly submitted to

Contracting Officer, who shall promptly make a determination in writing. Any adjustment by the Contractor without such a determination shall be at his own risk and expense. The Contracting Officer shall furnish from time to time such detail drawings and other information as he may consider necessary, unless otherwise provided. (DAR 7-602.2)

3. CHANGES (1968 FEB)

- (a) The Contracting Officer may, at any time, without notice to the sureties, by written order designated or indicated to be a change order, make any change in the work within the general scope of the contract, including but not limited to changes:
- (i) In the specifications (including drawings and designs);
- (ii) In the method or manner
 of performance of the work;
- (iii) In the Governmentfurnished facilities, equipment, materials, services, or site; or
- (iv) Directing acceleration in the performance of the work.
- (b) Any other written order or an oral order (which terms as used in this paragraph (b) shall include direction, instruction, interpretation, or determination) from the Contracting officer, which causes any such change, shall be treated as a change order under this clause, provided that the Contractor

gives the Contracting Officer written notice stating the date, circumstances, and source of the order and that the Contractor regards the order as a change order.

- (c) Except as herein provided, 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 hereunder.
- (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 order, an equitable adjustment shall be made and the contract modified in writing accordingly. Provided, however, that except for claims based on defective specifications, no claims for any change under (b) above shall be allowed for any costs incurred more than 20 days before the Contractor gives written notice as therein required: And provided further, that 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 such defective specifications.
- (e) If the Contractor intends to assert a claim for an equitable adjustment under this clause, he must, within 30 days after receipt of a written change order under (a) above or the furnishing of a written notice under (b) above, submit to the Contracting Officer a written statement setting forth the general nature and monetary extent of such claim, unless this period is extended by the Government. The statement of claim hereunder may be included in the notice under (b) above.

- (f) No claim by the Contractor for an equitable adjustment hereunder shall be allowed if asserted after final payment under this contract. (DAR 7-602.3)
- 4. DIFFERING SITE CONDITIONS (1968 FEB)
- (a) The Contractor shall promptly, and before such conditions are disturbed, notify the Contracting Officer in writing of: (1) subsurface or latent physical conditions at the site differing materially from those indicated in this contract, or (2) unknown physical conditions at the site, of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inhering in work of the character provided for in this contract. Contracting Officer shall promptly investigate the conditions, and if he finds that such conditions do materially so differ and cause an increase or decrease in the Contractor's cost of, or the time required for, performance of any part of the work under this contract, whether or not changed as a result of such conditions, an equitable adjustment shall be made and the contract modified in writing accordingly.
- (b) No claim of the Contractor under this clause shall be allowed unless the Contractor has given the notice required in (a) above, provided, however, the time prescribed therefor may be extended by the Government.
- (c) No claim by the Contractor for an equitable adjustment hereunder shall be allowed if asserted after final payment under this contract. (DAR 7-602.4)

- 5. TERMINATION FOR DEFAULT-DAMAGES FOR DELAY-TIME EXTENSIONS (1969 AUG)
- (a) If the Contractor refuses or fails to prosecute the work, or any separable part thereof, with such diligence as will insure its completion within the time specified in this contract, or any extension thereof, or fails to complete said work within such time, the Government may, by written notice to the Contractor. terminate his right to proceed with the work or such part of the work as to which there has been delay. In such event the Government may take over the work and prosecute the same to completion, by contract or otherwise, and may take possession of and utilize in completing the work such materials, appliances, and plant as may be on the site of the work and necessary therefor. Whether or not the Contractor's right to proceed with the work is terminated, he and his sureties shall be liable for any damage to the Government resulting from his refusal or failure to complete the work within the specified time.
- (b) If fixed and agreed liquidated damages are provided in the contract and if the Government so terminates the Contractor's right to proceed, the resulting damage will consist of such liquidated damages until such reasonable time as may be required for final completion of the work together with any increased costs occasioned the Government in completing the work.
- (c) If fixed and agreed liquidated damages are provided in the contract, and if the Government does not so terminate the Contractor's right to proceed, the resulting damage will consist of such liquidated damages until the work is completed or accepted.
- (d) The Contractor's right to proceed shall not be so terminated nor

the Contractor charged with resulting damage if:

- (1) The delay in the completion of the work arises from unforeseeable causes beyond the control and without the fault or negligence of the Contractor, including but not restricted to, acts of God, acts of the public enemy, acts of the Government in either its sovereign or contractual capacity, acts of another contractor in the performance of a contract with the Government, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes, unusually severe weather, or delays of subcontractors or suppliers arising from unforeseeable causes beyond the control and without the fault or negligence of both the Contractor and such subcontractors or suppliers; and
- (2) The Contractor, within 10 days from the beginning of any such delay (unless the Contracting Officer grants a further period of time before the date of final payment under the contract), notifies the Contracting Officer in writing of the causes of delay.

The Contracting Officer shall ascertain the facts and extent of the delay and extend the time for completing the work when, in his judgment, the findings of fact justify such an extension, and his findings of fact shall be final and conclusive on the parties, subject only to appeal as provided in the "Disputes" clause of this contract.

(e) If, after notice of termination of the Contractor's right to proceed under the provisions of this clause, it is determined for any reason that the Contractor was not in default under the provisions of this clause, or that the delay was excusable under the provisions of this clause, the rights

and obligations of the parties shall if the contract contains a clause providing for termination for convenience of the Government, be the same as if the notice of termination had been issued pursuant to such clause. If, in the foregoing circumstances, this contract does not contain a clause providing for termination for convenience of the Government, the contract shall be equitably adjusted to compensate for such termination and the contract modified accordingly; failure to agree to any such adjustment shall be a dispute concerning a question of fact within the meaning of the clause of this con- tract entitled "Disputes."

- (f) The rights and remedies of the Government provided in this clause are in addition to any other rights and remedies provided by law or under this contract.
- (g) As used in paragraph (d)(1) of this clause, the term "subcontractors or suppliers" means subcontractors or suppliers at any tier. (DAR 7602.5)

6. DISPUTES (1980 JUN)

- (a) This contract is subject to the Contract Disputes Act of 1978 (P.L. 95-563).
- (b) Except as provided in the Act, all disputes arising under or relating to this contract shall be resolved in accordance with this clause.
- (c) (i) As used herein, "claim" means a written demand or assertion by one of the parties seeking, as a matter of right, the payment of money, adjustment or interpretation of contract terms, or other relief, arising under or relating to this contract. However, a written demand by the contractor seeking the payment of money in excess

of \$50,000 is not a claim until certified in accordance with (d) below.

- (ii) A voucher, invoice, or other routine request for payment that is not in dispute when submitted is not a claim for the purpose of the Act. However, where such submission is subsequently disputed either as to liability or amount or not acted upon in a reasonable time, it may be converted to a claim pursuant to the Act by complying with the submission and certification requirements of this clause.
- (iii) A claim by the Contractor shall be made in writing and submitted to the Contracting Officer for decision. A claim by the Government against the contractor shall be subject to a decision by the Contracting Officer.
- (d) For contractor claims of than \$50,000, the contractor shall submit with the claim a certification that the claim is made in good faith; the supporting data are accurate and complete to the best of the contractor's knowledge and belief; and the amount requested accurately reflects the contract adjustment for which the contractor Government is liable. believes The certification shall be executed by the contractor if an individual. When the contractor is not an individual, the certification shall be executed by a senior company official in charge at the contractor's plant or location involved, or by an officer or general partner of the contractor having overall responsibility for the conduct of the contractor's affairs.
- (e) For contractor claims of \$50,000 or less, the Contracting Officer must, if requested in writing by the contractor, render a decision

within 60 days of the request. For contractor certified claims in excess of \$50,000 the Contracting Officer must decide the claim within 60 days or notify the contractor of the date when the decision will be made.

- (f) The Contracting Officer's decision shall be final unless the contractor appeals or files a suit as provided in the Act.
- (g) Interest on the amount found due on a contractor claim shall be paid from the date the contracting officer receives the claim, or from the date payment otherwise would be due, if such date is later, until the date of payment.
- (h) The Contractor shall proceed diligently with performance of this contract, pending final resolution of any request for relief, claim, appeal or action arising under the contract, and comply with any decision of the Contracting Officer.

7. PAYMENTS TO CONTRACTOR (1979 MAR)

- (a) The Government will pay the contract price as hereinafter provided.
- (b) The Government will make progress payments monthly as the work proceeds, or at more frequent intervals as determined by the Contracting Officer, on estimates approved by the Contracting Officer. If requested by the Contracting Officer, the Contractor shall furnish a breakdown of the total contract price showing the amount included therein for each principal category of the work, in such detail as requested, to provide a basis for determining progress payments. In the preparation of estimates the Contracting Officer, at his discretion, may authorize material delivered on the site and preparatory work done to be taken into consideration. Material delivered to the Contractor at locations other than the

site may also be taken into consideration (1) if such consideration is specifically authorized by the contract and (2) if the Contractor furnishes satisfactory evidence that he has acquired title to such material and that is will be utilized on the work covered by this contract.

- In making such progress payments, there shall be retained 10 percent (10%) of the estimated amount until final completion and acceptance of the contract work. However, if the Contracting Officer finds that satisfactory progress was achieved during any period for which a progress payment is to be made, he may authorize such payment to be made in full without retention of a percentage. Also, whenever the work is substantially complete, the Contracting Officer shall retain an amount he considers adequate for the protection of the Government and, at his discretion, may release to the Contractor all or a portion of any excess amount. Furthermore, on coupletion and acceptance of each senarate building, public work, or other division of the contract, on which the price is stated separately in the contract, payment may be made therefore without retention of a percentage.
- (d) All material and work covered by progress payments made shall there—upon become the sole property of the Government, but this provision shall not be construed as relieving the Contractor from the sole responsibility for all material and work upon which payments have been made or the restoration of any damaged work, or as waiving the right of the Government to require the fulfillment of all of the terms of the contract.
- (e) The Contractor shall, upon request, be reimbursed for the entire amount of premiums paid for performance and payment bonds (including

coinsurance and reinsurance agreements, when applicable) after furnishing evidence of full payment to the surety.

Upon completion and acceptance of all work, the amount due the Contractor under this contract shall be paid upon the presentation of a properly executed voucher and after the Contractor shall have furnished the Government with a release of all claims against the Government arising by virtue of this contract, other than claims in stated amounts as may be specifically excepted by the Contractor from the operation of the release. If the Contractor's claim to amounts payable under the contract has been assigned under the Assignment of Claims Act of 1940, as amended (31 U.S.C. 203, 41 U.S.C. 15), a release may also be required of the assignee.

8. ASSIGNMENT OF CLAIMS (1976 OCT)

(a) Pursuant to the provisions of the Assignment of Claims Act of 1940, as amended (31 U.S.C. 203, 41 U.S.C. 15), if this contract provides for payments aggregating \$1,000 or more, claims for moneys due or to become due the Contractor from the Government under this contract may be assigned to a bank, trust company, or other financing institution, including any Federal lending agency, and may thereafter be further assigned and reassigned to any such institution. Any such assignment or reassignment shall cover all amounts payable under this contract and not already paid, and shall not be made to more than one party, except that any such assignment or reassignment may be made to one party as agent or trustee for two or more parties participating in such financing. Unless otherwise provided in this contract, payments to an assignee of any moneys due or to become due under this contract shall not,

to the extent provided in said Act, as amended, be subject to reduction or setoff. (The preceding applies only if this contract is made in time of war or national emergency as defined in said Act; and is with the Department of Defense, the General Services Administration, the Energy Research and Development Administration, the National Aeronautics and Space Administration, the Federal Aviation Administration, or any other department or agency of the United States designated by the President pursuant to Clause 4 of the proviso of Section 1 of the Assignment of Claims Act of 1940, as amended by the Act of May 15, 1951, 65 Stat. 41).

(b) In no event shall copies of this contract or of any plans, specifications, or other similar documents relating to work under this contract, if marked "Top Secret," "Secret," or "Confidential," be furnished to any assignee of any claim arising under this contract or to any other person not entitled to receive the same. However, a copy of any part or all of this contract so marked may be furnished, or any information contained there in may be disclosed, to such assigned upon the prior written authorization of the Contracting Officer. (DAR 7-602.8)

9. MATERIAL AND WORKMANSHIP (1964 JUN)

provided in this contract, all equipment, material, and articles incorporated in the work covered by this contract are to be new and of the most suitable grade for the purpose intended. Unless otherwise specifically provided in this contract, reference to any equipment, material, article, or patented process, by trade name, make, or catalog number, shall be regarded as establishing a standard of quality and shall not be construed as limiting competition, and the Contractor may at his

option, use any equipment, material, article, or process which, in the judgment of the Contracting Officer, is equal to that named. The Contractor the Contracting shall furnish to Officer for his approval the name of the manufacturer, the model number, and other identifying data and information respecting the performance, capacity, nature, and rating of the machinery and mechanical and other equipment which the Contractor contemplates incorporating in the work. When required by this contract or when called for by the Contracting Officer, the Contractor shall furnish the Contracting Officer for approval full information concerning the material or articles which he contemplates incorporating in the work. When so directed, samples shall be submitted for approval at the Contractor's expense, with all shipping charges prepared. Machinery, equipment, material and articles installed or used without required approval shall be at the risk of subsequent rejection.

(b) All work under this contract shall be performed in a skillful and workmanlike manner. The Contracting Officer may, in writing, require the Contractor to remove from the work any employee the Contracting Officer deems incompetent, careless, or otherwise objectionable. (DAR 7-602.9)

10. INSPECTION AND ACCEPTANCE (1976 OCT)

(a) All work (which term includes but is not restricted to materials, workmarship, and manufacture and fabrication of components) shall be subject to inspection and test by the Government at all reasonable times and at all places prior to acceptance. Any such inspection and test is for the sole benefit of the Government and shall not relieve the Contractor of the responsibility of providing quality

control measures to assure that the work strictly complies with the contract requirements. No inspection or test by the Government shall be construed as constituting or implying acceptance. Inspection or test shall not relieve the Contractor of responsibility for damage to or loss of the material prior to acceptance, nor in any way affect the continuing rights of the Government after acceptance of the completed work under the terms of paragraph (f) of this clause, except as hereinabove provided.

- (b) The Contractor shall, without charge, replace any material or correct any workmanship found by the Government not to conform to the contract requirements, unless in the public interest the Government consents to accept such material or workmanship with an appropriate adjustment in contract price. The Contractor shall promptly segregate and remove rejected material from the premises.
- (c) If the Contractor does not promptly replace rejected workmanship, the Government (1) may, by contract or otherwise, replace such material or correct such workmanshiop and charge the cost thereof to the Contractor, or (2) may terminate the Contractor's right to proceed in accordance with the clause of this contract entitled "Termination for Default Damages for Delay Time Extensions."
- (d) The Contractor shall furnish promptly, without additional charge, all facilities, labor, and material reasonably needed for performing such safe and convenient inspection and test as may be required by the Contracting Officer. All inspection and test by the Government shall be performed in such manner as not unnecessarily to delay the work. Special, full size, and performance tests shall be performed as

described in this contract. The Government reserves the right to charge to the Contractor any additional cost of inspection or test when material or workmanship is not ready at the time specified by the Contractor for inspection or test or when reinspection or retest is necessitated by prior rejection.

- (e) Should it be considered necessary or advisable by the Government at any time before acceptance of the entire work to make an examination of work already completed, by removing or tearing out same, the Contractor shall, on request, promptly furnish all necessary facilities, labor, and material. If such work is found to be defective or nonconforming in any material respect, due to the fault of the Contractor or his subcontractors, he shall defray all the expenses of such examination and of satisfactory reconstruction. If, however, such work is found to meet the requirements of the contract, an equitable adjustment shall be made in the contract price to compensate the Contractor for the additional services involved in such examination and reconstruction and, if completion of the work has been delayed thereby, he shall, in addition, be granted a suitable extension of time.
- (f) Unless otherwise provided in this contract, acceptance by the Government shall be made as promptly as practicable after completion and inspection of all work required by this contract, or that portion of the work that the Contracting Officer determines can be accepted separately. Acceptance shall be final and conclusive except as regards latent defects, fraud, or such gross mistakes as may amount to fraud, or as regards the Government's rights under any warranty of guarantee. (DAR 7-602.11)

11. SUPERINTENDENCE BY CONTRACTOR (1976 OCT)

The Contractor, at all times during performance and until the work is completed and accepted, shall give his personal superintendence to the work or have on the work a competent superintendent, satisfactory to the Contracting Officer and with authority to act for the Contractor. (DAR 7-602.12)

12. PERMITS AND RESPONSIBILITIES (1964 JUN)

Contractor shall, without additional expense to the Government, be responsible for obtaining any necessary licenses and permits, and for complying with any applicable Federal, State, and municipal laws, codes, and regulations, in connection with the prosecution of the work. He shall be similarly responsible for all damages to persons or property that occur as a result of his fault or negligence. He shall take proper safety and health precautions to protect the work, the workers, the public, and the property of others. He shall also be responsible for all materials delivered and work performed until completion and acceptance of the entire construction work, except for any completed unit of construction thereof which theretofore may have been accepted. (DAR 7-602.13)

13. CONDITIONS AFFECTING THE WORK (1964 JUN)

The Contractor shall be responsible for having taken steps reasonably necessary to ascertain the nature and location of the work, and the general and local conditions which can affect the work or the cost thereof. Any failure by the Contractor to do so will not relieve him from responsibility for successfully performing

the work without additional expense to the Government. The Government assumes no responsibility for any understanding or representations concerning conditions made by any of its officers or agents prior to the execution of this contract, unless such understanding or representations by the Government are expressly stated in the contract. (DAR 7-602.14)

14. OTHER CONTRACTS (1964 JUN)

The Government may undertake or award other contracts for additional work, and the Contractor shall fully cooperate with such other contractors and Government employees and carefully fit his own work to such additional work as may be directed by the Contracting Officer. The Contractor shall not commit or permit any act which will interfere with the performance of work by any other contractor or by Government employees. (DAR 7-602.15)

15. SHOP DRAWINGS (1976 OCT)

- (a) The term "shop drawings" 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.
- (b) 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 his 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 his approval or disapproval

of the shop drawings and if not approved as submitted shall indicate his reasons therefor. Any work done prior to such approval shall be at the Contractor's risk. Approval by the Contracting Officer shall not relieve the Contractor from any 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 (c) below.

- (c) 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 variation(s), he shall issue an appropriate contract modification, except that, if the variation is minor and does not involve a change in price or time of performance, a modification need not be issued.
- (d) The Contractor shall submit to the Contracting Officer for approval four copies (unless otherwise indicated herein) of all shop drawings as called for under the various headings of these specifications. Three sets (unless otherwise indicated herein) of all shop drawings will be retained by the Contracting Officer and one set will be returned to the Contractor. (DAR 7-602.54(a))

16. USE AND POSSESSION PRIOR TO COMPLETION (1976 CCT)

The Government shall have the right to take possession of or use any completed or partially completed part of the work. Prior to such possession or use, the Contracting Officer shall furnish the Contractor an itemized list of work remaining to be performed or corrected on such portions of the projects as are to be possessed or used by

the Government, provided that failure to list any item of work shall not relieve the Contractor of responsibility for compliance with the terms of the contract. Such possession or use shall not be deemed an acceptance of any work under the contract. While the Government has such possession or use, the Contractor, notwithstanding the provisions of the clause of this contract entitled. "Permits and Responsibilities," shall be relieved of the responsibility for the loss or damage to the work resulting from the Government's possession or use. If such prior possession or use by the Government delays the progress of the work or causes additional expense to the Contractor, an equitable adjustment in the contract price or the time of completion will be made and the contract shall be modified in accordingly. (DAR 7-602.39)

17. SUSPENSION OF WORK (1968 FEB)

- (a) The Contracting Officer may order the Contractor in writing to suspend, delay, or interrupt all or any part of the work for such period of time as he may determine to be 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 by an act of the Contracting Officer in the administration of this contract, or by his failure to act within the time specified in this contract (or if no time is specified, within a reasonable time), an adjustment shall be made for any increase in the cost of performance of this contract (excluding profit) necessarily caused by such 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 (1) that performance would have been so suspended, delayed, or interrupted by any other cause, including the fault or negligence of the Contractor or (2) for which an equitable adjustment is provided for or excluded under any other provision of this contract.

- (c) No claim under this clause shall 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 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 such suspension, delay, or interruption, but not later than the date of final payment under the contract. (DAR 7-602.46)
- 18. TERMINATION FOR CONVENIENCE OF THE GOVERNMENT (1974 APR)
- (a) The performance of work under this contract may be terminated by the Government in accordance with this clause in whole, or from time to time in part, whenever the Contracting Officer shall determine that such termination is in the best interest of the Government. Any such termination shall be effected by delivery to the Contractor of a Notice of Termination specifying the extent to which performance of work under the contract is terminated, and the date upon which such termination becomes effective.
- (b) After receipt of a Notice of Termination, and except as otherwise directed by the Contracting Officer, the Contractor shall:

- (i) stop work under the contract on the date and to the extent specified in the Notice of Termination;
- (ii) place no further orders or subcontracts for materials, services or facilities, except as may be necessary for completion of such portion of the work under the contract as is not terminated;
- (iii) terminate all orders and subcontracts to the extent that they relate to the performance of work terminated by the Notice of Termination;
- (iv) assign to the Government, in the manner, at the times, and to the extent directed by the Contracting Officer, all of the right, title, and interest of the Contractor under the orders and subcontracts so terminated, in which case the Government shall have the right, in its discretion, to settle or pay any or all claims arising out of the termination of such orders and subcontracts;
- (v) settle all outstanding liabilities and all claims arising out of such termination of orders and subcontracts with the approval or ratification of the Contracting Officer, to the extent he may require, which approval or ratification shall be final for all the purposes of this clause;
- (vi) transfer title and deliver to the Government, in the manner, at the times, and to the extent, if any, directed by the Contracting Officer, (A) the fabricated or unfabricated parts, work in process, completed work, supplies, and other material produced as a part of, or acquired in connection with the performance of, the work terminated by the Notice of Termination, and (B) the completed or partially completed plans,

drawings, information, and other property which, if the contract had been completed, would have been required to be furnished to the Government.

(vii) use his best efforts to sell, in the manner, at the times, to the extent, and at the price or prices directed or authorized by the Contracting Officer, any property of the types referred to in (vi) above; provided, however, that the Contractor (A) shall not be required to extend credit to any purchaser, and (B) may acquire any such property under the conditions prescribed by and at a price or prices approved by the Contracting Officer, and provided, further that the proceeds of any such transfer of disposition shall be applied in reduction of any payments to be made by the Government to the Contractor under this contract or shall otherwise be credited to the price or cost of the work covered by this contract or paid in such other manner as the Contracting Officer may direct;

(viii) complete performance of such part of the work as shall not have been terminated by the Notice of Termination; and

(ix) take such actions as may be necessary, or as the Contracting Officer may direct, for the protection and preservation of the property related to this contract which is in the possession of the Contractor and in which the Government has or may acquire any interest.

At any time after expiration of the plant clearance period, as defined in Section VIII, Defense Acquisition Regulation, as it may be amended from time to time, the Contractor may submit to the Contracting Officer a list, certified as to quantity and quality, of any or all items of termination inventory

not previously disposed of, exclusive of items the disposition of which has been directed or authorized by the Contracting Officer, and may request the Government to remove such items or enter into a storage agreement covering them. Not later than fifteen (15) days thereafter, the Government will accept title to such items and remove them or enter into a storage agreement covering the same; provided, that the list submitted shall be subject to verification by the Contracting Officer upon removal of the items, or if the items are sorted, within forty-five (45) days from the date of submission of the list, and any necessary adjustments to correct the list as submitted shall be made prior to final settlement.

- (c) After receipt of a Notice of Contractor Termination. the submit to the Contracting Officer his termination claim, in the form and with certification prescribed by the Contracting Officer. Such claim shall be submitted promptly but in no event later than one year from the effective date of termination, unless one or more extensions in writing are granted by the Contracting Officer, upon request of the Contractor made in writing within such one year period or authorized extension thereof. However, if the Contracting Officer determines that the facts justify such action, he may receive and act upon any such termination claim at any time after such one year period or any extension thereof. Upon failure of the Contractor to submit his termination claim within the time allowed, the Contracting Officer may determine, on the basis of information available to him, the amount, if any, due to the Contractor by reason of the termination and shall thereupon pay to the Contractor the amount so determined.
- (a) Subject to the provisions of paragraph (c), the Contractor and the

Contracting Officer may agree upon the whole or any part of the amount or amounts to be paid to the Contractor by reason of the total or partial termination of work pursuant to this clause. which amount or amounts may include a reasonable allowance for profit or work done; provided, that such agreed amount or amounts, exclusive of settlement costs, shall not exceed the total contract price as reduced by the amount of payments otherwise made and as further reduced by the contract price of work not terminated. The contract shall be amended accordingly, and the Contractor shall be paid the agreed amount. Nothing in paragraph (e) of clause, prescribing the amount to be paid to the Contractor in the event of failure of the Contractor and the Contracting Officer to agree upon the whole amount to be paid to the Contractor by reason of the termination of work pursuant to this clause, shall be deemed to limit, restrict, or otherwise determine or affect the amount or amounts which may be agreed upon to be paid to the Contractor pursuant to this paragraph (d).

- (e) In the event of the failure of the Contractor and the Contracting Officer to agree, as provided in paragraph (d), upon the whole amount to be paid to the Contractor by reason of the termination of work pursuant to this clause, the Contracting Officer shall pay to the Contractor the amounts determined by the Contracting Officer as follows, but without duplication of any amounts agreed upon in accordance with paragraph (d):
- (i) with respect to all contract work performed prior to the effective date of the Notice of Termination, the total (without duplication of any items) of-
- (A) the cost of such work;

- (B) the cost of settling and paying claims arising out of the termination of work under subcontracts or orders as provided in paragraph (b) (v) above, exclusive of the amounts paid or payable on account of supplies or materials delivered or services furnished by the subcontractor prior to the effective date of the Notice of Termination of Work under this contract, which amounts shall be included in the cost on account of which payment is made under (A) above; and
- (C) a sum, as profit on determined by the Con-(A) above, tracting Officer pursuant to 8-303 of the Defense Acquisition Regulation, in effect as of the date of execution of this contract, to be fair and reasonable; provided, however, that if it appears that the Contractor would have sustained a loss on the entire contract had it been completed, no profit shall be included or allowed under this subdivision (C) and an appropriate adjustment shall be made reducing the amount of the settlement to reflect indicated rate of loss; and
- (ii) the reasonable cost of the preservation and protection of property incurred pursuant to paragraph (b)(ix); and any other reasonable cost incidental to termination of work under this contract, including expense incidental to the determination of the amount due to the Contractor as the result of the termination of work under this contract.

The total sum to be paid to the Contractor under (i) above shall not exceed the total contract price as reduced by the amount of payments otherwise made and as further reduced by the contract price of work not terminated. Except for normal spoilage, and except to the extent that the Government shall have otherwise expressly assumed the

- risk of loss, there shall be excluded from the amounts payable to the Contractor under (i) above, the fair value, as determined by the Contracting Officer of property which is destroyed, lost, stolen, or damaged so as to become undeliverable to the Government or to a buyer pursuant to paragraph (b) (vii).
- (f) Costs claimed, agreed to, or determined pursuant to (c), (d), (e), and (i) hereof shall be in accordance with Section XV of the Defense Acquisition Regulation as in effect on the date of this contract.
- (g) The Contractor shall have the right of appeal, under the clause of this contract entitled "Disputes," from any determination made by the Contracting Officer under paragraph (c). (e), or (i) hereof, except that if the Contractor has failed to submit his claim within the time provided in paragraph (c) or (i) hereof, and has failed to request extension of such time, he shall have no such right of appeal. In any case where the Contracting Officer had made a determination of the amount due under paragraph (c), (e) or (i) hereof, the Government shall pay to the Contractor the following: (i) if there is no right of appeal hereunder of if no timely appeal has been taken, the amount so determined by the Contracting Officer, or (ii) if an appeal has been taken, the amount finally determined on such appeal.
- (h) In arriving at the amount due the Contractor under this clause there shall be deducted (i) all unliqudated advance or other payments on account theretofore made to the Contractor, applicable to the terminated portion of this contract, (ii) any claim which the Government may have against the Contractor in connection with this contract, and (iii) the agreed price for,

or the proceeds of sale of, any materials, supplies, or other things acquired by the Contractor or sold, pursuant to the provisions of this clause, and not otherwise recovered by or credited to the Government.

- (i) If the termination hereunder be partial, the Contractor may file with the Contracting Officer a claim for an equitable adjustment of the price or prices specified in the contract relating to the continued portion of the contract (the portion not terminated by the Notice of Termination), and such equitable adjustment as may be agreed upon shall be made in such price or prices. Any claim by the Contractor for an equitable adjustment under this clause must be asserted within ninety (90) days from the effective date of the termination notice, unless an extension is granted in writing by the Contracting Officer.
- (j) The Government may from time to time, under such terms and conditions as it may prescribe, make partial payments and payments on account against costs incurred by the Contractor in connection with the terminsted portion of this contract whenever in the opinion of the Contracting Officer the aggregate of such payments shall be within the amount to which the Contractor will be entitled hereunder. If the total of such payments is in excess of the amount finally agreed or determined to be due under this clause, such excess shall be payable by the Contractor to the Government upon demand, together with interest computed at the rate established by the Secretary of the Treasury pursuant to the Public Law 92-41, 85 STAT 97 for the Renegotiation Board, for the period from the date such excess payment is received by the Contractor to the date on which excess payment is received by

the Contractor to the date on which excess is repaid to the Government; provided, however, that no interest shall be charged with respect to any such excess payment attributable to a reduction in the Contractor's claim by reason of retention or other disposition of termination inventory until ten days after the date of such retention or disposition, or such later date as determined by the Contracting Officer by reason of the circumstances.

(k) Unless otherwise provided for in this contract, or by applicable statute, the Contractor shall -- from the effective date of termination until the expiration of three years after final settlement under this contract-preserve and make available to the Government at all reasonable times at the office of Contractor but without charge to the Government, all his books, records, documents and other evidence bearing on the costs and expenses of the Contractor under this contract and relating to the work terminated hereunder, or, to the extent approved by the Contracting Officer, photographs, microphotographs, or other authentic reproductions thereof. (DAR 7-602.29(a))

19. INTEREST (1972 MAY)

Notwithstanding any other vision of this contract, unless paid within 30 days 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) shall bear interest from the date due until paid and shall be subject to adjustments as provided by Part 6 of Appendix E of the Defense Acquisition Regulation, as in effect on the date of this contract. interest rate per annum shall be the interest rate in effect which has been established by the Secretary of the

Treasury pursuant to Public Law 92-41; 85 STAT 97 for the Renegotiation Board, as of the date the amount becomes due as herein provided. Amounts shall be due upon the earliest one of (i) the date fixed pursuant to this contract; (ii) the date of the first written demand for payment, consistent with this contract, including demand consequent upon default termination; (iii) the date of transmittal by the Government to the Contractor of a proposed supplemental agreement to confirm completed negotiations fixing amount; or (iv) 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 in connection with a negotiated pricing agreement not confirmed by contract supplement.

20. PRICING OF ADJUSTMENTS (1970 JUL)

When costs are a factor in any determination of a contract price adjustment pursuant to the "Changes" clause or any other provision of this contract, such costs shall be in accordance with Section XV of the Defense Acquisition Regulation as in effect on the date of this contract. (DAR 7-103.26)

21. PATENT INDEMNITY (1964 JUN)

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 Letters Patent of the United States (except Letters Patent issued upon an application which is now or may hereafter be, for reasons of national security, ordered by the Government to be kept secret or otherwise withheld from issue) arising out of the performance of this contract or out of

the use or disposal by or for the secount of the Government of supplies furnished or construction work performed hereunder. (DAR 7-602.16)

22. ADDITIONAL BOND SECURITY (1976 OCT)

If any surety upon any bond furnished in connection with this contract becomes unacceptable to the Government, or if any such surety fails to furnish reports as to his financial condition from time to time as requested by the Government, or if the contract price is increased to such an extent that the penal sum of any bond becomes inadequate in the opinion of the Contracting Officer, the Contractor shall promptly furnish such additional security as may be required from time to time to protect the interests of the Government and of persons supplying labor or materials in the prosecution of the work contemplated by this contract. (DAR 7-602.17)

23. EXAMINATION OF RECORDS BY COMPTROLLER GENERAL (1975 JUN)

- (a) This clause is applicable if the amount of this contract exceeds \$10,000 and was entered into by means of negotiation, including small business restricted advertising, but is not applicable if this contract was entered into by means of formal advertising.
- (b) The Contractor agrees that the Comptroller General of the United States or any of his duly authorized representatives shall, until the expiration of three years after final payment under this contract or such lesser time specified in either Appendix M of the Defense Acquisition Regulation or the Federal Procurement Regulations Part 1-20, as appropriate, have access to and the right to examine any directly pertinent books, documents,

papers, and records of the Contractor involving transactions related to this contract.

- (c) The Contractor further agrees to include in all his subcontracts hereunder a provision to the effect that the subcontractor agrees that the Comptroller General of the United States or any of his duly authorized representatives shall, until the expiration of three years after final payment under the subcontract or such lesser time specified in either Appendix M of the Defense Acquisition Regulations Part 1-20, as appropriate, have access to and the right to examine any directly pertinent books, documents, papers, and records of such subcontractor, involving transactions related to the subcontract. The term "subcontract" as used in this clause excludes (i) purchase orders not exceeding \$10,000 and (ii) subcontracts or purchase orders for public utility services at rates established for uniform applicability to the general public.
- (d) The periods of access and examination described in (b) and (c) above for records which relate to (i) appeals under the "Disputes" clause of this contract, (ii) litigation or the settlement of claims arising out of the performance of this contract, or (iii) costs and expenses of this contract as to which exception has been taken by the Comptroller General or any of his duly authorized representatives, shall continue until such appeals, litigation, claims or exceptions have been disposed of. (DAR 7-104.15)

24. BUY AMERICAN (1966 OCT)

(a) Agreement. In accordance with the Buy American Act (41 U.S.C. 10a-10d), the Contractor agrees that only domestic construction material

will be used (by the Contractor, subcontractors, materialmen, and suppliers) in the performance of this contract, except for nondomestic construction material listed in the "Nondomestic Construction Materials" clause, if any, of this contract.

- (b) Domestic construction material. "Construction materal" means any article, material, or supply brought to the construction site for incorporation in the building or work. An unmanufactured construction material is a "domestic construction material" if it has been mined or produced in the United States. A manufactured construction material is a "domestic construction material" if it has been manufactured in the United States and if the cost of its components which have been mined, produced, or manufactured in the United States exceeds 50 percent of the cost of all its components. "Component" means any article, material, or supply directly incorporated in a construction material.
- (c) Domestic component. A component shall be considered to have been "mined, produced, or manufactured in the United States" (regardless of its source in fact) if the article, material, or supply in which it is incorporated was manufactured in the United States and the component is of a class or kind determined by the Government to be not mined, produced, or manufactured in the United States in sufficient and reasonably available commercial quantities and of a satisfactory quality. (DAR 7-602.20)

25. EQUAL OPPORTUNITY (1978 SEP)

(If, during any twelve (12) month period (including the twelve months preceding the award of this contract), the Contractor has been or is awarded federal contracts and/or subcontracts

which have an aggregate value in excess of \$10,000 the Contractor shall comply with (a) through (g) below. Upon request, the Contractor shall provide information necessary to determine the applicability of this clause.)

During the performance of this contract, the Contractor agrees as follows:

- (a) The Contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin. The Contractor will 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. Such action shall include, but not be limited to. the following: Employment upgrading, demotion, or transfer, recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the Contracting Officer setting forth the provisions of this Equel Opportunity clause.
- (b) The Contractor will, in all solicitation 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.
- (c) The Contractor will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding a notice to be provided by the agency Contracting Officer, advising the labor union or workers' representative of the Contractor's

commitments under this Equal Opportunity clause and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

- (d) The Contractor will comply with all provisions of Executive Order No. 11246 of September 24, 1965, as amended by Executive Order No. 11375 of October 13, 1967, and of the rules, regulations, and relevant orders of the Secretary of Labor.
- (e) The Contractor will furnish all information and reports required by Executive Order No. 11246 of September 24, 1965, as amended by Executive order No. 11375 of October 13, 1967, and by the rules, regulations, and orders of the Secretary of Labor or pursuant thereto, and will permit access to his books, records, and accounts by the contracting agency and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations, and orders.
- (f) In the event of the Contractor's noncompliance with the Equal Opportunity clause of this contract or with any of the said rules, regulations, or orders, this contract may be canceled, terminated, or suspended, in whole or in part, and the Contractor may be declared ineligible for further Government contracts in accordance with procedures authorized in Executive Order No. 11246 of September 24, 1965, as amended by Executive Order No. 11375 of October 13, 1967, and such other sanctions may be imposed and remedies invoked as provided in Executive Order No. 11246 of September 24, 1965, as amended by Executive Order No. 11375 of October 13, 1967, or by rule, regulation, or order of the Secretary of Labor, or as otherwise provided by law.
- (g) The Contractor will include the provisions of Paragraphs (a)

through (g) in every subcontract or purchase order unless exempted by rules, regulations, or orders of the Secretary of Labor issued pursuant to Section 204 of Executive Order No. 11246 of September 24, 1965, as amended by Executive Order No. 11375 of October 13, 1967, so that such provisions will be binding upon each subcontractor or vendor. The Contractor will take such action with respect to any subcontract or purchase order as the contracting agency may direct as a means of enforcing such provisions, including sanctions for noncompliance: Provided, however, that in the event the Contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction by the contracting agency, the Contractor may request the United States to enter into such litigation to protect the interest of the United States. (DAR 7-103.18)

26. CONVENANT AGAINST CONTINGENT FEES (1958 JAN)

The Contractor warrants that no person or selling agency has been employed or retained to solicit or secure this contract upon an agreement of commission, understanding for a percentage, brokerage, or contingent fee, excepting bona fide employees or bona fide established commercial or selling agencies maintained by the Contractor for the purpose of securing business. 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 such commission, percentage, brokerage, or contingent fee. (DAR 7-103.20)

27. OFFICIALS NOT TO BENEFIT (1964 JUN)

No member of Congress or resident Commissioner shall be admitted to any share or part of this contract, or to any benefit that may arise therefrom; but this provision shall not be construed to extend to this contract if made with a corporation for its general benefit. (DAR 7-602.19)

28. CONVICT LABOR (1975 OCT)

In connection with the performance of work under this contract, the Contractor agrees not to employ any person undergoing sentence of imprisonment except as provided by Public Law 89-176, September 10, 1965 (18 U.S.C. 4082 (c)(2)) and Executive Order 11755, December 29, 1973. (DAR 7-104.17)

29. UTILIZATION OF SMALL BUSINESS AND SMALL DISADVANTAGED BUSINESS CONCERNS (1980 AUG)

- (a) It is the policy of the United States that small business and small business concerns owned and controlled by socially and economically disadvantaged individuals shall have the maximum practicable opportunity to participate in the performance of contracts let by any Federal agency.
- (b) The Contractor hereby agrees to carry out this policy in the awarding of subcontracts to the fullest extent consistent with the efficient performance of this contract. The term "subcontract" means any agreement (other than one involving an employeremployee relationship) to be entered into by a Federal Covernment prime contractor or subcontractor calling for supplies or services required for the performance of the original contract or subcontract. The Contractor further agrees to cooperate in any

studies or surveys as may be conducted by the United States Small Business Administration or the awarding agency of the United States as may be necessary to determine the extent of the Contractor's compliance with this clause.

- (c) As used in this contract, the term "small business concern" shall mean a small business as defined pursuant to Section 3 of the Small Business Act and relevant regulations promulgated pursuant thereto. The term "small business concern owned and controlled by socially and economically disadvantaged individuals," hereafter referred to as disadvantaged business, shall mean a small business concern -
- (1) which is at least 51 per centum owned by one or more socially and economically disadvantaged individuals; or, in the case of any publicly owned business, at least 51 per centum of the stock of which is owned by one or more socially and economically disadvantaged individuals; and
- (2) whose management daily business operations are controlled by one or more of such individuals. The Contractor shall presume that socially and economically disadvantaged individuals include Black Americans, Hispanic Americans, Native Americans (i.e., American Indians, Eskimos, Aleuts and Native Hawaiians), Asian-Pacific Americans (i.e., U.S. citizens whose origins are from Japan, China, the Philippines, Vietnam, Korea, Samos, Guam, the U.S. Trust Territories of the Pacific, Northern Marianas, Laos, Cambodia, and Taiwan, and other minorities, or any individuals found to be disadvantaged by the Administration pursuant to Section 8(a) of the Small Business Act.

- (d) Contractors acting in good faith may rely on written representations by their subcontractors regarding their status as either a small business concern or a small business concern owned and controlled by socially and economically disadvantaged individuals. (DAR 7-104.14)
- 30. FEDERAL, STATE, AND LOCAL TAXES (1971 NOV)
- (a) Except as may be otherwise provided in this contract, the contract price includes all applicable Federal, State, and local taxes and duties.
- (b) Nevertheless, with respect to any Federal excise tax or duty on the transactions or property covered by this contract, if a statute, court decision, written ruling, or regulation takes effect after the contract date and—
- (1) results in the Contractor being required to pay or bear the burden of any such Federal excise tax or duty or increase in the rate thereof which would not otherwise have been payable on such transactions or property, the contract price shall be increased by the amount of such tax or duty or rate increase, 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; or
- (2) results in the Contractor not being required to pay or bear the burden of, or in his obtaining a refund or drawback of, any such Federal excise tax or duty which would otherwise have been payable on such transactions or property or which was the basis of an increase in the contract price, the contract price shall be decreased by the amount of the relief, refund, or

drawback, or that amount shall be paid to the Government, as directed by the Contracting Officer. The contract price shall be similarly decreased if the Contractor, through his fault or negligence or his failure to follow instructions of the Contracting Officer, is required to pay or bear the burden of, or does not obtain a refund or drawback of, any such Federal excise tax or duty.

- (c) Paragraph (b) above shall not be applicable to social security taxes or to any other employment tax.
- (d) No adjustment of less than \$100 shall be made in the contract price pursuant to paragraph (b) above.
- (e) As used in paragraph (b) above, the term "contract date" means the date set for bid opening, or if this is a negotiated contract, the contract date. As to additional supplies or services procured by modification to this contract, the term "contract date" means the date of such modification.
- (f) Unless there does not exist any reasonable basis to sustain an exemption, the Government upon the request of the Contractor shall, without further liability, furnish evidence appropriate to establish exemption from any Federal, State, or local tax; provided, that evidence appropriate to establish exemption from any Federal excise tax or duty which may give rise to either an increase or decrease in the contract price will be furnished only at the discretion of the Government.
- (g) The Contractor shall promptly notify the Contracting Officer of matters which will result in either an increase or decrease in the contract price, and shall take action with

respect thereto as directed by the Contracting Officer. (DAR 7-103.10(a))

31. CONTRACTOR INSPECTION SYSTEM (1964 NOV)

The Contractor shall (i) maintain an adequate inspection system and perform such inspections as will assure that the work performed under the contract conforms to contract requirements, and (ii) maintain and make available to the Government adequate records of such inspection. (DAR 7-602.10)

32. GRATUITIES (1952 MAR)

- (a) The Government may, written notice to the Contractor, terminate the right of the Contractor to proceed under this contract if it is found, after notice and hearing by the Secretary or his duly authorized representative, that gratuities (in the form of entertainment, gifts, or otherwise) were offered or given by the Contractor, or any agent or representative of the Contractor, to any officer or employee of the Government with a view toward securing a contract or securing favorable treatment with respect to the awarding or amending, or the making of any determinations with respect to the performing, of such contract; provided, that the existence of the facts upon which the Secretary or his duly authorized representative makes such findings shall be in issue and may be reviewed in any competent court.
- (b) In the event this contract is terminated as provided in paragraph (a) hereof, the Government shall be entitled (i) to pursue the same remedies against the Contractor as it could pursue in the event of a breach of the contract by the Contractor, and (ii) as a penalty in addition to any other damages to which it may be entitled by

law, to exemplary damages in an amount (as determined by the Secretary or his duly authorized representative) which shall be not less than three nor more than ten times the cost incurred by the Contractor in providing any such gratuities to any such officer or employee.

- (c) 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. (DAR 7-602.25)
- 33. NOTICE AND ASSISTANCE REGARDING PATENT AND COPYRIGHT INFRINGEMENT (1965 JAN)

The provisions of this clause shall be applicable only if the amount of this contract exceeds \$10,000.

- (a) The Contractor shall report to the Contracting Officer, promptly and in reasonable written detail each notice or claim of patent or copyright infringement based on the performance of this contract of which the Contractor has knowledge.
- (b) In the event of any claim or suit against the Government on account of any alleged patent or copyright infringement arising out of the performance of this contract or out of the use of any supplies furnished or work or services performed hereunder, the Contractor shall furnish to the Government, when requested by the Contracting Officer, all evidence and information in possession of the Contractor pertaining to such suit or claim. Such evidence and information shall be furnished at the expense of the Government except where the Contractor has agreed to indemnify the Government.
- (c) This clause shall be included in all subcontracts. (DAR 7-103.23)

34. AUTHORIZATION AND CONSENT (1964 MAR)

The Government hereby gives its authorization and consent (without prejudice to its rights of indemnification, if such rights are provided for in the contract) for all use and manufacture, in the performance of this contract or any part thereof or any amendment hereto or any subcontract hereunder (including any lower-tier subcontract), of any patented invention (i) embodied in the structure or composition of any article the delivery of which is accepted by the Government under this contract, or (ii) utilized in the machinery, tools, or methods the use of which necessarily results from compliance by the Contractor or the using subcontractor with (a) specifications or written provisions now or hereafter forming a part of this contract, or (b) specific written instructions given by the OICC directing the manner of performance. The Contractor's entire liability to the Government for patent infringement shall be determined solely by the provisions of the indemnity clause, if any, included in the contract and the Government assumes liability for all other infringement to the extent of the authorization and consent hereinabove granted. (DAR 7-103.22)

35. COMPOSITION OF CONTRACTOR (1965 JAN)

If the Contractor hereunder is comprised of more than one legal entity, each such entity shall be jointly and severally liable hereunder. (DAR 7-602.32)

36. SITE INVESTIGATION (1965 JAN)

The Contractor acknowledges that he has investigated and satisfied himself as to the conditions affecting the

work, including but not restricted to those bearing upon transportation disposal, handling and storage of materials, availability of labor, water, electric power, roads and uncertainties of weather, river states, tides or similar physical conditions at the site. the conformation and conditions of the ground, the character of equipment and facilities needed preliminary to and during prosecution of the work. The Contractor further acknowledges that he has satisfied himself 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 information presented by the drawings and specifications made a part of this contract. Any failure by the Contractor to acquaint himself with the available information will not relieve him from responsiblity for estimating properly the difficulty or cost of successfully performing the work. The Government assumes no responsibility for any conclusions or interpretations made by the Contractor on the basis of the information made available by the Government. (DAR 7-602.33)

37. PROTECTION OF EXISTING VEGETATION, STRUCTURES, UTILITIES, AND IMPROVEMENT (1965 JAN)

(a) The Contractor will preserve and protect all existing vegetation such as trees, shrubs, and grass on or adjacent to the site of work which is not to be removed and which does not unreasonably interfere with the construction work. Care will be taken in removing trees authorized for removal to avoid damage to vegetation to remain in place. Any limbs or branches of trees broken during such operations or by the careless operation of equipment,

or by workmen, shall be trimmed with a clean cut and painted with an approved tree pruning compound as directed by the Contracting Officer.

(b) The Contractor will protect from damage all existing improvements or utilities at or near the site of the work, the location of which is made known to him, and will repair or restore any damage to such facilities, resulting from failure to comply with the requirements of this contract or the failure to exercise reasonable care in the performance of the work. If the Contractor fails or refuses to repair any such damage promptly, the Contracting Officer may have necessary work performed and charge the cost thereof to the Contractor. 7-602.34

38. OPERATIONS AND STORAGE AREAS (1965 JAN)

- (a) All operations of the Contractor (including storage of materials) upon Government premises shall be confined 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 his operations.
- (b) Temporary buildings (storage sheds, shops, offices, etc.) 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. Such temporary buildings and utilities shall remain the property of the Contractor and shall be removed by him at his expense upon the completion of the work. With the written consent of the Contracting Officer, such 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 construct and use such temporary roadways as may be authorized by the Contracting Officer. Where materials are transported in the prosecution of 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 curbings or sidewalks, protection against damage shall be provided by the Contractor and any damaged roads, curbings, or sidewalks shall be repaired by or at the expense of the Contractor. 7-602.35

39. MODIFICATION PROPOSALS -- PRICE BREAKDOWN (1968 APR)

The Contractor, in connection with any proposal he makes for a contract modification, shall furnish a price breakdown, itemized as required by the Contracting Officer. Unless otherwise directed, the breakdown shall be in sufficient details to permit an analysis of all material, labor, equipment, subcontract, and overhead costs, as well as profit, and shall cover all work involved in the modification, whether such work was deleted, added or changed. Any amount claimed for subcontracts shall be supported by a similar price breakdown. In addition, if the proposal includes a time extension, a justification thereof shall also be furnished. The proposal, together with the price breakdown and time extension justification, shall be furnished by the date specified by the Contracting Officer. (DAR 7-602.36)

40. SUBCONTRACTORS (1979 MAR)

Within seven days after the award of any subcontract either by himself or

a subcontractor, the Contractor shall deliver to the Contracting Officer a completed DD Form 1566. The form shall include the subcontractor's acknowledgement of the inclusion in his subcontract of the clauses of this contract entitled "Davis-Bacon Act," "Contract Work Hours and Safety Standards Act - Overtime Compensation," "Apprentices and Trainees," "Compliance with Copeland Regulations," "Withholding of Funds," "Subcontracts," "Contract Termination - Debarment," and "Payrolls and Basic Records." Nothing contained in this contract shall create any contractual relation between the subcontractor and the Government.

41. CLEANING UP (1965 JAN)

The Contractor shall at all times keep the construction area, including storage areas used by him, free from accumulations of waste material or rubbish and prior to completion of the work remove any rubbish from the premises and all tools, scaffolding, equipment, and materials not the property of the Government. Upon completion of the construction the Contractor shall leave the work and premises in a clean, neat and workmanlike condition satisfactory to the Contracting Officer. (DAR 7-602.40)

42. ADDITIONAL DEFINITIONS (1965 JAN)

(a) 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.

(b) 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 "provided complete in place," that is "furnished and installed." (DAR 7-602.41)

43. ACCIDENT PREVENTION (1977 JUN)

- (a) In order to provide safety controls for protection to the life and health of employees and other persons; for prevention of damage to property, materials, supplies, and equipment; and for avoidance of work interruptions in the performance of this contract, the Contractor shall comply with all pertinent provisions of Corps of Engineers Manual, EM 385-1-1, dated 1 June 1977 entitled "General Safety Requirements," as amended, and will also take or cause to be taken such additional measures as the Contracting Officer may determine to be reasonably necessary for the purpose.
- (b) The Contractor will maintain an accurate record of, and will report to the Contracting Officer in the manner and on the forms prescribed by the Contracting Officer, exposure data and all accidents resulting in death, traumatic injury, occupational disease, and damage to property, materials, supplies and equipment incident to work performed under this contract.
- (c) The Contracting Officer will notify the Contractor of any noncompliance with the foregoing provisions and the action to be taken. The Contractor shall, after receipt of such notice, immedia. Yet ake corrective

action. Such notice, when delivered to the Contractor or his representative at the site of the work, shall be deemed sufficient for the purpose. If the Contractor fails or refuses to comply promptly, the Contracting Officer may issue an order stopping all or part of work until satisfactory corrective action has been taken. No part of the time lost due to any such stop orders shall be made the subject of claim for extension of time or for excess costs or damages by the Contractor.

(d) Compliance with the provisions of this article by subcontractors will be the responsibility of the Contractor.

If the contract involves more than 6 months work or is described as hazardous character in the Invitation for Bids, Schedule, or Specifications, the following paragraph (e) will apply.

- (e) Prior to commencement of the work the Contractor will:
- (1) submit in writing his proposals for effectuating this provision for accident prevention;
- (2) meet in conference with representatives of the Contracting Officer to discuss and develop mutual understandings relative to administration of the overall safety program. (DAR 7-602.42)

44. GOVERNMENT INSPECTORS (1965 JAN)

The work will be conducted under the general direction of the Contracting Officer and is subject to inspection by his appointed inspectors to insure strict compliance with the terms of the contract. No inspector is authorized to change any provision of the specifications without written

authorization of the Contracting Officer, nor shall the presence or absence of an inspector relieve the Contractor from any requrements of the contract. (DAR 7-602.43)

45. RIGHTS IN SHOP DRAWINGS (1966 APR)

- (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. (DAR 7-602.47)

46. PRIORITIES, ALLOCATIONS, AND ALLOTMENTS (1975 OCT)

(The following clause is applicable to rateable contracts.)

The Contractor shall follow the provisions of DMS Reg. 1 or DPS Reg. 1 and all other applicable regulations and orders of the Bureau of Domestic Commerce in obtaining controlled materials and other products and materials needed to fill this order. (DAR 7-104.18)

- 47. PRICE REDUCTION FOR DEFECTIVE COST OF PRICING DATA--PRICE ADJUSTMENTS (1970 JAN)
- (a) This clause shall become operative only with respect to any modification of this contract which involves aggregate increases and/or decreases in costs plus applicable profits in excess of \$500,000 unless the

modification is priced on the basic of adequate competition, established catalog or market prices of commercial items sold in substantial quantities to the general public, or prices set by law or regulation. The right to price reduction under this clause is limited to defects in data relating to such modification.

- (b) If any price, including profit or fee, negotiated in connection with any price adjustment under this contract was increased by any significant sums because:
- (i) the Contractor furnished cost or pricing data which was not complete, accurate and current as certified in the Contractor's Certificate of Current Cost or Pricing Data:
- (ii) a subcontractor, pursuant to the clause of this contract entitled "Subcontractor Cost or Pricing Data" or "Subcontractor Cost or Pricing Data -- Price Adjustment" or any subcontract clause therein required, furnished cost or pricing data which was not complete, accurate and current as certified in the subcontractor's Certificate of Current Cost or Pricing Data;
- (iii) a subcontractor or prospective subcontractor furnished cost
 or pricing data which was required to
 be complete, accurate and current and
 to be submitted to support a subcontract cost estimate furnished by the
 Contractor but which was not complete,
 accurate and current as of the date
 certified in the Contractor's Certificate of Current Cost or Pricing Data;
 or
- (iv) the Contractor or a subcontractor or prospective subcontractor furnished any data, not within
 (i), (ii) or (iii) above, which was not
 accurate, as submitted; the price shall
 be reduced accordingly and the contract
 shall be modified in writing as may be

necessary to reflect such reduction. However, any reduction in the contract price due to defective subcontract data of a prospective subcontractor, when the subcontract was not subsequently awarded to such subcontractor, will be limited to the amount (plus applicable overhead and profit markup) by which the actual subcontract, or actual cost to the Contractor if there was no subcontract, was less than the prospective subcontract cost estimate submitted by the Contractor, provided the actual subcontract price was not affected by defective cost or pricing data.

Note: Since the contract is subject to reduction under this clause by reason of defective cost or pricing data submitted in connection with certain subcontracts, it is expected that the Contractor may wish to include a clause in each such subcontract requiring the subcontractor to appropthe riately indemnify Contractor. However, the inclusion of such a clause and the terms thereof are matters for negotiation and agreement between the Contractor and the subcontractor, provided that they are consistent with DAR 23- 203 relating to Disputes provisions in subcontracts. It is also expected that any sub- contractor subject to such indemnification will generally require substantially similar indemnification for defective cost or pricing data required to be submitted by his lower tier subcontractors. 7-104.29(b))

48. AUDIT BY DEPARTMENT OF DEFENSE (1978 AUG)

(The following clause is applicable unless this contract was entered into by formal advertising and is not in excess of \$100,000)

(a) General. The Contracting Officer or his representatives shall

have the audit and inspection rights described in the applicable paragraphs (b), (c) and (d) below.

- Examination of Costs. this is a cost reimbursement type, incentive, time and materials, lebor hour, or price redeterminable contract. or any combination thereof, the Contractor shall maintain, and the Contracting Officer or his representatives shall have the right to examine books, records, documents, and other evidence and accounting procedures and practices, sufficient to reflect properly all direct and indirect costs of whatever nature claimed to have been incurred and anticipated to be incurred for the performance of this contract. Such right of examination shall include inspection at all reasonable times of the Contractor's plants, or such parts thereof, as may be engaged in the performance of this contract.
- (c) Cost or Pricing Data. If the Contractor submitted cost or pricing data in connection with the pricing of this contract or any change or modification thereto, unless such pricing was based on adequate price competition, established catalog or market prices of commercial items sold in substantial quantities to the general public, or prices set by law or regulation, the Contracting Officer or his representatives who are employees of the United States Government shall have the right to examine all books, records, documents and other data of the Contractor related to the negotiation, pricing or performance of such contract, change or modification, for the purpose of evaluating the accuracy, completeness and currency of the cost or pricing data submitted. Additionally, in the case of pricing any change or modification exceeding \$100,000 to formally advertised contracts, the Comptroller General of the United States or his

representatives who are employees of the United States Government shall have such rights. The right of examination shall extend to all documents necessary to permit adequate evaluation of the cost or pricing data submitted, along with the computations and projections used therein.

- (d) Reports. If the Contractor is required to furnish Contractor Cost Data Reports (CCDR), Contract Fund Status Reports (CFSR), or Cost Performance Reports (CPR), the Contracting Officer or his representatives shall the right to examine books. records, other documents, and supporting materials, for the purpose of evaluation (i) the effectiveness of the Contractor's policies and procedures to produce data compatible with the objectives of these reports, and (ii) the data reported.
- (e) Availability. The materials described in (b), (c) and (d) above shall be made available at the office of the Contractor, at all reasonable times, for inspection, audit, or reproduction, until the expiration of three years from the date of final payment under this contract or such lesser time specified in Appendix M of the Defense Acquisition Regulation, and for such longer period, if any, as is required by applicable statute, or by other clauses of this contract, or by (1) and (2) below:
- (1) If this contract is completely or partially terminated, the records relating to the work terminated shall be made available for a period of three years from the date of any resulting final settlement.
- (2) Records which relate to appeals under the "Disputes" clause of this contract, or litigation or the settlement of claims arising out of the

performance of this contract, shall be made available until such appeals, litigation, or claims have been disposed of.

- (f) The Contractor shall insert a clause containing all the provisions of this clause, including this paragraph (f), in all subcontracts exceeding \$10,000 hereunder, except altered as necessary for proper identification of the contracting parties and the Contracting Officer under the Government prime contract. (DAR 7-104.41)
- 49. SUBCONTRACTOR COST OR PRICING DATA--PRICE ADJUSTMENTS (1970 JAN)
- (a) Paragraphs (b) and (c) of this clause shall become operative only with respect to any modification made pursuant to one or more provisions of this contract which involves aggregate increases and/or decreases in costs plus applicable profits expected to exceed \$500,000. The requirements of this clause shall be limited to such modifications.
- (b) The Contractor shall require subcontractors hereunder to submit cost or pricing data under the following circumstances: (i) prior to the award of any subcontract the amount of which is expected to exceed \$500,000 when entered into; (ii) prior to the pricing of any subcontract modification which involves aggregate increases and/or decreases in costs plus applicable profits expected to exceed \$500,000; except where the price is based on adequate price competition, established catalog or market prices of commercial items sold in substantial quantities to the general public, or prices set by law or regulation.
- (c) The Contractor shall require subcontractors to certify that to the best of their knowledge and belief the

cost and pricing data submitted under (b) above is accurate, complete, and current as of the date of agreement on the negotiated price of the subcontract or subcontract change or modification.

(d) The Contractor shall insert the substance of this clause including this paragraph (d) in each subcontract which exceeds \$500,000. (DAR 7-104.42(b))

50. GOVERNMENT-FURNISHED PROPERTY (SHORT FORM) (1964 NOV)

- (a) The Government shall deliver to the Contractor, for use only in connection with this contract, the property described in the schedule or specifications (hereinafter referred to as "Government-furnished property"), at the times and locations stated therein. If the Government-furnished property, suitable for its intended use, is not so delivered to the Contractor, the Contracting Officer shall, upon timely written request made by the Contractor, and if the facts warrant such action. equitably adjust any affected provision of this contract pursuant to the procedures of the "Changes" clause hereof.
- (b) Title to Government-furnished property shall remain in the Government. The Contractor shall maintain adequate property control records of Government-furnished property in accordance with sound industrial practice.
- (c) Unless otherwise provided in this contract, the Contractor upon delivery to him of any Government-furnished property, assumes the risk of, and shall be responsible for, any loss thereof or damage thereto except for reasonable wear and tear, and except to the extent that such property is consumed in the performance of this contract.

(d) The Contractor shall, upon completion of this contract, prepare for shipment, deliver f.o.b. origin, or dispose of all Government-furnished property not consumed in the performance of this contract or not therefore delivered to the Government, 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 paid in such other manner as the Contracting Officer may direct. (DAR 7-104.24(f))

51. VARIATIONS IN ESTIMATED QUANTITIES (1968 APR)

Where the quantity of a pay item in this contract is an estimated quantity and where the actual quantity of such may item varies more than fifteen percent (15%) above or below the estimated quantity stated in this contract, 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 one hundred fifteen percent (115%) or below eighty-five percent (85%) of the estimated quantity. If the quantity variation is such as to cause an increase in the time necessary for completion, the Contracting Officer shall, upon receipt of a written request for an extension of time within ten (10) days from the beginning of such delay, or within such further period of time which may be granted by the Contracting Officer prior to the date of final settlement of the contract, ascertain the facts and make such adjustment for extending the completion date as in his judgment the findings justify. (DAR 7-603.27)

52. SALVAGE MATERIALS AND EQUIPMENT (1965 JAN)

The Contractor shall maintain adequate property control records for all

materials or equipment specified to be These records may be in salvaged. accordance with the Contractor's system of property control, if approved by the property administrator. The Contractor shall be responsible for the adequate storage and protection of all salvaged materials and equipment and shall replace, at no cost to the Government, all salvage materials and equipment which are broken or damaged during salvage operations as the result of his negligence, or while in his (DAR 7-603.29)

53. AVAILABILITY AND USE OF UTILITY SERVICES (1967 APR)

This clause shall be applicable only if so expressly stated in the Schedule, or specification, or Invitation for Bids.

- (a) The Government will make available to the Contractor, from existing outlets and supplies, all reasonably required amounts of utilities as specified in the Schedule or specifications. Except as otherwise provided in the Schedule or specifications, each utility 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 as determined by the Contracting Officer.
- (b) The Contractor shall carefully conserve utilities furnished without charge. The Contractor, at his own expense and in a workmanlike manner satisfactory to the Contracting Officer, shall install and maintain all necessary temporary connections and distribution lines and, if necessary to determine charges, all meters required to measure the amount of each utility used; and he shall remove the same prior to final acceptance of the construction. (DAR 7-603.30)

54. MISPLACED MATERIAL (1965 JAN)

Should the Contractor, during the progress of the work lose, dump, throw overboard, sink, or misplace any material, plant, machinery, or appliance, which in the opinion of the Contracting Officer may be dangerous to or obseruct navigation, the Contractor shell recover and remove the same with the utmost dispatch. The Contractor shall give immediate notice, with description and location of such obstructions, to the Contracting Officer or inspector, and when required shall mark or buoy such obstructions until the same are removed. Should he refuse, neglect, or delay compliance with the above requirements, such obstructions may be removed by the Contracting Officer, and the cost of such removal may be deducted from any money due or to become due the Contractor, or may be recovered under his bond. The liability of the Contractor for the removal of a vessel wrecked or sunk without fault or negligence shall be limited to that provided in Sections 15, 19, and 20 of the River and Harbor Act of March 3. 1899. (33 U.S.C. 410 et seq.)(DAR 7-603.32)

55. SIGNAL LIGHTS (1965 JAN)

Contractor shall display signal lights and conduct his operations in accordance with the General Regulations of the Department of the Army and of the Coast Guard governing lights and day signals to be displayed by towing vessels with tows on which no signals can be displayed, vessels working on wrecks, dredges, and vessels engaged in laying cables or pipe or in submarine or bank protection operations, lights to be displayed on dredge pipe lines, and day signals to be displayed by vessels of more than to leet in length moored or anchored in a fairway or channel, and the passing by other vessels of floating plant working in navigable channels, as approved by the Secretary of the Army (33 C.F.R. 201.1-201.16) and the Commandent, U.S. Coast Guard (33 C.F.R. 80.18-31a and 33 C.F.R. 95.51-95.70). (DAR 7-603.33)

56. IDENTIFICATION OF EMPLOYEES (1965 JAN)

The Contractor shall be responsible for furnishing to each employee and for requiring each employee engaged on the work to display such identification as may be approved and directed by the Contracting Officer. All prescribed identification shall immediately be delivered to the Contracting Officer, for cancellation upon the release of any employee. When required by the Contracting Officer, the Contractor shall obtain and submit fingerprints of all persons employed or to be employed on the project. (DAR 7-603.34)

57. TIME EXTENSIONS (1965 JAN)

Notwithstanding any other provisions of this contract it is mutually understood that the time extensions for changes in the work will depend upon the extent, if any, by which the changes cause delay in the completion of the various elements of construction. The change order granting the time extension may provide that the contract completion date will be extended only for those specific elements so delayed and that the remaining contract completion dates for all other portions of the work will not be altered and may further provide for an equitable readjustment of liquidated damages pursuant to the new completion schedule. (DAR 7-603.36)

58. UTILIZATION OF WOMEN-OWNED BUSINESS CONCERNS (OVER \$10,000) (1980 AUG)

(a) It is the policy of the United States Government that women-owned

businesses shall have the maximum practicable opportunity to participate in the performance of contracts awarded by any Federal agency.

- (b) The Contractor agrees to use its best efforts to carry out this policy in the award of subcontracts to the fullest extent consistent with the efficient performance of this contract. As used in this contract, a "womenowned business" concern means a business that is at least 51 percent owned by a woman or women who are U.S. citizens and who also control and operate the business and that is a small business as defined pursuant to Section 3 of the Small Business Act and relevant regulations promulgated pursuant there-"Control" in this context means exercising the power to make policy decisions. "Operate" in this context means being actively involved in the day-to-day management.
- (c) Contractors acting in good faith may rely on written representations by their subcontractors regarding their status as women-owned business concerns. (DAR 7-104.52)

59. PROGRESS CHARTS AND REQUIREMENTS FOR OVERTIME WORK (1965 JAN)

(a) The Contractor shall within 5 days or within such time as determined by the Contracting Officer, after date of commencement of work, prepare and submit to the Contracting Officer for approval practicable a schedule, showing the order in which the Contractor proposes to carry on the work, the date on which he will start the severa! salient features (including procurement of materials, plant and equipment) and the contemplated dates for completing the same. The schedule may be in any form, at the option of the Contractor, but shall maintain current with eact. submittal, at least the fellowing information:

- (1) The various classes and areas of work, broken down into:
- a. Times projected for submittals, approvals, and procurement.
- b. Times for installation and erection.
- c. Times for testing and inspection.
- (2) The work completed and the work remaining to be done to complete the project.
- (3) Any items of work which will delay the start or completion of other major items of work so as to delay completion of the whole project.

The Contractor shall submit an updated copy of his schedule with each invoice, and when required by major changes in the work. If the Contractor fails to submit a progress schedule within the time herein prescribed, the Contracting Officer may withhold approval of progress payments until such time as the Contractor submits the required progress schedule.

- (b) If, in the opinion of the Contracting Officer, the Contractor falls behind the progress schedule, the Contractor shall take such steps as may be necessary to improve his progress and the Contracting Officer may require him to increase the number of shifts, or overtime operations, days of work, or the amount of construction planned or all of them, and to submit for approval such supplementary schedule or schedules in chart form as may be deemed necessary to demonstrate the manner in which the agreed rate of progress will be regained, all without additional cost to the Government.
- (c) Failure of the Contractor to comply with the requirements of the

Contracting Officer under this provision shall be grounds for determination by the Contracting Officer that the Contractor is not prosecuting the work with such diligence as will insure completion within the time specified. Upon such determination the Contracting Officer may terminate the Contractor's right to proceed with the work, or any separable part thereof, in accordance with the clause of the Contract entitled "Termination for Default-Damages for Delay-Time Extensions." (DAR 7-603.48)

60. PERFORMANCE OF WORK BY CONTRACTOR (1965 JAN)

The Contractor shall perform on the site, and with his own organization, work equivalent to at least 20 percent of the total amount of the work to be performed under the contract. If during the progress of the work the Contractor requests a reduction in such percentage and the Officer in Charge of Construction determines that it would be to the Government's advantage, the percentage of the work hereunder required to be performed by the contractor may be reduced, provided written approval of such reduction is obtained from the Officer in Charge of Construction. (DAR 7-603.15)

61. LAYOUT OF WORK (1965 JAN)

The Contractor shall layout his work from Government-established base lines and bench marks indicated on the drawings and shall be responsible for all measurements in connection therewith. The Contractor shall furnish, at his own expense, all stakes, templates, platforms, equipment, tools, and materials and labor as may be required in laying out any part of the work from the base lines and bench marks established by the Government. The Contractor will be held responsible for

the execution of the work to such lines and grades as may be established or indicated by the Officer in Charge of Construction. It shall be the responsibility of the Contractor to maintain and preserve all stakes and other marks established by the Officer in Charge of Construction until authorized to remove them. If such marks are destroyed, by the Contractor or through his negligence, prior to their authorized removal, they may be replaced by the Officer in Charge of Construction at his dis-The expense of replacement will be deducted from any amounts due or to become due the Contractor. (DAR 7-604.3)

62. WARRANTY OF CONSTRUCTION (1974 APR)

(a) In addition to any other warranties set out elsewhere in this contract, the Contractor warrants that work performed under this contract conforms to the contract requirements and is free of any defect of equipment. material or design furnished, workmanship performed by the Contractor or any of his subcontractors or suppliers at any tier. Such warranty shall continue for a period of one year from the date of final acceptance of the work, but with respect to any part of the work which the Government takes possession of prior to final acceptance, such warranty shall continue for a period of one year from the date the Government takes possession. Under this warranty, the Contractor shall remedy at his own expense any such failure to conform or any such defect. In addition, the Contractor shall remedy at his own expense any damage to Government owned or controlled real or personal property, when that damage is the result of the Contractor's failure to conform to contract requirements or any such defect of equipment, material, workmanship, or design. The Contractor

shall also restore any work damaged in fulfilling the terms of this clause. The Contractor's warranty with respect to work repaired or replaced hereunder will run for one year from the date of such repair or replacement.

- (b) The Government shall notify the Contractor in writing within a reasonable time after the discovery of any failure, defect, or damage.
- (c) Should the Contractor fail to remedy any failure, defect, or damage described in (a) above within a reasonable time after receipt of notice thereof, the Government shall have the right to replace, repair, or otherwise remedy such failure, defect, or damage at the Contractor's expense.
- (d) In addition to the other rights and remedies provided by this clause, all subcontractors', manufacturers', and suppliers' warranties expressed or implied, respecting any work and materials shall, at the direction of the Government, be enforced by the Contractor for the benefit of the Government. In such case if the Contractor's warranty under (a) above has expired, any suit directed by the Government to enforce a subcontractor's, manufacturer's or supplier's warranty shall be at the expense of the Government. The Contractor shall obtain any warranties which the subcontractors, manufacturers, or suppliers would give in normal commercial practice.
- (e) If directed by the Contracting Officer, the Contractor shall require any such warranties to be executed in writing to the Government.
- (f) Notwithstanding any other provision of this clause, unless such a defect is caused by the negligence of the Contractor or his subcontractors or

suppliers 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 which results from any such defect in Government furnished material or design.

- (g) The warranty specified herein shall not limit the Government's rights under the "Inspection and Acceptance" clause of this contract with respect to latent defects, gross mistake, or fraud.
- (h) Defects in design or manufacture of equipment specified by the Government on a "brand name and model" basis, shall not be included in this warranty. The Contractor shall require any subcontractors, manufacturers, or suppliers thereof to execute their warranties in writing directly to the Government. (DAR 7-604.4)

63. VALUE ENGINEERING INCENTIVE (1977 AUG)

- (a) Application. This clause applies to a contractor developed and documented Value Engineering Change Proposal (VECP) which:
- (i) requires a change to this contract to implement the VECP, and
- (ii) reduces the contract price without impairing essential function or characteristics, provided that it is not based solely on a change in deliverable end item quantities.
- (b) Documentation. As a minimum, the following information shall be submitted by the Contractor with each VECP:
- (i) a description of the difference between the existing contract requirement and the proposed change,

and the comparative advantages and disadvantages of each, justification where function or characteristics of a work item is being altered, and the effect of the change on the performance of the end item;

- (ii) an analysis and itemization of the requirements of the contract which must be changed if the VECP is accepted and a recommendation as to how to make each such change (e.g., a suggested specification revision);
- (iii) a separate detailed cost estimate for both the existing contract requirement and the proposed change to provide an estimate of the reduction in costs, if any, that will result from acceptance of the VECP, taking into account the costs of development and implementation by the Contractor (including any amount attributable to subcontracts in accordance with paragraph (f) below):
- (iv) a prediction of any effects the proposed change would have on related costs to the Military Department such as Government-furnished property costs, and costs of maintenance and operation;
- (v) a statement of the time by which a change order adopting the VECP must be issued so as to obtain the maximum cost reduction during the remainder of this contract, noting any effect on the contract completion time or delivery schedule; and
- (vi) identification of any previous submission of the VECP, including the dates submitted, the agencies involved, the numbers of the Government contracts involved, and the previous actions by the Government, if known.
- (c) Submission. To expedice a determination, VECPs shall be submitted

to the Resident Engineer at the worksite with a copy to the Contracting Officer. Proposals shall be processed expeditiously; however, the Government shall not be liable for any delay in acting upon any proposal submitted pursuant to this clause. If the evaluation period is likely to exceed 45 calendar days, the PCO shall promptly notify the Contractor of the estimated decision date and provide the reasons for the additional time required. The Contractor has the right to withdraw, in whole or in part, any VECP not accepted by the Government within the period specified in the VECP.

- (d) Acceptance. The Contracting Officer may accept, in whole or in part, by contract modification any VECP submitted pursuant to this clause. The Contracting Officer may accept the VECP even though an agreement on price reduction has not been reached, by issuing the Contractor a notice to proceed with the change. Until a notice to proceed is issued or a contract modification applies a VECP to this contract, the Contractor shall remain obligated to perform in accordance with this contract. Contract modification made pursuant to this clause will so state. The decision of the Contracting Officer as to the acceptance of any VECP under this contract shall be final and shall not be subject to the "Disputes" clause of this contract.
- (e) Sharing. If a VECP submitted by the Contractor pursuant to this clause is accepted, the contract price shall be adjusted without regard to profit in accordance with the following provisions:

(i) Definition:

(A) Instant contract savings to the Contractor (ICS) are the estimated reduction in the Contractor's

cost of performance resulting from the acceptance of the VECP. The proposed cost reduction includes estimated allowable Contractor development and implementation costs (CC). The Contractor's development and implementation costs include any subcontractor development and implementation costs (see (f) below). For purposes of this clause, Contractor development costs are those costs incurred after the Contractor has identified a specific VE project and prior to acceptance and implementation by the Government.

- (GC) are those DoD costs which directly result from development and implementation of the VECP, such as test and evaluation of the VECP.
- (ii) Calculations and Actions. Multiply ICS by 45% and GC by 55%. Add these two results, e.g., (.45 ICS plus .55 GC) and subtract from the contract price.
- (f) Subcontracts. The Contractor shall include appropriate VE arrangements in any subcontract of \$50,000 or greater, and may include such arrangements in contracts of lesser value. To compute any adjustment in the contract price under paragraph (e) above, the Contractor's cost of development and implementation of a VECP which is accepted under this contract shall include any development and implementation costs of a subcontractor which clearly pertains to such VECP, but shall exclude any VE incentive payments which the Contractor may make to a subcontractor. The Contractor may make whatever VE incentive payment arrangements he chooses with his subcontractors, provided that any payments to subcontractors under such arrangements are made from the Contractor's, and not the Government's, share of the savings resulting from the VECP.

(g) Data. The Contractor may restrict the Government's right to use any sheet of a VECP or of the supporting data, submitted pursuant to this clause, in accordance with the terms of the following legend if it is marked on such sheet:

"This data furnished -pursuant to the Value Engineering Incentive clause of contract shall not disclosed be outside the Government, or duplicated, used, disclosed, in whole or in part, for any purpose other than to evaluate a VECP submitted under said clause. This restriction does not limit the Government's right to use information contained this data if it is or has obtained. or is otherwise available, the Contractor or from another source. without limitations."

In the event of acceptance of a VECP, the Contractor hereby grants to the Government unlimited rights, as defined in the clause of DAR 7-104.9(a), in the VECP and supporting data, except that, with respect to data which qualifies as and is submitted as limited rights technical data in accordance with the clause of DAR 7-104.9(a), the Government shall have the rights specified in the contract modification referred to in paragraph (d) hereof and the data shall be appropriately marked. (DAR 7-602.50)

64. VALUE ENGINEERING COST COMPUTATION (1-75)

In computing the instant contract savings to the Contractor (ICS), under

Clause 66, "Value Engineering Incentive (1977 Aug)," there shall not be taken into consideration any Value Engineering incentive payments which the Contractor may make to the subcontractor, i.e., such amounts will not be deemed a development and implementation cost at any tier.

65. REQUIRED INSURANCE (1977 JAN)

(a) The Contractor shall procure and maintain during the entire period of this performance under this contract the following minimum insurance.

COVERAGE

Type of Per Per Insurance Person Accident Property

- 1. Comprehensive
 General
 Liability \$300,000 \$1,000,000 \$100,000
- 2. Automobile Liability \$300,000 \$1,000,000 \$100,000
- 3. Workmen's As required
- 4. (Other as required by State Law)
- (b) 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 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 thirty (30) days after written notice thereof to the Contracting Officer.

(c) The Contractor agrees to insert the substance of this clause, including this paragraph (c), in all subcontracts hereunder. (DAR 7-603.10)

66. GOVERNMENT REPRESENTATIVES (6-72)

- The work will be under the general direction of the Contracting Officer, the Commander Naval Facilities Engineering Command, who shall designate an officer of the Civil Engineer Corps, United States Navy, or other officer or representative of the Government, as Officer in Charge of Construction, referred to as the "OICC", who except in connection with the "Disputes" clause shall be the authorized representative of the Contracting Officer and under the direction of the Contracting Officer have charge of the work, and shall exercise full supervision and general direction of the work, so far as it affects the interest of the Government. For the purposes of the "Dispute" clause the Contracting Officer shall mean the Commander, Naval Facilities Engineering Command, the Acting Commander, their successors, or their representatives specially designated for this purpose.
- (b) The provisions in this clause or elsewhere in this contract regarding supervision, approval or direction by the Contracting Officer or the OICC or action taken pursuant thereto are not intended to and shall not relieve the Contractor of responsibility for the accomplishment of the work either as regards sufficiency or the time of performance, except as expressly otherwise provided herein.

67. SPECIFICATIONS AND DRAWINGS (6-72)

To Clause 2 add the following paragraphs:

- (b) Omissions and Misdescriptions. Omissions from the drawings or specifications or the misdescription of details of work which are manifestly necessary to carry out the intent of the drawings and specifications, or which are customarily performed, shall not relieve the Contractor from performing such omitted or misdescribed details of work but they shall be performed as if fully and correctly set forth, and described in the drawings and specifications.
- (c) Deviations. Deviations from the drawings and dimensions therein given, whether or not error is believed to exist, shall be made only after written authority is obtained from the OICC.

68. PRECEDENCE (6-72)

In the event of conflict or inconsistency between any of the provisions of the various portions of this contract (the reconciliation of which is not otherwise provided for here), precedence shall be given in the following order, the provisions of any particular portion prevailing over those of a subsequently listed portion.

- (1) Typewritten portions of the contract.
- (2) the specifications referred to in Standard Form 23 (including all addenda, and mechanical and technical but not contractual aspects of incorporated provisions) as specifically amended herein, if amended.
- (3) printed provisions of the contract form, including printed provisions of added slip sheets.

69. ORAL MODIFICATION (6-72)

No oral statement of any person whomsoever shall in any manner or degree modify or otherwise affect the terms of this contract.

70. NO WAIVER BY GOVERNMENT (6-72)

The failure of the Government in any one or more instances to insist upon the strict performance of any of the terms of this contract or to exercise any option herein conferred, shall not be construed as a waiver or relinquishment to any extent of the right to assert or rely upon such terms or option on any future occasion.

71. SUPERSEDURE (6-72)

If this contract has been preceded by a Letter or Dispatch of Intent or a Notice of Award, anticipating the execution of this contract then such Letter or Dispatch or Notice and all rights and obligations of the parties thereunder are superseded and merged into this contract. All acts of the Contractor and the Government and all payments, if any, made by the Government under said Letter or Dispatch or Notice shall be deemed to have been under this contract.

72. SANITATION (6-72)

Adequate sanitary conveniences of any approved type for the use of persons employed on the work, and properly secluded from public observation, shall be constructed and maintained by the Contractor in such a manner and at such points as shall be required or approved by the OICC. These conveniences shall be maintained at all times without nuisance and their use shall be strictly enforced. Upon completion of the work they shall be removed from the premises, leaving the premises clean and free from nuisance.

73. TESTING FOUNDATIONS (6-72)

Tests of the bearing value of the material underlying the foundation of the structure to be built shall be made at such times and places and in such a

manner as may be directed by the OICC. As far as practicable, test piles, when used, shall be so located that they can become part of the finished structure. The Contractor shall furnish OICC ample opportunity for viewing tests making such records as the latter may consider advisable. The Contractor shall be entitled to compensation for making such tests in the same manner as for a change required by the OICC under Clause 3 to the extent the contract price does not include compensation therefor. Notice must be given of intention to request compensation in accordance with Clause 3.

74. PAYMENT TO CONTRACTOR (6-72)

(a) To Clause 7 add the following sentence at the end of paragraph (a) and add paragraph (g) below:

Such payments shall be made on submission of itemized requests by the Contractor and shall be subject to reduction for overpayments or increase for underpayments on preceding payments to the Contractor.

(g) The obligation of the Government to make any of the payments required under any of the provisions of this contract shall, in the discretion of the OICC, be subject to (1) reasonable deductions on account of defects in material or workmanship, and (2) any claims which the Government may have against the Contractor under or in connection with this contract. Any overpayments to the Contractor shall, unless otherwise adjusted, be repaid to the Government upon demand.

75. CHANGES BOARD AND ESTIMATES (2-81)

In determining any equitable adjustment under Clause 3, the OICC shall, in those instances where the adjustment to be made in compensation is

estimated by the OICC to amount to \$50,000 or more, convene, and give full consideration to the report of an advisory board of three members, consisting of two Government representatives appointed by the OICC and one representative appointed by the Contractor. This board shall estimate and report to the OICC the amount of the change in cost, time, or both, resulting from the ordered change. making all equitable adjustments under Clause 3, compensation for additions will be based upon estimated costs at the time the work is performed and credit for deductions will be based upon estimated costs at the time the contract was made. To such cost estimates, 6 percent shall be added to adjust the Contractor's profits. In arriving at the amount of the change in price, if any, allowance may be made for overhead and general expenses, plant rental, and other similar items.

76. CONTRACTOR QUALITY CONTROL (CQC) (4-77)

This clause applies only when specifically required by the specifications.

(a) The contractor shall provide a quality control organization and system to perform inspections, tests, and retesting in the event of failure of all items of work, including that of his subcontractors, to assure compliance with the contract provisions. Quality control will be established for all work, except where specific provisions of the contract provide for Government approvals, inspections, and tests. The CQC system will specifically include, but not be limited to. the inspections and tests required in the technical provisions of the contract specifications and shall cover all construction operations, including both on-site and off-site fabrication.

- (b) The contractor shall provide a CQC representative, supplemented as necessary by additional personnel, who shall be on the work at all times during progress, with complete authority to take any action necessary to ensure compliance with the contract, COC representative shall appointed by a letter addressed to him and signed by an officer of the firm. This letter shall detail the CQC representative's authority and responsibility to act for the contractor. The CQC representative shall report directly to an officer of the firm, and shall not be the same individual as, nor be subordinate to, the job superintendent or project manager. The CQC representative shall have no job-related responsibilities other than quality control.
- (c) The contractor shall furnish four copies of the CQC plan to the Contracting Officer within fifteen calendar days after receipt of the Notice of Award. The CQC plan shall detail the procedures, instructions, and reports to be used to assure compliance with the contract. Unless specifically authorized by the Contracting Officer in writing, no construction will be started until the CQC plan is approved. This plan will include, as a minimum:
- (1) A copy of the letter appointing the CQC representative, signed by an officer of the firm, outlining the CQC representative's duties, responsibilities, and authority. This letter must include the authority to direct removal and replacement of any defective work.
- (2) The quality control organization in chart form, showing the relationship of the quality control organization to other elements of the firm.

- (3) Names and qualifications of personnel in the quality control organization.
- (4) Area of responsibility and authority of each individual in the quality control organization.
- (5) A listing of outside organizations such as testing laboratories, architects, and consulting engineers that will be employed by the contractor, and a description of the services these firms will provide.
- (6) Procedures for reviewing all shop drawings, samples, certificates, or other submittals for contract compliance, including the name of the person(s) authorized to sign the submittals for the contractor, as complying with the contract.
- (7) An inspection schedule, keyed to the construction schedule and following the order of the specification technical sections, indicating what inspections and tests, the names of persons responsible for the inspection and testing for each segment of work, and the time schedule for each inspection and test.
- (8) The procedures for documenting quality control operation, inspection, and testing, with a copy of all forms and reports to be used for this purpose. The contractor shall also include a submittal status log listing all submittals required by the specifications and stating the action required by contractor or the Government. The contractor shall complete columns (a) through (e) of this log and name the persons authorized to review the submittals.
- (d) Inspection procedures shall include, as a minimum:

- Preparatory Inspection. Preparatory Inspection shall be performed before beginning any work, and in addition, before beginning each segment of work. Preparatory Inspection shall include a review of the contract requirements, the review and approval of shop drawings and other submittal data, a check to assure that required control testing will be provided, a physical examination to assure that all materials and equipment conform to approved shop drawings and submittal data, and a check to assure that all required preliminary work has been completed.
- (2) Initial Inspection. An Initial Inspection shall be performed as soon as a representative segment of the particular item of work has been accomplished. Initial inspection shall include performance of scheduled tests, examination of the quality of workmanship, a review of test results for compliance with contract requirements, a review for omissions or dimensional errors, and approval or rejection of the initial segment of the work.
- (3) Follow-up Inspections. Follow-up Inspections shall be performed daily, and more frequently as necessary, and shall include continued testing and examinations to assure continued compliance with the contract requirements.
- (e) At least five days after the CQC Plan is submitted, but before construction operations are started, the contractor shall meet with the Contracting Officer and discuss the quality control requirements. The purpose of the meeting shall be to develop a mutual understanding relative to details of the system, including forms to be used for recording the quality control operations, inspections, tests, approvals, certifications, administration of the system, and Government surveillance. This meeting shall also

develop a schedule for future weekly or biweekly CQC meetings and shall establish procedures for submission of daily reports and other records and documents.

- (f) The contractor shall submit daily CQC reports to the Contracting Officer identifying prime and subcontractor personnel and equipment on the site, idle equipment and personnel, material deliveries, weather conditions, work accomplished, inspections and tests conducted, results of inspection and tests, nature of defects found, causes for rejection, proposed remedial action, and corrective actions taken, together with the following certification: "On behalf of the contractor, I certify that this report is complete and correct, and all materials and equipment used and work performed during this reporting period are in compliance with the contract plans and specifictions, to the best of my knowledge, except as noted above." This certification shall be signed for the contractor by the authorized COC representative.
- (g) Test results provided shall cite the contract requirements, the test or analysis procedures used, and the actual tests results, and include a statement that the item tested or analyzed conforms or fails to conform to the specification requirements. report shall be conspicuously stamped on the cover sheet in large red letters "CONFORMS" or "DOES NOT CONFORM" to the specification requirements as the case may be. All test reports shall be signed by a testing laboratory representative authorized to sign certified The contractor shall test reports. arrange for immediate and direct delivery of the signed original of all reports, certifications, and other documentation to the Contracting Officer.

(h) All submittals, shop drawings, catalog cuts, samples, etc., unless otherwise specifically noted, shall be approved and certified by the contractor as conforming to the drawings and specifications. Four copies of all shop drawings, catalog cuts, or other submittals, with the contractor's approval indicated thereon, shall be sent to the Contracting Officer within one working day of the contractor's approval.

77. DAMAGES FOR DELAY--DEFENSE MATERIALS SYSTEM AND PRIORITIES (6-72)

The Government will take no action pursuant to Clause 5 of Standard Form 23A to terminate the right of the Contractor to proceed or to assess liquidated or actual damages where failure of the Contractor to complete the work within the time specified is due solely to the operation of the Defense Materials System and Priorities, provided the Contractor and his subcontractors comply with the provisions of this System and the Contractor's lateness in completion of the work is not otherwise caused by the fault or negligence of the Contractor. Such delays will be excusable within the meaning of Clause 5, and the Contractor will be entitled to a time extension by reason thereof.

78. SPECIFICATIONS AND STANDARDS (6-72)

The specifications and standards referenced in this specification (including addenda, amendments, and errata listed) shall govern in all cases where references thereto are made. In case of differences between these specifications or standards and this specification or its accompanying drawings, this specification and its accompanying drawings shall govern to the extent of such differences; otherwise, the referenced specifications and standards,

shall apply. The requirement for packaging, packing, marking, and preparation for shipment or delivery included in the referenced specifications shall apply only to materials and equipment that are furnished directly to the Government and not to materials and equipment that are to be furnished and installed by the Contractor.

- (a) When a number in parenthesis is suffixed to a NAVFAC, NAVDOCKS, Military or Federal Specification, it denotes the effective amendment or change to the document. Amendments to Federal and Military Specifications shall be designated by placing the notation, "Amendment 1" under the basic specification designation.
- (b) Unless otherwise specified by this contract specification, all tests required by the referenced specifications and standards shall be conducted at no expense to the Government under the supervision of and in a laboratory acceptable to the Government.
- (c) Application for specifications other than NAVFAC, Yards and Docks, Military or Federal specifications should be made to the organizations publishing them. NAVFAC, Yards and Docks, Federal, and Military specifications may be ordered from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, Pennsylvania 19120. However, a copy of all referenced documents will be available for examination only at the office of the Officer in Charge of Construction.

79. SECURITY REQUIREMENTS (6-72)

No employee or representative of the Contractor will be admitted to the site of the work unless he furnishes satisfactory proof that he is a citizen of the United States or, is specifically authorized admittance to the sire of the work by the OICC.

80. STATION REGULATIONS (6-72)

The Contractor and his employees and subcontractors shall become familiar with and obey all Station regulations including fire, traffic, and security regulations. All personnel employed on the station shall keep within the limits of the work (and avenues of ingress and egress), and shall not enter any restricted areas unless required to do so and are cleared for such entry. The Contractor's equipment shall be conspicuously marked for identification.

81. ORDER OF WORK (8-75)

The Contractor shall schedule his work as to cause the least amount of interference with Station operations. Work schedules shall be subject to the approval of the Officer in Charge of Construction. Permission to connect or interrupt any Station Roads, Railroads and/or utility service shall be requested in writing a minimum of 15 calendar days prior to the desired date of interruption.

82. SCHEDULES OF PRICES (6-72)

Within 5 days of receipt of a Notice of Award, the Contractor shall prepare and submit to the Officer in Charge of Construction, a Schedule of Prices (Construction Contract), NAVFAC 4330/4. The schedule shall consist of a detailed breakdown of the contract price, giving the quantities for each of the various kinds of work, the unit prices, and the total prices therefor. The detailed breakdown shall be segregated under each of the construction categories given hereinafter. The required schedule must be based on the

actual breakdown of the bid price. Accordingly, subcontractors who may be involved in work under more than one of these categories shall be advised of this requirement in order to assure their being in a position to furnish these data without delay. The format, content and number of copies required shall be as further prescribed by the Officer in Charge of Construction and shall be subject to his approval. The submission of the required data shall not otherwise affect the contract terms. Form NAVFAC 4330/4 will be furnished by the Officer in Charge of Construction.

83. CONTRACTOR'S INVOICE AND CONTRACT PERFORMANCE STATEMENT (6-72)

Requests for payment in accordance with the terms of the contract shall consist of:

- (a) Contractor's Invoice on form NAVFAC 10-7300/30, which shall show, in summary form, the basis for arriving at the amount of the invoice, and
- (b) Contract Performance Statement on form NAVFAC 10-7300/31, which shall show in detail, the estimated cost percentage of completion and value of completed performance for each of the construction categories given hereinafter. The format, content, and number of copies required shell be as further prescribed by the Officer in Charge of Construction and shall be subject to his approval. The submission of the required data shall not otherwise affect the contract terms. NAVFAC 10-7300/30 and 10-7300/31 will be furnished by the Officer in Charge of Construction.

84. AS-BUILT RECORD OF MATERIALS USED IN BUILDINGS (6-72)

Prior to completion of the contract, the Contractor shall furnish an

"as-built" record of materials used in the construction. Submittal of this data is made a condition for final payment under the contract. Where several manufacturer's brands, types, or classes of the item listed have been used in the project, the specific areas where each item was used shall be designated. Designations shall be keyed to the area and space designations on the contract drawings.

85. OPTIONAL REQUIREMENTS (6-72)

Where a choice of materials and/or methods is permitted herein, the Contractor will be given the right to exercise the option unless stated specifically otherwise.

86. PROPOSED MATERIAL SUBMITTALS REQUIRED OF THE CONTRACTOR (6-72)

Proposed material submittals required of the Contractor shall be made allowing sufficient time for processing, reviews, approval, and procurement before the Contractor is ready to use the material. No material shall be used prior to written approval. Submittals shall be prepared and assembled as follows:

- (a) Submit seven copies of each submittal.
- (b) Present all submittals for each specification section as a complete bound volume, titled with project title and contract number.
- (c) Provide index of included items with each volume. Title the index with applicable specification section name and number.
- (d) Clearly mark each item in volume with specification paragraph number to which it pertains.

- (e) Assemble each volume in same numerical sequence as specifications section paragraphs.
- (f) See individual technical sections for additional information.

The Contractor shall certify on all submittals that the material being proposed conforms to contract requirements. In the event of any variance, the Contractor shall state specifically which portions vary, and request approval of a substitute. The Contractor shall also certify that all Contractor shall also certify that all Contractor furnished equipment can be installed in the allocated spaces. Incomplete submittals and submittals with inadequate data will be rejected.

87. CATALOG DATA (6-72)

Catalog data shall be printed pages on permanent copies of the manufacturer's catalogs.

88. SAMPLES (6-72)

Samples in the number specified, shall be shipped prepaid, and delivered as directed by the Officer in Charge of Construction. Samples shall be marked to show name of material, name of supplier, contract number, segment of work where material represented by sample is to be used, and name of Contractor submitting sample.

89. STORM PROTECTION (6-72)

Should warnings of winds of gale force or stronger be issued, the Contractor shall take every practicable precaution to minimize danger to person, to the work and to adjacent property.

90. CONTRACTOF'S DAILY REPORT (6-72)

The Contractor will be required to submit a "Daily Report to Inspector,"

Form NAVFAC 4330/34. The forms shall be completed daily and delivered to the Office in Charge of Construction. Data to be included in the form is data on workers by classification, the move-on and move-off of construction equipment furnished by the prime and subcontractor or furnished by the Government, and materials and equipment delivered to the site of installation in the work.

If Clause 76, "Contractor Quality Control" is applicable to this contract, the information required by this clause shall be submitted as a part of the reports required under Clause 76.

91. WORK OUTSIDE REGULAR HOURS (6-72)

If the Contractor desires to carry on work outside regular hours or on Saturdays, Sundays, or holidays, he shall submit application to the Officer in Charge of Construction, but shall allow ample time to enable satisfactory arrangements to be made by the Government for inspecting the work in progress. At night, he shall light the different parts of the work in an approved manner. All utility cutovers shall be made after normal working hours or on weekends. Anticipated costs shall be included in the bid.

92. EXISTING WORK (6-72)

The disassembling, disconnecting, cutting, removal or altering in any way of existing work shall be carried on in such a manner as to prevent injury or damage to all portions of existing work, whether they are to remain in place, be re-used in the new work, or be salvaged and stored. All portions of existing work which have been cut, damaged or altered in any way during construction operations shall be repaired or replaced in kind and in an approved manner to match existing or

adjoining work. All work of this nature shall be performed by the Contractor at his expense and shall be as directed. Existing work shall, at the completion of all operations, be left in a condition as good as existed before the new work started.

- 93. SUBCONTRACTING PLAN FOR SMALL BUSINESS AND SMALL DISADVANTAGED BUSINESS CONCERNS (FORMALLY ADVERTISED) (1980 AUG)
- (a) This provision does not apply to small business concerns.
- (b) The apparent low bidder, upon request by the Contracting Officer, shall submit a subcontracting plan which addresses separately subcontracting with small business concerns and small disadvantaged bu iness concerns, and which shall be included in and made a material part of the resultant contract. The subcontracting plan shall be submitted within the time specified by the Contracting Officer. Failure to submit the subcontracting plan shall make the bidder ineligible for the award of the contract. As a minimum, the subcontracting plan shall include:
- (1) Separate percentage goals (expressed in terms of percentage of total planned subcontracting dollars) for the utilization as subcontractors of small business concerns and small business concerns owned and controlled by socially and economically disadvantaged individuals; for the purposes of the subcontracting plan, the Contractor shall include all subcontracts to be awarded for the specific purpose of performing this contract and include a proportionate share of supplies and services whose costs are normally allocated as indirect or overhead costs when reasonably determined to be attributable to this contract.

- a. A statement of: (i) total dollar planned to be subcontracted; (ii) total dollars planned to be subcontracted to small business; and (iii) total dollars planned to be subcontracted to small disadvantaged business.
- b. A description of the principal supply and service areas to be subcontracted and an identification of those areas where it is planned to use (i) small business subcontractors, and (ii) small disadvantaged business subcontractors.
- c. A statement of the method used in developing proposed subcontracting goals for small business and small disadvantaged business concerns.
- d. If the offeror includes indirect and overhead costs as an element in establishing the goals in the subcontracting plan, the method used in determining the proportionate share of indirect and overhead costs incurred with (i) small business, and (ii) small disadvantaged business subcontractors shall be explained.
- e. A statement of the method used for solicitation purposes (e.g., did the offeror use company source lists, the small business and disadvantaged small business source identification system provided by the Small Business Administration's Procurement Automated Source System, the National Minority Purchasing Council Vendor Information Service, or the services provided by the U.S. Department of Commerce Minority Business Development Agency's Research and Information Division, and the facilities of small business and disadvantaged business trade associations?).
- (2) The name of an individual within the employ of the bidder who

will administer the subcontracting plan of the bidder and a description of the duties of such individual;

- (3) A description of the efforts the bidder will make to assure that small business and small disadvantaged business concerns will have an equitable opportunity to compete for subcontracts;
- Assurances that the (4) include the clause will bidder entitled Utilization of Small Business Disadvantaged Business Small Concerns in all subcontracts which offer further subcontracting possibilities in the United States, and that the bidder will require all subcontractors (except small business concerns) who receive subcontracts in excess of \$1 million in the case of a contract for the construction of any public facility, or in excess \$500,000 in the case of all other contracts, to adopt a plan in consonance with this clause;
- (5) Assurances that the bidder will submit such periodic reports and cooperate in any studies or surveys as may be required by the contracting agency or the Small Business Administration in order to determine the extent of compliance by the bidder with the subcontracting plan; and
- (6) A recitation of the types of records the successful bidder will maintain to demonstrate procedures which have been adopted to comply with the requirements and goals set forth in the plan, including the establishment of source lists of small business concerns and small disadvantaged business concerns; and efforts to identify and award subcontracts to such small business concerns. The records shall include at least the following (these

records may be maintained on a plantwide or company-wide basis unless otherwise indicated):

- a. Small and disadvantaged business source lists, guides, and other data identifying small and small disadvantaged business vendors.
- b. Organizations contacted for small and disadvantaged business sources.
- c. On a contract-bycontract basis, records on all subcontract solicitations over \$100,000,
 indicating on each solicitation (i)
 whether small business was solicited
 and if not, why not; (ii) whether small
 disadvantaged business was solicited
 and if not, why not; and (iii) reasons
 for the failure of responding small
 businesses or small disadvantaged businesses to receive the subcontract
 award.
- d. Records to support such efforts as:
- (i) contacts with disadvantaged and small business trade associations;
- (ii) contacts with business development organizations; and
- (iii) attendance at small and disadvantaged business procurement conferences and trade fairs.
- e. Records to support internal activities to guide and encourage buyers such as:
- (i) workshops, seminars, training programs, etc., and
- (ii) monitoring activities to evaluate compliance.

- f. On a contract-bycontract basis, records to support award data submitted to the Government to include name, address, and size status of subcontractor.
- (c) In order to effectively implement this plan, the Contractor shall:
- (1) Issue and promulgate company-wide policy statements in support of this effort, develop written procedures and work instructions, and assign specific responsibilities regarding the requirements of this clause.
- (2) Demonstrate continuing management interest and involvement in support of these programs through such actions as regular reviews of progress and establishment of overall corporate and divisional goals and objectives.
- (3) Train and motivate contractor personnel in support of these programs.
- (4) Assist small business and small disadvantaged 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 and disadvantaged 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.
- (5) Provide adequate and timely consideration of the potential-ities of small business and small disadvantaged business concerns in all "make-or-buy" decisions.

- (6) Counsel and discuss subcontracting opportunities with representatives of small and disadvantaged business firms as are referred by the Small and Disadvantaged Business Utilization Specialist responsible for monitoring performance under this program and representatives of the SBA.
- (d) The Contractor shall submit Standard Form 295 in accordance with instructions provided on the form.

(e) The bidder understands that:

- (1) Prior compliance of the bidder with other such subcontracting plans under previous contracts will be considered by the Contracting Officer in determining the responsibility of the bidder for award of the contract.
- (2) The failure of any contractor or subcontractor to comply in good faith with (i) the clause entitled Utilization of Small Business Concerns and Small Disadvantaged Business Concerns, or (ii) the terms of any subcontracting plan required by this Small Business and Small Disadvantaged Business Subcontracting Plan (Advertised) provision, will be a material breach of the contract or subcontract.
- (f) In the acquisition of commercial products, the bidder further understands that:
- (1) If a commercial product (defined below) is offered, the required subcontracting plan may cover the company's production generally, both for Government contracts and for regular commercial sales, rather than just this acquisition. In such cases, the Contractor may request approval from the Contracting Officer to submit one company-wide, or division-wide, annual plan. If such request is deemed appropriate, the offeror shall submit

- a proposed company-wide, or division-wide, annual plan for acceptance.
- (2) Upon approval by the Contracting Officer, the plan will remain in effect for the company's entire fiscal year. During period, Government contracts for commercial products of the affected company or division will not be required to contain individual subcontracting plans relating only to the supply or services being acquired, unless the Contracting Officer determines for a particular contract that there are unforeseen possibilities for small business and small disadvantaged business subcontracting.
- (3) At least 60 days before the scheduled termination of the company or division-wide plan, the Contractor may submit to the Contracting Officer a proposed company or division-wide subcontracting plan for its commercial products for the succeeding fiscal year. If the plan would otherwise terminate prior to approval of the succeeding fiscal year's plan, it will remain in effect until the succeeding plan is accepted or rejected, but no longer than 60 days after the end of the company's fiscal year.
- (4) For the purpose of this program, the term "commercial product" means a product in regular production sold in substantial quantities to the general public and/or industry at established catalog or market prices. A product which, in the opinion of the Contracting Officer, differs only insignificantly from the Contractor's commercial product may be regarded for the purpose of this clause as a commercial product. (DAR 7-104.14)

- 94. PREFERENCE FOR DOMESTIC SPECIALTY METALS. (1972 NOV)
- (a) The Contractor agrees that any specialty metals (as hereinafter defined) furnished by it or purchased by it for direct incorporation in any article delivered to the Government under this contract shall have been melted in the United States, its possessions, or Puerto Rico, provided that this clause shall have no effect to the extent that the Secretary or his designee determines, as to any such articles, that a satisfactory quality and sufficient quantity cannot be procured as an when needed at United States market prices.
- (b) For the purposes of this clause, the term "specialty metals" means:
- (i) steels, where the maximum alloy content exceeds one or more of the following limits: manganese, 1.65 percent; silicon, 0.60 percent; or copper 0.60 percent or which contains more than 0.25 percent of any of the following elements: aluminum, chromium, cobalt, columbium, molybdenum, nickel, titanium, tungsten, or vanadium;
- (ii) metal alloys consisting of nickel, iron-nickel and cobalt base alloys containing a total of other alloying metals (except iron) in excess of ten percent (10%);
- (iii) titanium and titanium alloys; or
- (iv) zirconium and zirconium base alloys. (DAR 7-104.93(b))
- 95. ENVIRONMENTAL LITIGATION (12-74)
- (a) If the performance of all or any part of the work is suspended, delayed, or interrupted due to an order of a court of competent jurisdiction as

a result of environmental litigation as defined below, the Contracting Officer, at the request of the Contractor, shall determine whether the order is due in any part to the acts or omissions of the Contractor or a Subcontractor at any tier not required by the terms of this contract. If it is determined that the order is not due in any part to acts or omissions of the Contractor or a Subcontractor at any tier other than as required by the terms of this contract, such suspension, delay, or interruption shall be considered as if ordered by the Contracting Officer in the administration of this contract under the terms of the "Suspension of Work" clause of this contract. The period of such suspension, delay or interruption shall be considered unreasonable, and an adjustment shall be made for any increa in the cost of performance of this contract (excluding profit) as provided in that clause. subject to all the provisions thereof.

(b) The term "environmental litigation," as used herein, means a lawsuit alleging that the work will have an adverse effect on the environment or that the Government has not duly considered, either substantively or procedurally, the effect of the work on the environment.

96. COST ACCOUNTING STANDARDS (1978 MAY)

(Applicable only if the price of this contract exceeds \$100,000 and the contract is not exempt under DAR 3-1204.)

(a) Unless the Cost Accounting Standards Board has prescribed rules or regulations exempting the Contractor or this contract from standards, rules, and regulations promulgated pursuant to 50 U.S.C. App. 2168 (Public Law 91-379, August 15, 1970), the Contractor, in connection with this contract shall:

- (1) By submission of a Disclosure Statement, disclose in writing his cost accounting practices as required by regulations of the Cost Accounting Standards Board. The required disclosures must be made prior to contract award unless the Contracting Officer provides a written notice to the Contractor authorizing post-award submission in accordance with regulations of the Cost Accounting Standards The practices disclosed for this contract shall be the same as the practices currently disclosed applied on all other contracts and subcontracts being performed by the Contractor and which contain this Cost Accounting Standards clause. If the Contractor has notified the Contracting Officer that the Disclosure Statement contains trade secrets and commercial or financial information which is privileged and confidential, the Disclosure Statement will be protected and will not be released outside the Government.
- (2) Follow consistently the cost accounting practices disclosed pursuant to (1) above in accumulating and reporting contract performance cost data concerning this contract. If any change in disclosed practices is made for purposes of any contract or subcontract subject to Cost Accounting Standards Board requirements, the change must be applied prospectively to this contract, and the Disclosure Statement must be amended accordingly. contract price or cost allowance of this contract is affected by such changes, adjustment shall be made in accordance with subparagraph (a)(4) or (a)(5) below, as appropriate.
- (3) Comply with all Cost Accounting Standards in effect on the date of award of this contract or if the Contractor has submitted cost or pricing data, on the date of final

agreement on price as shown on the Contractor's signed certificate of current cost or pricing data. The Contractor shall also comply with any Cost Accounting Standard which hereafter becomes applicable to a contract or subcontract of the Contractor. Such compliance shall be required prospectively from the date of applicability to such contract or subcontract.

- (4)(A) Agree to an equitable adjustment as provided in the changes clause of this contract if the contract cost is affected by a change which, pursuant to (3) above, the Contractor is required to make his established cost accounting practices whether such practices are covered by a Disclosure Statement or not.
- (B) Negrtiate with the Contracting Officer to determine the terms and conditions under which a change may be made to either a disclosed cost accounting practice or an established cost accounting practice, other than a change made under provisions of this subparagraph (4): Provided, that no agreement may be made under this provision that will increase costs paid by the United States.
- (C) When the parties agree to a change to either a disclosed cost accounting practice or an established cost accounting practice, other than a change order under (4)(A) above, negotiate an equitable adjustment as provided in the changes clause of this contract.
- (5) Agree to an adjustment of the contract price or cost allowance, as appropriate, if he or a subcontractor fails to comply with an applicable Cost Accounting Standard or to follow any practice disclosed pursuant to subparagraphs (a)(1) and (a)(2) above and such failure results in any

increased cost paid by the United States. Such adjustment shall provide for recovery of the increased costs to the United States together with interest thereon computed at the rate determined by the Secretary of the Treasury pursuant to Public Law 92-41, 85 STAT. 97, or seven percent (7%) per annum, whichever is less, from the time the payment by the United States was made to the time the adjustment is effected.

- whether the Contractor or a subcontractor has complied with an applicable Cost Accounting Standard, rule, or regulation of the Cost Accounting Standards Board and as to any cost adjustment demanded by the United States, such failure to agree shall be a dispute concerning a question of fact within the meaning of the disputes clause of this contract.
- (c) The Contractor shall permit any authorized representatives of the head of the agency, of the Cost Accounting Standards Board, or of the Comptroller General of the United States to examine and make copies of any documents, papers, or records relating to compliance with the requirements of this clause.
- (d) The Contractor shall include in all negotiated subcontracts which he enters into the substance of this clause except paragraph (b), and shall require such inclusion in all other subcontracts of any tier, including the obligation to comply with all Cost Accounting Standards in effect on the date of award of the subcontract of in the subcontractor has submitted cost or pricing data, on the date of final agreement on price as shown on the subcontractor's signed certificate of current cost or pricing data. This requirement shall apply only to negotiated subcontracts in excess of \$100,000

where the price negotiated is not based on:

- (i) established catalog or market prices of commercial items sold in substantial quantities to the general public, or
- (ii) prices set by law or regulation and except that the requirement shall not apply to negotiated subcontracts otherwise exempt from the requirement to accept the Cost Accounting Standards clause by reason of Section 331.30(b) of Title 4 Code of Federal Regulations (4 CFR 331.30(b)).
- Note: (1) Subcontractors shall be required to submit their Disclosure Statements to the Contractor. However, if a subcontractor has previously submitted his Disclosure Statement to a Government Administrative Contracting Officer (ACO) he may satisfy that requirement by certifying to the Contractor the date of such Statement and the address of the ACO.

Note: (2) In any case where a Subcontractor determines that the Disclosure Statement information is privileged and confidential and declines to provide it to his Contractor or higher tier subcontractor the Contractor may authorize direct submission of that subcontractor's Disclosure Statement to the same Government offices to which the Contractor was required to make submission of his Disclosure Statement. Such authorization shall in no way relieve the Contractor of liability as provided in paragraph (a)(5) of this clause. In view of the foregoing and since the contract may be subject to adjustment under this clause by reason of any failure to comply with rules, regulations, and Standards of the Cost Accounting Standards Board in connection with covered subcontracts, it is expected that the Contractor may wish to include a clause in each such

subcontract requiring the subcontractor to appropriately indemnify the Contractor. However, the inclusion of such a clause and the terms thereof are matters for negotiation and agreement between the Contractor and the subcontractor, provided that they do not conflict with the duties of the Contractor under its contract with the Government. It is also expected that any subcontractor subject to such indemnification will generally require substantially similar indemnification to be submitted by his subcontractors.

Note: (3) If the Subcontractor is a business unit which, pursuant to 4 CFR 332 is entitled to elect modified contract coverage and to follow Standards 401 and 402 only, the clause entitled "Disclosure and Consistency of Cost Accounting Practices" set forth in DAR 7-104.33(a)(2) shall be inserted in lieu of this clause.

- (e) The terms defined in Section 331.20 of Part 331 of Title 4, Code of Federal Regulations (4 CFR 331.26) shall have the same meanings herein. As there defined, "negotiated subcontract" means "any subcontract except a firm fixed-price subcontract made by a Contractor or subcontractor after receiving offers from at least two firms not associated with each other or such Contractor or Subcontractor, providing (1) the solicitation to all competing firms is identical, (2) price is the only consideration in selecting the Subcontractor from among the competing firms solicited, and (3) the lowest offer received in compliance with the solicitation from among those solicited is accepted." (DAR 7-104.83)
- 97. AFFIRMATIVE ACTION COMPLIANCE REQUIREMENTS FOR CONSTRUCTION (1978 SEP)
 - (a) As used in this clause:

- (1) "Covered area" means the geographical area described in the solicitation from which this contract resulted;
- (2) "Director" means Director, Office of Federal Contract Compliance Programs, United States Department of Labor, or any person to whom the Director delegates authority;
- (3) "Employer identification number" means the Federal Social Security number used on the Employer's Quarterly Federal Tax Return, U.S. Treasury Department Form 941.

(4) "Minority" includes:

- (i) Black (all persons having origins in any of the Black African racial groups not of Hispanic origin);
- (ii) Hispanic (all persons of Mexican, Puerto Rican, Cuban, Central or South American or other Spanish Culture or origin, regardless of race);
- (iii) 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); and
- (iv) 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).
- (b) Whenever the Contractor, or any subcontractor at any tier, subcontracts a portion of the work involving any construction trade, it shall physically include in each subcontract in excess of \$10,000 the provisions of this clause and the Notice which contains the applicable goals for minority and female participation and which is

set forth in the solicitation from which this contract resulted.

- (c) If the Contractor is participating (pursuant to 41 CFR 60-4.5) in a Hometown Plan approved by the U.S. Department of Labor in the covered area either individually or through an association, its affirmative action obligations on all work in the Plan area (including goals) shall be in accordance with that Plan for those trades which have unions participating in the Plan. Contractors must be able to demonstrate their participation in and compliance with the provisions of any such Hometown Plan. Each Contractor or subcontractor participating in an approved Plan is individually required to comply with its obligations under the EEO 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 covered Contractor's or subcontractor's failure to take good faith efforts to achieve the Plan goals.
- (d) The Contractor shall implement the specific affirmative action standards provided in subparagraph (g)(1) through (16) of this clause. The goals set forth in the solicitation from which this contract resulted are expressed as percentages of the total hours of employment and training of minority and female utilization 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 (whether or not it is Federal or Federally assisted) in a geographical area located outside of the covered area, it shall apply the goals established for the geographical area where such work is actually performed. The Contractor is expected to make substantially uniform progress toward its goals in each craft.

- (e) Neither the provisions of any collective bargaining agreement, nor the failure by a union with whom the Contractor has a collective bargaining agreement, to refer either minorities or women shall excuse the Contractor's obligations under this clause, Executive Order 11246, or the regulations promulgated pursuant thereto.
- (f) In order for the nonworking training hours of apprentices and trainees to be counted in meeting the goals, such 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 trained pursuant to training programs approved by the U.S. Department of Labor.
- (g) The Contractor shall take specific affirmative actions 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 shall implement affirmative action steps at least as extensive as the following:
- Ensure and maintain a working environment free of harassment, intimidation, and coercion at all sites, and in all facilities at which the Contractor's employees are assigned work. The Contractor. where possible, will assign two or more women to each construction project. The Contractor shall specifically ensure that all foremen, superintendents, and other on-site 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 et such sites or in such facilities.

- (2) Establish and maintain a current list of minority and female recruitment sources, provide written notification to minority and female recruitment sources and to community organizations when the Contractor or its unions have employment opportunities available, and maintain a record of the organizations' responses.
- (3) Maintain a current file of the names, addresses and telephone numbers of each minority and female off-the-street applicant and minority or female referral from a union, a recruitment source or community organization and of what action was taken with respect to each such individual. If such individual was sent to the union hiring hall for referral and was not referred back to the Contractor by the union or, if referred, not employed by the Contractor, this shall be documented in the file with the reason therefor, along with whatever additional actions the Contractor may have taken.
- (4) Provide immediate written notification to the Director when the union or unions with which the Contractor has a collective bargaining agreement has not referred to the Contractor a minority person 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 which 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 (g)(2) above.

- (6) Disseminate the Contractor's EEO policy by providing notice of the policy to unions and training programs and requesting their cooperation in assisting the Contractor in meeting its EEO obligations; by including it in any policy manual and collective bargaining agreement; by publicizing it in the company newspaper, annual report, etc.; by specific review of the policy with all management personnel and with all minority and female employees at least once a year; and by posting the company EEO policy on bulletin boards accessible to all employes at each location where construction work is performed.
- (7) Review, at least annually, the company's EEO policy and affirmative action obligations under this clause with all employees having any responsibility for hiring, assignment, layoff, termination or other employment decisions including specific review of these items with onsite supervisory personnel such as superintendents, general foremen, etc., prior to the initiation of construction work at any 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 EEO policy externally by including it in any advertising in the news media, specifically including minority and female news media, and providing written notification to and discussing the Contractor's EEO policy

with other Contractors and subcontractors with whom the Contractor does or anticipates doing business.

- (9) Direct its 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 one month prior to the date for the acceptance of applications for apprenticeship or other training by any recruitment source, the Contractor send written notification to shall 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 other minority persons and women and, where reasonable, provide after school, summer and vacation employment to minority and female youth both on the site and in other areas of a Contractor's workforce.
- (11) Validate all tests and other selection requirements where there is an obligation to do so under 41 CFR Part 60-3.
- (12) Conduct, at least annually, an inventory and evaluation at least of all minority and female personnel for promotional opportunities and encourage these employees to seek or to prepare for, through appropriate training, etc., such opportunities.
- 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 EEO policy and

the Contractor's obligations under this clause are being carried out.

- (14) Ensure that all facilities and company activities are nonsegregated except that separate or single-user toilet and necessary changing facilities shall be provided to assure privacy between the sexes.
- (15) Document and maintain a record of all solicitations of offers for subcontracts from 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 EEO policies and affirmative action obligations.
- (h) Contractors are encourged to participate in voluntary associations which assist in fulfilling one or more of their affirmative action obligations ((g)(1) through (16)). The efforts of a contractor association, joint contractor-union, contractor-community, or other similar group of which the contractor is a member and participant, may be asserted as fulfilling any one or more of its obligations under (g)(1) through (16) of this clause provided that the contractor actively participates in the group, makes every effort to assure that the group has a positive impact on the employment of minorities and women in the industry, ensures that the concrete benefits of the program reflected in the Contractor's minority and female workforce participation, makes a good faith effort to meet its individual goals, and can provide access to documentation which the effectiveness of demonstrates

actions taken on behalf of the Contractor. The obligation to comply, however, 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 have been established. The Contractor, however, 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 non-minority. Consequently, the Contractor may be in violation of the Executive Order if a particular group is employed in a substantially disparate manner example, even though the Contractor has achieved its goals for women generally, the Contractor may be in violation of the Executive Order if a specific minority group of women is underutilized).
- (j) The Contractor shall not use the 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 pursuant to Executive Order 11246.
- out such sanctions and penalities for violation of this clause and of the Equal Opportunity Clause, including suspension, termination and cancellation of exiting subcontracts as may be imposed or ordered pursuant to Executive Order 11246, as amended, and its implementing regulations, by the Office of Federal Contract Compliance Programs. Any Contractor who fails to carry out such sanctions and penalties

shall be in violation of this clause and Executive Order 11246, as amended.

- (m) The Contractor, in fulfilling its obligations under this clause shall implement specific affirmative action steps, at least as extensive as those standards 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 the Executive Order, the implementing regulations, or this clause, the Director shall proceed in accordance with 41 CFR 60-4.8.
- The Contractor shall designate a responsible official to monitor all employment related activity to ensure that the company EEO policy is being carried out, to submit reports relating to the provisions hereof as may be required by the Government and to keep records. Records shall at least include for each employee the name, address, telephone numbers, construction trade, union affiliation if employee identification number when assigned, social security number, race, sex, status (e.g., mechanic, helper. apprentice, trainee, 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, contractors shall not be required to maintain separate records.
- . (o) Nothing herein provided shall be construed as a limitation upon the application of other laws which establish different standards of compliance or upon the application of 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).

98. AFFIRMATIVE ACTION FOR HANDICAPPED WORKERS (1976 MAY)

- (a) The contractor will not discriminate against any employee or applicant for employment because of physical or mental handicap in regard to any position for which the employee or applicant for employment is qualified. The contractor agrees to take affirmative action to employ, advance in employment and otherwise treat qualified handicapped individuals without discrimination based upon their physical or mental handicap in all employment practices such as the following: employment, upgrading, demotion transfer, recruitment, advertising. layoff or termination, rates of pay or other forms of compensation, for training, selection including apprenticeship.
- (b) The contractor agrees to comply with the rules, regulations, and relevant orders of the Secretary of Labor issued pursuant to the Act.
- (c) In the event of the contractor's noncompliance with the requirements of this clause, action for noncompliance may be taken in accordance with the rules, regulations and relevant orders of the Secretary of Labor issued pursuant to the Act.
- (d) The contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices in a form to be prescribed by the Director, provided by or through the Contracting Officer. Such notices shall state the contractor's obligation under the law to take affirmative action to employ and advance in employment qualified handicapped employees and applicants for

employment, and the rights of applicants and employees.

- (e) The contractor will 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 Rehabilitation Act of 1973, and is committed to take affirmative action to employ and advance in employment physically and mentally handicapped individuals.
- (f) The contractor will include the provisions of this clause in every subcontract or purchase order of \$2,500 or more unless exempted by rules, regulations, or orders of the Secretary issued pursuant to section 503 of the Act, so that such provisions will be binding upon each subcontractor or vendor. The contractor will take such action with respect to any subcontract or purchase order as the Director of the Office of Federal Contract Compliance Programs may direct to enforce such provisions, including action for noncompliance. (DAR 7-103.28)

99. CLEAN AIR AND WATER (1975 OCT)

(Applicable only if the contract exceeds \$100,000, or the Contracting Officer has determined that orders under an indefinite quantity contract in any one year will exceed \$100,000, or a facility to be used has been the subject of a conviction under the Clean Air Act (42 U.S.C. 1857c-8c(1)) or the Federal Water Pollution Control Act (33 U.S.C. 1319(c)) and is listed by EPA, or the contract is not otherwise exempt.)

- (a) The Contractor agrees as follows:
- (i) to comply with all the requirements of section 114 of the

Clean Air Act, as amended (42 U.S.C. 1857, et seq., as amended by Public Law 91-604) and section 308 of the Federal Water Pollution Control Act (33 U.S.C. 1251, as amended by Public Law 92-500), respectively, relating to inspection, monitoring, entry, reports, and information, as well as other requirements specified in section 114 and section 308 of the Air Act and the Water Act, respectively, and all regulations and guidelines issued thereunder before the award of this contract;

- (ii) that no portion of the work required by this prime contract will be performed in a facility listed on the Environmental Protection Agency List of Violating Facilities on the date this contract was awarded unless and until the EPA eliminates the name of such facility or facilities from such listing;
- (iii) to use his best efforts to comply with clean air standards and clean water standards at the facilities in which the contract is being performed; and
- (iv) to insert the substance of the provisions of this clause in any nonexempt subcontract, including this paragraph (iv).
- (b) The terms used in this clause have the following meanings.
- (1) The term "Air Act" means the Clean Air Act, as amended (42 U.S.C. 1857 et seq., as amended by Public Law 91-604).
- means Federal Water Pollution Control Act, as amended (33 U.S.C. 1251 et seq., as amended by Public Law 92-500).
- (3) The term "clean air standards" means any enforceable rules.

regulations, guidelines, standards, limitations, orders, controls, prohibitions, or other requirements which are contained in, issued under, or otherwise adopted pursuant to the Air Act or Executive Order 11738, an applicable implementation plan as described in section 110(d) of the Clean Air Act (42 U.S.C. 1857c-5(d), an approved implementation procedure or plan under section 111(c) or section 111(d), respectively, of the Air Act (42 U.S.C. 1857c-6(c) or (d)), or an approved implementation procedure under section 112(d) of the Air Act (42 U.S.C. 1857c-7(d)).

- The term "clean water standards" means any enforceable limitation, control, condition, prohibition, standard or other requirement which is promulgaed pursuant to the Water Act or contained in a permit issued to a discharger by the Environmental Protection Agency or by a State under an approved program, as authorized by section 402 of the Water Act (33 U.S.C. 1342), or by a local government to ensure compliance with pretreatment regulations as required by section 307 of the Water Act (33 U.S.C. 1317).
- means compliance with clean air or water standards. Compliance shall also mean compliance with a schedule or plan ordered or approved by a court of competent jurisdiction, the Environmental Protection Agency or an air or water pollution control agency in accordance with the requirement of the Air Act or Water Act and regulations issued pursuant thereto.
- (6) The term "facility" means any building, plant, installation, structure, mine, vessel or other floating craft, location, or site of operations, owned, leased, or supervised by a contractor, subcontractor, to be utilized in the performance of a contract or subcontract. Where a location or site of operations contains or

includes more than one building, plant, installation, or structure, the entire location or site shall be deemed to be a facility except where the Director, Office of Federal Activities, Environmental Protection Agency, determines that independent facilities are colocated in one geographical area.

- contract or subcontract" means a contract or subcontract of more than \$100,000 which is not otherwise exempted pursuant to the EPA regulations implementing the Air Act and Water Act (40 CFR 15.5), as further implemented in DAR 1-2302.4 or in FPR 1-1.2302-4 (whichever is applicable) and the procedures of the Department awarding the contract. (DAR 7-103.29)
- 100. EQUITABLE ADJUSTMENTS: WAIVER AND RELEASE OF CLAIMS (7-76)
- (a) Whenever the contractor submits a claim for equitable adjustment under any clause of this concract whileprovides for equitable adjournment of the contract, such claim shall include all types of adjustments in the total amounts to which the clause entitles contractor, including but not limited to adjustments arising out of delays or disruptions or both caused by such change. Except as the parties may otherwise expressly agree, the contractor shall be deemed to have waived (1) any adjustments to which it otherwise might be entitled under the clause where such claim fails to request such adjustments, and (ii) any increase in the amount of equitable adjustments additional to those requested in its claim.
- (b) Further, the contractor agrees that, if required by the Contracting Officer, he will execute a release, in form and substance satisfactory to the Contracting Officer, as part of the supplemental agreement setting forth the aforesaic equitable adjustment, and that such release shall discharge the Government, its officers,

agents and employees, from any further claims, including but not limited to further claims arising out of delays or disruptions or both, caused by the aforesaid change.

101. AFFIRMATIVE ACTION FOR DISABLED VETERANS AND VETERANS OF THE VIETNAM ERA (1976 JUL)

(This clause is applicable pursuant to 41 C.F.R. 60-250, if this contract is for \$10,000 or more.)

- (a) The contractor will not discriminate against any employee or applicant for employment because he or she is a disabled veteran or veteran of the Vietnam era in regard to any position for which the employee or applicant for employment is qualified. The contractor agrees to take affirmative action to employ, advance in employment and otherwise treat qualified disabled veterans and veterans of the Vietnam era without discrimination based upon their disability of veterans status in all employment practices such the following: employment grading, demotion or transfer, recruitment, advertising, layoff or termination, rates of pay or other forms of compensation, and selection for training, including apprenticeship.
- The contractor agrees that all suitable employment openings of the contractor which exist at the time of the execution of this contract and those which occur during the performance of this contract, including those not generated by this contract and including those occurring at an establishment of the contractor other than the one wherein the contract is being performed but excluding those of independently operated corporate affiliates, shall be listed at an appropriate local office of the State employment service system wherein the opening occurs. The contractor further agrees to provide such reports to such local office regarding employment openings and hires as may be required.

State and local government agencies holding Federal contracts of \$10,000 or more shall also list all their suitable openings with the appropriate office of the State employment service, but are not required to provide those reports set forth in paragraphs (d) and (e).

- (c) Listing of employmen. openings with the employment service system pursuant to this clause shall be made at least concurrently with the use of any other recruitment source or effort and shall involve the normal obligations which attach to the placing of a bona fide job order, including the acceptance of referrals of veterans and nonveterans. The listing of employment openings does not require the hiring of any particular job applicant or from any particular group of job applicants, and nothing herein is intended to relieve the contractor from any requirements in Executive Orders or regulations regarding nondiscrimination employment.
- (d) The reports required by paragraph (b) of this clause shall include, but not be limited to, periodic reports which shall be filed at least quarterly with the appropriate local office or, where the contractor has more than one hiring location in a State, with the central office of that State employment service. Such reports shall indicate for each hiring location (1) the number of individuals hired during the reporting period, (2) the number of nondisabled veterans of the Vietnam era hired, (3) the number of disabled veterans of the Vietnam era hired, and (4) the total number of disabled veterans hired. The reports should include covered veterans hired for on-the-job training under 38 USC 1787. The contractor shall submit a report within 30 days after the end of each reporting period wherein any performance is made on this contract identifying data for each hiring location. The contractor shall maintain at each hiring location copies of the reports' submitted

until the expiration of one year after final payment under the contract, during which time these reports and related documentation shall be made available, upon request, for examination by any authorized representatives of the Contracting Officer or of the Secretary of Labor. Documentation would include personnel records respecting job openings, recruitment and placement.

- (e) Whenever the contractor becontractually bound to listing provisions of this clause, it shall advise the employment service system in each State where it has establishments of the name and location of each hiring location in the State. As long as the contractor is contractually bound to these provisions and has so advised the State system, there is no need to advise the State system of subsequent contracts. The contractor may advise the State system when it is no longer bound by this contract clause.
- (f) This clause does not apply to the listing of employment openings which occur and are filled outside of the 50 States, the District of Columbia, Puerto Rico, Guam, and the Virgin Islands.
- (g) The provisions of paragraphs (b), (c), (d) and (e) of this clause do not apply to openings which the contractor proposes to fill from within his own organization or to fill pursuant to a customary and traditional employer-union hiring arrangement. This exclusion does not apply to a particular opening once an employer decides to consider applicants outside of his own organization or employer-union arrangement for that opening.

(h) As used in this clause:

(1) "All suitable employment openings" includes, but is not limited to, openings which occur in the following job categories: production and

nonproduction; plant and office; laborers and mechanics: supervisory and nonsupervisory; technical; and executive, administrative. and professional openings as are compensated on a salary basis of less than \$25,000 per year. This term includes full-time employment, temporary employment of more than 3 days' duration, and part-time employ-It does not include openings which the contractor proposes to fill from within his own organization or to fill pursuant to a customary and traditional employer-union hiring arrangement nor openings in an educational institution which are restricted to students of that institution. the most compelling circumstances an employment opening may not be suitable for listing, including such situations where the needs of the Government cannot reasonably be otherwise supplied, where listing would be contrary to security, or national where the requirement of listing would otherwise not be for the best interest of the Government.

- (2) "Appropriate office of the State employment service system" means the local office of the Federal-State national system of public employment offices with assigned responsibility for serving the area where the employment opening is to be filled, including the District of Columbia, Guam, Puerto Rico, and the Virgin Islands.
- (3) "Openings which the contractor proposes to fill from within his own organization" means employment openings for which no consideration will be given to persons outside the contractor's organization (including any affiliates, subsidiaries, and the parent companies) and includes any openings which the contractor proposes to fill from regularly established "recall" lists.
- (4) "Openings which the contractor proposes to fill pursuant to a customary and traditional employer-union hiring arrangement" means employ-

ment openings which the contractor proposes to fill from union halls, which is part of the customary and traditional hiring relationship which exists between the contractor and representatives of his employees.

- (i) The contractor agrees to comply with the rules, regulations, and relevent orders of the Secretary of Labor issued pursuant to the Vietnam Veterans Readjustment Act, hereinafter referred to as the "Act" (38 U.S.C. 2012).
- (j) In the event of the contractor's noncompliance with the requirements of this clause, actions for noncompliance may be taken in accordance with the rules, regulations, and relevant orders of the Secretary of Labor issued pursuant the Act.
- (k) The contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices in a form to be prescribed by the Director, Office of Federal Contract Compliance Programs, provided by or through the Contracting Officer. Such notice shall state the contractor's obligation under the law to take affirmative action to employ and advance in employment qualified disabled veterans and veterans of the Vietnam era for employment, and the rights of applicants and employees.
- (1) The contractor will notify each labor union or representative of workers with which it has a collective bargaining agreement or other contract understanding, that the contractor is bound by the terms of the Vietnam Era Veterans Readjustment Assistance Act, and is committed to take affirmative action to caploy and advance in employment qualified disabled veterans and, veterans of the Vietnam Era.
- (m) The contractor will include the provisions of this clause in every subcontract or purchase order of \$10,000 or more unless exempted by

rules, regulations, or orders of the Secretary issued pursuant to the Act, so that such provisions will be binding upon each subcontractor or vendor. The Contractor will take such action with respect to any subcontract or purchase order as the Director of the Office of Federal Contract Compliance Programs may direct to enforce such provisions, including action for noncompliance. (DAR 7-103.27)

102. ADMINISTRATION OF COST ACCOUNTING STANDARDS (1978 MAY)

For the purpose of administering Cost Accounting Standards requirements under this contract, the Contractor shall:

- (a) Submit to the cognizant Contracting Officer a description of the accounting change and the general dollar magnitude of the change to reflect the sum of all increases and the sum of all decreases for all contracts containing the Cost Accounting Standards clause (7-104.83(a)(1) or the Dischosure and Consistency of Cost Accounting Practices clause (7-104.83(a)(2)):
- (i) for any change in cost accounting practices required to comply with a new cost accounting standard in accordance with paragraph (a)(3) and (a)(4)(A) of the clause entitled "Cost Accounting Standards" within sixty (60) days (or such other date as may be mutually agreed to) after award of a contract requiring such change:
- (ii) for any change to cost accounting practices proposed in accordance with paragraph (a)(4)(B) or (a)(4)(C) of the clause entitled "Cost Accounting Standards" or with paragraphs (a)(3) or (a)(5) of the clause entitled "Disclosure and Consistency of Cost Accounting Practices" not less than sixty (60) days (or such other date as may be mutually agreed to) prior to the effective date of the proposed change; or

- (iii) for any failure to comply with an applicable Cost Accounting Standard or to follow a disclosed practice as contemplated by paragraph (a) (5) of the clause entitled "Cost Accounting Standards" or with paragraph (a)(4) of the clause entitled "Disclosure and Consistency of Cost Accounting Practices" within sixty (60) days (or such other date as may be mutually agreed to) after the date of agreement of such noncompliance by the Contractor.
- (b) Submit a cost impact proposal in the form and manner specified by the cognizant Contracting Officer within sixty (60) days (or such other date as may be mutually agreed to) after the date of determination of the adequacy and compliance of a change submitted pursuant to (a)(i), (ii), or (iii) above.
- (c) Agree to appropriate contract and subcontract amendments to reflect adjustments established in accordance with paragraphs (a)(4) and (a)(5) of the clause entitled "Cost Accounting Standards" or with paragraphs (a)(3), (a)(4), and (a)(5) of the clause entitled "Disclosure and Consistency of Cost Accounting Practices."
- (d) When the subcontract is subject to either the clause entitled "Cost Accounting Standards" or the clause entitled "Disclosure and Consistency of Cost Accounting Practices" so state in the body of the subcontract and/or in the letter of award. Self-deleting clauses shall not be used.
- (e) Include the substance of this clause in all negotiated subcontracts containing either the clause entitled "Cost Accounting Standards" or the clause entitled "Disclosure and Consistency of Cost Accounting Practices." In addition within thirty (30) days after award of such subcontract submit the following information to the Contractor's cognizant Contract Administration Office for transmittal to the

- Contract Administration Office cognizant of the subcontractor's facility.
- (1) Subcontractor's name and subcontract number.
- (2) Dollar amount and date of award.
- . (3) Name of Contractor making the award.
- (4) A statement as to whether the subcontractor has made or proposes to make any changes to accounting practices that affect prime contracts or subcontracts containing the Cost Accounting Standards clause or Disclosure and Consistency of Cost Accounting Practices clause because of the award of this subcontract unless such changes have already been reported. If award of the subcontract results in making a Cost Accounting Standard(s) effective for the first time, this shall also be reported.
- (f) For negotiated subcontracts containing the clause entitled "Cost Accounting Standards", require the subcontractor to comply with all standards in effect on the date of final agreement on price as shown on the subcontractor's signed certificate of current cost or pricing data or date of award whichever is earlier.
- (g) In the event an adjustment is required to be made to any subcontract hereunder, notify the Contracting Officer in writing of such adjustment and agree to an adjustment in the price or estimated cost and fee of this contract, as appropriate, based upon the adjustment established under the subcontract. Such notice shall be given within thirty (30) days after receipt of the proposed subcontract adjustment, or such other date as may be mutually agreed to, and shall include a proposal for adjustment to such higher tier subcontract or prime contract as appropriate.

- (h) When either the Cost Accounting Standards clause or the Disclosure and Consistency of Cost Accounting Practices clause and this clause are included in subcontracts, the term "Contracting Officer" shall be suitably altered to identify the purchaser.
- 103. OVERSEAS DISTRIBUTION OF DEFENSE SUBCONTRACTS:

(This paragraph shall apply only if the contract price exceeds \$500,000, or if any modification increases the amount of the contract to more than \$500,000. In the latter case, the reporting requirement will not be retroactive so as to require the reporting of subcontracts awarded prior to such a modification.)

- (a) For each subcontract or modification thereof which exceeds \$10,000 where the principal place of performance is outside the United States or its territories and possessions, the contractor agrees to furnish the information listed below on a quarterly basis to the Director for Information, Operations and Reports, Washington Headquarters Services, Department of Defense, Washington, D.C. 20301:
 - (i) Name and address of prime contractor (or subcontractor required to report)
 - (ii) Prime contract number
 - (iii) Name and address of overseas subcontractor (this data item is important for discussion of trade balances with other countries but submission of this information is not mandatory)
 - (iv) Subcontract number (including modification number) being reported

- (v) Dollar amount of this action (enclose decommitments in parenthesis)
- (vi) Principal place of subcontract performance
- (vii) Type of supply or service
- (b) The required information, if any, shall be as of the last day of the calendar year quarter and submitted within 10 days of the end of each quarter.
- (c) The prime contractor agrees to insert a provision substantially similar to this in all first tier subcontracts over \$100,000 except subcontracts for ores, natural gas, utilities, petroleum products and crudes, timber (logs) and subsistence. The prime contractor shall also identify the applicable prime contract number to the subcontractor for reporting purposes.
- 104. EMPLOYMENT OF OCEAN-GOING VESSELS BY CONSTRUCTION CONTRACTORS (1979 JUN)
- If ocean transportation is required after the date of award of this contract to bring any supplies, materials, or equipment, to the construction site from the United States either for use in performance of or for incorporation in the work called for by this contract, United States-flag vessels shall be employed in such transportation to the extent such vessels are available at fair and reasonable rates for United States-flag vessels. The Contractor shall not make any shipment exceeding ten measurement tons (400 cubic feet) by other than a United States-flag vessel without notifying the Contracting Officer that United States-flag vessels are not availble at fair and reasonable rates for such vessels and obtaining his permission to ship in other vessels. If such permission is granted, the contract price

shall be equitably adjusted to reflect the difference in cost.

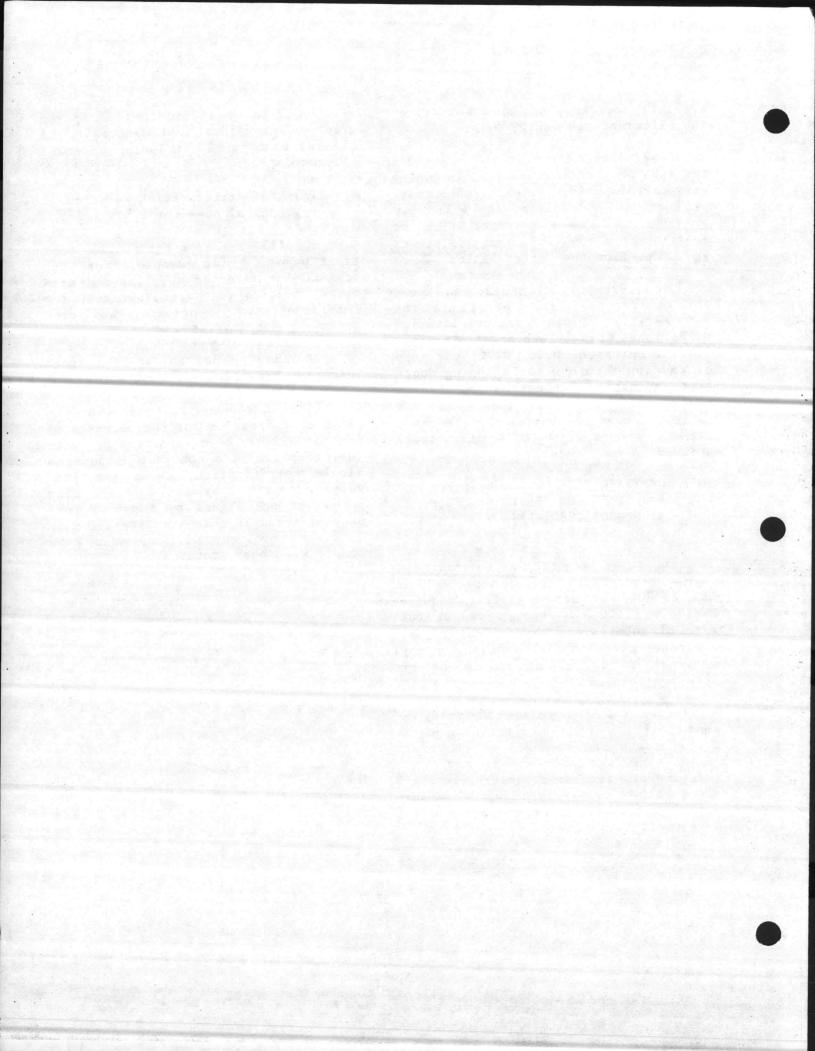
- (b) The Contractor shall include the substance of this clause, including this paragraph (b), in each subcontract or purchase order hereunder which may involve the ocean transportation of construction supplies, materials, or equipment from the United States.
- (c) Promptly after each shipment the contractor shall furnish to the U.S. Maritimes Administration, Division of National Cargo, 14th and E. Streets, N.W., Washington, D.C. 20230, one copy of the applicable ocean shipping document indicating for each shipment made under this contract the name and nationality of the vessel and the measurement tonnage (400 cubic feet) shipped on such vessel.
- 105. CERTIFICATION OF REQUESTS FOR ADJUSTMENT OR RELIEF EXCEEDING \$100,000 (1980 FEB)
- (a) Any contract claim, request for equitable adjustment to contract terms, request for relief under Public Law 85-804, or other similar request exceeding \$100,000 shall bear, at the time of submission, the following certificate given by a senior company official in charge at the plant or location involved:

I certify that the claim is made in good faith, that the supporting data are accurate and complete to the best of my knowledge and belief; and that the amount requested accurately reflects the contract adjustment for which the Contractor believes the Government is liable.

(Official's Name)

(Title)

- (b) The certification in paragraph (a) requires full disclosure of all relevant facts, including cost and pricing data.
- (c) The certification requirement in paragraph (a) does not apply to:
- (i) requests for routine contract payments—for example, those for payment for accepted supplies and services, routine vouchers under cost reimbursement—type contracts, and progress payment invoices;
- (ii) final adjustments under incentive provisions of contracts;
- (d) In those situations where no claim certification for the purposes of Section 813 has been submitted prior to the inception of a contract dispute, a single certification, using the language prescribed by the Contract Disputes Act but signed by a senior company official in charge at the plant or location involved, will be deemed to comply with both statutes.



DEPARTMENT OF THE NAVY

ATLANTIC DIVISION, NAVAL FACILITIES ENGINEERING COMMAND NAVAL STATION, NORFOLK, VIRGINIA

NOTICE:

N62470-81-B-1478

Bids to be opened at 2:00 p.m.

NAVFAC

7 FEBRUARY 1984

SPECIFICATION No. 05-81-1478

at the Atlantic Division Naval Facilities Engineering Command Naval Station, Norfolk, Virginia 23511

Appropriation: MCON

UTILITIES IMPROVEMENTS

AT THE

MARINE CORPS BASE - COURTHOUSE BAY AREA

CAMP LEJEUNE, NORTH CAROLINA

(Station Project P-784)

DESIGN BY: L. E. Wooten and Company Raleigh, North Carolina

SPECIFICATION PREPARED BY:

Architect: Boone/Buck

Padia Mechanical:

Civil-Structural: Boone/Buck

Electrical: Gambrell

Fire-Protection: N/A

Submitted by: W. D. Barlow

Date: 11 August 1983

SPECIFICATION APPROVED BY:

CIL

Specification Branch Head: C. R. Rose, P.E.

Design Director: K.E. Godfrey, P.E. KT For EFD for Commader, NAVFAC: 25

Date: 14 December 1983

05-81-1478 Spec. No. - 1

INDEX

DIVISION

1. GENERAL REQUIREMENTS

SECTION

01011	General Paragraphs
01012	Additional General Paragraphs
01400	Contractor Quality Control System
01560	Environmental Protection

2. SITE WORK

SECTION

02050	Demolition and Removal
02200	Earthwork
02444	Fence, Chain Link
02581	Rotary Drilled Water Well
02680	Bituminous Concrete Pavement
02690	Pavement Removal and Replacement
02713	Water Distribution
02722	Exterior Sanitary Sewers and Force Mains
02821	Turf

3. CONCRETE

SECTION

03302	Cast-In-Place Concrete		
03410	Precast Structural	Concrete	(Non-Prestressed)

4. MASONRY

SECTION

04200	Unit	Masonry

5. METALS

SECTION

05120	Structural Steel
05210	Steel Joists
05311	Steel Roof Decking
05500	Metal Fabrications

6. WOOD AND PLASTICS

SECTION

06201 Carpentry and Woodwork

7. THERMAL AND MOISTURE PROTECTION

SECTION

07220	Roof Insulation	
07221	Masonry Wall Insulation	
07230	Perimeter Insulation	
07511	Aggregate Surfaced Bituminous Built-Up Roofing	
07600	Flashing and Sheet Metal	
07920	Sealants and Calkings	

8. DOORS AND WINDOWS

SECTION

08110	Hollow Metal Doors and Frames
08360	Overhead Metal Doors
08510	Steel Windows
08710	Finish Hardware
08800	Glazing

9. FINISHES

SECTION

09500	Acoustical Treatment
09910	Painting of Buildings (Field Painting)

11. EQUIPMENT

SECTION

11210 .	Water Pumps
11233	Water Softeners
11240	Pressure Water Filters
11310	Sewage Pumps
11334	Comminutor
11361.2.1	Circular Clarifier Equipment for Primary Clarifier
11361.2.2	Circular Clarifier Equipment for Secondary Clarifier
11600	Proportional Samplers
11961	Chlorination Equipment
	- 프랑크

13. SPECIAL CONSTRUCTION

SECTION

13440	Central Monitoring Panel
13625.1	Flow Measuring Equipment (Sewage Treatment Plant) Variable
	Head Meter for Open Channel
13625.2	Flow Measuring Equipment (Sewage Treatment Plant) Kennison
	Nozzle
13626	Sludge Drying Beds

14. CONVEYING SYSTEMS

SECTION

14337 Underruning Bridge Crane, 3-Ton Capacity

15. MECHANICAL

SECTION

15011	Mechanical General Requirements
15250	Insulation for Mechanical Systems
15271	In-Plant Piping and Accessories
15309	Cleaning, Inspection, and Repair of Sewers
15386	Trickling Filter
15390	Aeration Equipment
15392	Grit Handling Equipment
15400	Plumbing
15411	Compressed Air Systems (Non-Breathing Air Type)
15649	Diesel Engine
15801	Heating, Ventilating, and Air Conditioning

16. ELECTRICAL

SECTION

Electrical General Requirements
Diesel Engine - Generator Set
Underground Electrical Work
Overhead Electrical Work
Interior Wiring Systems
Lighting, Interior
Exterior Lighting

Submittal Status Log

SECTION 01011

GENERAL PARAGRAPHS

- 1. GENERAL INTENTION: It is the declared and acknowledged intention and meaning to provide and secure Utilities Improvements complete and ready for use. This is a fixed-price contract awarded on a lump sum basis.
- 2. GENERAL DESCRIPTION: The work includes providing a new well, renovations to two existing wells, renovations and additions to the existing water plant, renovations to two wastewater pumping stations, new sewer line, renovations and modifications to the existing wastewater treatment plant, and sewer system rehabilitation and incidental related work.
- 3. LOCATION: The work shall be located at the Marine Corps Base, Camp Lejeune, North Carolina, approximately as shown. The exact location will be indicated by the Contracting Officer.
- 4. COMMENCEMENT, PROSECUTION, AND COMPLETION OF WORK: The Contractor will be required to commence work under the contract 15 calendar days after the date of "Notice of Award", to prosecute said work diligently, and to complete the entire work ready for use within 540 calendar days. The time stated for completion shall include final cleanup of the premises. The contract completion date will be computed starting 15 calendar days after the date of the Notice of Award. This 15 day period is to allow for mailing of the Notice of Award and the Contractor's submission of required bonds.
- 5. LIQUIDATED DAMAGES: In case of failure on the part of the Contractor to complete the work within the time fixed in the contract or any extensions thereof, the Contractor shall pay to the Government as liquidated damages pursuant to Clause entitled, "Termination for Default Damages for Delay Time Extensions," and Clause entitled, "Damages for Delay Defense Materials System and Priorities" of the General Provisions the sum of \$225.00 for each day of delay.
- 6. DRAWINGS ACCOMPANYING SPECIFICATION: The following drawings accompany this specification and are a part thereof. Drawings are the property of the Government and shall not be used for any purpose other than that contemplated by the specification. The drawings included with this specification are half-size. Full-size drawings are available at the bidder's or Contractor's expense. Information on procuring these full-size drawings may be obtained from the Contracting Officer. Full-size drawings may be inspected during regular working hours at the office of the Contracting Officer.

EFD Dwg. No.	NAVFAC Dwg. No.	Title		
191404	4091404	Location Map - Vicinity Map - Schedule of Drawings		
191405	4091405	New Well Site Plan & Details Existing Well Renovations		
191406	4091406	Raw Water Line - Plan & Profile		
191407	4091407			
191408	4091408	Water Plant Site Plan & Boring Log		
191409	4091409	Water Plant - Demolition Plan		
		Water Plant - Summary Of New Work Process		
191410	4091410	Piping - Floor Plan Water Plant - Process Piping - Elevation & Details		
191411	4091411			
191412	4091411	Softener Control Panel & Flow Schematic		
191413	4091413	Location Map		
III. I Printer de marie	4071415	Pump Stations - Modifications to		
191414	4091414	Sewage Lift Stations BB-1, SA-38		
191415	4091415	Parallel Sanitary Sewer Line Access Road		
191416	4091416			
191417	4091417	Boring Logs		
.,,	4031417	Wastewater Treatment Plant Site Plans -		
191418	4091418	Grit Chamber & Comminutor Site Plan		
191419	4091419	Grit Chamber & Comminutor		
191420	4091420	Hydraulic Profile		
191421	4091421	Primary Clarifiers - Plan & Sections		
171721	4091421	Scum Pump, Primary Clarifier Effluent		
191422	4091422	Box Inlet Structure, Junction Box No. 2		
191423	4091423	ii icki iiig riiter		
191424	4091423	Secondary Clarifier		
191425	4091424	Chlorine Contact Chamber		
171727	4091425	Waste Sludge Pump Station		
191426	4091426	Equipment, Elevations & Sections		
171120	4091426	New Waste Sludge Pump Station -		
191427	4091427	Foundation & Roof Plans & Sections		
171127	4091427	Existing Control Building - Work &		
191428	4091428	Aerobic Digester Supernatant Pump		
191429	4091429	Control Building		
191430	4091430	Control Building Elevations		
191431	4091431	Control Building Structure		
. 7 7.	4031431	Aerobic Digester/Imhoff Tank		
191432	4091432	Demolition		
. 7 72	4031432	Aerobic Digester/Imhoff Tank Conversion		
191433	4091433			
191434	4091434	Sludge Drying Beds		
191435	4091435	Miscellaneous Details		
		Floor Plan, Elevation & Drainage Piping		
191436	4091436	Water Plant - Elevations & Sections		
191437	4091437	Roof Plan, Generator Pad, Sections & Details		
191438	4091438	Control Building - Mechanical		

191439	4091439	Electrical Plan & Details
191440	4091440	Electrical Plan & Details - New &
		Existing Wells
191441	4091441	Electrical Site Plan & Symbol Schedule
191442	4091442	Electrical Plans & Schedule
191443	4091443	Electrical Plans & Details
191444	4091444	Panel & Equipment Schedule
191445	4091445	Control, Wiring Site Plan
191446	4091446	Electrical Details

- 7. SPECIFICATIONS AND PRINTS FURNISHED TO CONTRACTOR: Five copies of the project specification, five sets of one-half size prints, and one set of full-size reproducibles of each drawing accompanying this specification will be furnished the Contractor without charge. Additional prints required by the Contractor shall be reproduced by him at his own expense.
- 8. SCHEDULE OF PRICES: A schedule of prices shall be furnished in accordance with Clause entitled, "Schedule of Prices" of the General Provisions. The original and seven copies of the schedule of prices shall be submitted to the Contracting Officer, via the Resident Officer in Charge of Construction, for approval in accordance with Clause entitled, "Schedule of Prices" of the General Provisions. Pursuant to Clause entitled "Payments to Contractor" of the General Provisions, payments will not be made until the schedule of prices has been submitted and approved.
- 9. CONTRACTOR'S INVOICE AND CONTRACT PERFORMANCE STATEMENT: Requests for payment in accordance with the terms of the contract shall consist of:
- (a) Contractor's Invoice on form NAVFAC 7300/30 (10/81), which shall show, in summary form, the basis for arriving at the amount of the invoice.
- (b) Contract Performance Statement on form NAVFAC 10-7300/31 required by Clause entitled "Contractor's Invoice and Contract Performance Statement" of the General Provisions is deleted.
 - (c) Contractor's Monthly Estimate for Voucher.
- (d) Affidavit to accompany invoice (LANTDIV NORVA form 4-4235/4 (Rev 5/81).
- (e) Updated copy of progress schedule. (See Clause entitled "Progress Charts and Requirements For Overtime Work" of the General Provisions.)

Forms will be furnished by the Contracting Officer. The Contractor has the option to use the government furnished progress schedule and record form. Monthly invoices and supporting forms for work performed through the 20th of the month shall be submitted to the Contracting Officer by the 25th of the month in the following quantities.

- (a) Contractor's Invoice (NAVFAC 7300/30) Original and five copies
- (b) Contractor's Monthly Estimate for Voucher (5ND GEN 4265/1) -Original and two copies shall be required on all jobs where there is a schedule of prices
- (c) Affidavit (LANTDIV 4-4235/4) Original
- (d) Progress Schedule Two copies

10. CONSTRUCTION CATEGORIES: The following construction categories shall apply to all work covered by this specification:

Program	Category		Description	
	Primary	Secondary		
MCON	822	822-12	Utilities Improvements	

The construction categories given above may be modified by the Contracting Officer as necessary during the course of the work.

- 11. MATERIALS AND EQUIPMENT TO BE SALVAGED: Existing materials and equipment to be removed and which are listed on the drawings or in the technical sections of the specification to be salvaged shall remain the property of the Government. Materials and equipment to be salvaged shall be carefully removed and handled in such a manner as to avoid damage, and shall be delivered to storage on the station at a location designated by the Contracting Officer within 9 miles of the project site.
- 12. BORING LOGS: The Test Boring Logs which accompany this specification are furnished to make available to the Contractor the information obtained by Government investigation. The Government does not guarantee that these borings indicate actual conditions other than at the exact locations and at the time they were made.
- 13. AVAILABILITY OF UTILITY SERVICES: Reasonable amounts of utilities will be made available to the Contractor at the prevailing Government rates and may be obtained upon application to the Base Maintenance Officer, Bldg. 1202, Marine Corps Base, Camp Lejeune. A refundable security deposit must be provided to the Resident Officer in Charge of Construction prior to application for services. The Contractor will be responsible for providing transformers, meter bases, electrical service poles and drops for electrical services, and backflow preventing devices on connections to domestic water lines. Final taps and tie-ins to the Government utility grid will be made by Base Maintenance who will also provide and seal a 120/208 volt 3-wire KWH meter. Tap-in cost, if any shall be the responsibility of the Contractor. Any tampering or movement of a sealed meter without notification to Base Maintenance is grounds for discontinuance of electrical service. The Contractor will be required to provide any larger meters required than is available from the Government. The Contractor will be responsible for the cost of all utility services required until the date of Government acceptance. Under no circumstances will taps to Base fire hydrants for obtaining domestic water be allowed.

14. AS-BUILT RECORD OF MATERIALS USED IN BUILDINGS: A record of materials used, in accordance with Clause entitled "As-Built Record of Materials Used in Buildings" of the General Provisions shall be furnished in the following format:

	SPEC.		MATERIAL USED		
MATERIAL	DESIGNATION	MANUF ACTURER	MFG. DESIGNATION	WHERE USED	
	-				
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- 15. TRAILERS OR STORAGE BUILDINGS: In accordance with Clause entitled "Operations and Storage Areas" of the General Provisions, trailers or storage buildings will be permitted on the job site, where space is available, subject to the approval of the Contracting Officer. The trailers or buildings shall be suitably painted and kept in a good state of repair. Failure of the Contractor to maintain his trailers or storage buildings in good condition will be considered sufficient reason to require their removal from the job site.
- 16. WRITTEN GUARANTEES AND GUARANTOR'S LOCAL REPRESENTATIVE: Prior to completion of the contract, the Contractor shall obtain and furnish to the Contracting Officer's designated representative written guarantees for all the equipment and appliances furnished under the contract. The Contractor shall furnish with each guarantee: The name, address, and telephone number of the guarantor's representative nearest to the location where the equipment and appliances are installed, who, upon request of the Using Service's representative, will honor the guarantee during the guaranty period and will provide the services prescribed by the terms of the guarantee. At the time of installation, the Contractor shall tag each item of warranted equipment with a durable, oil and water resistant tag approved by the Contracting Officer. Tag shall be attached with copper wire and sprayed with a clear silicone waterproof coating. Leave the date of acceptance and inspector's signature blank until project is accepted for beneficial occupancy. Tag shall show the following information:

EQUIPMENT WARRANTY TAG

STATION PERSONNEL TO PERFORM ONLY OPERATIONAL MAINTENANCE

- 17. SAFETY PROGRAM: The Contractor shall implement a safety program conforming to the requirements of Federal, State and Local laws, rules and regulations. The program shall include, but is not limited to the following:
- a. "Occupational Safety and Health Standards", which can be ordered from the Superintendent of Documents, U. S. Government Printing Office, Washington, DC 20402.
- b. Department of the Army, Corps of Engineers, "Safety and Health Requirements Manual", which may be examined in the office where bids are being received or may be purchased from the Superintendent of Documents, U. S. Government Printing Office, Washington, DC 20402.
 - c. General Provisions, Clause entitled "Accident Prevention."
- d. NFPA 241-1975, Safeguarding Building Construction and Demolition Operations, which may be examined in the office where bids are being received or may be purchased from the National Fire Protection Association, 470 Atlantic Avenue, Boston, MA 02210.
- e. Work in Confined or Enclosed Spaces: In addition to the requirements in Section XXVII of the Corps of Engineers Safety Manual, EM 385-1-1, "Work in Confined or Enclosed Spaces", the following provisions apply:

(1) Definitions

- (a) Confined Space Refers to a space which by design has limited openings for entry and exit; unfavorable natural ventilation which could contain or produce dangerous air contaminants, and which is not intended for continuous employee occupancy. Confined spaces include but are not limited to storage tanks, compartments of ships, process vessels, pits, silos, vats, degreasers, reaction vessels, boilers, ventilation and exhaust ducts, sewers, tunnels, underground utility vaults, and pipelines.
- (b) Qualified Person A person designated by the Contractor, in writing, as capable (by education or specialized training) of anticipating, recognizing, and evaluating employee exposure to hazardous substances or other unsafe conditions in a confined space. This person shall be capable of specifying necessary control and protective action to insure worker safety.
- (2) Entry into a confined or enclosed space by personnel for any purpose, including hot work, shall be prohibited until the qualified person has conducted appropriate tests to assure the confined or enclosed space is safe for the work intended.
- (3) A permit shall be provided and posted at the work site, by the qualified person, certifying the confined or enclosed space as safe

for personnel entry and the work intended. The permit shall also indicate the necessary precautions, protective equipment, and procedures required to maintain a safe operation.

- (4) The contractor shall submit to the Contracting Officer a letter of certification for the qualified person. The letter shall state the qualified person's name and qualifications and delineate his authority to direct work stoppage in the event of hazardous conditions.
- 18. EMERGENCY MEDICAL CARE: Emergency medical care only is available at Government facilities at Marine Corps Base, Camp Lejeune for Contractor employees who suffer on-the-job injury or disease. Emergency care will be rendered at the prevailing rates established in BUMEDINST 6320.4 series. Reimbursement will be made by the Contractor to the Naval Regional Medical Center Collection Agent upon receipt of a monthly statement.
- 19. PROPRIETARY NAMES: Names indicated for colors, textures and patterns of materials are for the purpose of color, texture and pattern selection only. Other manufacturers materials are acceptable provided they closely approximate colors, textures and patterns indicated and provided they conform to all other requirements.

20. SCHEDULING THE WORK:

20.1 General Scheduling Requirements: Notwithstanding the requirements of Clause entitled "Progress Charts and Requirements for Overtime Work" of the General Provisions, immediately after award the Contractor shall meet with the Contracting Officer and present a schedule of work, prepared in accordance with said Clause, for review by the Contracting Officer. The schedule will be reviewed at this meeting and will be retained by the Contracting Officer for final review and approval. The normal working hours are 8:00 a.m. to 4:30 p.m. Monday through Friday.

20.2 Special Scheduling Requirements:

- 20.2.1 The Utility and Treatment Systems will remain in operation during the entire construction period and the Contractor shall conduct his operations so as to cause the least possible interference with the normal operations of the activity.
- 20.2.2 The new filters and softeners in the water plant addition including controls and brine tank shall be useably complete and ready for operation as approved by the Contracting Officer before any work is started on replacing the existing filters and softeners which would interfere with normal operation.
- 20.2.3 The existing buildings and their contents shall be kept secure at all times and the Contractor shall provide all temporary closures as required to maintain security as directed by the Contracting Officer. The Contractor shall remove all debris from all spaces being

used by the activity at the end of each shift or more frequently if required to keep the space useable. Dust covers or protective enclosures shall be provided to protect existing work to remain and Government material located in the project during the construction period.

- 20.2.4 Permission to interrupt any utility service shall be requested in writing at least fifteen days in advance and approval of the Contracting Officer shall be received before any service is interrupted. Interruptions of utility services will be allowed only when they will cause no interference with the operations of the activity. All utility cutovers shall be made after normal working hours or on weekends; anticipated costs shall be included in the bid.
- 20.2.5 The existing sewage pump station BB-1 shall remain in operation during the entire construction period. One new pump, motor, and associated electrical and mechanical equipment shall be usably complete and ready for operation as approved by the Contracting Officer before any work is started on the other pump and motor.
- 21. FORWARDING OF SAMPLES AND SUBMITTALS: Notwithstanding the requirements of Clause entitled "Shop Drawings" and Clause entitled "Contractor Quality Control" of the General Provisions, the quantity of submittals required shall be as specified hereinafter.
- 21.1 Samples Required of the Contractor: As soon as practicable, and before installation, submit to the Architect-Engineer: L. E. Wooten and Company, 120 N. Boylan Avenue, Raleigh, North Carolina 27603, for approval, samples of materials and equipment as may be requested, including all samples required in the technical sections of this specification.
- 21.2 Shop Drawings, Manufacturers Data and Certifications Required of the Contractor: As soon as practicable after award of the contract, and before procurement or fabrication, submit, except as specified otherwise, to the Architect-Engineer: L. E. Wooten and Company, 120 N. Boylan Avenue, Raleigh, North Carolina 27603, all the shop drawings, manufacturers data and certifications required in the technical sections of this specification. Seven copies of all submittals to be approved by the Contracting Officer shall be forwarded. The Architect-Engineer for this project will review and approve for the Contracting Officer if the submittal complies with the contract requirements. One copy of the transmittal form for all submittals shall be forwarded to the Resident Officer in Charge of Construction. Submittals for environmental protection shall be submitted to the Commander, Atlantic Division, Naval Facilities Engineering Command (Code 05), Naval Station, Norfolk, Virginia 23511. Specification DOD-D-1000B shall be used as a guide and its use is encouraged for all drawings and data submitted by the Contractor. Conformance to the provisions of specification DOD-D-1000B is not mandatory for maps, sketches, presentation drawings, perspectives, renderings, and all other drawings not requiring Naval Facilities Engineering Command drawing

- 22. SUBMITTAL OF PROOF OF QUALIFICATIONS AND EXPERIENCE: Where qualifications or experience requirements are set forth in the specifications with respect to equipment and equipment installers, written proof of such qualifications or experience must be provided within 45 calendar days after contract award, and before placing any order for such equipment or before dispatching equipment installers to the project site.
- 23. QUARANTINE FOR IMPORTED FIRE ANT (7/76): All of Onslow, Jones and Carteret Counties and portions of Duplin and Craven Counties have been declared a generally infested area by the United States Department of Agriculture for the imported fire ant. Compliance with the quarantine regulations established by this authority as set forth in USDA Quarantine No. 81 dated 9 October 1970, and USDA Publication 301.81-2A of 23 July 1976, is required for operations hereunder. Pertinent requirements of the quarantine for materials, originating on the Camp Lejeune reservation, the Marine Corps Air Station (Helicopter), New River and the Marine Corps Air Station, Cherry Point, which are to be transported outside the Onslow County or adjacent suppression areas, include the following:
 - (a) Certification is required for the following articles, and they shall not be moved from the reservation to any point outside the Onslow County and adjacent designated areas unless accompanied by a valid inspection certificate issued by an Officer of the Plant Protection and Quarantine Program of the U.S. Department of Agriculture.
 - (1) Bulk soil.
 - (2) Used mechanized soil-moving equipment.
 - NOTE: Used mechanized soil-moving equipment is exempt if cleaned of all loose noncompacted soil.
 - (3) Any other products, articles, or means of conveyance, if it is determined by an inspector that they present a hazard of spread of the imported fire ant and the person in possession thereof has been so notified.
 - (b) Authorization for movement of equipment outside the imported fire ant regulated area shall be obtained from USDA, APHIS, PPQ, Rural Route 6, Box 53D, Wilmington, NC 28405, Telephone (919) 343-4667, and requests for inspection shall be made sufficiently in advance of the date of movement to permit arrangements for the services of authorized inspectors. The equipment shall be prepared and assembled so that it may be readily inspected. All soil on or attached to equipment, supplies and materials shall be removed by washing with water and/or such other means as

necessary to accomplish complete removal. Resulting spoil shall be wasted as necessary and as directed.

*** END OF SECTION ***

ADDITIONAL GENERAL PARAGRAPHS

- 1. APPROVAL OF SAMPLES, CUTS, AND DRAWINGS: Matter submitted for approval shall be accompanied by complete information concerning the material, articles, and/or design proposed for use in sufficient detail to show compliance with the specification, and shall be approved before incorporation into the work. Approval thereof will not be construed as relieving the Contractor of compliance with the specification, even if such approval is made in writing, unless the attention of the Contracting Officer is called to the noncomplying features by letter accompanying the submitted matter. Partial submittals or submittals of less than the whole of any system made up of interdependent components, will not be considered. Approval of drawings, cuts, and samples by the Contracting Officer shall not be construed as a complete check or approval of the detailed dimensions, weights, gauges and similar details of the proposed articles. The conformance of such details with the contract requirements, together with the necessary coordination of dimensions and details between the various elements of the work and between the various subcontractors and suppliers, shall be solely the responsibility of the Contractor, approval of submitted matter notwithstanding.
- 2. OPERATION OF STATION UTILITIES: The Contractor shall not operate nor disturb the setting of any control devices in the station utilities system, including water, sewer, electrical and steam services. The Government will operate the control devices as required for normal conduct of the work. The Contractor shall notify the Contracting Officer giving reasonable advance notice when such operation is required.
- 3. CHANGED CONDITIONS: Wherever changed conditions as defined in Clause 4 of the General Provisions are encountered, and wherever conditions exposed during the course of the work necessitate a change from quantities indicated or specified as either estimated quantities or as a basis for bids, whether or not provision for a change in price for such variation is specified, the Contracting Officer must be notified in writing and written directions to do so must be obtained before quantities stated in the contract documents are exceeded.
- 4. SUBCONTRACTORS AND PERSONNEL: Promptly after the award of the contract, the Contractor shall submit to the Contracting Officer, in triplicate, a list of his subcontractors and the work each is to perform. On this form shall appear the names of the key personnel of the Contractor and subcontractors, together with their home addresses and telephone numbers, for use in event of any emergency. From time to time as changes occur and additional information becomes available, the Contractor shall amplify, correct, and change the information contained in previous lists.

- 5. AS-BUILT DRAWINGS: During the progress of the work one full-size print of each of the drawings accompanying this specification shall be neatly and clearly marked in red to show all variations between the construction actually provided and that indicated or specified in the contract documents. The as-built drawings shall be kept up-to-date at the work site at all times during the contract, and shall be available for inspection by the Contracting Officer upon request. The Contractor shall also mark the drawings to indicate the exact location of any underground utility lines discovered in the course of the work. Where a choice of materials or methods, or both, is permitted herein, and where variations in the scope or character of the work indicated or specified are permitted either by award on bidding items specified for that purpose or by subsequent change to the contract, the as-built drawings shall define the construction actually provided. The representation of such variations shall conform to standard drafting practice and shall include such supplementary notes, legends, and details as may be necessary for legibility and clear portrayal of the as-built construction; the marked prints shall be subject to approval of the Contracting Officer before acceptance. Upon completion of the work, the completed as-built drawings shall be presented to the Contracting Officer.
- 6. LOCATION OF UNDERGROUND UTILITIES: Where existing piping, utilities, and underground obstructions of any type are indicated in locations to be traversed by new piping, ducts, and other work provided hereunder, and are not indicated or specified to be removed, the elevations of the existing utilities and obstructions shall be determined before the new work is laid closer than the nearest manhole or other structure at which an adjustment in grade could be made. For any additional work required by reason of conflict between the new and existing work, an adjustment in contract price will be made in accordance with Clause 4 of the General Provisions.

CONTRACTOR QUALITY CONTROL SYSTEM

PART 1 - GENERAL

- 1.1 APPLICABLE PUBLICATIONS: 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.
 - 1.1.1 American Society for Testing and Materials (ASTM) Publications:

D 3666-78	Inspection and Testing Agencies for Bituminous Paving Materials
D 3740-78	Evaluation of Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Construction
E 329-77	Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction
E 543-76	Nondestructive Testing Agencies, Rec. Practice for Determining the Qualifications of
E 548-79	Testing and Inspection Agencies, Rec. Practice for Generic Criteria for Use in Evaluation of

- 1.2 QUALITY CONTROL: This contract will be administered under the General Provisions Clause entitled "Contractor Quality Control (CQC)."
- 1.3 QUALIFICATIONS OF THE CQC REPRESENTATIVE: The CQC representative or a member of the CQC staff shall have the following specific minimum qualifications:
 - a. Shall be a graduate engineer or architect with at least three years of acceptable field experience and shall be familiar with the generally accepted construction practices, applicable codes and standards, and materials as will be applied to and incorporated into this project, or
 - b. Shall have at least a high school education and shall have functioned for not less than five years as an inspector, project superintendent or project manager on both utilities and building construction for Government or private agency (or agencies); and shall be familiar with the generally accepted construction practices, applicable codes and standards, and materials as will be applied to and incorporated into this project.

- 1.3.1 Government Approval of CQC Representative: If, in the Government's opinion, the proposed CQC representative fails to meet the referenced minimum qualifications, he shall be withdrawn from consideration by the Contractor and an individual with qualifications which, in the Government's opinion, meet the referenced minimum standards shall be proposed. Construction activities shall not begin until an acceptable CQC representative is approved by the Government. No contract time extension will be granted to the Contractor due to his failure to propose a CQC representative with the referenced minimum qualifications.
- 1.3.2 Removal of Disqualified CQC Representative: Upon receipt by the Contractor of written notification from the Contracting Officer that the CQC representative has, in the Contracting Officer's opinion, consistently failed to perform his duties adequately and that replacement is required, the Contractor shall immediately provide a replacement acceptable to the Government as meeting the minimum qualifications. Construction activities shall not be performed between the time when written notification is received by the Contractor and the time when the Government approves of the replacement CQC representative. No contract time extension will be granted to the Contractor for replacement and approval of the CQC representative.

1.4 DEFINITIONS:

- 1.4.1 Contractor Quality Control (CQC): The quality control and inspection system established and maintained by the Contractor that assures compliance with the contract drawings and specifications.
- 1.4.2 Factory Tests: Tests made on various products and component parts prior to shipment to the job site, including but not limited to such items as transformers, boilers, air conditioning equipment, electrical equipment, and precast concrete.
- 1.4.3 Field Tests: Tests or analyses made at, or in the vicinity of the job site in connection with the actual construction.
- 1.4.4 Product: The term "product" includes the plural thereof and means a type or a category of manufactured goods, constructions, installations, and natural and processed materials or those associated services whose characterization, classification, or functional performance determination is specified by standards.
- 1.4.5 Person: The term "person" means associations, companies, corporations, educational institutions, firms, Government agencies at the Federal, State and local level, partnerships, and societies, as well as divisions thereof, and individuals.
- 1.4.6 Testing Laboratory: The term "testing laboratory" means any "person," as defined above, whose functions include testing, analyzing, or inspecting "products," as defined above, and/or evaluating the designs or specifications of such "products" according to the requirements of applicable standards.

- 1.4.7 Certified Test Reports: Test reports signed by an authorized official stating that tests were performed in accordance with the test method specified, that the results reported are accurate, and that items tested either meet or fail to meet the stated minimum requirements. These test reports include those performed by Factory Mutual, Underwriters Laboratories, Inc. and others.
- 1.4.8 Certified Inspection Reports: Reports signed by approved inspectors attesting that the items inspected meet the specification requirements other than any exceptions included in the report.
- 1.4.9 Manufacturer's Certificate of Conformance: A certificate signed by an authorized manufacturer's official attesting that the material or equipment delivered meets the specification requirements.
- 1.5 SUBMITTALS: Those required by the technical sections of the contract specifications shall be approved and certified by the Contractor in accordance with the Contractor Quality Control Clause of the General Provisions, unless specifically stated otherwise, in which case the Clauses entitled "Shop Drawings" and "Catalog Data" of the General Provisions apply. In accordance with the clause entitled "Contractor Quality Control (CQC)" of the General Provisions, where the words "approved," "approval," "submit for approval," or words of similar import are used they shall be taken to mean approval of the Contractor's Quality Control Organization, unless specifically stated otherwise in the technical sections of the specification. Clearly mark and identify in the submittals and catalog cuts each item proposed to be incorporated into the project with cross-references to the contract drawings and specifications so as to identify clearly the use for which it is intended. Maintain at the job site an up-to-date submittal status log showing the status of all submittals required by the contract. A sample format of an acceptable log is attached at the end of this section. While the use of this sample format is not required, any other format must contain the same information as shown on the sample.
- 1.5.1 Shop Drawings and Manufacturer's Data: Stamp each sheet of catalog cuts, technical data sheets, and descriptive literature with the Contractor's approval stamp, except that data submitted in a bound volume or on one sheet printed on two sides may be stamped on the front of the first sheet only. The approval stamp shall have blanks to indicate whether Government approval or Contractor approval is required by the contract. The stamp shall be worded as follows:

marked in this submit	ied that the (material) (equipment) shown and tal, shop drawings, catalog cut(s), etc., and be incorporated into Contract	
Number	is in compliance with the contract	
drawings and specific	cations and can be installed in the allocated oproved for use/ submitted for Government	
approval	approved for use subject to Government approva	.1
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Authorized	Reviewer	Date	
Signature (700 D		
Signature (LQC Rep	Date	**

The person(s) signing the certification shall be the one(s) designated in the Contractor Quality Control Plan as having this authority. The signature(s) shall be in original ink. Stamped signatures will not be acceptable.

- 1.5.2 Samples: Prepare and submit in accordance with the General Provisions Clauses entitled "Contractor Quality Control (CQC)" and "Samples."
- 1.5.3 Certified Test Reports: Before delivery of materials and equipment, four certified copies of the reports of all tests listed in the technical sections shall be submitted and approved. The testing shall have been performed in a laboratory meeting the requirements specified herein. The tests shall have been performed within 3 years of submittal of the reports for approval except that tests for concrete and bituminous mix designs shall have been performed within one year of submittal. Test reports shall be accompanied by certificates from the manufacturer certifying that the material and equipment proposed to be supplied is of the same type, quality, manufacture, and make as that tested.
- 1.5.4 Manufacturer's Certificates of Conformance: Before delivery, Manufacturer's Certifications shall be furnished by the Contractor as required on items of materials and equipment indicated in the technical sections. Pre-printed certifications will not be acceptable. All certifications shall be in the original. The original of all manufacturer's certifications shall name the appropriate item of equipment or material, specification, standard, or other document specified as controlling the quality of that item and shall have attached thereto certified copies of test data upon which the certifications are based. All certificates shall be signed by the manufacturer's official authorized to sign certificates of conformance or compliance.
- 1.5.5 Tabulation of Tests: In addition to the General Provisions requirements for CQC test reports, prior to final payment the Contractor shall obtain from each laboratory a tabulation of all tests it has performed in connection with the construction contract, including conforming, nonconforming, and repeated test results. The tabulation(s) shall be certified as complete, and signed by the authorized representative of the laboratory, and shall be delivered to the Contracting Officer.

PART 2 - EXECUTION

- 2.1 QUALITY CONTROL REQUIREMENTS: The Contractor, through his CQC representative and staff, shall inspect, sample, test, and perform the required approvals for all work under the contract. Approvals, except those required for field installations, field applications, and field tests, shall be obtained before delivery of materials and equipment to the project site. As a minimum, inspection, sampling, testing, and approvals shall be performed and recorded on a Contractor Quality Control Daily Report Form in accordance with the General Provisions Clause entitled "Contractor Quality Control (CQC)." A sample format of an acceptable form is attached at the end of this section. While the use of this sample format is not required, any other format must contain the same information as shown on the sample. The Officer in Charge of Construction will assign a Resident Officer in Charge of Construction (ROICC) to the project. The ROICC will designate a Navy Construction Representative who will be the primary point of contact between the Contractor and the Government. The Navy Construction Representative will review the Contractor's Quality Control Reports, perform surveillance of the Contractor's testing and inspection procedures, and perform such job inspections as deemed necessary. He will visit the construction site whenever it is considered necessary or advisable. The ROICC will exercise the right of the Government to accept materials, workmanship, and construction-in-place in accordance with the General Provisions Clause entitled "Inspection and Acceptance."
- 2.1.1 Factory Tests: Unless otherwise specified, the Contractor shall arrange for factory tests when they are required under the contract.
- 2.1.2 Factory Inspections by the Contractor: Unless otherwise specified, the Contractor shall arrange and perform all factory inspections specifically required in the technical sections of the specifications. These inspections shall be reported on the CQC Daily Report as to the type and locations of the work.
- 2.1.3 Factory Inspections by the Government: The Contracting Officer will arrange for factory inspections specified to be performed by the Government.
- 2.1.4 Field Inspections and Tests by the Contractor: They shall be in accordance with the General Provisions Clause entitled "Contractor Quality Control (CQC)."
- 2.1.5 Field Inspections and Tests by the Government: If deemed necessary by the Contracting Officer, field inspections and tests will be made in accordance with the General Provisions Clause entitled "Inspection and Acceptance."

- 2.1.6 Approval of Testing Laboratories: All laboratory work under this contract shall be performed by a laboratory approved by the Government, whether the laboratory is employed by the Contractor, or is owned and operated by the Contractor. The basis of approval includes the following:
 - a. Testing laboratories performing work in connection with concrete, steel, and bituminous materials shall comply with ASTM E 329 and ASTM D 3666, respectively.
 - b. Testing laboratories engaged in the testing and inspection of soils and rock or performing non-destructive testing shall comply with ASTM D 3740 and ASTM E 543, respectively.
 - c. Testing laboratories performing work not in connection with concrete, steel, bituminous materials, soils and non-destructive testing shall comply with ASTM E 548.
- 2.1.6.1 Laboratory Inspection: Prior to approval the laboratory shall submit in writing the following:
 - a. Functional description of the laboratories organizational structure, operational departments, and support departments and services.
 - b. A list and resume of the personnel assigned to the proposed testing, including the person charged with engineering managerial responsibility.
 - c. Affidavit of compliance with the applicable ASTM publication and certification that the laboratory performs work in accordance with technical requirements as required by the contract specifications.
 - d. A list of test and inspection equipment for each of the proposed test procedures and certification that the equipment is calibrated at prescribed intervals to insure the validity of the test and inspection data.
 - e. A copy of any recent certification or inspection report of the laboratory by a nationally recognized agency, including a statement of corrections made based on the findings of the agency. In the absence of inspection by a nationally recognized agency, the laboratory will be subject to inspection by the Contracting Officer upon receipt of all the above information 30 days before the required approval of the testing laboratory.

*** END OF SECTION ***

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INSTRUCTIONS

- 1. This form may be used by the Contractor for listing all material submittals that require action by either the Contractor or the Government.
- 2. Columns (a) through (e) should be completed by the Contractor and must include all submissions that are required by the specifications. This partially completed form then becomes the submittal log portion of the CQC Plan.
- 3. As submittals are received and processed, the remaining columns are to be completed by the Contractor.
- In those instances where the Contractor has approved the submittal under his contract responsibility, there may be a dual action code indicated under column (f): e.g., "A/E," indicating approved as submitted and forwarded to the ROICC for record purpose.
- 5. In column (f) for those items requiring ROICC action (action code "D"), THE REASON FOR FORWARDING TO THE ROICC should be entered in the column (1), the remarks column; e.g., Government approval required; waiver requested because of variance substitution, etc.
- 6. Where no Government action is required, (for Contractor review/approval items), there need be no entry in columns (h) and (i).
- 7. Column (j) is completed when material or equipment is delivered to the project. Column (k) is completed only after verification that the delivered item is that represented by the approved submittal.

ACTION CODE: To be used when completing columns (f) and (h)

A - Approved as submitted D - Forwarded to ROICC for action

B - Approved as noted

E - Forwarded to ROICC for record purpose

C - Disapproved

CONTRACTOR'S QUALITY CONTROL DAILY REPORT (SAMPLE FORMAT)

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ENVIRONMENTAL PROTECTION

- 1. ENVIRONMENTAL PROTECTION PLAN: The Contractor shall be responsible for the preparation and submission of an environmental protection plan. After the contract is awarded, but prior to the commencement of the work, the Contractor shall meet with the Contracting Officer, or his representative, and discuss the proposed environmental protection plan. The meeting shall develop mutual understanding relative to details of environmental protection, including required reports and measures to be taken should the Contractor fail to provide adequate protection in an adequate and timely manner. Not more than 14 days after the meeting, the Contractor shall submit for approval his proposed environmental protection plan.
- 2. GENERAL REQUIREMENTS: The Contractor shall provide and maintain environmental protection during the life of the contract as defined herein. The Contractor's operations shall comply with all Federal, State, and Local regulations pertaining to water, air, solid waste, and noise pollution.

3. DEFINITIONS OF POLLUTANTS:

- 3.1 Non-Hazardous Wastes: Solid or liquid substances that are to be discarded by the Contractor and that normally do not constitute a hazard to man or to the environment. This includes, but is not limited to, paper, metal (other than toxic metals such as lead and mercury), masonry, wood, brick, stone, asphaltic concrete, plastics, rubber, rubbish, and concrete.
- 3.2 Hazardous Wastes: Solid and liquid substances that are to be discarded by the Contractor and that constitute a significant active or potential hazard to man and/or to the remainder of the environment. This includes, but is not limited to, asbestos, glass, lead, mercury, pesticides, herbicides, other toxic chemicals and waste, liquid petroleum products, human excrement, garbage, sediment, and radioactive materials.
- 3.2.1 Sediment: Soil that has been eroued and transported by running water.
 - 3.2.2 Garbage: Waste foodstuffs.
- 3.2.3 Human Excrement: Solid or liquid wastes produced by the human body.

4. PROTECTION OF NATURAL RESOURCES:

4.1 General: It is intended that the natural resources within the project boundaries and outside the limits of permanent work performed under this contract be preserved in their existing condition or be restored to an equivalent or improved condition upon completion of the

- work. The Contractor shall confine his construction activities to areas defined by the work schedule, plans, and specifications.
- 4.2 Land Resources: The Contractor shall not remove, cut, deface, injure, or destroy trees or shrubs without written permission from the Contracting Officer. No ropes, cables, or guys shall be fastened to or attached to any existing nearby trees for anchorages unless specifically authorized. Where such special emergency use is permitted, the Contractor shall be responsible for repairing or replacing any damage resulting from such use.
- 4.2.1 Protection Plan: Where trees may possibly be defaced, bruised, injured or otherwise damaged by the Contractor's activity, equipment, or by his dumping, or other operations, the Contractor shall submit a plan for protecting such trees. Monuments, markers, and works of art shall be protected before beginning operations.
- 4.2.2 Repair or Restoration: Any trees or other landscape features scarred or damaged by the Contractor's equipment or operations shall be repaired and/or restored to their original condition at the Contractor's expense. The Contracting Officer shall approve the repair and/or restoration planned prior to its initiation.
- 4.2.3 Temporary Construction: The Contractor shall obliterate all signs of temporary construction facilities such as work areas, structures, stockpiles of excess or waste materials, or any other vestiges of construction as directed by the Contracting Officer.
- 4.3 Water Resources: It shall be the responsibility of the Contractor to investigate and comply with all applicable Federal, State, and Local regulations concerning the discharge (directly or indirectly) of pollutants to the underground and natural waters. All work under this contract shall be performed in such a manner that any adverse environmental impacts are reduced to a level that is acceptable to the Contracting Officer.
- 4.4 Oily Substances: At all times, special measures shall be taken to prevent oily or other hazardous substances from entering the ground, drainage areas, or local bodies of water in such quantities as to affect normal use, aesthetics or produce a measurable ecological impact on the area.
- 4.5 Historical and Archaeological Resources: All items having any apparent historical or archaeological interest which are discovered in the course of any construction activities shall be carefully preserved and reported immediately to the Contracting Officer for determination of actions to be taken.
 - 5. EROSION AND SEDIMENT CONTROL MEASURES:
 - 5.1 Burn-off of ground cover will not be permitted.

- 5.2 Reduction of Exposure of Unprotected Erodible Soils: Earthwork which has been brought to final grade shall immediately be paved or otherwise finished as indicated and specified. All earthwork shall be planned and conducted in such a manner as to minimize the area and duration of exposure of unprotected soils.
- 5.3 Temporary Protection of Erodible Soils: Such methods as may be necessary shall be utilized to effectively prevent erosion and control sedimentation, including, but not limited to, the following:
- 5.3.1 Mechanical Retardation and Control of Runoff: The rate of runoff from the construction site shall be mechanically retarded and controlled. This includes construction of diversion ditches, benches, and berms, to retard and divert runoff to protected drainage courses.
- 5.3.2 Sediment Basins: Sediment shall be trapped in temporary or permanent sediment basins. The basins shall be designed (sized) to accommodate the runoff of a local 10-year storm and shall be pumped dry and all sediment removed after each storm. Overflow shall be by paved weir or by vertical overflow pipe, draining from the surface. The collected sediment shall, for example: (1) be returned to the source of erosion, (2) be used as fill on the construction site, or (3) be used as fill at other sites. The Contractor shall institute effluent quality monitoring programs as required by State and Local environmental agencies.
- 5.3.3 Buffer Zones: No land-disturbing activity shall be permitted in proximity to a lake or natural watercourse unless a buffer zone is provided along the margin of the watercourse of sufficient width to confine visible siltation within the twenty-five percent of the buffer zone nearer the land-disturbing activity, provided, that this paragraph shall not apply to a land-disturbing activity in connection with the construction of facilities to be located on, over, or under a lake or natural watercourse.
- 5.3.4 Angle for graded slopes and fills shall be no greater than the angle which can be retained by vegetative cover or other adequate erosion control devices or structures. In any event, slopes left exposed will, within 30 working days of completion of any phase of grading, be planted or otherwise provided with ground cover, devices, or structures sufficient to restrain erosion.
- 5.3.5 Revegetation: Whenever land-disturbing activity is undertaken on a tract comprising more than one acre, if more than one contiguous acre is uncovered, a ground cover sufficient to restrain erosion must be planted or otherwise provided within 30 working days on that portion of the tract upon which further active construction is not being undertaken.
 - 6. CONTROL AND DISPOSAL OF HAZARDOUS AND NON-HAZARDOUS WASTES:
- 6.1 Non-hazardous wastes, except rubble, shall be picked up and disposed of daily or placed in containers which are emptied on a weekly schedule. All handling and disposal shall be so conducted as to prevent contamination of the site and any other areas. The Contractor shall

transport all such waste and dispose of it in the Base Sanitary Landfill, unless otherwise approved. If transporting any material off Government property, the Contractor shall provide the Contracting Officer a copy of State and/or local permit which reflects the responsible agency's approval of the disposal area and proposed waste disposal methods. Rubble such as masonry, stone, concrete without reinforcing steel, and brick shall be deposited as directed near Building 1317 or at the site of the old Camp Geiger Sanitary Landfill. Upon completion, the work and disposal areas shall be left clean and natural looking. All signs of temporary construction and activities incidental to construction of the required permanent work in place shall be obliterated.

6.2 Hazardous Wastes:

- 6.2.1 Garbage Disposal: The Contractor shall transport his garbage to the Base Sanitary Landfill. The preparation, cooking, and disposing of food are strictly prohibited on the project site.
- 6.2.2 Sewage, Odor, and Pest Control: Chemical toilets or comparably effective units shall be used with wastes periodically emptied into municipal, district, or Base sanitary sewage systems. Provisions shall be included for masking or elimination of odors and pest control. Compliance with Federal, State, and Local regulations shall be established by the Contractor providing the Contracting Officer with a copy of the permit or license when applicable.
- 6.2.3 Liquid wastes shall be stored in corrosion-resistant containers, removed from the project site, and disposed of not less frequently than monthly unless directed otherwise. Disposal of liquid waste shall be in accordance with Federal, State, and Local regulations. Fueling and lubricating of equipment and motor vehicles shall be conducted in a manner that affords the maximum protection against spills and evaporation. For oil and hazardous material spills which may be large enough to violate Federal, State, and Local regulations, the Contracting Officer shall be notified immediately.

*** END OF SECTION ***

DEMOLITION AND REMOVAL

PART 1 - GENERAL

- 1.1 SUBMITTALS: Submit proposed salvage, demolition and removal procedures to the Contracting Officer for approval before work is started. Procedures shall provide for careful removal and disposition of materials specified to be salvaged, coordination with other work in progress, a disconnection schedule of utility services, a detailed description of methods and equipment to be used for each operation, and sequence of operations.
- 1.2 REQUIREMENTS: The work includes demolition or removal of all construction indicated or specified. All materials resulting from demolition work, except as indicated or specified otherwise, shall become the property of the Contractor and shall be removed to a disposal area on station within 9 miles of the site. Remove rubbish and debris from the station daily, unless otherwise directed; do not allow accumulations inside or outside the buildings. Store materials which cannot be removed daily in areas specified by the Contracting Officer.
- 1.3 DUST CONTROL: Take appropriate action to check the spread of dust to occupied portions of the building and to avoid the creation of a nuisance in the surrounding area. Do not use water if it results in hazardous or objectionable conditions, such as ice, flooding or pollution. Comply with all dust regulations imposed by local air pollution agencies.

1.4 PROTECTION:

- 1.4.1 Buildings: Protect existing work that is to remain in place, that is to be reused, or that is to remain the property of the Government by temporary covers, shoring, bracing, and supports. Repair items damaged during performance of the work or replace with new. Do not overload structural elements. Provide new supports or reinforcement for existing construction weakened by demolition or removal work.
- 1.4.2 Weather Protection: Protect building interior and all materials and equipment from the weather at all times. Where removal of existing roofing is necessary to accomplish work, have materials and workmen ready to provide adequate and approved temporary covering of exposed areas. Temporary coverings shall be attended, as necessary, to insure effectiveness and to prevent displacement.
- 1.4.3 Trees: Protect trees within the project site which might be damaged during demolition, and which are not indicated to be removed, by a 6-foot high fence. Erect fence a minimum of 5-feet from the trunks of individual trees or follow the outer perimeter of branches of clumps of trees. Restore trees scarred or damaged by Contractor equipment or

operations to their original condition or replace as determined by the Contracting Officer. The Contracting Officer shall approve restoration prior to its initiation.

- 1.4.4 Personnel: Where pedestrian and driver safety is endangered in the area of removal work, use traffic barricades with flashing lights. Notify the Contracting Officer prior to beginning any such work.
 - 1.5 EXPLOSIVES: Use of explosives will not be permitted.

PART 2 - EXECUTION

- 2.1 EXISTING FACILITIES TO BE REMOVED:
- 2.1.1 Structures, Walls, and Partitions: Remove indicated existing structures to lines indicated on drawings.

2.1.2 Utilities:

- 2.1.2.1 Utilities and Related Equipment: Remove all existing utilities, as indicated and terminate in a manner conforming to the nationally recognized code covering the specific utility and at a time satisfactory to the Contracting Officer. Remove meters and related equipment and deliver to a location on the station in accordance with instructions of the Contracting Officer or his representative without additional cost to the Government. If utility lines are encountered that are not shown on the drawings, contact the Contracting Officer for further instructions.
- 2.1.3 Paving and Slabs: Remove concrete and asphaltic concrete paving and slabs including aggregate base as indicated.
- 2.1.4 Roofing: Remove built-up roofing to effect the connections with new flashing or roofing. Cut existing felts and insulation along straight lines. Remove gravel surfacing from existing roofing felts for a distance of not less than 18 inches back from the cut. Remove gravel without damaging felts down to the top ply of felt. Remove roofing without damaging the roof deck.
- 2.1.5 Masonry: Remove masonry carefully so as to prevent damage to surfaces to remain and to facilitate the installation of new work. Where new masonry adjoins existing, the new work shall abut or tie into the existing construction as indicated.
- 2.1.6 Concrete: Where concrete work is to be removed, saw concrete along straight lines to a depth of not less than 2 inches. Make each cut in walls perpendicular to the face and in alignment with the cut in the opposite face. The remainder of the concrete shall be broken out, provided that the broken area is concealed in the finished work, and the remaining concrete is sound. At locations where the broken face cannot

be concealed, it shall be ground smooth or the saw cut shall be made entirely through the concrete.

2.3 DISPOSITION OF MATERIAL:

- 2.3.1 Title to Materials: Title to all materials to be removed, except as specified otherwise, is vested in the Contractor upon receipt of notice to proceed. The Government will not be responsible for the condition or loss of, or damage to, such property after notice to proceed. Materials and equipment shall not be viewed by prospective purchasers or sold on the site.
- 2.3.2 Salvaged Materials and Equipment: Carefully remove materials and equipment that are indicated to be removed and salvaged and deliver to a storage site, as directed by the Contracting Officer within 10 miles of the work site. Remove items in a manner that will prevent damage.
- 2.3.2.1 All equipment removed shall remain the property of the Government and shall be delivered to a storage site as stated above.

2.4 CLEANUP:

- 2.4.1 Debris and Rubbish: Remove and transport debris and rubbish in a manner that will prevent spillage on streets or adjacent areas. Clean up spillage from streets and adjacent areas.
- 2.4.2 Regulations: Comply with Federal, State, and Local hauling and disposal regulations.

*** END OF SECTION ***

EARTHWORK

PART 1 - GENERAL

- 1.1 APPLICABLE PUBLICATIONS: 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.
 - 1.1.1 American Society for Testing and Materials (ASTM) Publications:

C 33-81	Concrete Aggregates
C 136-81	Sieve or Screen Analysis of Fine and Coarse Aggregates
D 423-66 (R 1972)	Liquid Limit of Soils
D 424-59 (R 1971)	Plastic Limit and Plasticity Index of Soils
D 698-78	Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5.5-1b. (2.49kg) Rammer and 12-in. (305-mm) Drop
D 1140-54 (R 1971)	Amount of Material in Soils Finer than the No. 200 (75 micrometer) Sieve
D 1556-64 (R 1974)	Density of Soil in Place by the Sand Cone Method
D 2419-74 (R 1979)	Test for Sand Equivalent Value of Soils and Fine Aggregrates
D 2487-69 (R 1975)	Classification of Soils for Engineering Purposes
American Wate	er Works Association (ANANA) Dubis

1.1.2 American Water Works Association (AWWA) Publication:

C600-82 Installation of Gray and Ductile Cast-Iron Water Mains and Appurtenances

1.1.3 Army Corps of Engineers (COE) Publication:

EM-385-1-1 COE Manual

1.2 SUBMITTALS:

- 1.2.1 Certified Test Reports: Submit certified test reports before starting work for the following:
 - a. Fill and backfill tested in accordance with ASTM C 136 and ASTM D 2487
 - b. Granular fill tested in accordance with ASTM C 136 and ASTM D 2419
 - c. Filter Material tested in accordance with ASTM C 33 and ASTM C 136
- 1.2.2 Shoring and Sheeting Plan: Before starting work submit shoring and sheeting plan.
- 1.2.3 Dewatering Plan: Before starting work submit a dewatering plan describing the basic components of the dewatering system proposed and its planned method of operation. Submit the dewatering performance records weekly.
- 1.3 DELIVERY AND STORAGE: Deliver and store materials in a manner to prevent contamination or segregation.
 - 1.4 CRITERIA FOR BIDDING: Base bids on the following criteria:
 - a. That the surface elevations are as indicated.
 - b. That no pipes or other artifical obstructions, except those indicated, will be encountered.
 - c. That the character of the material to be removed is as indicated.
 - d. That ground water elevations indicated are those existing at the time sub-surface investigations were made and do not necessarily represent ground water elevation at the time of construction.

1.5 PROTECTION:

- 1.5.1 Shoring and Sheeting: Provide shoring and sheeting as necessary.
- 1.5.1.1 In addition to Section XXIII A and B of the Army Corps Engineer Manual EM-385-1-1 meet the following requirements:
 - a. Prevent undermining of pavements and slabs
 - b. Banks may be sloped where space permits and as directed

- c. Where shoring and sheeting materials must be left in place in the completed work to prevent settlements or damage to adjacent structures or as directed, backfill the excavation to 3 feet below the finished grade and remove the remaining exposed portion of the shoring before completing the backfill.
- 1.5.1.2 Shoring and Sheeting Plan: Shall include the following:
 - a. Calculations by a Registered Professional Engineer with all data and references used
 - b. The sequence and methods of installation and removal
 - The materials, sizes, and arrangement of members proposed for use as shoring and sheeting
- 1.5.2 Dewatering: Include in dewatering the collection and disposal of all forms of surface and subsurface water that may be encountered in the course of construction.
- 1.5.2.1 Dewatering Plan: Base on site surface and subsurface conditions, available soil, and hydrological data. Remove water by pumping or other methods to prevent the softening of surfaces exposed by excavation. Provide and place into operation prior to excavation below ground water level the dewatering system in order to lower the water levels at least one foot below the bottom and side slopes of the excavation. Use filters on the dewatering devices to prevent the removal of fines from the soil.
- 1.5.2.2 Operation and Performance: Operate the dewatering system continuously until such time as construction work below existing water levels is complete, unless directed otherwise. Measure and record the performance of the dewatering system at the same time each day by use of suitable observation wells or piezometers installed in conjunction with the dewatering system. After placement of initial slabs and backfill, the water level may be allowed to rise but at no time allow it to be higher than one foot below the prevailing level of excavation or backfill.
- 1.5.3 Drainage of Construction Sites: It shall be the Contractor's responsibility to adequately and completely drain construction sites as required to keep subgrades and subsoils sufficiently dry to permit all construction operations to successfully progress during all periods in which work is in progress. In addition to permanent drainage features required, the Contractor shall provide all necessary additional temporary ditches, swales, and other drainage features and equipment required to maintain the soils dry during construction. Where the Contractor's operations or failure to comply with the above requirements results in the development of unsuitable working platforms for equipment operation and unsuitable soil support for subsequent construction features, the Contractor shall, at his expense, remove the unsuitable material to whatever depth is required to restore suitable working platforms and soil support and replace it with suitable material from sources outside the station.

- 1.5.4 Protection of Underground Utilities: Contact the PWC 48 hours prior to construction for the location of all existing underground utilities.
- 1.5.5 Movement of construction machinery and equipment over any pipes during any stage of construction shall be at the Contractor's risk. Repair or remove and provide new pipe for existing or newly-installed pipe that has been displaced or damaged.

PART 2 - PRODUCTS

- 2.1 SOIL MATERIALS: In general, shall be free of debris, roots, wood, scrap material, vegetable matter, refuse, soft unsound particles, frozen, deleterious, or objectionable materials.
- 2.1.1 Granular Fill: For capillary water barrier shall conform to the general requirements for soil materials above and shall be a clean, coarse grained crushed stone, uncrushed gravel, or crushed gravel conforming to the following gradation: 90 to 100 percent passing the 3/4-inch sieve and zero to five percent passing the No. 4 sieve, and with a sand equivalent of not less than 50 when tested in accordance with ASTM D 2419.
- 2.1.2 Backfill and Fill: For structures and under spread footings, paving, or concrete slabs on grade which are not pile supported shall conform to the general requirements for soil materials above and shall be classified as GW, GP, GM, SW, SP, SM, GC, or SC by ASTM D 2487 and conform to the following: liquid limit shall not exceed 35 percent when tested in accordance with ASTM D 423, plasticity index shall not be greater than 12 percent when tested in accordance with ASTM D 424, and no more than 25 percent by weight shall be finer than No. 200 sieve when tested in accordance with ASTM D 1140.
- 2.1.3 General Site Fill: And embankment material shall conform to the general requirements for soil materials above and shall be an unclassified soil material from the site or borrow, submitted for approval by the Contractor as possessing the characteristics required for compaction to the specified values of soil density herein specified for the location of intended use.
- 2.1.4 Topsoil: Shall be material free of subsoil, stumps, rocks larger than one inch diameter, brush, weeds, toxic substances, and other material or substance detrimental to plant growth. Topsoil shall be a natural, friable soil representative of productive soils in the vicinity. The pH range shall be from 5.5 to 6.5. Topsoil that does not meet this pH range shall be amended by the addition of pH adjusters.
- 2.1.5 Borrow: Shall be materials conforming the requirements for general site fill, fill, and backfill. Take borrow erials from the source indicated on Government property within a 5-mile haul radius.

- 2.1.6 Silt Fence Fabric: Reinforcing fabric shall be nonwoven and rot resistant polypropylene or polyester and shall conform to the following requirements:
 - a. Minimum grab tensile strength in both the machine and transverse directions of 90 pounds when tested in accordance with ASTM D 1682.
 - b. Grab elongation in the machine and transverse directions ranging between 15 and 70 percent when tested in accordance with ASTM D 1682.
 - c. Minimum trapezoidal tear strength in both the machine and transverse direction of 50 pounds when tested in accordance with ASTM D 1117.
 - d. Minimum mullen burst strength of 100 psi when tested in accordance with ASTM D 1117.
 - e. Equivalent opening size greater than/or equal to 70 when tested in accordance with CW-02215.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION:

- 3.1.1 Clearing and Grubbing: Remove all trees, logs, shrubs, and brush within the indicated clearing limits. Remove stumps entirely. Grub out roots and matted roots to at least 18 inches below the existing surface. Dispose of brush, refuse, stumps, roots, and unmerchantable timber in Government landfill.
- 3.1.2 Topsoil: Strip existing topsoil to a depth of 4 inches, stockpile separately from other excavated materials, and reuse for finished surface grading. Topsoil shall be free of stones, wood matter, cuttings, excessive quantities of vegetation, and debris of every kind. Locate piles of topsoil so that the material can be used readily for finished surface grading; protect topsoil and maintain until needed. The top 4-inch thickness of all newly graded earth surfaced areas shall consist of topsoil. If there is insufficient topsoil available to form the 4-inch thickness, utilize that available as directed. The Contractor will not be required to haul in additional topsoil if all requirements specified are complied with. Placing of topsoil is specified in Section 02821, "Turf."
- 3.1.3 Unsuitable Material: Remove vegetation, sod, muck, and rubbish under embankments which are less than 4 feet in thickness and under pavements or concrete slabs.

- 3.2 EXCAVATION: Shall be to the contours and dimensions indicated. Keep excavations free from water while construction is in progress. Notify the Contracting Officer immediately in writing in the event that it becomes necessary to remove hard, soft, weak, or wet material to a depth greater than indicated and an adjustment in contract price will be considered in accordance with "Differing Site Conditions" paragraph of the General Provisions. Refill excavations cut below the depths indicated, unless otherwise specified, with fill and compact to 90 percent of ASTM D 698 maximum density. Excavate and refill soil disturbed or weakened by the Contractor's operations and soils permitted to soften from exposure to weather with fill and compact to 90 percent of ASTM D 698 maximum density. All additional work of this nature will be at the Contractor's expense.
- 3.2.1 Excavations for Concrete Footings and Slabs on Grade: Where footings and/or slabs on grade are to be constructed on original soil, excavate to a minimum depth of 18 inches below the bottom of the footing or slab extending a minimum of 3'-6" beyond the inside and outside edges of footings and outside edge of slabs all around the structure. Precompact the exposed soil using a 10-ton vibratory roller (or equal) until stabilized. The soil will be considered stabilized when total settlement after four passes of the roller does not exceed 1/8-inch. After stabilized, the required grades shall be attained using compacted fill as specified.
- 3.2.2 Excavation of Pipe Trenches: Excavation shall be to grade (as set forth in AWWA C600), unless otherwise directed in the event of poor soil. Width of trench shall be as shown on the Standard Pipe Trench width details accompanying this section. Compaction of soil in the backfilling operation shall be as specified herein.
- 3.2.2.1 Bedding Requirements: Provide in accordance with applicable pipe sections.

3.3 FILLING AND BACKFILLING:

- 3.3.1 Backfill for Structures: Place under spread footings and concrete slabs not pile supported in lifts of 6 inches thick and compact each lift as specified herein before the overlaying lift is placed. Backfill adjacent to structural elements shall be placed, as far as practicable, as the adjacent structural elements have been completed and accepted. Backfill against concrete only when directed by the Contracting Officer.
- 3.3.2 General Site Fill and Embankments: Place in lifts of 12 inches thick and compact as specified herein, before the overlaying lift is placed. In all areas not accessible to rollers or compactors, compact the fill with mechanical hand tampers. If the mixture is excessively moistened by rain, aerate it by means of blade graders or harrows until the moisture content of the mixture is satisfactory. Finish the surface of the layer by blading or rolling with a smooth roller, or a combination thereof: surface shall be smooth.

- 3.3.3 Fill for Capillary Water Barrier: Place granular fill on compacted subgrade in lifts of 4 inches and compact with a minimum of two passes of a hand-operated plate type vibratory compactor.
- 3.3.4 Backfill for Trenches: Backfilling of trenches shall progress as rapidly as the construction, testing, and acceptance of the work permits. Except as specified otherwise elsewhere in this specification, in backfilling pipe trenches, fill shall be compacted in 6-inch layers to a depth of one foot over the top of the pipe: the remainder of the trench shall be backfilled and compacted as specified under compaction. For trenches excavated in roads and streets, the backfill shall be placed and compacted in 6-inch layers to the top of the trench.

3.4 COMPACTION OF SUBGRADES:

- 3.4.1 Subgrade of Soils in Cut: For structures, concrete floor slabs and paved areas shall have a density of 95 percent of ASTM D 698 maximum density to a depth of 12 inches; if the existing subgrade natural density is less than 95 percent of ASTM D 698 maximum density, compact to that value.
- 3.4.2 Structure, Spread Footing, and Concrete Floor Slab: Compact subgrades to 95 percent of ASTM D 698 maximum density.
- 3.4.3 Adjacent Area: Compact subgrade adjacent to but not supporting any structural elements or areas within 5 feet of structures to 90 percent of ASTM D 698 maximum density.
- 3.4.4 Paved Area: Compact subgrade to 95 percent of ASTM D 698 maximum density in the upper 12 inches of the subgrade.
- 3.4.5 General Site: Compact area and embankment subgrades under vegetation to 90 percent of ASTM D 698 maximum density.

3.5 FINISH OPERATIONS:

- 3.5.1 Grading: Shall be to finished grades indicated within one tenth of a foot. Grade areas to drain water away from structures and to provide suitable surfaces for mowing machines. Grade as directed existing grades which are to remain but are disturbed by the Contractor's operations.
- 3.5.2 Spreading Topsoil: Areas indicated to receive topsoil for the finished surface shall be free of materials that would interfere with planting and maintenance operations. Do not place topsoil when the subgrade is frozen, extremely wet or dry, or in other conditions detrimental to seeding, planting, or grading. Comply with the requirements of Section 02821, "Turf."
- 3.5.3 Borrow Areas: Grade to drain properly. Maintain and restore borrow pits as specified in Section 01560, "Environmental Protection."

- 3.5.4 Disposition of Surplus Material: Surplus or other soil material not required or suitable for filling, backfilling, or embankment shall be disposed of at the station borrow pit. Comply with the requirements of Section 01560, "Environmental Protection."
- 3.5.5 Protection of Surfaces: Protect newly graded areas from traffic, erosion, and settlements that may occur and as required in Section 01560, "Environmental Protection." Repair or re-establish damaged grades, elevations, or slopes.

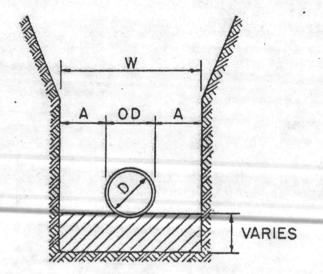
3.6 FIELD SAMPLING AND TESTING:

3.6.1 Samples: Submit one 50-pound composite sample for each type of embankment material being placed. Also submit samples, in the number directed, whenever the source or character of the embankment material changes. Take each sample in three increments from the same truck — one increment from the first third of the load, one when half of the load has been dumped, and one from the final third of the load during dumping of the material.

Deposit each sample in a clean container fastened to prevent loss of material. Tag each sample for identification. The tag shall contain the following information:

Contract No.	
Sample No.	
Date of Sample	
Sampler	
Source	
Intended Use	and the second s

3.6.2 Tests: Test fill, backfill, and granular fill in accordance with ASTM C 136 for conformance to ASTM C 33, ASTM D 2419, and ASTM D 2487 gradation limits. Test fill and backfill for material finer than the No. 200 sieve in accordance with ASTM D 1140. Test fill and backfill for liquid limit in accordance with ASTM D 423 and for plasticity index in accordance with ASTM D 424. Test fill and backfill materials for moisture density relations in accordance with ASTM D 698. Perform two of each of the required tests for each material used. Provide additional tests as specified above for each source change. Perform density tests in randomly selected locations and in accordance with ASTM D 1556 as follows: one test per 2500 square feet in each layer of lift.



PIPE DIA	MAXIMUM "A"
6" TO 15"	8"
18" TO 21"	10"
24" TO 30"	12"
33" TO 42"	15"
48" & LARGER	18"

MAXIMUM TRENCH WIDTH "W"
TAKEN AT TOP OF PIPE

NOTE: PROVIDE BEDDING IN ACCORDANCE WITH THE SPECIFICATIONS.

STANDARD PIPE TRENCH WIDTH

02200 - 1

*** END OF SECTION ***

FENCE, CHAIN LINK

PART 1 - GENERAL

1.1 APPLICABLE PUBLICATIONS: 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.

1.1.1 Federal Specifications (Fed. Spec.):

FF-P-101E & Am-2	Padlocks
RR-F-191 J/GEN	Fencing, Wire and Post Metal (and Gates, Chain-Link Fence Fabric, and Accessories) (General specification)
RR-F-191/1C	Fencing, Wire and Post, Metal (Chain-Link Fence Fabric) (Detail Specification)
RR-F-191/2C	Fencing, Wire and Post, Metal (Chain-Link Fence Gates) (Detail Specification)
RR-F-191/3C	Fencing, Wire and Post, Metal (Chain-Link Fence Posts, Top Rails and Braces) (Detail Specification)
RR-F-191/4C	Fencing, Wire and Post, Metal (Chain-Link Fence Accessories) (Detail Specification)

1.1.2 Military Specification (Mil. Spec.):

MIL-B-52775B Barbed Tapes, Obstacle, General Purpose and & Int. Am.-1 Barbed Tape, Fence Topping

1.1.3 American Society for Testing and Materials (ASTM) Publication:

C 94-81 Ready-Mixed Concrete

1.2 SUBMITTALS:

1.2.1 Shop Drawings and Catalog Cuts: Show all fencing components, details of fencing, and accessories. These drawings or cuts shall be accompanied by a layout drawing showing spacing of posts and location of gate, corner, end, and pull posts.

1.2.2 Manufacturer Certificates of Conformance:

- a. Fabric
- b. Posts
- c. Braces
- d. Framing
- e. Rails
- f. Tension wire
- g. Gates
- 1.3 DELIVERY, STORAGE, AND PROTECTION: Deliver materials to the site in an undamaged condition. Carefully store materials off the ground to provide proper protection against oxidation caused by ground contact.

PART 2 - PRODUCTS

- 2.1 CHAIN-LINK FENCING, FABRIC, GATES, POSTS, TOP RAILS, BRACES, AND ACCESSORIES: Fed. Spec. RR-F-191/Gen and detailed specifications as referenced herein. Materials shall conform to referenced specifications and other requirements as specified herein.
- 2.1.1 Chain-Link Fencing Fabric: Fed. Spec. RR-F-191/1; Type I, zinc-coated steel, 9-gage coated wire size. Mesh size shall be 2 inches. Selvage shall be twisted and barbed at both selvages.
- 2.1.2 Chain-Link Fencing Gates: Fed. Spec. RR-F-191/2; Type I, single swing and Type II, double swing as indicated. Shape and size of the gate frame shall be as indicated. Type II gates shall have equidistant leaf sections. Framing and bracing members shall be round of alloy. Steel member finish shall be zinc-coated. Gate fabric shall be as specified herein for chain-link fencing fabric. Coating on latches, stops, hinges, keepers, and accessories shall be zinc-coated steel. Gate latches shall be fork or plunger bar type. Gate leaves less than 8 feet wide shall have truss rods or intermediate braces. Attach gate fabric to the gate frame by method standard with the manufacturer, except that welding will not be permitted. Arrange latches for padlocking so that padlock will be accessible from both sides of the gate regardless of latching arrangement.
- 2.1.3 Chain-Link Fencing, Posts, and Braces: Fed. Spec. RR-F-191/3; posts and braces, Class 1, steel pipe, Grade A. Material shall be zinc-coated steel. Braces shall be the minimum sizes shown in RR-F-191/3 for each class and grade.
 - 2.1.4 Chain-Link Fencing Accessories: Fed. Spec. RR-F-191/4.
- 2.1.5 Concrete: ASTM C 94, using 3/4-inch maximum-size aggregate, and having minimum compressive strength of 3,000 psi at 28 days. Proportion grout one part portland cement to three parts clean, well-graded sand

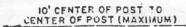
and minimum amount of water to produce a workable mix, as specified in Section 03302, "Cast-in-Place Concrete".

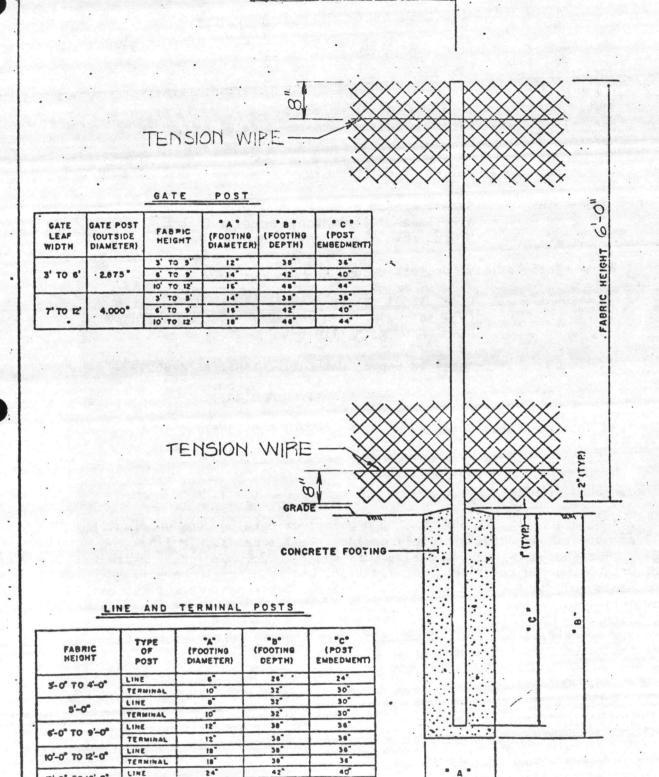
2.1.6 Padlocks: Fed. Spec. FF-P-101, Type EPA or EPB, 1-3/4 inch size. with 1/2 inch diameter shackles.

PART 3 - EXECUTION

- 3.1 INSTALLATION: Install the fence on previously prepared surfaces to line and grade as indicated and as shown on Sketch 02444-1. Install fence in accordance with the fence manufacturer's written installation instructions except as modified herein.
- 3.1.1 Grading: A graded fence line shall be established prior to the installation of fencing. The ground along the line of the fence shall be solid, and dirt fill used to establish the fence line shall be thoroughly compacted. The fence line shall be cleared of all trees, brush, or other obstacles that will interfere with the fencing.
- 3.1.2 Excavation: Excavate for concrete-embedded items to dimensions indicated, except in bedrock. If bedrock is encountered before reaching required depth, continue excavation to depth indicated or 18 inches into bedrock, whichever is less, and a minimum of 2 inches larger than outside diameter of post. Clear post holes of loose material. Dispose of waste material on station as directed by the Contracting Officer.
- 3.1.3 Post Spacing: Provide line posts spaced at 10-foot centers maximum. Provide gate posts spaced as necessary for the size of gate openings. Straight runs between braced posts shall not exceed 500 feet. Provide corner posts or pull posts for any change in direction of 15 degrees or more, or for any abrupt change in grade, with bracing in both directions.
- 3.1.4 Post Setting: Set posts plumb. Provide concrete bases of dimensions indicated. Thoroughly compact concrete to be free of voids and finish in a dome. Straight runs between braced posts shall not exceed 500 feet. In bedrock, set posts with a minimum of one inch of grout around each post. Thoroughly work grout into the hole so as to be free of voids and finish in a dome. Cure concrete and grout a minimum of 72 hours before any further work is done on posts.
- 3.1.5 Bracing: Brace gate, corner, end, and pull posts to the nearest post with a horizontal brace used as a compression member and two diagonal truss rods and truss tighteners used as tension members.
- 3.1.6 Post Caps: Install post caps as recommended by the manufacturer.

- 3.1.7 Top and Bottom Tension Wires: Install top and bottom tension wires before installing chain-link fabric and pull wires taut.
- 3.1.8 Fabric: Pull fabric taut and secure fabric to top wire and bottom wire close to both sides of each post and at intervals of not more than 24 inches on centers. Secure fabric to posts using stretcher bars and ties or clips or by integrally weaving to integral fastening loops of end, corner, pull, and gate posts for full length of each post. Install fabric on opposite side of posts from area being secured. Install fabric such that bottom of fabric is 2 inches above ground level. Install fence fabric to provide approximately 2-inch deflection at center of span of fabric between two posts, when a force of approximately 30 pounds is applied perpendicular to fabric. Fabric should return to its original position when force is removed.
- 3.1.9 Gates: Install swing gates to swing through 90 degrees from closed to open.
- 3.1.10 Padlocks: Provide padlocks for gate openings and provide chains that are securely attached to gate or gate posts. Provide padlocks keyed alike and provide two keys for each padlock.
- $3.2\,$ CLEANUP: All waste fencing materials and other trash and debris shall be cleared from the fencing site.





NOTE- TERMINAL POSTS INCLUDE END, CORNER, AND PULL POSTS.

13'-0" TO 18'-0"

CHAIN LINK FENCE

. SKETCH 02444-! *** END OF SECTION ***

ROTARY DRILLED WATER WELL

- 1. 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:
 - 1.1 Federal Specification (Fed. Spec.):

GG-G-76F Gages, Pressure and Vacuum, Dial Indicating (for Air, Steam, Oil, Water, Ammonia, Chloro-Fluoro Hydrocarbon Gases, and Compressed Gases)

1.2 American Society for Testing and Materials (ASTM) Publications:

A120-81 Pipe, Steel, Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless, for Ordinary Uses (ANSI/ASTM A120)

B88-81 Seamless Copper Water Tube (ANSI/ASTM B88)

C150-81 Portland Cement (ANSI/ASTM C150)

1.3 American Water Works Association (AWWA) Publication:

A100-66 Deep Wells

- 2. SUBMITTALS:
- 2.1 Shop Drawings: Submit shop drawings or catalog cuts showing all well components and details of well casings, well screens, air lines and gages. The shop drawings or catalog cuts shall be accompanied by a cross section showing the relative size, location, and spacing of the well components such as the hole size, outer casing, inner casing, well screen, gravel fill, air line and gage, and grout.
- 2.2 Certificates of Conformance or Compliance: Certificates of conformance or compliance are required for the following:
 - a. Casings
 - b. Screens
 - c. Gravel
 - d. Cement
 - e. Air Piping
 - f. Air Gage
 - g. Drilling Clay
 - 2.3 Samples: Submit one five-pound sample of gravel.

- 3. DELIVERY, STORAGE, AND PROTECTION: Deliver materials in an undamaged condition. Carefully store materials off the ground to provide proper protection against oxidation caused by ground contact. Replace defective or damaged materials.
- 4. MATERIALS: Materials shall conform to the respective specifications and other requirements as specified herein.
- 4.1 Casings: ASTM A120; outer casing, 18-inch nominal diameter, 0.375-inch wall thickness, black steel pipe; inner casing, 10-inch nominal diameter, 0.365-inch wall thickness, zinc-coated steel pipe. Casings shall have welded joints.
- 4.2 Well Screens: Type 304 or 316 stainless steel, 10-inch inside diameter, continuous slot type. Screens shall have adequate strength to resist all external forces to which they will be subjected, both during and after installation. Length shall be as required to provide the quantity of water specified. Water velocity through openings shall not exceed 0.1 feet per second. Determine the well screen openings from an analysis of the sand in the water bearing strata. Fit a back-pressure valve to the bottom of the screen to permit washing without the inflow of sand into the screen. Joints shall be of the same material as the screen, and shall be either threaded rings or butt type welding rings.
- 4.3 Gravel: Clean, round, hard, water worn quartz or granite with less than 5 percent feldspar, no fossils, carbonate, or organics, and of proper size and gradation that it will allow free flow of water in the well and prevent the infiltration of sand. Gravel size will be selected by the Government, based upon the analysis of the sand in the water bearing strata. Thoroughly sterilize gravel with hypochlorite before using.
- 4.4 Grout: Cement grout, type I portland cement conforming to ASTM C150, and water. The mixed grout shall contain no more than 6 gallons of water per cubic foot of cement.
 - 4.5 Air Line: ASTM B88, Type K, copper tube, 3/8-inch diameter.
- 4.6 Air Gage: Fed. Spec. GG-G-76, class 1, Style X, 4 1/2-inch, brass case, bronze tube, calibrated in feet of water.
- 4.7 Drilling Clay: Bentonite type readily thinned with commercial mud thinners or biodegradable polymer mud which will breakdown naturally. The specific gravity and the character of the mud-laden fluid shall be such that the production of the aquifers will not be impaired.
- 4.8 Auxiliary Equipment: Provide the necessary discharge piping to dispose of pumped water during developing and testing of well a sufficient distance from each well so as to prevent flooding of the site and flow back into the well, as approved by the Contracting Officer.

- 5. TEST WELL: Drill a test well at the well site before construction of the permanent well is started. Test well shall be of sufficient size to obtain the necessary information required for the construction of the permanent well, but shall be not less than 3 inches. The location, size of well, and method of drilling must be approved before work is started. Test well shall be not less than 250 feet deep. Keep an accurate log and record of all material drilled through and the depths at which changes in formation occur. Do not construct permanent well until all data submitted for test well has been analyzed and approved by the Contracting Officer. Should the data obtained from any test well indicate unfavorable conditions, exploration shall be continued at other locations approved by the Contracting Officer until a suitable well site is located. In the event additional test wells are required and approved, the contract price and time for completion will be adjusted in accordance with the contract. A test well may be incorporated into the finished construction provided it meets the requirements for a finished well. Test well not used in finished construction shall be sealed as recommended in AWWA A100.
- 5.1 Material Samples: Take samples of the type of material found in each soil stratum and preserve in approved containers furnished by the Contractor. In addition, take samples at five-foot intervals below the static water level to insure that changes in sand size are noted. Label samples to show depth below ground surface and thickness of the stratum from which the samples were obtained. Describe all water bearing strata in detail as to whether material is loose or compact, its color, and if gravel, whether it is water worn or angular. The presence of clay must be noted.
- 5.2 Water Quality Determination: Collect and have analyzed by a testing laboratory approved by the Government, samples of water from all water bearing strata encountered so as to accurately show the quality of water from each stratum. Include bacteriological and physical—chemical analysis, and further include all field and routine analysis data set forth in Parts I and III of DD Form 710, Physical and Chemical Analysis of Water, which accompanies this specification. In addition, analyze the water for any additional suspected minerals or contaminants which would make it unfit for human consumption, such as nitrate, flouride, and mercury.
- 5.3 Electric Log: Furnish a complete electric log indicating resistivity and potential of all formations.
- 5.4 Recommendation and Data Submittal: Make recommendations for the permanent wells and submit all data obtained at each well site. Include with the recommendations the appropriate depth, details of construction, length and location of screens, screen openings, gravel size, and an estimation of the quantity of water that can be obtained from each water bearing stratum and from each completed well. Submit electric log, drillers log, time penetration log (time to drill through each formation) and sieve analysis to substantiate recommendations.

- 6. CONSTRUCTION: Except as modified herein, provide rotary drilled water well in accordance with AWWA A100. The depth of well and number of screens provided shall be adequate to produce a guaranteed capacity of 300 gallons per minute of clear potable water, with a maximum drawdown of 40 feet. Secure all flow from a single aquifer; do not allow mixing of water from different aquifers.
- 6.1 Drilling: Drill a hole 16 inches in diameter to a minimum depth of 200 feet and to additional depths as required to produce the flow capacity required. When conventional rotary drilling is used accomplish all drilling using drilling clay. Maintain the pH value of the drilling clay at 7.6 or more at all times, except that for polymer muds maintain the pH at from 5 to 7.
- 6.2 Outer Casing: Install the outer casing concentrically in the drilled hole and extend the casing down to a minimum depth of 30 feet. Fill the void between the outer casing and the drilling hole with cement grout to seal the outer casing to the wall of the drilled hole. Grout outer casing from the bottom upward so as to effectively seal the void.
- 6.3 Inner Casing, Well Screens and Gravel: Install the inner casing and well screens concentrically in the outer casing and drilled hole and completely envelope the inner casing and well screens with gravel. Provide sufficient screens at the water-bearing layer to be developed to secure therefrom all available flow. Pump gravel into place under pressure, through a temporary pipe line extending to the bottom of the Raise the pipe line as the gravel fills the hole, so that the lower end of the pipe is always 2 to 6 feet below the gravel level. The gravel shall entirely fill the space around the screens and inner casing, and equipment and methods for placing the gravel shall be approved as adequate to accomplish the result before placement is begun. Control speed of gravel placement such as will prevent bridging and will allow for settlement of the gravel. When the placement of gravel is completed, thin the drilling clay and pump the well free of all sand, mud, drillings, and other foreign matter. Extend the gravel from the bottom of the well to A minimum of 10 feet above the top screen.
- 6.3.1 Provide the air line at the same time as the inner casing and locate it so as not to interfere with the pumping units provided.
- 6.3.2 Repairs to Zinc-Coating: Zinc coating on inner casing which is damaged during fabrication and assembly shall be repaired with a galvanizing repair paint.
- 6.4 Underreaming and Gravel Envelope: After the casing has been set and after the cement has hardened, the Contractor may proceed to underream the sand strata to a diameter not less than the diameter indicated. Extend the underream continuously through the entire depth of the waterbearing strata. Following completion of the underream, completely fill the entire annular space between the screen and the outside wall of the underreamed hole with gravel. Extend the gravel pack a minimum of 20 feet

up into the space between the upper casing and the lap pipe. Place the gravel by means of a gravel pipe lowered into the underreamed space.

- 6.5 Development of Well: Furnish all necessary pumps, compressors, plungers, bailing, or other needed equipment and fully develop the well as necessary to give the maximum yield of water per foot of drawdown and to limit the amount of sand which may be drawn into the well during the life of the well.
- 6.6 Tests: Upon completion of the permanent well, provide a temporary pump in the well for measuring the flow and drawdown. The temporary pump shall have a capacity of not less than 450 gallons per minute. After determining the static water level in the well, begin pumping at a rate of approximately 200 gallons per minute and check the drawdown at 15-minute intervals until it stabilizes. Continue pumping at that rate for 2 hours and check the water level at 30 minute intervals. The pumping rate shall then be increased in uniform increments not exceeding 50 gallons per minute and the described procedure repeated at each increment of increased rate until the capacity of the well is determined. The capacity of the well shall be the flow obtained at a drawdown level 10 feet above the top of the uppermost screen. After the safe maximum yield of the well has been determined, conduct a continuous 24 hour pumping test at that rate and check the drawdown at hourly intervals. Provide the necessary pipe and ditches to take the water away from the well site. Submit methods of disposing of the discharge to the Contracting Officer for approval. Furnish a complete written log of the test, showing static water level, pumping rate, and drawdown at the specified intervals. At the end of the 24 hour test, water samples shall be taken and tested by an approved testing laboratory for complete chemical and bacteriological analysis. Furnish additional samples in suitable containers.
- 6.7 Disinfection: Disinfect well, equipment, and material therein in accordance with AWWA A100. Disinfect piping in accordance with AWWA C601.
- 6.8 Sanitary Seal: Provide a sanitary seal for the well to prevent contamination until the pump foundation and pump are installed on the well.
- 7. DISPOSAL OF SOIL: Dispose of soil removed from the drilled holes by deposition on Government property, as directed by the Contracting Officer, within a haul distance of 9 miles.

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SECTION 02680

BITUMINOUS CONCRETE PAVEMENT

PART 1 - GENERAL

- 1.1 APPLICABLE PUBLICATIONS: 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.
- 1.1.1 American Association of State Highway and Transportation Officials (AASHTO):

M81-75	Cut-Back Asphalt (Rapid-Curing Type)
M82-75	Cut-Back Asphalt (Medium Curing Type)
M140-70	Emulsified Asphalt
M208-72	Cationic Emulsified Asphalt
M226-78	Viscosity Graded Asphalt Cement
Т96-77	Resistance to Abrasion of Small Size Coarse Aggregate by Use of the Los Angeles Machine

1.1.2 American Society for Testing and Materials (ASTM) Publications:

D977-80	Emulsified Asphalt
D1556-64	Density of Soil in Place by the Sand-Cone Method
D1557-78	Moisture-Density Relations of Soils and Soil- Aggregate Mixtures Using 10-1b (4.54 kg) Rammer and 18-inch (457 mm) Drop
D2922-78	Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
D3017-78	Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

1.1.3 North Carolina Department of Transportation and Highway Safety (NCDOT):

Standard Specifications for Roads and Structures, dated July 1, 1978

1.2 SUBMITTALS:

- 1.2.1 Certificates of Conformance or Compliance: Submit the following for approval:
 - a. Asphalts and Asphalt Cement
 - b. Base Course Materials
 - c. Paint
- 1.2.2 Job Mix Formula: Before starting any work, submit the formula, including mixing temperature, for approval. The submission shall include a certified laboratory analysis of mix composition and the Marshall test value obtained therefrom for stability, void content, and flow. After the job mix formula is established and approved, all mixtures furnished shall conform to the ranges of tolerances specified in the referenced NCDOT "Standard Specifications for Roads and Structures".
- 1.2.3 Materials Tests and Test Reports: The testing requirements for materials incorporated in referenced documents will be waived provided the manufacturer submits certificates stating: previously manufactured materials have been tested by recognized laboratories; such materials meet testing requirements specified; and the materials furnished for this project are of the same type, quality, manufacture and make as that tested. Do not submit copies of the test reports unless specifically requested by the Contracting Officer.
- 1.3 REQUIREMENTS: The work includes construction of a crushed stone base, priming coat and a bituminous concrete surface course. Preparation of the subgrade shall be as specified under Section 02200, "Earthwork". Except as specified herein or indicated on the drawings, work and materials shall be in accordance with the NCDOT "Standard Specifications for Roads and Structures". The provisions therein for method of measurement and payment do not apply. Provide crushed stone aggregates for the bituminous mix.

PART 2 - PRODUCTS

2.1 MATERIALS:

- 2.1.1 Stone Base Course: Materials shall be in accordance with the NCDOT "Standard Specifications for Roads and Structures, Sections 905 and 910 for Aggregate Base Course, Standard Size No. ABC. When tested in accordance with AASHTO T96, Test Grading A, aggregate shall show a loss not greater than 55 percent.
- 2.1.2 Bituminous Prime Coat: Grade MC-70 or MC-30 cut back asphalt conforming to AASHTO M82, Grade RC-30 cut-back asphalt conforming to AASHTO M81: HFMS-2 or HFMS-2h emulsified asphalt conforming to ASTM D977, or RC-30 cut back asphalt conforming to AASHTO M81.

- 2.1.3 Bituminous Tack Coat for Cold Joints: Grade RC-30, RC-70 or RC-250 cut back asphalt conforming to AASHTO M81 or AC-20 asphalt cement conforming to AASHTO M226; Grade SS-1 emulsified asphalt conforming to AASHTO M208; HFMS-1, cationic emulsified asphalt conforming to AASHTO M208; HFMS-1, emulsified asphalt conforming to ASTM D977. The SS-1, emulsified asphalt and CSS-1, cationic emulsified asphalt shall be diluted at the minimum of one part water to one part emulsified asphalt.
- 2.1.4 Bituminous Concrete: Materials and mix shall be in accordance with the NCDOT "Standard Specifications for Roads and Structures", Section 645. Type I-1 or I-2 Surface Course. Asphalt cement shall be AC-20 viscosity grade conforming to AASHTO M226.

PART 3 - EXECUTION

3.1 CONSTRUCTION:

- 3.1.1 Stone Base Course: Begin spreading the base material at the point nearest the source of supply. Hauling shall be done and traffic permitted over the base to assist in compaction. Fill ruts formed by the traffic and re-roll. After the base course is in place, continue machining and rolling until the surface is smooth, hard, well bonded, and true to the designed cross section. Obtain compaction of 100 percent of maximum dry density, as determined by ASTM D1557, Method D. Machine the base as often as necessary to maintain it smooth and true to grade and cross section until the surface course is applied.
- 3.1.2 Bituminous Prime Coat: Provide a bituminous prime coat on the finished stone base course. Apply prime coat material at a uniform rate of 0.25 gallon residual asphalt per square yard. Allow prime coat to cure for a period of at least 48 hours prior to placing the surface material. Apply the prime coat only when the surfaces to be treated are dry and the atmospheric temperature is at least 50 degrees Fahrenheit. Maintain the treated surfaces and protect them from damage until the bituminous paving material is placed. Remove surface glaze on the base course by approved methods just prior to application of the prime coat.

3.1.3 Bituminous Concrete Surface Course:

- 3.1.3.1 Placing temperature: The temperature of the asphalt mixture at the time of dumping into the mechanical spreader shall be not less than 225 degrees Fahrenheit. Mixtures which have a temperature of less than 225 degrees Fahrenheit when dumped into the spreader will be rejected.
- 3.1.3.2 Joints: Where new pavement abuts existing flexible pavement, cut back the existing surface course along uniform lines approximately 6 inches from the edge. Make a vertical cut and extend cut full depth of the surface course. Prior to placing the surface course, paint the exposed edge of cold joints with a thin layer of bituminous tack coat.

- 3.1.3.3 Spreading and finishing equipment: Shall be capable of spreading the bituminous mixture to a uniform density and striking a smooth finish, true to cross section and free from inequalities. Provide adjustable screed to shape the surface to true cross section.
- 3.1.3.4 Compaction: Equipment and compaction procedures shall be in accordance with NCDOT "Standard Specification for Roads and Structures" modified if necessary to produce the density specified in this section.
- 3.1.3.5 Placing of the surface course: Shall be as nearly continuous as possible. Pass the roller over the unprotected end of the mixture only when laying is discontinued for sufficient time to permit the mixture to cool. If this condition occurs, make a joint by cutting back the surface course to expose a granular surface for its full depth to bond with the fresh mixture. When laying is resumed, coat the exposed edge with hot asphalt cement and rake the fresh mixture against the joint, then thoroughly tamp with hot tamps and roll. Compact the surface course to a density of at least 96 percent of that obtained in the laboratory specimen.
- 3.1.3.6 Do not produce or place bituminous materials or mixtures when weather is rainy or foggy, when the base course is frozen or shows any evidence of excess moisture, or when the air temperature is less than 40 degrees Fahrenheit in the shade away from artificial heat.
- 3.1.3.7 Finished surfaces shall be uniform in texture and appearance and free of cracks and creases.
- 3.1.3.8 Protection of pavement: After final rolling, do not permit vehicular traffic of any kind on the pavement until it has cooled and hardened, and in no case in less than 6 hours.
- 3.2 TESTS: Perform the following minimum number of tests to insure compliance with the thickness and compaction requirements for base course and bituminous concrete surface course and job—mix requirements for bituminous concrete pavement:
 - a. Thickness of base course and bituminous concrete surface course: One test for each 500 square yards or fraction thereof.
 - b. Density of base course: One laboratory test for the project and one field test for each 1000 square yards or fraction thereof of each lift. Field tests shall be in accordance with ASTM D1556 or ASTM D2922 and ASTM D3017.
 - c. Bituminous concrete job-mix test: One test for each 400 tons or fraction thereof of each mix to determine gradation and bitumen content.

d. Density of bituminous concrete surface course: One field test for each 1000 square yards or fraction thereof.

*** END OF SECTION ***

SECTION 02690

PAVEMENT REMOVAL AND REPLACEMENT

PART 1 - GENERAL

- 1.1 APPLICABLE PUBLICATIONS: 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.
- 1.1.1 American Association of State Highway and Transportation Officials (AASHTO):

M81-75	Cut-Back Asphalt (Rapid-Curing Type)
M82-75	Cut-Back Asphalt (Medium Curing Type)
M140-70	Emulsified Asphalt
M208-72	Cationic Emulsified Asphalt
M226-78	Viscosity Graded Asphalt Cement
Т96-77	Resistance to Abrasion of Small Size Coarse Aggregate by Use of the Los Angeles Machine

1.1.2 American Society for Testing and Materials (ASTM) Publications:

D977-77 Emulsified Asphalt

D1557-78 Moisture-Density Relations of Soils and SoilAggregate Mixtures Using 10-1b (4.54 kg) Rammer and 18-inch (457 mm) Drop

1.1.3 North Carolina Department of Transportation and Highway Safety (NCDOT):

> Standard Specifications for Roads and Structures, dated July 1, 1978

1.2 SUBMITTALS:

- 1.2.1 Certificates of Conformance or Compliance: Submit the following for approval:
 - a. Base materials
 - b. Asphalts and asphalt cement
 - c. Bituminous Concrete Mix

1.2.2 Materials Tests and Test Reports: The testing requirements for materials incorporated in referenced documents will be waived provided the manufacturer submits certificates stating: previously manufactured materials have been tested by recognized laboratories; such materials meet testing requirements specified; and the materials furnished for this project are of the same type, quality, manufacture and make as that tested. Do not submit copies of the test reports unless specifically requested by the Contracting Officer.

PART 2 - PRODUCTS

2.1 MATERIALS:

- 2.1.1 Stone Base Course: NCDOT "Standard Specifications for Roads and Structures, Sections 905 and 910 for Aggregate Base Course, Standard Size No. 7. When tested in accordance with AASHTO T96, Test Grading A, aggregate shall show a loss not greater than 55 percent.
- 2.1.2 Bituminous Prime Coat: Grade RC-30 or MC-30 cut back asphalt conforming to AASHTO M82, Grade RC 30 conforming to AASHTO M81; HFMS-2 or HFMS-2h emulsified asphalt conforming to ASTM D977.
- 2.1.3 Bituminous Tack Coat: Grade RC-30,RC-70, or RC-250 cut back asphalt conforming to AASHTO M81, Grade AC20 conforming to AASHTO M226; Grade SS-1 emulsified asphalt conforming to AASHTO M140; CSS-1, Cationic emulsified asphalt conforming to AASHTO M208; HFMS-1, emulsified asphalt conforming to ASTM D977. The SS-1, emulsified asphalt and the CSS-1, cationic emulsified asphalt shall be diluted at the minimum of one part water to one part emulsified asphalt.
- 2.1.4 Bituminous Concrete: Materials and mix shall be in accordance with the NCDOT "Standard Specifications for Road and Structures", Section 645, Type.I-1 or I-2 Surface Course. Asphalt cement shall be AC-20 viscosity grade conforming to AASHTO M226.

PART 3 - EXECUTION

3.1 CONSTRUCTION:

- 3.1.1 Existing Surface Treatments: Where trenches, pits or other excavations are made in existing roadways and other areas of pavement where surface treatment of any kind exists, restore such surface treatment to the same thickness and in the same kind as previously existed, except as otherwise specified. Restored areas shall match and tie into the adjacent and surrounding existing surfaces in a neat and acceptable manner.
- 3.1.2 Pavement Removal: Make a straight line cut 12 inches beyond the edge of the excavation to permit proper replacement. Where bituminous concrete is overlaid on concrete paving, remove the bituminous concrete along straight lines to at least 6 inches beyond the edge of the concrete

removal. Using a saw, score edges of concrete to a depth of 1.50 inches unless bounded by joints. Cut reinforcing bars or mesh through the center and bend to edge of cut to provide work clearance. At cuts which are to become expansion joints and at locations where the broken edge of the concrete cannot be effectively concealed in the finished work, grind the break smooth or saw cut clear through the concrete. Removed pavement, debris and spoil material shall be deposited on the station, as directed by the Contracting Officer, within a haul distance of 9 miles from the site of the work.

- 3.1.3 Backfilling and Tamping: Replace soil materials under pavement in layers not to exceed 8 inches of loose depth and compact to at least 95 percent of the maximum dry density determined in accordance with ASTM D1557, Method D.
- 3.1.4 Bituminous Surface: Except as otherwise specified, provide in accordance with the NCDOT "Standard Specifications for Roads and Structures". Provide a stone base course a minimum of 6 inches thick. Apply a prime coat on the base course at the rate of 0.25 gallon residual asphalt per square yard. Paint the cut edge of bituminous pavement with a bituminous tack coat and provide bituminous concrete pavement.

*** END OF SECTION ***

SECTION 02713

EXTERIOR WATER DISTRIBUTION SYSTEM

PART 1 - GENERAL

- 1.1 APPLICABLE PUBLICATIONS: 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.
- 1.1.1 Manufacturers Standardization Society of the Valve and Fittings Industry Publication:

SP-80-74 Bronze Gate, Globe, Angle and Check Valves

1.1.2 American National Standards Institute (ANSI) Publications:

B16.18-78	Cast Copper Alloy Solder Joint Pressure Fittings
B16.22-80	Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
B16.26-75	Cast Copper Alloy Fittings for Flared Copper

1.1.3 American Society for Testing and Materials (ASTM) Publications:

В 32-76	Solder Metal
B 61-82	Steam or Valve Bronze Castings
B 62-82	Composition Bronze or Ounce Metal Castings
В 88-81	Seamless Copper Water Tube
D 698-78	Moisture Density Relations of Soils and Soil- Aggregate Mixtures Using 5.5-1b Rammer and 12-inch Drop
D 1785-76	Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
D 2241-80	Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR)
D 2321-74 (R80)	Underground Installation of Flexible Thermoplastic Sewer Pipe

	D 2466-78	Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
	D 2487-69 (R75)	Classification of Soils for Engineering Purposes
	D 2564-80	Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings
	D 2774-72 (R78)	Underground Installation of Thermoplastic Pressure Piping
	D 2855-81	Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings
	D 3139-77	Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
	F 402-80	Safe Handling of Solvent Cements and Primers Used for Joining Thermoplastic Pipe and Fittings
	F 477-76 (R81)	Elastomeric Seals (Gaskets) for Joining Plastic Pipe
1.1.	.4 American Water	Works Association (AWWA) Publications:
	C104-80	Cement-Mortar Lining for Cast-Iron and Ductile-Iron Pipe and Fittings for Water
	C110-82	Gray-Iron and Ductile-Iron Fittings 3 In. through 48 In. for Water and Other Liquids
	C111-80	Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings
	C115-75	Flanged Cast-Iron and Ductile-Iron Pipe with Threaded Flanges
	C151-81	Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, For Water and Other Liquids
	C500-80	Gate Valves, 3 Through 48 In. NPS, for Water and Sewage Systems
	C600-82	Installation of Ductile-Iron Water Mains and Their Appurtenances
	C601-81	Disinfecting Water Mains
	C800-66	Threads for Underground Service Line Fittings

C900-81 Polyvinyl Chloride (PVC) Pressure Pipe, 4 In.
Through 12 In., for Water

1.1.5 Underwriters Laboratories Inc. (UL) Publications:

262-80

Gate Valves for Fire-Protection Service

1.1.6 Uni-Bell Plastic Pipe Association (UNI) Publication:

B-3-79 Installation of Polyvinyl Chloride (PVC)
Pressure Pipe Complying with AWWA Standard C-900

1.2 DESCRIPTION OF WORK: The work includes providing new and modifying existing water piping systems and related work. Provide each system complete and ready for operation. Water piping systems including equipment, materials, installation, and workmanship shall be as specified herein. Exterior water piping systems shall include all piping buried more than 5 feet outside of building walls. Piping less than 5 feet outside of the building walls is specified under Section entitled "Plumbing." This section applies to raw water piping and potable water yard piping at wastewater treatment plant.

1.3 SUBMITTALS:

- 1.3.1 Manufacturer's Data:
 - a. Pipe, fittings, joints, couplings, and gaskets
 - b. Valves
 - c. Yard hydrants
 - d. Corporation stops
 - e. Valve boxes
- 1.3.2 Manufacturer's Certificates of Conformance:
 - a. Pipe and fittings, including shop-applied linings and coatings
 - b. Pipe joint materials
 - c. Solvent cement
 - d. Valves
- 1.4 DELIVERY, STORAGE, AND HANDLING OF MATERIALS:
- 1.4.1 Delivery and Storage: Inspect materials delivered to site for damage. Unload and store with minimum handling. Store materials in enclosures or under protective covering. Store rubber gaskets and plastic piping not to be installed immediately under cover, out of direct sunlight. Do not store materials directly on the ground. Keep interior of pipes and fittings free of dirt and debris.
- 1.4.2 Handling: Handle pipe, fittings, valves, hydrants, and other accessories in such manner as to ensure delivery to the trench in sound, undamaged condition. Avoid injury to coatings and linings on pipe and fittings; make satisfactory repairs if coatings or linings are damaged. Carry pipe to the trench; do not drag it.

1.5 EXCAVATION, TRENCHING, AND BACKFILLING: Provide in accordance with Section entitled "Earthwork," except as specified herein.

PART 2 - PRODUCTS

- 2.1 MATERIALS FOR WATER DISTRIBUTION PIPING: (Piping 4-inch diameter and larger)
- 2.1.1 Ductile-Iron Pipe and Fittings: AWWA C151, minimum thickness Class 52; AWWA C115 for flanged pipe. Fittings shall be AWWA C110 with a pressure rating not less than that of the pipe. Provide AWWA C104 standard thickness cement-mortar lining for pipe and fittings. Provide AWWA C111 mechanical joints or push-on joints for buried piping. Provide AWWA C111 rubber gaskets for each flange in water piping.
- 2.1.2 Polyvinyl Chloride (PVC) Pipe and Fittings: AWWA C900 plain end or gasket bell end, minimum pressure Class 150 (DR18) with cast-iron pipe equivalent OD. Fittings shall be AWWA C110 gray-iron or ductile-iron, with a pressure rating not less than that of the pipe, and shall have AWWA C104 standard thickness cement-mortar lining. ASTM D 3139 push-on joints or ASTM D 3139 and AWWA C111 compression type mechanical joints for buried piping. ASTM F 477 gaskets for push-on joints for pipe, and AWWA C111 gaskets for push-on joints and mechanical joints for joint connections between pipe and metal fittings, valves, and accessories.
- 2.1.3 Insulating Joints: Joints between pipe of dissimilar metals shall have a rubber gasket or other approved type of insulating joint or dielectric coupling which will effectively prevent metal-to-metal contact between adjacent sections of piping.
- 2.1.4 Accessories: Provide flanges, connecting pieces, transition glands, transition sleeves, and other adapters as required.
- 2.2 MATERIALS FOR WATER SERVICE PIPING: (Piping smaller than 4-inch diameter)
- 2.2.1 Copper Tubing and Associated Fittings: ASTM B 88, Type K; ANSI B16.18 or ANSI B16.22 solder joint fittings using ASTM B 32, 50-50 tin-lead solder; ANSI B16.26 flared joint fittings.
- 2.2.2 Polyvinyl Chloride (PVC) Pipe, Fittings, and Solvent Cement: Pipe and fittings shall bear the seal of approval of the National Sanitation Foundation for potable water service. ASTM D 1785, Schedule 40; or ASTM D 2241, with SDR as necessary to provide 150 psig minimum pressure rating. Provide ASTM D 2466 fittings. Pipe and fittings shall be of the same PVC material and shall be one of the following pipe/fitting combinations, as marked on the pipe and fitting, respectively: PVC 1120/PVC I; PVC 1220/PVC 12; PVC 2120/PVC II; PVC 2116/PVC II. Provide ASTM D 2564 solvent cement for jointing.

- 2.2.3 Insulating Joints: Provide between pipes of dissimilar metals a rubber gasket or other approved type of insulating joint or dielectric coupling which shall effectively prevent metal-to-metal contact between adjacent sections of piping.
- 2.2.4 Accessories: Provide flanges, connecting pieces, transition glands, transition sleeves, and other adapters as required.
 - 2.3 VALVES AND OTHER WATER PIPING ACCESSORIES:
- 2.3.1 Gate Valves on Buried Piping: Valves shall have nonrising stems and shall be double-disc parallel or inclined seat type. Valves shall open by counterclockwise rotation of the valve stem. Valves shall have 0-ring stem seals, except when gearing is specified, use conventional packing. Stuffing boxes shall be bolted and constructed to permit easy removal of parts for repair.
- 2.3.1.1 Valves 3-Inch Size and Larger: AWWA C500 or UL 262, except as specified herein. Valves shall have AWWA C111 mechanical joint or push-on joint ends and gaskets. Valves conforming to UL 262 shall be designed for a hydraulic working pressure of 175 psig for valve sizes 12-inch.
- 2.3.1.2 Valves Smaller Than 3-Inch Size: MSS SP 80, double disc, parallel seat, inside screw rising stem, with a water pressure rating of 200 psig. Valves shall have flanged or threaded end connections, with a union on one side of the valve. Provide operators with solid brass tee-shaped handles.
- 2.3.2 Air Release Valve: Shall be of the 2-inch automatic type that when the weight of the float, which is mounted on a compound lever mechanism, exceeds the systems pressure produced against the orifice, the valve shall release the atmosphere entrained air valve shall be designed for water service with a minimum working pressure of 150 psi and shall have a 2 inch N.P.T. inlet, 1/2 inch N.P.T. outlet and a 5/16 inch orifice. Valve shall have a cast iron body and cover, stainless steel float and linkage with a VITON orifice button or seat.
- 2.3.3 Yard Hydrants: Compression type, extend above the ground and below the frostline. hydrant shall drain of all water when valve is closed. Hydrants shall be of cast iron or galvanized steel construction. Provide 2 cubic feet of crushed stone at bottom of hydrant to permit drainage. Hydrant shall have 3/4-inch inlet and outlet. Provide 15-inch square by 4 inch thick concrete pad at hydrant.
- 2.3.4 Valve Boxes: Gate valves on buried piping shall be provided with an adjustable cast- iron valve box of a size suitable for the valve. Provide each cast-iron box with a heavy coat of bituminous paint. Outside of paved areas, boxes may be of plastic; such plastic valve boxes shall be constructed of ABS (Acrylonitrile-Butadiene-Styrene) plastic or of inorganic fiber reinforced black polyolefin plastic. The head shall be round and the lid shall have the word "WATER" cast on it. The least diameter of the box shaft shall be 5.25 inches.

2.4 WATER SERVICE PIPING APPURTENANCES:

- 2.4.1 Corporation Stops: ASTM B 61 or ASTM B 62 bronze ground key type; and shall be designed for the working pressure of the system. Provide ends for solder-joint, or flared tube compression type joint. AWWA C800 threaded ends for inlet and outlet of corporation stops; and ANSI B16.26 coupling nut for connection to flared copper tubing.
- 2.5 TRACER WIRE FOR NONMETALLIC PIPING: Shall be bare copper or aluminum wire not less than 0.10 inch in diameter and provided in sufficient length to be continuous over each separate run of nonmetallic piping. Attach wire to top of pipe to prevent displacement during construction operations.
- 2.6 BURIED UTILITY WARNING AND IDENTIFICATION TAPE: Provide detectable aluminum foil plastic-backed tape or detectable magnetic plastic tape manufactured specifically for warning and identification of buried piping. Tape shall be detectable by an electronic detection instrument. Provide tape in rolls, 3 inches minimum width, color coded for the utility involved, with warning and identification imprinted in bold black letters continuously over entire tape length. Warning and identification shall be CAUTION BURIED WATER LINE BELOW or similar. Use permanent code and letter coloring unaffected by moisture and other substances contained in trench backfill material. Bury tape with the printed side up at a depth of 6 inches below the top surface of earth or the top surface of the subgrade under pavements.
- 2.7 IDENTIFICATION TAGS AND PLATES: Provide valves with tags or plates numbered and stamped for their usage. Plates and tags shall be of brass or nonferrous material and shall be mounted or attached to the valve.

PART 3 - EXECUTION

- 3.1 INSTALLATION: These requirements shall apply to all piping except as specified otherwise.
 - 3.1.1 Location of Water Piping:
 - 3.1.1.1 Water Piping Installation Parallel With Sewer Piping:
- 3.1.1.1.1 Normal Conditions: Water piping shall be laid at least 10 feet horizontally from a sewer or sewer manhole whenever possible. The distance shall be measured edge-to-edge.
- 3.1.1.2 Unusual Conditions: When local conditions prevent a horizontal separation of 10 feet, the water piping may be laid closer to a sewer or sewer manhole provided that:
 - a. The bottom (invert) of the water piping shall be at least 18 inches above the top (crown) of the sewer piping.

- b. Where this vertical separation cannot be obtained, the sewer piping shall be constructed of AWWA-approved water pipe, pressure tested in place without leakage prior to backfilling.
- c. The sewer manhole shall be of watertight construction and tested in place.
- 3.1.1.2 Installation of Water Piping Crossing Sewer Piping:
- 3.1.1.2.1 Normal Conditions: Water piping crossing above sewer piping shall be laid to provide a separation of at least 18 inches between the bottom of the water piping and the top of the sewer piping.
- 3.1.1.2.2 Unusual Conditions: When local conditions prevent a vertical separation described above, the following construction shall be used:
 - a. Sewer piping passing over or under water piping shall be constructed of AWWA-approved water piping, pressure tested in place without leakage prior to backfilling.
 - b. Water piping passing under sewer piping shall, in addition, be protected by providing:
 - (1) A vertical separation of at least 18 inches between the bottom of the sewer piping and the top of the water piping.
 - (2) Adequate structural support for the sewer piping to prevent excessive deflection of the joints and the settling on and breaking of the water piping.
 - (3) That the length (minimum 18 feet) of the water piping be centered at the point of the crossing so that joints shall be equidistant and as far as possible from the sewer piping.
- 3.1.1.3 Sewer Piping or Sewer Manholes: No water piping shall pass through or come in contact with any part of a sewer manhole.
- 3.1.2 Connections to Existing Water Supply Systems: Locate existing raw water piping. Remove existing 90 degree bend and install new tee and blocking.
- 3.1.3 Pipe Laying and Jointing: Inspect pipe, fittings, valves, and accessories before and after installation; those found defective shall be replaced with new materials. Remove fins and burrs from pipe and fittings. Before placing in position, clean pipe, fittings, valves, and accessories, and maintain in a clean condition. Provide facilities for lowering sections of pipe into trenches. Do not drop or dump pipe, fittings, valves, or any other water piping material into trenches. Cut pipe accurately to measurements established at the site and work into place without springing or forcing. Replace pipe or fitting that does not allow sufficient space for proper installation of jointing material

with new pipe or fittings of proper dimensions. Blocking or wedging between bells and spigots will not be permitted. Lay bell-and-spigot pipe with the bell end pointing in the direction of laying. Grade the piping in straight lines; avoid the formation of any dips or low points. Support pipe at its proper elevation and grade; ensure firm and uniform support. Wood support blocking will not be permitted. Lay pipe so that the full length of each section of pipe and each fitting will rest solidly on the pipe bedding; excavate recesses to accommodate bells, joints, and couplings. Provide anchors and supports [where indicated and] where necessary for fastening work into place. Make proper provision for expansion and contraction of piping. Keep trenches free of water until joints have been completely assembled. At the end of each day's work, close open ends of pipe temporarily with wood blocks or bulkheads. Depth of cover over top of pipe shall be not less than 2-1/2 feet.

- 3.1.4 Installation of Tracer Wire: Attach wire to top of pipe to prevent displacement during construction operations.
- 3.2 SPECIAL REQUIREMENTS FOR INSTALLATION OF WATER DISTRIBUTION PIPING: Install pipe and fittings in accordance with the general requirements for installation of piping, except as otherwise specified herein.
- 3.2.1 Ductile-Iron Pipe and Fittings: AWWA C600 for pipe installation, joint assembly, valve and fitting installation, and thrust restraint, except as otherwise specified hereunder. Provide AWWA C600 joint assembly for push-on joints. Provide AWWA C600 joint assembly for mechanical joints and with the recommendations of Appendix A to AWWA Clll. Make flanged joints up tight; avoid undue strain on flanges, fittings, valves, and other accessories. Use full-sized bolts for the bolt holes; use of undersized bolts to make up for misalignment of bolt holes or for any other purpose will not be permitted. Do not allow adjoining flange faces to be out of parallel to such degree that the flanged joint cannot be made watertight without overstraining the flange. When any flanged pipe or fitting has dimensions that do not allow the making of a proper flanged joint as specified in this paragraph, replace it with one of proper dimensions. Assemble insulating joints as specified for flanged joints, except that bolts with insulating sleeves shall be full size for the bolt holes. Assure that there is no metal-to-metal contact between dissimilar metals after joint has been assembled.
- 3.2.2 Polyvinyl Chloride (PVC) Pipe and Fittings: UNI-B-3 for laying of pipe, joining PVC pipe to fittings and accessories, and setting of hydrants, valves, and fittings, except as specified hereunder. Make push-on joints with elastomeric gaskets using either elastomeric gasket bell-end pipe or elastomeric gasket couplings. Use push-on joint having factory-made bevel on pipe ends for pipe-to-pipe joint connections only; for push-on joint connections to metal fittings, valves, and other accessories, cut spigot end of pipe off square and rebevel pipe end to a bevel approximately the same as that on ductile-iron pipe used for the

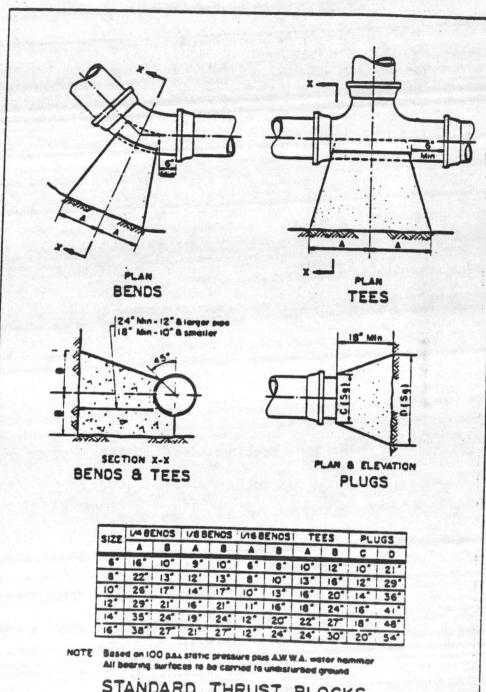
same type of joint. Use an approved lubricant recommended by the pipe manufacturer for push-on joints. Assemble push-on joints for pipe-to-pipe joint connections in accordance with the requirements of UNI-B-3 for laying the pipe. Assemble push-on joints for connection to fittings, valves, and other accessories in accordance with the requirements of UNI-B-3 for joining PVC pipe to fittings and accessories and with the applicable requirements of AWWA C600 for joint assembly. Assemble compression-type joints and mechanical joints with the gaskets, glands, bolts, nuts, and internal stiffeners in accordance with the requirements of UNI-B-3 and AWWA C600, and Appendix A to AWWA C111. Cut off spigot end of pipe for compression-type joint and mechanical-joint connections and do not rebevel.

- 3.2.3 Bedding Requirements: AWWA C600, Type 4, except as specified herein: Backfill to top of pipe shall be compacted to 95 percent of ASTM D 698 maximum density. Polyvinyl chloride (PVC) piping shall have bedding to springline of pipe. Materials shall be Class I, II, or III in accordance with ASTM D 2321 as follows:
 - a. Class I -- Angular, 6 to 40 mm (0.25 to 1.5 inches), graded stone, including a number of fill materials that have regional significance such as coral, slag, cinders, crushed stone, and crushed shells.
 - b. Class II -- Coarse sands and gravels with maximum particle size of 40 mm (1.5 inches), including variously graded sands and gravels containing small percentages of fines, generally granular and noncohesive, either wet or dry. Soil Types GW, GP, SW, and SP are included in this class as specified in ASTM D 2487.
 - c. Class III -- Fine sand and clayey gravels, including fine sands, sand-clay mixtures, and gravel-clay mixtures. Soil Types CM, GC, SM, and SC are included in this class as specified in ASTM D 2487.
- 3.2.4 Pipe Anchorage: Provide anchorage of buried piping by using concrete thrust blocks (reaction backing) having a minimum compressive strength of 2000 psi. All 22.5 degrees and sharper bends, tees, and dead ends of piping shall be securely blocked in the direction of flow with cast-in-place concrete bearing solidly against the piping and affording a minimum of 3 square feet of bearing area against a vertical trench face for 3- and 4-inch piping, and in accordance with Sketch NFGS-02713-1 for piping 6-inch diameter and larger.
 - 3.2.5 Valves for Water Mains: AWWA C600.
 - 3.3 SPECIAL REQUIREMENTS FOR INSTALLATION OF WATER SERVICE PIPING:
- 3.3.1 Installation: Terminate water service piping 5 feet from the building wall; such water service piping shall be closed with plugs or caps and staked with wood markers.

- 3.3.2 Metallic Piping: Install pipe and fittings in accordance with the general requirements for installation of piping and with the applicable requirements of AWWA C600 for pipe installation, except as otherwise specified in the following subparagraphs.
- 3.3.2.1 Joints for Copper Tubing: Cut copper tubing with square ends; remove fins and burrs. Replace dented, gouged, or otherwise damaged tubing with new tubing. Before making joint, clean ends of tubing and interior of fitting or coupling with wire brush or abrasive. Apply a rosin flux to the tubing end and on recess inside of fitting or coupling. Insert tubing end into fitting or coupling for the full depth of the recess and solder. For compression joints on flared tubing, insert tubing through the coupling nut and then flare tubing with a flaring tool.
- 3.3.2.2 Flanged Joints: Make flanged joints up tight; avoid undue strain on flanges, valves, fittings, and accessories.
- 3.3.3 PVC Piping: Install pipe and fittings in accordance with the general requirements for installation of piping and with the applicable requirements of ASTM D 2774 and ASTM D 2855, except as modified herein. ASTM F 402 for safe handling of solvent cements.
- 3.3.3.1 Jointing: Make solvent-cemented joints and assemble in accordance with ASTM D 2855. Make pipe joints to other pipe materials in accordance with the recommendations of the PVC pipe manufacturer, as approved.
- 3.3.4 Connections to Water Main Piping: Connect service lines to the main by a corporation stop and install a curb stop below the frostline. Connect service lines 2-inch size and larger to the main with a rigid connection and install a gate valve on service line below frostline.
- 3.3.5 Installation of Valves and Valve Boxes: Valves and valve boxes shall be set plumb, with valve boxes centered directly over the valves. Valve boxes shall be located outside the area of the roads and streets whenever possible. Earth fill shall be tamped around the valve box to a distance of 4 feet on all sides of the box, or to the undisturbed trench face if less than 4 feet. Clean foreign matter from interior of valves before installation. Stuffing boxes shall be tightened and the valve shall be inspected in open and closed positions to ensure that all parts are in proper working order.
- 3.4 DISINFECTION: Disinfect the new potable water piping and existing potable water piping affected by Contractor's operations in accordance with AWWA C601. Fill the piping systems with solution containing minimum of 50 parts per million of available chlorine, and allow solution to stand for a minimum of 24 hours. Flush the solution from the systems with clean water until maximum residual chlorine content is not greater than 0.2 parts per million.

- 3.5 FIELD TESTS AND INSPECTIONS: Perform all field tests, and provide all labor, equipment, and incidentals required for testing, except that water and electric power needed for field tests will be furnished as set forth in Division 1. The Contractor shall produce evidence, when required, that any item of work has been constructed in accordance with contract requirements. Allow concrete to cure a minimum of 5 days before testing any section of piping where concrete thrust blocks have been provided.
- 3.5.1 Testing Procedure: Test water mains and water service piping in accordance with the following applicable standards, as modified herein:
 - 3.5.1.1 Water Distribution Piping:
 - a. Ductile-Iron: AWWA C600 for pressure and leakage tests, except no leakage will be allowed for flanged joints.
 - b. PVC: UNI-B-3 for pressure and leakage tests.
 - 3.5.1.2 Water Service Piping:
 - a. Copper Tubing and PVC: AWWA C600 for hydrostatic testing. No leakage shall be allowed.
- 3.5.1.3 Special Testing Requirements: For pressure test, use a hydrostatic pressure 50 psi greater than the maximum working pressure of the system, but not less than 200 psi. Hold this pressure for not less than 2 hours. Prior to the pressure test, fill that portion of the piping being tested with water for a soaking period of not less than 24 hours. For leakage test, use a hydrostatic pressure not less than the maximum working pressure of the system. Leakage test may be performed at the same time and at the same test pressure as the pressure test.
- 3.5.1.4 All equipment shall be tested in operation to demonstrate compliance with the contract requirements.

*** END OF SECTION ***



STANDARD THRUST BLOCKS
FOR WATER MAINS

Sketch NFGS-02713-1

SECTION 02722

EXTERIOR SANITARY SEWERS AND FORCE MAINS

- 1. APPLICABLE PUBLICATIONS: The following publications of the issues listed below, but referred to elsewhere by basic designation only, form a part of this specification to the extent indicated by references thereto (where a number is suffixed to the specification number, it denotes the effective amendment to the specification):
 - 1.1 Federal Specifications (Fed. Spec.):

RR-F-621C	Frames, Covers, Gratings, Steps, Sump and Catch Basin, Manhole
WW-P-421D	Pipe, Cast Gray and Ductile Iron, Pressure (For Water and Other Liquids)
WW-V-51E(2)	Valve, Angle, Check, and Globe, Bronze (125, 150 and 200 Pound, Threaded Ends, Flange Ends, Solder Ends, and Brazed Ends, For Land Use)
WW-V-54D(3)	Valve, Gate, Bronze (125, 150, and 200-Pound; Threaded Ends, Flange Ends, Solder End, and Brazed Ends, For Land Use)
WW-V-58B	Valves, Gate, Cast-Iron; Threaded and Flanged (For Land Use)

1.2 Military Specification:

MIL-V-18436c(2) Valves, Check: Bronze, Cast-Iron, and Steel Body

1.3 American Society for Testing and Materials (ASTM):

A 74-81	Cast-Iron Soil Pipe and Fittings
в 88-81	Seamless Copper Water Tube
C 32-73 (R 79)	Sewer and Manhole Brick (Made From Clay or Shale)
C 62-81	Building Brick (Solid Masonry Units Made From Clay or Shale)
C 139-73 (R 79)	Concrete Masonry Units for Construction of

	C 425-77 (R 82)	Compression Joints for Vitrified Clay Pipe and Fittings
	C 478-82 (Rev. A)	Precast Reinforced Concrete Manhole Sections
	C 564-70 (R 82)	Rubber Gaskets for Cast Iron Soil Pipe and Fittings
	C 700-78 (Rev. A)	Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated
	D 2235-81	Solvent-Cement for Acrylonitrile-Butadiene- Styrene (ABS) Plastic Pipe and Fittings
	D 2321-74 (R 80)	Underground Installation of Flexible Thermoplastic Sewer Pipe
	D 2487-69 (R 75)	Classification of Soils for Engineering Purposes
	D 2680-80	Acrylonitrile-Butadiene-Styrene (ABS) Composite Sewer Piping
	D 2751-80	Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings
	D 3033-81	Type PSP Poly (Vinyl Chloride)(PVC) Sewer Pipe and Fittings
	D 3034-81	Type PSM Poly (Vinyl Chloride)(PVC) Sewer Pipe and Fittings
	D 3212-81	Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Gaskets
	F 477-76 (R 81)	Elastomeric Seals (Gaskets) for Joining Plastic Pipe
1.4 Officials	American Association (AASHTO):	tion of State Highway and Transportation
	M 198-75 (R 82)	Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets
1.5	Cast-Iron Soil P	ipe Institute (CISPI) Publications:
	301-78	Cast Iron Soil Pipe and Fittings for Hubless Cast-Iron Sanitary System

	310–78	Patented Joint for Use in Connection with Hubless Cast Iron Sanitary System		
1.6	American National Standards Institute (ANSI):			
	A21.6-1975	Cast-Iron Pipe Centrifugally Cast in Metal Molds for Water or Other Liquids		
	A21.8-1975	Cast-Iron Pipe Centrifugally Cast in Sand-Lined Molds for Water or Other Liquids		
	A21.10-1971	Gray-Iron and Ductile-Iron Fittings, 2 inch Through 48 inch, For Water and Other Liquids		
	A21.11-1972	Rubber Gasket Joints for Cast-Iron and Ductile- Iron Pressure Pipe and Fittings		
	A21.15-1975	Flanged Cast-Iron and Ductile-Iron Pipe with Threaded Flanges		
1.7	Underwriters' l	aboratories (UL):		
	UL 194	The Performance of Gasketed Joints for Cast- Iron Pressure Pipe and Fittings, May 1973		
	UL 262	Gate Valves for Fire-Protection Service, May 1973		
	UL 312	Swing-Check Valves for Fire-Protection Service, June 1980		
1.8	American Water	Works Association (AWWA):		
	C 111-72	Rubber Gasket Joints for Cast-Iron and Ductile- Iron Pressure Pipe and Fittings		
	c 500-80	Gate Valves - 3 inch through 48 inch - For Water and Other Liquids		
	C 501-80	Sluice Gates		
1.9	LANTDIV Plates:			
	SS-1	Standard Manhole		
	SS-2	Standard Drop Manhole		
	SS-3	Cleanout Detail		

- 2. GENERAL REQUIREMENTS: Section 15011, "Mechanical General Requirements" also applies to this section except as specified otherwise. Exterior sanitary sewer systems shall include all sewer piping buried and above ground more than 5 feet outside of building walls. Piping less than 5 feet outside of building walls is specified under Section 15400, "Plumbing" and Section 15271, "Inplant Piping and Accessories". This section includes sanitary gravity sewer piping, sanitary force mains, and all sanitary yard piping at the wastewater treatment plant. Trenching and backfilling are specified in the section entitled "Earthwork". Concrete work shall be in accordance with the section entitled "Cast-In-Place Concrete," using concrete with a compressive strength not less than 3000 psi. Each system shall be complete and ready for operation. Piping shall be inspected, tested, and approved before being buried, covered, or concealed.
 - 2.1 Piping Application:
- 2.1.1 Sanitary Gravity Sewer Piping: Cast-iron soil pipe, ABS composite piping, ABS solid wall piping (6-inch diameter and smaller), or PVC solid wall piping.
 - 2.1.2 Sanitary Force Mains: Ductile iron pipe, or PVC.
- 2.1.3 Sanitary Yard Piping (Wastewater Treatment Plant): Ductile iron pipe (4-inch and larger), galvanized steel pipe (smaller than 4-inch).
- 3. SUBMITTALS REQUIRED: Shop drawings, manufacturer's data and certificates for equipment, materials, finish, and pertinent details for each system shall be submitted and approved before procurement, fabrication or delivery of such items to the job site. Partial submission will not be acceptable. Descriptive data shall be annotated to show the specific model, type and size of each item the Contractor proposes to furnish. The submittal requirements of Section 15011, "Mechanical General Requirements," applies to the following lists.
 - 3.1 Manufacturer's Data:
 - a. Frames and Covers for Manholes
 - b. Cleanouts
 - c. Precast Manholes
 - d. Adapters
 - e. Valves
 - f. Valve Boxes
 - g. Pipe, Fittings, Joints, Couplings, and Gaskets
- 3.2 Certificates: Submit certificates from the manufacturer attesting that each of the following items conform to all requirements of this specification and of reference publications.

- a. Pipe, and Pipe Fittings and Joints
- b. Frames and Covers for Manholes
- c. Precast Manholes
- d. Brick
- e. Masonry Units
- f. Valves

4. MATERIALS:

- 4.1 Sanitary Gravity Sewer Piping: Piping shall be either cast iron soil piping, acrylonitrile-butadiene-styrene (ABS) composite piping, ABS solid wall piping (6-inches in diameter and smaller), or polyvinyl chloride PVC solid wall piping.
 - 4.1.1 Cast-iron piping shall conform to ASTM A 74, service weight.
- 4.1.2 Hubless cast-iron piping. In lieu of service weight cast-iron hub-and-spigot pipe the Contractor may use hubless cast-iron piping and fittings conforming to CISPI Standard No. 301.
- 4.1.3 ABS composite piping shall conform to ASTM D 2680. Ends of pipe and fittings shall be suitable for either Type SC or Type OR joint.
- 4.1.4 ABS plastic solid wall piping shall conform to ASTM D 2751 SDR 35, and shall have ends suitable for either solvent cement joints or elastomeric joints.
- 4.1.5 PVC plastic solid wall piping shall conform to ASTM D 3033 or ASTM D 3034, SDR 35, with ends suitable for elastomeric gasket joints.
 - 4.2 Pipe Joints:
- 4.2.1 Hub and Spigot Cast-Iron Pipe: Joints in hub and spigot cast-iron pipe and fittings shall conform to ASTM C 564. The piping shall be as specified hereinbefore, except for dimensional modifications to the hub and the spigot end to suit the gasket. The gasket shall be furnished with the pipe and shall be the same class as the pipe in which it is installed.
- 4.2.2 Hubless Cast-Iron Pipe: Joints in hubless cast-iron pipe and fittings shall conform to CISPI Standard No. 310, coupling joints.
- 4.2.3 ABS Composite Pipe: Materials shall be in accordance with the requirements for jointing materials in the specification for the pipe. Installation shall be in strict compliance with the printed instructions and recommendations of the manufacturer of the pipe. Solvent cement for Type SC joint and gaskets for Type OR joint shall be as specified in ASTM D 2680.

- 4.2.4 ABS Plastic Solid Wall Pipe: Solvent cement for solvent cement joints shall conform to ASTM D 2235. Elastomeric joints shall conform to ASTM D 3212. Gaskets shall conform to ASTM F 477.
- 4.2.5 PVC Plastic Solid Wall Pipe: Joints shall conform to ASTM D 3212. Gaskets shall conform to ASTM F 477.
- 4.2.6 Joints between dissimilar types of pipe shall be made with manufacturer's standard adapters manufactured for connecting dissimilar types of pipe. Adapters shall be of polyvinyl chloride (PVC) or rubber, and shall be provided with stainless steel clamps with stainless steel take-up bolts for attaching to each end of the pipe.

4.3 Manholes:

- 4.3.1 Brick shall conform to ASTM C 32 for standard size, Grade MS, or ASTM C 62 for standard size, Grade SW, except that absorption test will be waived.
 - 4.3.2 Solid concrete masonry units shall conform to ASTM C 139.
- 4.3.3 Cement mortar for masonry work, pargeting and other purposes shall be mixed in the proportion of one part Portland cement and 2 parts of approved mortar sand. The quantity of water in the mixture shall be sufficient to produce a stiff workable mix. Water shall be potable and free from harmful acids, alkalies, and organic impurities. The mortar shall be used within 30 minutes after the ingredients are mixed with water.
- 4.3.4 Precast Concrete Manholes: Risers and tops shall conform to ASTM C 478. They shall be laid in full beds of mortar. Concrete precast and cast-in-place bases shall have smooth inverts accurately shaped to a semi-circular bottom conforming to the inside contour of the adjacent sewer sections. Changes in direction of the sewer and entering branches into the manhole shall have a circular curve in the manhole invert of as large a radius as the size of the manhole will permit. Joints in precast sections shall be made with preformed plastic gaskets conforming to AASHTO M 198, Type B. Precast manholes shall be provided with a 12-inch layer of gravel bedding under the concrete bases of the manholes.
- 4.3.5 Frames and covers for manholes shall conform to RR-F-621, Figure 1, Size 22A for frame and Figure 8, Size 22A for cover in paved areas, and Figure 4, Size 22 for frame and Figure 12, Size 22 for cover in nonpaved areas. Frames and covers shall be factory coated with asphalt based paint.
 - 4.3.6 Manhole steps shall conform to RR-F-621.

- 4.4 Sanitary Force Mains and Sanitary Yard Piping:
- 4.4.1 Ductile-Iron Pipe and Fittings: AWWA C151, minimum thickness Class 52; AWWA C115 and Appendix A for flanged pipe. Fittings shall be AWWA C110 with a pressure rating not less than that of the pipe. Provide AWWA C104 standard thickness cement-mortar lining for pipe and fittings. Provide AWWA C111 mechanical joints or push-on joints for buried piping. Provide AWWA C111 rubber gaskets for each flange in server piping.
- 4.4.2 Polyvinyl Chloride (PVC) Pipe and Fittings: AWWA C900 plain end or gasket bell end, minimum pressure Class 150 (DR18) with cast-iron pipe equivalent OD. Fittings shall be AWWA C110 gray-iron or ductile—iron, with a pressure rating not less than that of the pipe, and shall have AWWA C104 standard thickness cement—mortar lining. ASTM D 3139 push—on joints or ASTM D 3139 and AWWA C111 compression type mechanical joints for buried piping. ASTM F 477 gaskets for push—on joints for pipe, and AWWA C111 gaskets for push—on joints and mechanical joints for joint connections between pipe and metal fittings, valves, and accessories.
- 4.4.3 Steel Pipe: ASTM A 53 or ASTM A 120, Schedule 40, hot-dip galvanized, threaded end connections; with ANSI B16.12 hot-dip galvanized threaded fittings.
- 4.4.3.1 Threaded Connections: Jointing compound for pipe threads shall be polytetrafluoroethylene (PTFE) pipe thread tape, pipe cement and oil, or PTFE powder and oil; apply only on male threads. Provide exposed ferrous pipe threads with one coat of Fed. Spec. TT-P-645 primer applied to a minimum dry film thickness of 1.0 mil.
- 4.4.4 Insulating Joints: Joints between pipe of dissimilar metals shall have a rubber gasket or other approved type of insulating joint or dielectric coupling which will effectively prevent metal-to-metal contact between adjacent sections of piping.
- 4.4.5 Accessories: Provide flanges, connecting pieces, transition glands, transition sleeves, and other adapters as required.

4.5 Valves:

4.5.1 General: Valves shall be of the type, pattern, and sizes indicated and/or required for the service. All valves shall be equipped with suitable means of operation. Underground valves shall be of the inside screw type and shall have valve boxes. All gate valves that are not underground, except as otherwise noted, shall be of the outside screw and yoke type rising stem, with handwheel or floorstand as indicated or required for operation. All plug valves shall be equipped with a suitable lever and floorstand if indicated or required for operation. All valves shall open by counterclockwise rotation. Suitable extension stems of cold rolled steel shall be provided for operation of valves from floorstands. All valves shall be equipped with handwheel operator except where indicated otherwise.

4.5.2 Gate Valves:

- 4.5.2.1 Gate valves shall be cast iron body, fully bronze mounted, parallel seat, double disc design in accordance with AWWA Specification C500-80 or UL 262 and Federal Specification WW-V-58B. They shall be suitable for a working pressure of not less than 150 pounds per square inch.
- 4.5.2.2 Gate valves 3 inch and smaller shall conform to requirements of AWWA C500-80, except for size or to UL 262 and Federal Specification WW-V-54D(3). Valves shall be designed for a working pressure of 175 psi.
- 4.5.3 Plug Valves: MIL-V-12003 for sewage and sludge service as indicated. Class 150, Type I (lubricated tapered plug), Style A (without operating gears) for pipe smaller than 8 inches in diameter, and Style B (with operating gears) for pipe 8 inches in diameter and larger. The valves shall be flanged, epoxy coated cast iron bodies with full port opening. Geared valves shall be provided with 1/4 turn floor stands and handwheel operators.

4.6 Check Valves:

- 4.6.1 General: Unless otherwise noted all check valves 4 inches and larger shall be the horizontal, lever and weight type swing type check valves. Check valves 3 inches and smaller shall be swing type with screen in cap and renewable composition disc. All check valves shall conform to Military Specification MIL-V-18436C(2).
- 4.6.2 Swing Check Valves: Check valves, unless otherwise indicated, shall be lever and weight type, iron body, bronze bushed stainless steel hinge pin, seat ring of brass or bronze, and rubber disc face designed for a working pressure of not less than 150 pounds per square inch. Valves shall have a suitable opening for cleaning without disconnecting from the pipe.
- 4.7 Floorstands: Floorstands shall be provided where indicated or required for operation of valves and sluice gates. Floorstandards shall be cast iron, bronze mounted and equipped with a handwheel or lever as required. A suitable indicator shall be provided to indicate whether the valve is open or closed.
- 4.8 Bench Stands: Provide wall mounted bench stands where required for the operation of valves and sluice gates. Bench stands shall be either rising stem or non-rising stem type of cast iron construction with bronze bushing guide. The stand shall be fully adjustable in both the horizontal and vertical direction. Provide handwheel operator.
- 4.9 Valve Boxes: Valve boxes shall be provided for underground valves. The boxes shall be of cast iron and shall consist of a base section, center extension sections as required, and a top section with cover marked "SEWER". The box shall be set vertical with the top at

finished grade. Provide 24 inch square by 4 inch thick concrete pad at top of valve boxes located in grassed areas.

- 4.10 Shear Gates: Shear gates shall be iron body, bronze mounted, double wedge and of the size and pattern indicated or required. A suitable pull rod with guides and a catch for the proper operation of the gate shall be provided.
- Sluice Gates: In general, the gates shall be in accordance with AWWA Specification C501. The stem shall be type 303 SS of sufficient length to permit operation of the gate from a floor stand mounted on the operating floor or a bench stand as shown on the drawings. The stem shall be of a diameter to safely withstand the opening and closing thrust encountered in the operation of the gate under the specified head and be furnished in sections to permit reasonable ease in installation and removal. Stem couplings and thrust nut for connecting the stem to the gate shall be of manganese bronze. Couplings shall be threaded and keyed to the stem and provision made to prevent stem rotation in the thrust nut. Stem guides shall be provided in sufficient quantity such that the slinderness ratio L/r is less than 200. The guides shall be of cast iron and bronze brushed, adjustable in two directions to provide for proper alignment. A stem cover shall be provided. Wedges shall be adjustable, solid cast bronze keyed to cast iron pads.

5. INSTALLATION:

5.1 Pipe Laying (Gravity Sewer Pipe): Pipe shall be inspected in the sling and approved before lowering into the trench. Defective, damaged, or unsound pipe will be rejected. Batterboards shall be provided not more than 25 feet apart in trenches for checking and insuring proper pipe slope and elevation. Laser beam method may be used for insuring proper slope and elevation in lieu of batter boards. Except where otherwise necessary for making connections with other piping, pipe shall be laid with hubs or bells facing in the direction of the laying. Where cutting of the pipe is necessary, it shall be done with approved mechanical cutters in a manner that will not damage the pipe. The full length of each section of pipe shall rest solidly upon the pipe bed with recesses excavated to accommodate the bells, hubs, and joints. Pipe that has the grade or joint disturbed after laying shall be taken up and relaid. The interior of the pipe shall be thoroughly cleaned of all foreign matter before being laid in the trench and shall be kept clean during laying operations by means of plugs or other approved methods. When work is not in progress, open ends of pipe and fittings shall be securely closed so that no trench water or other foreign substance will enter the pipes or fittings. Installation of plastic piping shall be in accordance with the printed instruction of the pipe manufacturer and shall follow the recommended procedures of ASTM D 2321. Special precautions shall be taken in the installation of plastic piping to insure that no stress is induced in the pipe joints for at least 24 hours after the solvent welded joint is completed.

- 5.2 Bedding Requirements: AWWA C600, Type 4, except as specified herein: Backfill to top of pipe shall be compacted to 95 percent of ASTM D 698 maximum density. Plastic piping shall have bedding to springline of pipe. Materials shall be Class I, II, or III as specified in ASTM D 2321 as follows:
- a. Class I Angular, 6 to 40 mm (1/4 to 1-1/2 in.), graded stone, including a number of fill materials that have regional significance such as coral, slag, cinders, crushed stone, and crushed shells.
- b. Class II Coarse sands and gravels with maximum particle size of 40 mm (1-1/2 in.), including variously graded sands and gravels containing small percentages of fines, generally granular and noncohesive, either wet or dry. Soil Types GW, GP, SW, and SP are included in this class as specified in ASTM D 2487.
- c. Class III Fine sand and clayey gravels, including fine sands, sand-clay mixtures, and gravel-clay mixtures. Soil Types GM, GC, SM, and SC are included in this class as specified in ASTM D 2487.
- 5.3 Joints: Pipe joints shall be of the types specified hereinbefore. Except as specified otherwise, joint installation shall follow the printed instructions of the pipe manufacturer. Adapters shall be installed in accordance with the printed instructions of the adapter manufacturer.
- 5.4 Connections to Existing Sanitary Systems and Structures: The Contractor shall furnish all material and labor required to make connections into the existing sanitary systems; and shall perform all necessary excavating, backfilling, and other labor as required. Where new manholes are constructed on existing lines, the existing pipe shall be removed as required to properly construct the structures. The pipe shall be cut or broken neatly so that the pipe ends will be approximately flush with the interior face of structure walls, but not protruding beyond such face into the structure. The pipe to wall connections shall be mortared smoothly to produce smooth transitions and watertight connections. The Contracting Officer shall be notified in writing at least ten days prior to the date the connections are required. Approval by the Contracting Officer shall be received before any service is interrupted.
- 5.5 Buried Utility Warning and Identification Tape: Provide detectable aluminum foil plastic backed tape or detectable magnetic plastic tape manufactured specifically for warning and identification of buried piping. Tape shall be detectable by an electronic detection instrument. Provide tape in rolls, 3 inches minimum width, color coded for the utility involved with warning and identification imprinted in bold black letters continuously and repeatedly over entire tape length. Warning and identification shall be CAUTION BURIED SEWER LINE BELOW or similar. Use permanent code and letter coloring unaffected by moisture and other substances contained in trench backfill material. Bury tape with the

printed side up at a depth of 6 inches below the top surface of earth or the top surface of the subgrade under pavements.

- 5.6 Sanitary Force Mains and Sanitary Yard Piping:
- 5.6.1 Handling: Pipe, fittings, valves, hydrants, and other accessories shall be handled in such manner as to insure delivery to the trench in sound, undamaged condition. Special care shall be taken not to injure pipe coatings or linings. If coatings or linings of pipe and fittings are damaged, satisfactory repairs shall be made at no extra cost to the Government. Pipe shall be carried to the trench and not dragged. Rubber gaskets that are not to be installed immediately shall not be left in the sunlight, but shall be stored under cover out of direct sunlight.
- 5.6.2 Pipe Laying and Jointing: Pipe, fittings, valves, and accessories will be carefully inspected before and after installation and those found defective will be rejected. Pipe and fittings shall be free from fins and currs. Before being placed in position, pipe, fittings, valves. and accessories shall be cleaned, and shall be maintained in a clean condition. Proper facilities shall be provided for lowering section of pipe into trenches. Under no circumstances shall pipe, fittings, valves, or any other water line material be dropped or dumped into trenches. Pipe shall be cut accurately to measurements established at the site and shall be worked into place without springing or forcing. Piping that does not allow sufficient space for proper installation of jointing material shall be replaced by one of proper dimensions. Blocking or wedging between bells and spigots will not be permitted. Bell-and-spigot pipe shall be laid with the bell end pointing in the direction of laying. The pipe shall be graded in straight lines, taking care to avoid the formation of any dips or low points. Pipe shall be supported at its proper elevation and grade, care being taken to secure firm and uniform support. Wood support blocking will not be permitted. The full length of each section of pipe and fittings shall rest solidly on the pipe bed, with recesses excavated to accommodate bells, joints, and couplings. Anchors and supports shall be provided where necessary and where indicated on the project drawings for fastening work into place. Proper provision shall be made for the expansion and contraction of pipe lines. Trenches shall be kept free of water until joints have been properly made. Open ends of pipe at the end of each day's work shall be closed temporarily with wood blocks or bulkheads. Pipe shall not be laid when the conditions of trench or weather are unsuitable. Depth of bury shall be not less than three feet. Piping shall be inspected, tested, and approved before being completely buried, covered, or concealed. Excavation and backfilling of pipe trenches shall be as specified in the section entitled "Earthwork", as modified herein.
- 5.6.3 Ductile—Iron Pipe and Fittings: AWWA C600 for pipe installation, joint assembly, valve and fitting installation, and thrust restraint, except as otherwise specified hereunder. Provide AWWA C600 joint assembly for push—on joints. Provide AWWA C600 joint assembly for mechanical joints and with the recommendations of Appendix A to AWWA C111. Make

flanged joints up tight; avoid undue strain on flanges, fittings, valves, and other accessories. Use full-sized bolts for the bolt holes; use of undersized bolts to make up for misalignment of bolt holes or for any other purpose will not be permitted. Do not allow adjoining flange faces to be out of parallel to such degree that the flanged joint cannot be made watertight without overstraining the flange. When any flanged pipe or fitting has dimensions that do not allow the making of a proper flanged joint as specified in this paragraph, replace it with one of proper dimensions. Assemble insulating joints as specified for flanged joints, except that bolts with insulating sleeves shall be full size for the bolt holes. Assure that there is no metal-to-metal contact between dissimilar metals after joint has been assembled.

- 5.6.4 Polyvinyl Chloride (PVC) Pipe and Fittings: UNI-B-3 for laying of pipe, joining PVC pipe to fittings and accessories, and setting of hydrants, valves, and fittings, except as specified hereunder. Make push-on joints with elastomeric gaskets using either elastomeric gasket bell-end pipe or elastomeric gasket couplings. Use push-on joint having factory-made bevel on pipe ends for pipe-to-pipe joint connections only; for push-on joint connections to metal fittings, valves, and other accessories, cut spigot end of pipe off square and rebevel pipe end to a bevel approximately the same as that on ductile-iron pipe used for the same type of joint. Use an approved lubricant recommended by the pipe manufacturer for push-on joints. Assemble push-on joints for pipe-to-pipe joint connections in accordance with the requirements of UNI-B-3 for laying the pipe. Assemble push-on joints for connection to fittings, valves, and other accessories in accordance with the requirements of UNI-B-3 for joining PVC pipe to fittings and accessories and with the applicable requirements of AWWA C600 for joint assembly. Assemble compression-type joints and mechanical joints with the gaskets, glands, bolts, nuts, and internal stiffeners in accordance with the requirements of UNI-B-3 and AWWA C600, and Appendix A to AWWA C111. Cut off spigot end of pipe for compression-type joint and mechanical joint connections and do not rebevel.
- 5.6.5 Pipe Anchorage: Provide anchorage of buried piping by using concrete thrust blocks (reaction backing) having a minimum compressive strength of 2000 psi. All 22.5 degrees and sharper bends, tees, and dead ends of piping shall be securely blocked in the direction of flow with cast-in-place concrete bearing solidly against the piping and affording a minimum of 3 square feet of bearing area against a vertical trench face for 3- and 4-inch piping, and in accordance with LATNDIV Plate WD-1 for piping 6-inch diameter and larger.
 - 5.6.6 Valves: AWWA C600.
- 6. MANHOLES: Manhole construction shall be in accordance with LANTDIV Plate SS-1 and SS-2 which appears at the end of this section, using materials as specified hereinbefore. Pargeting shall be applied to all surfaces of the exterior surfaces of masonry manholes; pargeting is

not required on precast concrete manholes. Precast manholes shall be set on a 12-inch thick layer of gravel.

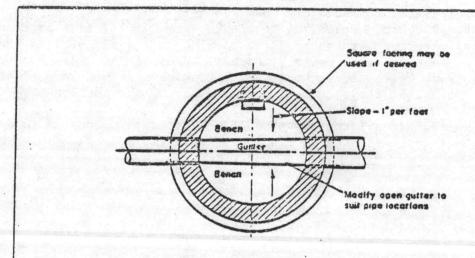
- 6.1 Brickwork: Brick shall be laid in all header courses to form full and close joints of cement mortar on their beds, ends, and sides in one operation. Vertical joints shall be radial from the center. Brickwork shall be built neatly around pipe inlets and outlets using sufficient mortar to seal the pipe tightly in the wall.
- 6.2 Concrete Block: The block wall shall be constructed in horizontal courses, with vertical joints broken. Blocks shall be laid in mortar and all joints shall be completely filled with mortar.
 - 6.3 Cleanouts: Provide in accordance with LANTDIV Plate SS-3.

7. TESTING AND INSPECTION:

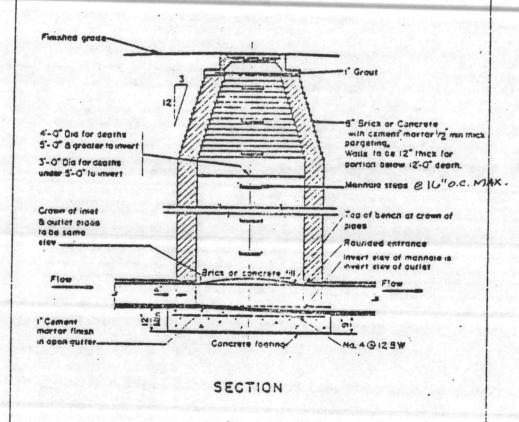
- 7.1 Field Tests and Inspections: Perform all field tests, and provide all labor, equipment, and incidentals required for testing, except that water and electric power needed for field tests will be furnished as set forth in Division 1. The Contractor shall produce evidence, when required, that any item of work has been constructed in accordance with contract requirements. Allow concrete to cure a minimum of 5 days before testing any section of piping where concrete thrust blocks have been provided.
- 7.2 Gravity Sewer Pipe: All work shall be proved to be constructed in accordance with the drawings and specifications. All defects in the work provided by the Contractor shall be corrected by him at his own expense. A light held at one end of the piping shall show a partically full circle of light through the pipe when viewed from the adjoining manhole or end of the piping. Piping shall be tested for infiltration by means of a suitable weir or other device. When determination of infiltration is not practicable because of dry trench conditions, an exfiltration test shall be performed by filling the piping with water so that the head will be at least 4 feet above the crown of the upper end of the section being tested. The amount of leakage (infiltration or exfiltration) shall not exceed 200 gallons per inch of diameter per day per mile of pipe.
- 7.3 Sanitary Force Main and Sanitary Yard Piping: Provide in accordance with the following standards, as modified herein:
 - a. Ductile-Iron: AWWA C600 for pressure and leakage tests, except no leakage will be allowed for flanged joints.
 - b. PVC: UNI-B-3 for pressure and leakage tests.
 - c. Steel Pipe: AWWA C600 for pressure and leakage tests.
- 7.3.1 Special Testing Requirements: For pressure test, use of hydrostatic pressure 50 psi greater than the maximum working pressure of

the system, but not less than 200 psi. Hold this pressure for not less than 2 hours. Prior to the pressure test, fill that portion of the piping being tested with water for a soaking period of not less than 24 hours. For leakage test, use a hydrostatic pressure not less than the maximum working pressure of the system. Leakage test may be performed at the same time and at the same test pressure as the pressure test.

7.3.2 All equipment shall be tested in operation to demonstrate compliance with the contract requirements.

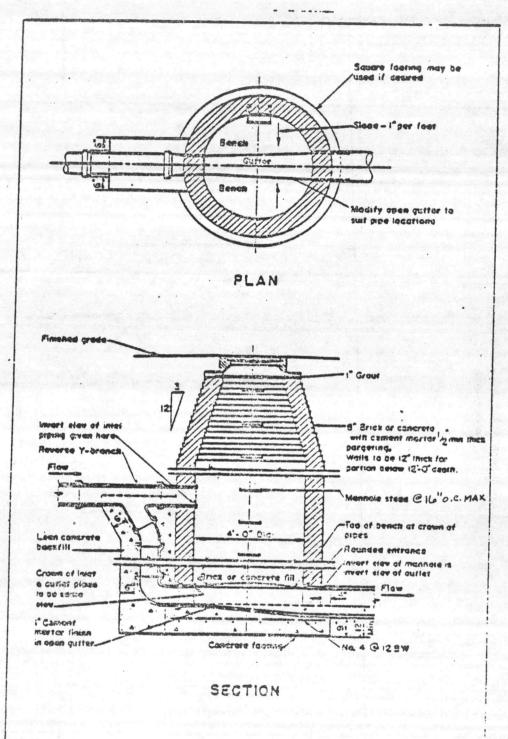


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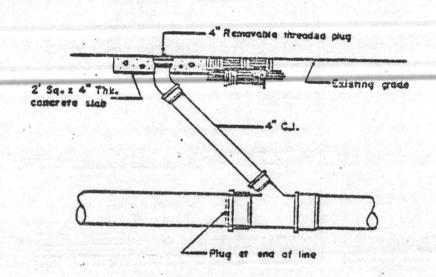
STANDARD MANHOLE

LANTDIV PLATE SS-1



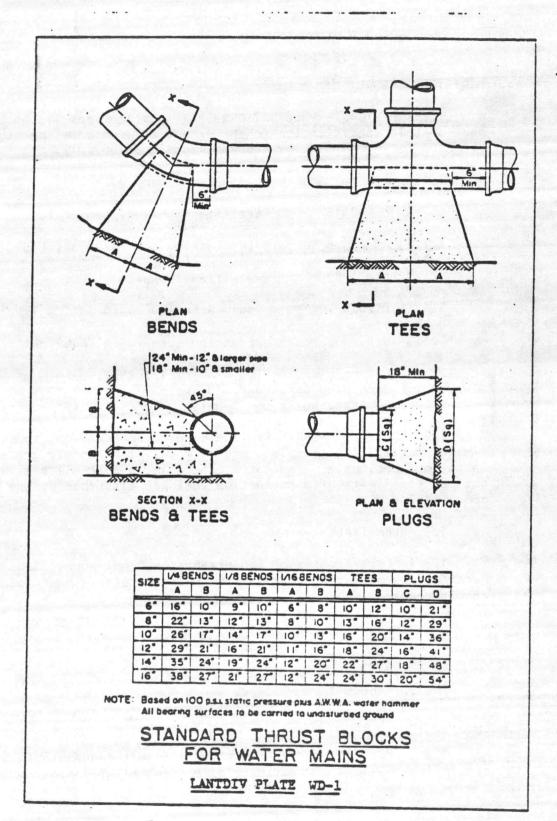
STANDARD DROP MANHOLE

LANTDIV PLATE SS-Z



CLEANCUT DETAIL

LANTOW PLATE SS-3



*** END OF SECTION ***

SECTION 02821

TURF

PART 1 - GENERAL

- 1.1 APPLICABLE PUBLICATIONS: 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.
 - 1.1.1 Federal Specification (Fed. Spec.):

0-F-241D Fertilizers; Mixed, Commercial

1.1.2 American Society for Testing and Materials (ASTM) Publications:

D 977-80 Emulsified Asphalt

D 2028-76 Liquid Asphalt (Rapid-curing Type)

1.1.3 U.S. Department of Agriculture (USDA) Publication:

Federal Seed Act of January 17, 1967, Reprinted September, 1975: 53 Stat. Rules and Regulations

- 1.2 EXTENT OF WORK: Provide seedbed preparation, topsoiling, liming, fertilizing, seeding, and mulching of all newly graded finish earth surfaces, unless indicated otherwise, and at all areas inside or outside the limits of construction that are disturbed by the Contractor's operation.
 - 1.3 SUBMITTALS:
- 1.3.1 Certificates of Conformance or Compliance: Submit three certificates attesting that the following materials meet specified requirements:
 - a. Seed
 - b. Fertilizer
 - c. Topsoil
 - d. Lime
- 1.3.2 Manufacturer's Literature: Submit manufacturer's literature specifying physical characteristics and installation instructions on the following:

a. Hydraulic Mulch Material

1.4 DELIVERY:

- 1.4.1 Material Delivery Schedule: Submit the schedule in advance of delivery so material may be inspected upon arrival at the job site. Remove rejected material from Government property.
- 1.4.2 Fertilizer and Lime: Deliver materials to the site in the original, unopened containers bearing the manufacturer's chemical analysis, name, trade name, trademark, and indication of conformance to state and federal laws. In lieu of containers, furnish fertilizer and lime in bulk with a certificate indicating the above information accompanying each delivery.
- 1.4.3 Seed: Deliver seed to the site in original sealed packages bearing the producer's guaranteed analysis for percentages of mixtures, purity, germination, weedseed content, and inert material labeled in conformance with U.S. Department of Agriculture rules and regulations under the Federal Seed Act and applicable state seed laws. Seed that has become wet, moldy, or otherwise damaged will be rejected.
- 1.5 STORAGE AND HANDLING: Store lime, fertilizer, and seed in dry locations away from contaminants. Protect seed from drying out. When handling materials, do not drop or dump from vehicles.
- 1.6 ENVIRONMENTAL PROTECTION: All work and Contractor operations shall comply with the requirements of Section 01560, "Environmental Protection."

PART 2 - PRODUCTS

- 2.1 MATERIALS: Materials for turf establishment.
- 2.1.1 Seed: State-certified seed of the latest season's crop. Mix seed on site only in the presence of the Contracting Officer. Proportion seed mixtures by weight as follows.

Variety	Percent	(by weight)
Spring - Fescue (KY 31)		80
Common Bermuda (hulled)		20
Fall - Fescue (KY 31)		83
Common Bermuda (unhulled)		17

2.1.2 Topsoil: Use existing on-site topsoil, stripped and stock-piled on the site, provided the topsoil is free of subsoil, stumps, rocks larger than one inch diameter, brush, weeds, toxic substances, and other material or substance detrimental to plant growth. Topsoil shall be a

natural, friable soil representative of productive soils in the vicinity. Furnish off-site topsoil conforming to the specified requirements for on-site topsoil. Obtain topsoil from well-drained areas.

- 2.1.3 Lime: Commercial agricultural limestone containing not less than 94 percent of total carbonates, 52 percent calcium, and 42 percent magnesium and ground to such fineness that at least 80 percent will pass a 100-mesh sieve and at least 95 percent will pass a 60-mesh sieve.
- 2.1.4 Fertilizer: Commercial grade, free flowing and uniform in composition. Provide granular fertilizer conforming to Fed. Spec. 0-F-241, Type I, Class 2, and bearing the manufacturer's guaranteed statement of analysis. Granular fertilizer shall contain a minimum percentage by weight of 10 percent nitrogen of which 50 percent shall be organic, 10 percent available phosphoric acid, and 10 percent potash.
 - 2.1.5 Mulch: One or a combination of the following mulch materials.
- 2.1.5.1 Grain Straw from Oats, Wheat, Rye, Barley, or Rice: Grain straw in an air-dry condition that is free from noxious weeds, mold, or other objectionable material and suitable for placing with commercial mulch blowing equipment.
- 2.1.5.2 Wood Cellulose Fiber: For use with hydraulic application of grass seed and fertilizer, provide wood cellulose fiber, processed to contain no growth or germination—inhibiting factors and dyed an appropriate color to facilitate visual metering during application of materials. On an air—dry weight basis, provide wood cellulose fiber containing not more than 12 percent moisture, plus or minus three percent at the time of manufacture, with a pH range from 3.5 to 6.0. Provide wood cellulose fiber manufactured so that:
 - a. After addition and agitation in slurry tanks with fertilizers, grass seeds, and water, the fibers in the material will become uniformly suspended to form a homogeneous slurry;
 - b. When hydraulically sprayed on the ground the material will form a blotterlike cover impregnated uniformly with grass seed;
 - c. The cover will allow the absorption of moisture and allow rainfall or applied water to percolate to the underlaying soil.
- 2.1.6 Asphalt Adhesive For Application With Straw Mulch: Cutback liquid asphalt conforming to ASTM D 2028, Designation RC-70, or emulsified asphalt conforming to ASTM D 977, Grade RS-1.
 - 2.1.7 Water: Suitable quality for irrigation.

3.1 INSTALLATION:

- 3.1.1 Tillage: After the areas required to be seeded have been brought to the required subgrade, thoroughly till to a depth of at least 6 inches by scarifying, disking, harrowing, or other approved methods. Remove debris and stones larger than one inch remaining on the surface after tillage.
- 3.1.2 Topsoiling: Prior to placing topsoil, scarify the subgrade to a 2-inch depth for bonding of topsoil with subsoil. Spread the topsoil evenly to a minimum depth of 4 inches. Do not spread topsoil when frozen or excessively wet or dry. Correct irregularities in finished surfaces to eliminate depressions. Protect finished topsoil areas from damage by vehicular or pedestrian traffic.
- 3.1.3 Fertilizer and Lime: Apply fertilizer at the rate of 1000 pounds per acre. Apply dolomitic lime at the rate of 3000 pounds per acre. Incorporate fertilizer and lime into the soil to a depth of at least 6 inches; this may be done as part of the tillage operation specified herein.
- 3.1.4 Seeding Seasons and Conditions: Sow seed between 1 March and 15 May for spring planting or 1 September and 30 October for fall planting. Immediately before seeding, restore soil to the proper grade. Do not seed when the ground is in any unsatisfactory condition for seeding. If special conditions exist that may warrant a variance in the above seeding dates or conditions, submit a written request to the Contracting Officer stating the special conditions and proposed variance.
- 3.1.5 Seeding: Accomplish seeding by one or a combination of the following methods at the rate of 240 pounds per acre. When using other than hydroseeding method of application, use maximum seeding depth of 1/4 inch in clayey soils and 1/2 inch in sandy soils.
 - a. Sow seed by approved sowing equipment. Sow one-half of the seed in one direction, and sow the remainder at right angles to the first sowing. Cover the seed by means of spike-tooth harrow, cultipacker, or other approved device.
 - b. Perform drill seeding using approved equipment such as cultipacker seeders and grass seed drills. Drill the seed to a depth not exceeding the specified maximum depth.
 - c. When hydroseeding, mix the seed and fertilizer in the required amount of water to produce a homogeneous slurry. After the seed and fertilizer have been thoroughly mixed, add wood cellulose fiber mulch to the slurry mix. Uniformly apply the slurry, under pressure, at the specified rates per

acre, dry weight, for seed and fertilizer and at the rate of 1,000 pounds per acre, dry weight, for the mulch.

- d. Immediately after seeding, firm the entire area, except for slopes in excess of 3 to 1, with a roller not exceeding 90 pounds for each foot of roller width. If seeding is performed with a cultipacker-type seeder or if seed is applied in combination with hydro-mulching, rolling may be eliminated.
- 3.1.6 Mulch: Spread the straw mulch evenly at the rate of 1.5 tons per acre. Anchor the mulch by using a light serrated disc, spraying asphalt emulsion on the mulched surface at the rate of 5 gallons per 1,000 square feet, or manually securing. When asphalt emulsion is used, apply either simultaneously or in a separate application. Take precautionary measures to prevent asphalt materials from marking or defacing structures, pavements, utilities, or plantings.
- 3.1.7 Protection of Seeded Areas: Immediately after seeding, protect the area against traffic or other use by erecting barricades, as required, and placing approved signs at appropriate intervals until final acceptance.
- 3.1.8 Equipment: Furnish and maintain all equipment necessary for the performance of the specified work. Operate equipment in a proper and efficient manner at all times to cause the least possible annoyance and disturbance. Equip all engine powered equipment with suitable noise abatement mufflers.
- 3.1.9 Restoration and Clean-up: Where existing turf areas have been damaged during turfing operations, restore the areas to their original condition. Keep at least one paved pedestrian access route and one paved vehicular access route to each building clean at all times. Clean other paving when work in adjacent areas is complete.

3.2 TURF ESTABLISHMENT PERIOD:

- 3.2.1 General: The turf establishment period will be in effect until the turf is mowed three times. A stand of turf is defined as 95 percent ground cover of the established species. The Contractor is responsible for the establishment and proper care of a stand of turf over the entire seeded area.
- 3.2.2 Maintenance During the Establishment Period: Mow the seeded area to an average height of 2 inches whenever the average height of the grass becomes 4 inches. Remove excess clippings, eradicate weeds, water, fertilize, overseed, and perform other operations necessary to promote the growth of grass.

3.3 FINAL ACCEPTANCE:

- 3.3.1 General: Final inspection and acceptance will be at the end of the turf establishment period. Acceptance will be based upon a satisfactory stand of turf as defined in paragraph titled, "TURF ESTABLISHMENT PERIOD."
- 3.3.2 Replanting: In areas which do not have a satisfactory stand of turf, replant within planting dates as directed by the Contracting Officer.

*** END OF SECTION ***

SECTION 03302

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

- 1.1 APPLICABLE PUBLICATIONS: 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.
- 1.1.1 U. S. Department of Commerce Product Standard (PS) Publication:

	1-74	Construction and Industrial Plywood
1.1.2	American Cor	ncrete Institute (ACI) Publications:
	211.1-81	Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
	315-80	Details and Detailing of Concrete Reinforcement
	318-77 & 1980	Building Code Requirements for Reinforced Concrete
	347-78	Recommended Practice for Concrete Formwork
1.1.3	American Soc	eiety for Testing and Materials (ASTM) Publications:
	A 185-79	Welded Steel Wire Fabric for Concrete Reinforce- ment
	A 615-81a	Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
	C 31-69 (R 1980)	Making and Curing Concrete Test Specimens in the Field
	C 33-81	Concrete Aggregates
	c 39-80	Compressive Strength of Cylindrical Concrete Specimens
	C 94-81	Ready-Mixed Concrete
	C 143-78	Slump of Portland Cement Concrete
	C 150-81	Portland Cement

C 171-69 (R 1980)	Sheet Materials for Curing Concrete
C 172-71 (R 1977)	Sampling Fresh Concrete
C 231-81	Air Content for Freshly Mixed Concrete by the Pressure Method
C 260-77	Air-Entraining Admixtures for Concrete
C 309-81	Liquid Membrane-Forming Compounds for Curing Concrete
D 98-77a	Calcium Chloride
D 1190-74 (R 1980)	Concrete Joint Sealer, Hot Poured Elastic Type
D 1751-73 (R 1978)	Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
D 1752-67 (R 1978)	Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
D 1850-74 (R 1979)	Concrete Joint Sealer, Cold-Application Type

1.2 SUBMITTALS:

- 1.2.1 Shop Drawings: Submit shop drawings for reinforcing steel, prepared in accordance with ACI 315. Indicate bending diagrams, assembly diagrams, splicing and laps of rods, and shapes, dimensions and details of bar reinforcing and accessories. Do not use scaled dimension from structural drawings to determine lengths of reinforcing rods.
- 1.2.2 Contractor Mix Design: Submit a mix design for each type of concrete, including a complete list of materials including admixtures and the applicable reference specifications, and copies of test reports showing that the mix has been successfully used to produce concrete with the properties specified.
- 1.2.3 Certification: Submit one copy of the delivery ticket for each load of ready-mixed concrete, showing all information required by ASTM C 94.
- 1.2.4 Catalog Data: Submit manufacturers' descriptive literature for the items listed below. Clearly mark data to indicate which type,

size, or item is proposed. Data shall be sufficient to show conformance to specified requirements.

- a. Joint Filler
- b. Joint Sealer
- c. Reinforcement
- d. Water Stop
- 1.3 DELIVERY: Do not deliver concrete until forms, reinforcement, and embedded items are in place and ready for concrete to be placed.
- 1.4 STORAGE: Store reinforcement in a manner that will avoid excessive rusting or coating with grease, oil, dirt, and other objectionable materials. Store in separate piles or racks so as to avoid confusion or loss of identification after bundles are broken.

PART 2 - PRODUCTS

2.1 CONCRETE:

- 2.1.1 Contractor Furnished Mix Design:
 - a. Normal Weight Concrete: Design mix for normal weight concrete in accordance with ACI 211.1. Slump shall be between 2 inches and 4 inches. The concrete shall have a 28-day compressive strength of 3000 psi. Maximum water cement ratio shall be 0.50 by weight.
 - b. Light Weight Concrete: Design mix for light weight concrete in accordance with ACI 211.2. Slump shall be between 2 inches and 3 inches. The concrete shall have a 28-day compressive strength of 3000 psi and shall have a maximum airdried weight of 115 pcf.
- 2.1.2 Air-Entrained Concrete: Provide for all concrete exposed to the weather. Accomplish air-entrainment by using an air-entraining admixture, not air-entraining cement. If the entrained air content falls below the specified limit, add a sufficient quantity of admixture to bring the entrained air content within the specified limits. Dissolve the admixture in a portion of the mixing water and add to the mix in the drum in a manner that will ensure uniform distribution of the agent throughout the batch. The air content of freshly mixed air-entrained concrete shall be as follows:

Maximum aggregate size

3/4 inch

Amount of air (percent volume of concrete)

between 5 and 7

2.1.3 Ready-Mixed Concrete: Ready-mixed concrete shall conform to ASTM C 94 as modified herein. Ready-mixed concrete is defined in this specification as concrete produced regularly by a commercial establishment and delivered to the purchaser in the plastic state. Ready-mixed concrete may be used provided that (a) the plant has sufficient capacity and transportation equipment to deliver the concrete at the rate desired, and (b) the plant meets the requirements specified herein for equipment, measurement of materials, and mixing, except as modified herein. The cement, aggregates, water, and admixtures shall conform to all applicable requirements of this specification.

2.2 MATERIALS:

- 2.2.1 Cement: ASTM C 150, Type I or II for all concrete. All cement for exposed concrete surfaces shall be of the same manufacture.
- 2.2.2 Water: Water, including free moisture and water in the aggregates, shall be fresh, clean, and potable.

2.2.3 Aggregates:

- 2.2.3.1 Aggregates for Normal Weight Concrete: ASTM C 33, size no. 67 except as modified herein. Obtain all aggregates for exposed concrete surfaces from one source. Aggregates shall be free from any substance which may be deleteriously reactive with the alkalies in the cement.
- 2.2.3.2 Aggregates for Light Weight Concrete: ASTM C 330, coarse aggregate shall be expanded shale, expanded clay, expanded slate, or expanded slag. Fine aggregate shall be normal fine aggregate as specified for normal weight concrete, fine aggregate conforming to ASTM C 330, or a combination of the normal and light weight fine aggregate.

2.2.4 Admixtures:

- 2.2.4.1 Air-entraining: ASTM C 260, for all air-entrained concrete.
- 2.2.4.2 Accelerating: ASTM D 98, Type I or Type II. Use only when approved.
- 2.2.5 Materials for Forms: Wood, plywood, steel, or other suitable material. Wood forms, for surfaces exposed to view in the finished structure, shall be boards or plywood. Dress boards to a uniform thickness, evenly match, and provide boards free from loose knots, holes, and other defects. Plywood shall be B-B concrete form panels conforming to PS-1. Surfaces of steel forms shall be free from irregularities, dents, and sags.

2.2.6 Reinforcement:

2.2.6.1 Reinforcing Bars: ASTM A 615, Grade 60. All bars shall be deformed.

- 2.2.6.2 Welded Wire Fabric: ASTM A 185, 6 by 6 W2.9 by W2.9, unless otherwise indicated.
 - 2.2.7 Materials for Curing Concrete:
- 2.2.7.1 Impervious Sheeting: Waterproof paper, polyethylene sheeting, or polyethylene coated burlap conforming to ASTM C 171.
- 2.2.7.2 Liquid Membrane-forming Compound: ASTM C 309, white-pigmented, Type 2, free of paraffin or petroleum.
- 2.2.7.3 Liquid Chemical Compound: A suitable sealer-hardener designed for sealing and hardening in addition to curing of the concrete applied by the method and at the rate recommended by the manufacturer. It shall not reduce the adhesion of tile, paint, roofing, waterproofing, or other material to be applied to the concrete. The chemical compound shall be free of petroleum resins or waxes.
- 2.2.8 Joint Sealing Materials: ASTM D 1190 or ASTM D 1850 inside buildings; ASTM D 1190 outside of buildings.
 - 2.2.9 Preformed Joint Filler: ASTM D 1751 or ASTM D 1752.
- 2.2.10 Vapor Barrier Material: Polyethylene sheeting of not less than 6-mil nominal thickness.
- 2.2.11 Water Stop: 8" strip 16-ounce copper or 6" x 3/8 vinyl dumbbell type.

PART 3 - EXECUTION

- 3.1 FORMS:
- 3.1.1 General: Provide forms for all concrete not indicated or specified otherwise. Set forms true to line and grade and maintain so as to insure completed work within the allowable tolerances specified, and make mortar-tight. Construct forms so that they can be removed without damaging the concrete. Chamfer all exposed joints, edges, and external corners of concrete 3/4 inch unless otherwise indicated. Concrete for footings may be placed in excavations without forms. The dimensions of excavations in earth shall be not less than 2 inches outside of the concrete lines indicated.
- 3.1.2 Coating: Before placing the concrete, coat the contact surfaces of forms with a non-staining mineral oil, non-staining form coating compound, or two coats of nitro-cellulose lacquer. Do not use mineral oil on forms for surfaces which are to be painted.

3.1.3 Tolerances and Variations: Set and maintain concrete forms to ensure that after removal of the forms no portion of the concrete work will exceed any of the tolerances specified in ACI 347.

3.2 PLACING REINFORCEMENT AND MISCELLANEOUS MATERIALS:

- 3.2.1 General: Provide all bars, wire fabric, and other reinforcing materials as indicated or specified, together with all necessary wire ties, supports, and other devices necessary to install and secure the reinforcement properly. All reinforcement, when placed, shall be free from rust, scale, oil, grease, clay, and other coating, and foreign substances that would reduce or destroy the bond. Rusting of reinforcement shall not be a basis of rejection, provided that the rusting has not reduced the effective cross sectional area of the reinforcement, and provided that loose rust shall be removed prior to placing. Where cover over reinforcing steel is not indicated, it shall be in accordance with ACI 318.
- 3.2.2 Vapor Barrier: Provide beneath the entire concrete floor slab of the building. Use the greatest widths and lengths practicable so as to eliminate joints wherever possible. Where joints are necessary, lap not less than 6 inches and seal with approved adhesive. Torn, punctured, or damaged vapor barrier material shall be removed and replaced as directed, prior to the placing of concrete. Place concrete in such a manner as to preclude damage to the vapor barrier material.
- 3.2.3 Placing: Place reinforcement accurately and secure in place on suitable chairs, spacers, or metal hangers. On the ground, use concrete or other non-corrodible material for supporting reinforcement.
- 3.2.4 Splicing: Conform to ACI 318, except as otherwise indicated or specified. Where splices in addition to those indicated are necessary, they shall be approved prior to their use. Do not make splices at points of maximum stress. Make splices in welded wire fabric so that the overlap is not less than the spacing of the cross wires.
- 3.2.5 Setting Miscellaneous Material: Place and secure anchors and bolts, pipe sleeves, conduits, and other such items in position before the concrete is placed. Plumb anchor bolts, check for location and elevation, and secure rigidly in position. Fill voids in sleeves temporarily with readily removable material to prevent the entry of concrete into the voids.
- 3.2.6 Expansion Joints and Cleavage Joints: Make joints 1/2-inch wide except as indicated otherwise. Fill expansion joints not exposed to weather completely, and fill joints exposed to weather to a depth of one inch from the surface, with preformed joint material. Clean the one-inch deep space above the preformed material after the concrete has been cured and, when dry, fill flush with joint sealing material. Do not extend reinforcement or other embedded metal items bonded to the concrete through any expansion joint.

- 3.2.7 Water Stop: Place water stop in all construction joints in water bearing construction with half the width on each side of the joint. Securely anchor water stop to forms or reinforcing to prevent displacement during concrete placing. Copper strips shall be crimped or lapped and soldered at joints. Vinyl stops shall be heat or solvent welded at joints.
- 3.3 MEASURING, MIXING, TRANSPORTING, AND PLACING CONCRETE: In accordance with ACI 301, Chapters 7 & 8, except as modified herein.
- 3.3.1 Measuring: Make moisture, volumetric, and air determinations at intervals specified herein under testing requirements. Allowable tolerances for measuring cement and water shall be one percent for aggregates, 2 percent; and for admixtures, 3 percent.
- 3.3.2 Mixing: Machine mix all concrete. Begin mixing within 30 minutes after the cement has been added to the aggregates. Introduce all mixing water in the drum before one-fourth of the mixing time has elapsed. The time elapsing between the introduction of the mixing water to the cement and aggregates or the cement to the aggregates and the start of placing of the concrete in final position in the forms shall not exceed 60 minutes if the air temperature is less than 85 degrees Fahrenheit, and 45 minutes if the air temperature is equal or greater than 85 degrees F. On arrival at the job site, no addition of water will be allowed other than that required initially to adjust to the specified slump. Such an addition must not exceed the limits of the specified maximum water-cement ratio.
- 3.3.3 Conveying: Convey concrete from the mixer to the forms as rapidly as practicable and so as not to cause segregation or loss of ingredients. Deposit concrete as close as practicable to its final position in the forms. At any point in the conveying, the free vertical drop of the concrete shall not exceed 3 feet. Clean conveying equipment thoroughly before each run. Do not use aluminum pipe or chutes. Place concrete as soon as practicable after the forms and the reinforcement have been inspected and approved. Remove any concrete which has segregated in conveying and dispose of as directed.
- 3.3.4 Placing: Do not place concrete when weather conditions prevent proper placement and consolidation. Do not place concrete in uncovered areas during periods of precipitation. Do not place concrete in water. Prepare subgrades of earth or other material properly and, if necessary, cover with heavy building paper or other suitable material to prevent the concrete from becoming contaminated. Dampen porous subgrade as required to prevent water of hydration from being absorbed into the subgrade. Clean forms of dirt, construction debris, water, snow, and ice. Place concrete in one continuous operation except where construction joints are provided. Place concrete in areas bounded by construction joints in one continuous operation. Remove water which accumulates on the surface of the concrete during placing by absorption with porous materials in a manner that prevents removal of cement.

- 3.3.5 Vibration: Compact all concrete, with the exception of concrete slabs 4 inches or less in depth, with high frequency, internal, mechanical vibrating equipment supplemented by hand spading and tamping. Consolidate concrete slabs 4 inches or less in depth by wood tampers, spading, and settling with a heavy leveling straight edge. Vibrators shall be designed to operate with vibratory element submerged in the concrete, and shall have a frequency of not less than 6,000 impulses per minute when submerged.
- 3.3.6 Cold Weather: Except with authorization, do not place concrete when the ambient temperature is below 40 degrees F or when the concrete is likely to be subjected to freezing temperatures within 24 hours. When so authorized, if concrete is likely to be subjected to freezing within 24 hours after placing, heat concrete materials so that the temperature of the concrete when deposited shall be between 65 and 80 degrees F. Methods of heating materials are subject to approval of the Contracting Officer. Do not heat mixing water above 165 degrees F. Remove lumps of frozen material and ice from the aggregates before placing aggregates in the mixer. When specifically approved by the Contracting Officer, the Contractor may add, not more than 2 pounds of Type I or not more than one pound, 10 ounces of Type II calcium chloride ASTM D 98, per bag of cement. Dissolve the admixture in a portion of the mixing water and add to the mix at the drum in a manner that will ensure uniform distribution of the agent throughout the batch.
- 3.3.7 Hot Weather: Cool ingredients before mixing so as to prevent rapid drying of newly placed concrete. When the ambient temperature is more than 90 degrees F, the temperature of the concrete as placed shall not exceed 90 degrees F; shade the fresh concrete as soon as possible after placing; and start curing as soon as the surface of the fresh concrete is sufficiently hard to permit curing without damage to the concrete.
 - 3.4 SURFACE FINISHES (EXCEPT FLOOR, SLAB, AND PAVEMENT FINISHES):
- 3.4.1 Defects: Repair all formed surfaces by patching minor honey-combed or otherwise defective areas with cement mortar of the same composition as that used in the concrete. Patch concrete as soon as the forms are removed. Concrete with honeycombing or other defects which affect the structural strength of the member, will be rejected, or the defects corrected as directed by the Contracting Officer.
- 3.4.2 Standard Finish: Provide standard finish for exposed concrete not indicated or specified otherwise. The surface of the concrete shall not vary more than 1/4 inch when measured from a five-foot template. Exposed surfaces shall be uniform in appearance.
- 3.4.2.1 Against Forms: Remove fins and other projections and level abrupt irregularities. Fill surface pits having a dimension greater than 1/8 inch with cement mortar as specified.

3.4.2.2 Not Against Forms: Finish surfaces not otherwise specified with wood floats to even surfaces.

3.5 FLOOR AND SLAB FINISHES:

- 3.5.1 General: For floors with drains, slope the floors uniformly to the drains. In areas where ceramic tile is to be laid, depress the concrete base slab as indicated. Depressed slabs shall receive a floated finish. Interior floor slabs shall receive a steel trowelled finish. Interior slabs which do not receive floor covering shall receive a sealer-hardener finish. Exterior concrete slabs shall receive a broom finish. Do not place dry cement directly upon the new concrete surface to absorb excess moisture.
- 3.5.2 Finishing: Place, consolidate and immediately strike off concrete to bring the top surface of the slab to proper contour, grade, and elevation. Immediately darby or bull float the surface with wooden tools so as to correct any unevenness. Complete striking-off and darbying before bleed water appears on the surface of the freshly-placed concrete. Permit the concrete to attain a set sufficient for floating and sufficient to support the weight of the finisher and equipment. If the bleed water has not disappeared by the time floating of the surface is to start, drag the excess water off using a rubber hose. Do not use dry cement to absorb bleed water.
- 3.5.2.1 Floated finish: At the proper time, float the surface by hand with a wood or magnesium float, or by a power-driven float. Floating of any one area shall be the minimum necessary to produce an even finish, level within 1/4 inch in 10 feet.
- 3.5.2.2 Troweled Finish: First, provide a floated finish. When slab has attained a proper set, hand— or machine—trowel to a smooth, hard, dense finish, level within 1/8 inch in 10 feet.
- 3.5.2.3 Sealer-hardener Finish: Provide trowelled finish and then apply liquid chemical compound as specified herein.
- 3.5.2.4 Broomed Finish: Provide a floated finish and a steel troweled finish, as specified herein, and then broom with a flexible bristle broom. At time of brooming the troweled surface shall have hardened sufficiently to retain the scoring or ridges. Broom in a direction transverse to that of traffic or at right angles to the slope of the slab.

3.6 CURING AND PROTECTION:

3.6.1 General Requirements: Protect concrete adequately from injurious action by sun, rain, flowing water, frost, mechanical injury, tire marks and oil stains, and do not allow it to dry out from the time it is placed until the expiration of the minimum curing periods specified herein. Use impervious-sheeting curing, liquid chemical or liquid

membrane-forming compound, except as specified otherwise herein. Do not use membrane-forming compound on surfaces where its appearance would be objectionable, on any surface to be painted, where coverings are to be bonded to the concrete, or on concrete to which other concrete is to be bonded. Begin curing immediately following the removal of forms. Maintain the temperature of the air next to the concrete at not less than 40 degrees F for the full curing periods.

- 3.6.2 Impervious-Sheeting Curing: Wet the entire exposed surface thoroughly with a fine spray of water and then cover with impervious sheeting. Lay sheets directly on the concrete surface and overlap 12 inches. Make sheeting not less than 18 inches wider than the concrete surface to be cured, and weight down on the edges and over the transverse laps to form closed joints. Repair or replace sheets if torn or otherwise damaged during curing. The sheeting shall remain on the concrete surface to be cured for not less than 7 days.
- 3.6.3 Liquid Membrane-Forming Compound Curing: Seal or cover all joint openings prior to application of the curing compound to prevent the curing compound from entering the joint. Compound shall remain on the concrete for 7 days before sealer or covering is removed and joint sealing material is placed in the joints.
- 3.6.3.1 Application: Apply the compound immediately after the surface loses its water sheen and has a dull appearance and before joints are sawed. Agitate curing compound thoroughly by mechanical means during use and apply uniformly in a two-coat continuous operation by suitable power-spraying equipment. The total coverage for the two coats shall be between 150 and 200 square feet per gallon of undiluted compound. 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. Apply an additional coat of the compound immediately to areas where the film is defective. Respray concrete surfaces that are subject to heavy rainfall within 3 hours after the curing compound has been applied in the same manner.
- 3.6.3.2 Protection of Treated Surfaces: Keep concrete surface to which liquid membrane-forming compounds have been applied free from foot and vehicular traffic and other sources of abrasion for not less than 72 hours. Maintain continuity of the coating for the entire curing period and repair damage to the coating during this period immediately.
- 3.6.4 Liquid Chemical Compound Curing: Provide for surfaces for which a sealer-hardener finish is specified, and, at the Contractor's option, provide in lieu of liquid membrane-forming compound curing for other surfaces. The application of the compound shall conform to the requirements for liquid membrane-forming compound curing except as specified otherwise herein. Sealing or covering of joints and openings in which joint sealer is to be applied will not be required. The coverage and number of applications shall be in accordance with the recommendations of the manufacturer of the compound.

- 3.6.5 Curing Periods: Cure not less than 10 days for concrete exposed to the weather and not less than 7 days for all other concrete.
- 3.6.6 Removal of Forms: Remove forms in a manner which will prevent damage to the concrete. Do not remove forms without approval, nor sooner than 24 hours after placement of concrete. Supported slabs and beams shall be supported for a minimum of 14 days.

3.7 MISCELLANEOUS CONSTRUCTION:

- 3.7.1 Splash Blocks: Provide at outlets of downspouts emptying at grade. Splash blocks shall be of precast concrete, 24 inches long, 12 inches wide, and 6 inches thick, unless otherwise shown, with countersunk dishes finished smooth and sloped to drain away from the building. Compact the earth to provide firm bases for the blocks.
- 3.7.2 Concrete Walks: Not less than 4 inches thick. Provide contraction joints every 5 linear feet, cut to a depth of 3/4 inch with a jointing tool after the surface has been finished. Provide transverse expansion joints at all returns and not more than 50 feet apart using preformed joint material. Walks shall receive a broom finish as specified herein. Tool the edges of the sidewalks and joints to a radius not greater than 1/4 inch. Walks shall have a transverse slope of 1/4 inch per foot. The surface of the concrete shall show no variation in cross section in excess of 1/4 inch in 5 feet.
- 3.7.3 Pits and Trenches: Where practicable, place bottoms and walls monolithically. Elsewhere provide shear keys and ensure bonding of sides to bottoms.
- 3.7.4 Curbs and Gutters: Construct to sizes and shapes indicated, either precast or cast-in-place. Provide contraction joints as specified for walks, but space 8 feet to 10 feet center to center, an expansion joints as indicated. Curbs and gutters shall receive a smooth finish.

3.8 SAMPLING AND TESTING:

3.8.1 Sampling: Collect samples of fresh concrete in accordance with ASTM C 172 during each working day as required to perform all tests specified herein. Make test specimens in accordance with ASTM C 31.

3.8.2 Testing:

3.8.2.1 Consistency Tests: Determine slump in accordance with ASTM C 143. Take samples for slump determination from the concrete while it is being placed. Perform tests at the beginning of a concrete placement operation and at subsequent intervals to insure that the specification requirements are met. In addition, perform tests each time test cylinders are made.

- 3.8.2.2 Compressive Tests: Determine compressive strength in accordance with ASTM C 39. Make four test specimens for each set of tests. Test two specimens at 7 days, and the other two at 28 days. The strength of the concrete will be considered satisfactory if the average of the 28-day test results equals or exceeds the specified 28-day compressive strength (f'c) and no individual strength test is less than f'c by more than 300 pounds per square inch. Frequency of compressive tests on concrete cylinders shall be not less than four test cylinders for each day for each class of concrete placed that day.
- 3.8.2.3 Core Samples: If the foregoing criteria are not met, core samples shall be taken and tested at the Contractor's expense. The number of cores required shall be based on the results of each pair of cylinders broken at 28 days. Sampling, testing, and evaluation of drilled cores shall be in accordance with ACI 318, Part 3, Chapter 4. Concrete which is defective according to ACI 318 shall be removed and replaced with acceptable concrete.
 - If both cylinders average below f'c, but no single cylinder is less than f'c 300 psi, take three cores.
 - b. If average is below f'c, and only one cylinder is less than f'c 300 psi, take three cores.
 - c. If average is below f'c, and both cylinders are less than f'c - 300 psi, take six cores.
- 3.8.2.4 Air Content: Test air-entrained concrete for air content at the same frequency as specified for slump tests. Determine percentage of air in accordance with ASTM C 231 on samples taken during placing of the concrete in the forms.
- 3.8.2.5 Watertightness: All water-bearing structures shall be watertight against water pressure which may come upon them. On completion of water-bearing structures, they shall be filled with water to the high water line and allowed to remain filled for 48 hours before testing for watertightness. Leaks which may appear shall be repaired and the structures made watertight. Test shall be completed prior to backfill.

*** END OF SECTION ***

SECTION 03410

PRECAST STRUCTURAL CONCRETE (NON-PRESTRESSED)

- APPLICABLE PUBLICATIONS: 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.
 - 1.1 American Iron and Steel Institute (AISI) Publication: Stainless and Heat Resisting Steels - 1974
 - 1.2 American Concrete Institute (ACI) Publications:

AC I	211.1-74(75)	Selecting Proportions for Normal and Heavy- Weight Concrete
AC I	214-65	Evaluation of Compression Test Results of Field Concrete
ACI	304-73	Measuring, Mixing, Transporting, and Placing Concrete
ACI	308-71	Curing Concrete
ACI	315-74	Detailing Reinforced Concrete Structures
AC I	318–77	Building Code Requirements for Reinforced Concrete
ACI	517-70(76)	Atmospheric Pressure Steam Curing of Concrete

1.3 American Society for Testing Materials (ASTM) Publications:

A185-73	Welded Steel Wire Fabric for Concrete Reinforcement
A615-76a	Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
C33-77	Concrete Aggregates
C42-68(74)	Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
C150-77	Portland Cement
C173-75	Air Content of Freshly Mixed Concrete by the

Air Content of Freshly Mixed Concrete by the Pressure Method

C260-74 Air Entraining Admixtures for Concrete

C330-77 Lightweight Aggregates for Structural Concrete

C494-77 Chemical Admixtures for Concrete

Unit Weight of Structural Lightweight Concrete

1.4 American Welding Society (AWS) Publications:

AWS D1.1-81 Structural Welding Code, Steel

AWS D1.4-79 Structural Welding Code, Reinforcing Steel

 CEMENT TESTS: The Contractor shall furnish mill certificates attesting to the quality of the cement.

3. SAMPLING AND TESTING:

- 3.1 General: Samples and tests required below shall be made at the Contractor's expense. The tests shall be performed by an independent commercial testing laboratory, or, if approved by the Contracting Officer, at the precaster's quality control laboratory. Certified test reports shall include all test data and results.
- 3.2 Concrete Testing: Plastic concrete, as delivered to the casting site, shall be sampled and tested as indicated below and in the paragraph entitled "Evaluation and Acceptance of Concrete" of ACI 318. A minimum of four cylinders shall be made during each concreting cycle of the same mix. Statistical evaluation of compressive test results shall be in accordance with ACI 214.
 - 3.2.1 Slump: In accordance with ASTM C143.
- 3.2.2 Air Content: Tests shall be made at the same time that specimens for compression tests are made. Tests shall be made in accordance with ASTM C173 or ASTM C231.
- 3.2.3 Lightweight Concrete: Unit weight of lightweight concrete shall be tested in accordance with ASTM C567.
- 3.3 Slump and Air Content Test Results: If the measured slump or air content falls outside the limits specified, a check test shall be made. In the event of a second failure, the load of concrete represented shall be rejected.
- 3.4 Compressure Strength Test Results: If the compressive strength tests fail to meet the above requirements, core testing shall be made in

accordance with ASTM C42. If the core tests prove unsatisfactory, load tests shall be made in accordance with ACI 318. Precast units failing to meet the requirements of the load tests shall not be used. Core tests and load tests shall be performed at the expense of the Contractor.

4. SUBMITTALS:

- 4.1 Shop Drawings: Shop drawings indicating details of construction and erection shall be submitted to the Contracting Officer for record in accordance with the requirements of Division 1. Drawings shall show dimensions, details of bonding, inserts, cutouts, sleeves, pickup points, and accessories, and the relationship of all pieces to adjacent materials. Reinforcing steel shall be detailed in accordance with ACI 315. Any revision to the design as shown on the engineering drawings, in order to adapt them to the manufacturer's method of operation, including handling, shall be shown on the shop drawings, and appropriate design calculations shall be submitted to the Contracting Officer for approval.
- 4.2 Certified Test Reports: Before delivery of materials and equipment, four certified copies of the tests reports specified herein shall be submitted to the Contracting Officer for approval, along with manufacturer's certification that the tested material and equipment are of the same type, quality, and manufacture as that proposed to be supplied.
- 5. GENERAL REQUIREMENTS: All work shall be as specified herein. Where conflicts between referenced publications exist, ACI 318 shall govern. Precast units shall be the product of a manufacturer specializing in the production of precast concrete units.
- 5.1 Contractor-Furnished Mix Design: The Contractor shall prepare, and submit for approval, a concrete mix design for each type of concrete required. The strength of concrete at 28 days and the maximum size concrete aggregate shall be as follows:

Use	Strength	Maximum Aggregate Size
	The second secon	ength port and the second of t
Concrete Planks	1000 psi	1/2"
Utility Boxes	4000 psi	3/4"

The design shall be prepared in accordance with ACI 318. The concrete may be proportioned from additional data derived from ACI 211.1 and ACI 214 for an assumed coefficient of variation of 15 percent and a probability of one test in ten falling below the specified strength, f'c, provided that the mix design reflects actual concrete plant standard deviations and the resulting production concrete conforms to the specified requirements. The mix-design shall be based on current materials previously evaluated by the concrete producer whose established methods of statistical quality control is in conformance with ACI 318. In the absence of such data, the Contractor shall sample and test the aggregates for the design of concrete. Air-entrained concrete may be approved, provided the air-entraining agent

is added to the mixer to produce 4 percent of air by volume, plus or minus 1 percent.

- 5.2 Miscellaneous Connections: Anchors, dowels, bolts, steel welding inserts, and connecting plates indicated and/or necessary in connection with the fabrication and erection of precast concrete members shall be in position rigidly to prevent displacement while concrete is being placed. On-site and off-site welding shall be in accordance with AWS D1.1 and D12.1, as applicable.
- 6. MATERIALS: Materials shall conform to the specifications and to the other requirements specified herein.
- 6.1 Portland Cement: ASTM C150, Type I or II. Cement used shall be obtained from a single mill. Type III cement may be used, when approved, at no increase in cost to the Government.
- 6.2 Water: Water shall be clean and free from injurious amounts of oils, acids, alkalis, salts, organic materials, or other substances that may be harmful to concrete or steel. Water shall not contain harmful amounts of chloride ion.
- 6.3 Aggregates: Aggregates shall be free from any materials which could react with the alkalies in the cement in a deleterious manner.
 - 6.3.1 Aggregates for Normal Weight Concrete: ASTM C33.
- 6.3.2 Aggregates for Lightweight Concrete: Coarse aggregates, ASTM C330; fine aggregates, ASTM C33 or C330.
- 6.3.3 Aggregate Maximum Size: The maximum size of aggregate shall not exceed 1/2 inch.
- 6.3.4 All Aggregates: All aggregates of each size, used for exposed concrete, shall be obtained from a single source.
- 6.4 Admixtures, Including Air Entraining: ASTM C260 (air entraining); ASTM C494 (chemical). All admixtures shall have prior approval of the Contracting Officer, shall be from one manufacturer, and shall be certified by the manufacturer to be free of chlorides. All admixtures shall be added at the mixer.
 - 6.5 Reinforcing:
- 6.5.1 Welded Wire Fabric Reinforcing: ASTM A185, electrically galvanized.
- 6.5.2 Reinforcing Bars: ASTM A615, Grade 60, sized and located as indicated. Welded splices shall be in accordance with AWS D1.4-79.

- 6.6 Attachment Accessories: Bolts, shims, washers and nuts, dowels, and clamps shall be corrosion resisting steel conforming to AIS! Type 304 or 316. Anchors, setting loops, lifting hooks, and like accessories set in castings shall be steel, hot-dipped zinc-coated in accordance with ASTM A123, malleable iron, or plated ferrous metal as best suited to prevent rust staining of members and to meet structural requirements.
 - 6.7 Caulking and Sealants: See Section 07920, Caulking and Sealants.

7. FABRICATION:

- 7.1 General: Fabrication of the members shall be for the design load conditions indicated and shall make structural provision for all required openings. Each precast member shall be marked to indicate its location in the structure, its top surface, and date of fabrication. Identification marks shall correspond to the placing plans.
- 7.2 Forms: Forms shall be well braced and stiffened against deformation, and shall be accurately constructed. The forms shall be such as to produce a smooth dense surface. A bond-breaking substance may be applied to the forms. Exposed ends of roof panels shall be square cut. Adjoining sides shall be tongue and groove. Form ties shall be either the threaded or snap-off type, so that no form wires or metal pieces will be within 1/2 inch of the surface.
- 7.2.1 Tolerances: The dimensions of the finished product shall be within the limits given below at the time of placement in the structure.
 - a. Overall dimensions of members = plus or minus 1/8-inch per 10 feet; maximum of plus or minus 3/4-inch.
 - b. Deviation from straight line in long sections: Not more than 1/8-inch per 10 ft.
 - c. Deviation from specified camber plus or minus 1/16-inch per 10 ft. of span.
- 7.3 Cast-In Items: Groups of inserts or cast-in items which must be located in close tolerance to each other shall not be separated into two panels by a joint.
- 7.4 Reinforcing: Steel reinforcing shall be fabricated as indicated and placed in position in the forms within the tolerances specified in ACI 318. Reinforcement shall be adequately secured so as to remain in the proper position during placement of the concrete. Where cover over reinforcing steel is not indicated, it shall be in accordance with ACI 318.

7.5 Concrete:

- 7.5.1 Concrete Mixing: Mixing operations shall be such as to produce batch-to-batch uniformity.
- 7.5.2 Concrete Placing: Concrete placing shall be in accordance with ACI 304 and ACI 305.
- 7.5.3 Concrete Curing: Curing shall be commenced immediately following the initial set or completion of surface finishing and shall conform to ACI 308. The application of heat at a controlled rate, combined with an effective method of supplying or retaining moisture in order to accelerate the curing process, shall be accomplished as described below.
 - 7.5.3.1 Steam Curing: Steam curing shall comform to ACI 517.
- 7.5.3.2 Curing with Radiant Heat and Moisture: The application of radiant heat to beds, whether by means of pipes circulating steam, hot oil or hot water, or by electric blankets or heating elements, shall be accomplished without pipes, blankets, or elements making contact with concrete, form surfaces, or test cylinders. Effective means shall be provided to prevent rapid loss of moisture in any part of the member. The ambient curing temperature shall not exceed 175 degrees F at any time. The curing procedures shall be carefully controlled.
- 7.6 Finishing: Honeycombed sections shall be inspected by a qualified structural engineer. If any unit is found to be structurally impaired, it shall be rejected. Where accepted, honeycombed sections shall be repaired unless the repair is specifically waived by the Contracting Officer. The repair shall be as follows: All loose material shall be removed and the areas cut back until the coarse aggregate breaks under chipping instead of falling out. The area shall be saturated, allowed to approach a condition of surface dryness, coated with a thin layer of neat cement slurry, and hammer-packed with stiff dry mortar. A proven bonding material shall be used, as per manufacturer's recommendations, for bonding the patching mortar.
- 7.6.1 Structural members will be accepted with form-finished appearance but with leakage fins removed. All faces shall have true, well-defined surfaces. Exposed ragged edges shall be corrected by rubbing or grinding.
- 7.6.2 Standard Finish: Small surface holes caused by air bubbles, normal form joint marks, and minor chips and spalls will be tolerated, but no major or unsightly imperfections, honeycomb, or structural defects will be accepted. However, the Contracting Officer may accept such defects subject to approved corrective measures.
- 7.6.3 Grade B Finish: All air pockets and holes over 1/4-inch in diameter shall be filled with a sand-cement paste. All form offsets or

fins over 1/8-inch shall be ground smooth. In addition, the members shall have a smooth-rubbed finish.

8. ERECTION:

- 8.1 General: Members shall be erected in accordance with approved shop drawings and erection schedules. The proposed sequence of operations shall be approved before erection begins. The work shall be supported, braced, guyed, and otherwise maintained in proper position pending completion of necessary structural connections.
- 8.2 Bearing Surfaces: Units shall be installed on bearing surfaces which are level and free of irregularities. The Contractor shall correct bearing surface irregularities by levelling with a stiff cement mortar. The units shall be installed at right angles to bearing surfaces, drawn up tight without forcing or distortion, and with sides plumb.
- 8.3 Joint Treatment: Joints between concrete roof planks shall be cemented on upper side with high melting point asphalt mastic recommended by manufacturer.
- 8.4 Caulking and Sealants: Seals, gaskets, sealant, and sealant backup shall be placed in vertical and horizontal joints between units in accordance with drawing details and as specified in Section 07920, Caulking and Sealants.

*** END OF SECTION ***

SECTION 04200

UNIT MASONRY

PART 1 - GENERAL

1.1 APPLICABLE PUBLICATIONS: 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.

1.1.1 American Society for Testing and Materials (ASTM) Publications:

A 82-79	Cold-Drawn Steel Wire for Concrete Reinforcement
A 90-69 (R 1978)	Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles
A 153-80	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
A 167-80B	Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
A 615-81	Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
A 616-79	Rail-Steel Deformed and Plain Bars for Concrete Reinforcement
В 370-81	Copper Sheet and Strip for Building Construction
C 55-75 (R 1980)	Concrete Building Brick
C 62-81	Building Brick (Solid Masonry Units Made from Clay or Shale)
C 67-81	Sampling and Testing Brick and Structural Clay Tile
C 90-75 (R 1981)	Hollow Load-Bearing Concrete Masonry Units
C 91-78	Masonry Cement
C 129-75 (R 1980)	Non-Load-Bearing Concrete Masonry Units
C 144-76	Aggregate for Masonry Mortar

C 145-75 (R 1981)

C 150-81 Portland Cement

C 207-79 Hydrated Lime for Masonry Purposes

C 216-81 Facing Brick (Solid Masonry Units Made from Clay or Shale)

C 270-80A Mortar for Unit Masonry

C 476-80 Grout for Reinforced and Nonreinforced Masonry

1.2 SUBMITTALS:

- 1.2.1 Certified Test Reports: Submit certified efflorescence test reports on masonry units and mortar that are to be exposed to weathering. Schedule tests far enough in advance of starting masonry work to permit retesting if necessary.
 - a. Masonry Units: Test five pairs of specimens of each type of masonry unit for efflorescence in accordance with ASTM C 67. If any pair is rated "effloresced," reject the units represented by the samples.
 - Mortar: Prepare a 3-ounce mortar specimen of each proposed mix using as little water as possible. Place each mortar specimen in a glass or glazed receptacle prior to its initial set. Mix 4 ounces of distilled water with the mortar and stir thoroughly for 5 minutes. Size of the receptacle shall be such that when the mortar specimen and water are combined in solution and a masonry unit is placed in it, the solution will have a depth of 1/2 to one inch. Place a masonry unit tested and found free of efflorescence on end in the solution. Maintain the water level at 1/2 to one inch with distilled water. After 7 days in drying room, inspect, dry, examine, and rate the unit for efflorescence in accordance with ASTM C 67. If the unit is rated "effloresced," test the mortar components in separate receptacles, each containing a masonry unit which has been tested and found free of efflorescence. Thoroughly mix each mortar component with 4 ounces of distilled water using one ounce of each cementitious material and 3 ounces of each aggregate. Maintain the water level at a depth of 1/2 to one inch with distilled water. After 7 days in drying room, inspect, dry, examine, and rate the unit for efflorescence in accordance with ASTM C 67. Reject the component causing efflorescence.
- 1.2.2 Sample Panel: At the job site provide for approval by the Contracting Officer a sample masonry panel approximately 4 feet long by 3

feet high showing the workmanship, coursing, bond, thickness and tooling of joints, range of color, texture of masonry, and mortar color. Finished work shall match the approved sample panel.

- 1.2.3 Samples: Submit for approval one strap of not less than five face brick units showing full range of color and texture.
- 1.2.4 Catalog Data: Submit complete descriptive literature for each type of masonry accessory, reinforcement, control joint, and flashing. Clearly mark the data to indicate which type, size, or item the Contractor intends to provide. Provide sufficient data to show conformance to specified requirements.
- 1.2.5 Certificates of Conformance: Submit certificates attesting that masonry cement meets the requirements specified herein.
- 1.3 DELIVERY AND STORAGE: Deliver cement, lime, and other cementitious materials to the site in unbroken bags, barrels, or other approved containers, plainly marked and labeled with manufacturers' names and brands. Store cementitious materials in dry, weathertight sheds or enclosures and handle so as to prevent entry of foreign materials and damage by water or dampness. Handle masonry units with care to avoid chipping and breakage. Protect masonry materials from damage and, except for sand, keep dry until used. Do not use materials containing frost or ice.

1.4 ENVIRONMENTAL CONDITIONS:

- 1.4.1 Cold Weather Construction: Do not lay masonry when the air temperature is below 40 degrees F and falling, or when it appears that air temperature will drop to 40 degrees F or below within 24 hours, unless the work is protected from freezing as specified below. Work will not be permitted with or on frozen materials. Comply with the requirements specified below for the respective air temperatures:
 - a. Air Temperature 40 to 32 degrees F: Heat sand or mixing water to produce mortar temperature between 40 and 120 degrees F.
 - b. Air Temperature 32 to 25 degrees F: Heat sand and mixing water to produce mortar temperature between 40 and 120 degrees F.
 - c. Air Temperature 25 to 20 degrees F: Heat sand and mixing water to produce mortar temperature between 40 and 120 degrees F. Use salamanders or other heat sources on both sides of walls under construction. Use windbreaks when wind is in excess of 15 mph.
 - d. Air Temperature 20 degrees F and Below: Heat sand and mixing water to produce mortar temperature between 40 and 120

degrees F. Provide enclosures and auxiliary heat to maintain air temperature above 32 degrees F on both sides of walls under construction. Ascertain that temperatures of masonry units are not less than 20 degrees F when units are laid.

- 1.4.2 Cold Weather Protection: Protect newly laid masonry as specified below for the respective mean daily air temperature (MDAT):
 - a. MDAT 40 to 32 degrees F: Protect masonry from rain and snow by covering with weather-resistive membrane for 24 hours after laying.
 - b. MDAT 32 to 25 degrees F: Completely cover masonry with weather-resistive membrane for 24 hours.
 - c. MDAT 25 to 20 degrees F: Completely cover masonry with insulating blankets and weather-resistive membrane for 24 hours.
 - d. MDAT 20 degrees F and Below: Maintain temperature of masonry above 32 degrees F for 24 hours by providing enclosures and supplementary heat or other approved means.

PART 2 - PRODUCTS

2.1 MASONRY UNITS:

- 2.1.1 Building Brick: ASTM C 62; Grade SW for vertical surfaces in contact with the earth and for all non-vertical surfaces Grade SW or MW for other locations. Average dimensions of brick shall be 3-5/8 inches thick, 2-1/4 inches high, and 7-5/8 inches long (modular), subject to the tolerances specified in ASTM C 62. The color range of brick used in the exterior face of walls shall match as closely as possible the brick on existing structures.
- 2.1.2 Concrete Masonry Units (CMU): Units of modular dimensions and air, water, or steam cured. Store Type II units at the site before use minimum of 28 days for air cured units, 10 days for atmospheric steam or water cured units, and 3 days for units cured with steam at a pressure of 120 to 150 psi and at a temperature of 350 to 365 degrees F for at least 5 hours. Exposed surfaces of units shall be comparatively smooth and of uniform texture.
 - a. Hollow Load-bearing Units: ASTM C 90, Grade N-I or N-II, made with light weight or normal weight aggregate. Provide load-bearing units for all exterior walls, foundation walls, load-bearing walls, and shear walls.

- b. Hollow Non-Load-bearing Units: ASTM C 129, Type I or II, made with light weight or normal weight aggregate. Loadbearing units may be provided in lieu of non-load-bearing units.
- c. Concrete Building Brick: ASTM C 55, Grade S-I or S-II, except brick exposed to weather shall be Grade N-I or N-II, and made with light weight or normal weight aggregate. Concrete brick shall match the concrete masonry units as closely as practicable in color and surface characteristics.
- d. Solid Load-bearing Units: ASTM C 145, Grade S-I or S-II, except units exposed to weather shall be Grade N-I or N-II, and made with light weight or normal weight aggregates. Provide solid units for masonry bearing under structural framing members.
- e. Special Shapes: Provide special shapes such as closures, header units, and jamb units as necessary to complete the work. Special shapes shall conform to the requirements for the units with which they are used.
- 2.1.3 Precast Concrete Lintels: Same materials and surface texture as adjacent masonry units, with a 28-day compressive strength of not less than 2,000 psi. Provide reinforcing as indicated. Provide lintels of sizes indicated, straight and true, with at least 8 inches of bearing at each end.
 - 2.2 MORTAR:
 - 2.2.1 Portland Cement: ASTM C 150, Type I, II, or III.
 - 2.2.2 Hydrated Lime: ASTM C 207, Type S.
- 2.2.3 Masonry Cement: ASTM C 91, except that the air content of the mortar specimen shall be not more than 16 percent by volume in lieu of 22 percent. Containers shall bear complete instructions for proportioning and mixing to obtain the required types of mortar.
 - 2.2.4 Sand: ASTM C 144.
- 2.2.5 Water: Clean, potable, and free from substances which could adversely affect the mortar.
- 2.2.6 Mortar Types: ASTM C 270, Type M for foundation walls; Type N or S for non-load-bearing, non-shear-wall interior concrete masonry; and Type S for all other masonry work. If masonry cement is used, submit the manufacturer's printed instructions on proportions of water and aggregates and on mixing to obtain the type of mortar required.

2.3 ACCESSORIES:

- 2.3.1 Horizontal Joint Reinforcement: Fabricate from cold drawn steel wire, ASTM A 82. Wire shall be zinc coated after fabrication by the hot-dip process in accordance with ASTM A 153. Reinforcement shall consist of two or more parallel longitudinal wires not lighter than 8-gage (0.1620 inch) weld connected with cross wires not lighter than 9-gage (0.1483 inch) at 16 inches 0.C. Provide at least one longitudinal wire for each wythe and one longitudinal wire for each face shell of concrete masonry units more than 4 inches thick. Crimp cross wires to provide an effective moisture drip in wall cavity. Out-to-out spacing of the longitudinal wires shall be 1-1/2 to 1-3/4 inches less than the actual width of the masonry. Provide joint reinforcement in flat sections, not less than 10 feet long, except that corner reinforcements and other special shapes may be shorter.
- 2.3.2 Anchors and Ties: Provide approved designs of copper-clad steel, zinc-coated steel, or noncorrosive metal having the equivalent total strength of steel types. Zinc coat items by the hot-dip process after fabrication to a minimum of 1.25 ounces of zinc per square foot of surface when tested in accordance with ASTM A 90.
 - a. Wire Mesh Ties: Wire not lighter than 20-gage, galvanized, 1/2-inch mesh with width of one inch less than thickness of masonry.
 - b. Corrugated Metal Ties: Not less than 7/8-inch wide by approximately 6 inches long and not lighter than 22-gage.
 - c. Rigid Steel Anchors: Not less than 1-1/2 inches wide, 3/16inch thick, and 18 inches long with each end bent not less than 2 inches.
 - d. Dovetail Flat Bar or Wire Anchors: Flat bar: Sheet steel, not lighter than 16-gage, and 7/8-inch wide, corrugated, with end turned up 1/4 inch. Wire: Not lighter than 6-gage, 7/8inch wide with wire looped and closed. Dovetail slots and inserts are specified in Section 03300, "Cast-In-Place Concrete."
- 2.3.3 Fastenings: Provide suitable bolts, metal wall plugs, or other approved metal fastenings for securing furring to masonry and elsewhere as necessary.
 - 2.3.4 Reinforcing Steel Rods: ASTM A 615 or ASTM A 616.
 - 2.3.5 Through-wall Flashing: Provide one of the following types.
 - a. Coated Copper Flashing: 5-ounce, electrolytic copper sheet, uniformly coated on both sides with acidproof, alkaliproof, elastic bituminous compound. Factory apply coating to a

- weight of not less than 6 ounces per square foot (approximately 3 ounces per square foot on each side).
- b. Six-Ounce Copper or Stainless Steel Flashing: Copper, ASTM B 370, 6-ounce weight; stainless steel, ASTM A 167, Type 301, 302, 304, or 316, 0.006-inch thick, No. 2 or No. 2D finish. Provide with factory fabricated deformations that mechanically bond flashing against horizontal movement in all directions. Deformations shall consist of dimples, diagonal corrugations, or a combination of dimples and transverse corrugations.

PART 3 - EXECUTION

3.1 INSTALLATION: Coordinate masonry work with the work of other trades to accommodate built-in items and to avoid cutting and patching. Do not change source of supply of materials after the work has started if the appearance of the finished work would be affected.

3.1.1 Protection:

- a. Stains: Protect exposed surfaces from mortar and other stains. When mortar joints are tooled, remove mortar from exposed surfaces with fiber brushes and wooden paddles. Protect base of walls from splash stains by covering adjacent ground with sand, sawdust, or polyethylene.
- b. Loads: Do not apply uniform loads for at least 12 hours or concentrated loads for at least 72 hours after masonry is constructed.
- 3.1.2 Workmanship: Carry masonry up level and plumb all around. Furnish and use "story poles" or "gage rods" prior to starting the work and throughout the work. Changes in coursing or bonding after the work is started will not be permitted. Do not carry one section of the walls up in advance of the others. Step back unfinished work for joining with new work; toothing will not be permitted. Check heights of masonry with an instrument at each floor and at sills and heads of openings to maintain the level of the walls. Build in door and window frames, louvered openings, anchors, pipes, ducts, and conduits carefully and neatly as the masonry work progresses. Fill spaces around metal door frames solidly with mortar. Handle masonry units with care to avoid chipping, cracking, and spalling of faces and edges. Drilling, cutting, fitting, and patching to accommodate the work of others shall be performed by masonry mechanics. Cut masonry with masonry saws for exposed work. Structural steelwork. bolts, anchors, inserts, plugs, ties, lintels, and miscellaneous metalwork specified elsewhere shall be placed in position as the work progresses. Provide chases of approved dimensions for pipes and other purposes where indicated or necessary. Cover tops of exposed walls and partitions not being worked on with a waterproof membrane well secured in place and

extended down at least 2 feet on both sides. Inspect scaffolding regularly to insure that it is amply strong, well braced, and securely tied in position. Do not overload scaffolding.

- 3.1.3 Mortar Mixing: Measure mortar materials in proper containers to maintain control and accuracy of proportions. Do not measure materials with shovels. Unless specified otherwise, mix mortar in proportions by volume. Introduce and mix aggregate in such a manner that the materials will be distributed uniformly throughout the mass. Add water gradually and mix not less than 3 minutes, until proper plasticity is obtained. Machine mix mortar in mixers of the type in which the quantity of water can be controlled accurately and uniformly. Keep mortar boxes, pans, and mixer drums clean and free of debris or dried mortar. Retemper mortar which has stiffened because of evaporation by adding water and mixing with a trowel to obtain the proper, workable consistency. Do not use or retemper mortar which has not been placed in its final position within 2-1/2 hours after the initial mixing. Do not use antifreeze compounds, salts, or any other substance to lower the freezing point of mortar.
 - a. Mortar: Mix mortar at the site using materials conforming to ASTM C 270 to obtain type mortar required. Measurement and mixing shall conform to ASTM C 270. When masonry cement is used, conform to printed mixing instructions of the masonry cement manufacturer.
 - b. Grout: ASTM C 476. Provide fine grout in grout spaces less than 2 inches in any horizontal dimension or in which clearance between reinforcing and masonry is less than 3/4 inch. Provide coarse grout in grout spaces 2 inches or greater in all horizontal dimensions provided the clearance between reinforcing and masonry is not less than 3/4 inch.
- 3.1.4 Mortar Joints: Uniform thickness of 3/8-inch unless otherwise indicated. Tool exposed joints slightly concave with a round or other suitable jointer when the mortar is thumbprint hard. Use jointer slightly larger than the width of the joint so that complete contact is made along the edges of the units, compressing and sealing the surface of the joint. Strike flush joints that will not be exposed. Tool horizontal joints first. Brush joints to remove all loose and excess mortar. All horizontal joints shall be level; vertical joints shall be plumb and in alignment from top to bottom of wall within a tolerance of plus or minus 1/2-inch in 40 feet.
- 3.1.5 Brickwork: Do not use overburned, underburned, warped, spalled, cracked, or broken brick. Brick, where exposed, shall be selected when placing for the better face for stretchers and the better end for headers.
 - a. Testing: Test clay or shale brick daily on the job, prior to laying, as follows: Using a wax pencil, draw a circle the size of a quarter on five randomly selected bricks. Apply 20

drops of water with a medicine dropper to the surface within the circle on each brick. If the average time that the water is completely absorbed in the five bricks is less than 1-1/2 minutes, wet bricks represented by the five bricks tested. During freezing weather, sprinkle units requiring wetting with warm water. Use method of wetting such as to insure that each unit is nearly saturated, but surface dry when laid.

- b. Application: Unless indicated or specified otherwise, lay brick in common bond to match existing brick work. Fill joints between bricks completely with mortar. Form bed joints of a thick layer of mortar, smooth on top, not furrowed. Form head joints by applying a full coat of mortar on the entire end or on the entire side of the brick to be laid and then shoving the mortar-covered end or side of the brick tightly against the brick laid previously. The practice of buttering at the corners of brick and then throwing mortar or scrapings into the empty joints will not be permitted. Lay closure bricks with a bed joint and with head joints; place the brick carefully without disturbing the brick previously laid. Dry or butt joints will not be permitted.
- c. Brick-faced Walls: Bond the facing and the concrete masonry unit backing in every sixth brick course with horizontal joint reinforcement. Provide additional bonding ties spaced not more than 3 feet apart around the perimeter of and within 12 inches of all openings. To match existing construction, use header course every sixth course of brick. Provide concrete masonry header units every other course of CMU or cut brick in half to form headers.
 - (1) Collar Joints: Parge the outside face of the backing with a uniform trowel coat of mortar to fill the collar joint. Apply parging so as not to disturb the alignment and the bond of the masonry units. Do not fill collar joints by slushing.
 - (2) Brick Sills: Lay brick on edge, slope, and project not less than 1/2 inch beyond the face of the wall to form a wash and drip. Fill all joints solidly with mortar and tool.
- d. Cavity Walls: Provide a continuous cavity as indicated. Securely tie the two wythes together with horizontal joint reinforcement. Bevel mortar beds away from cavity so that no mortar fins project into cavity when bricks are shoved in place. Keep cavities clear and clean of mortar droppings by use of wood strips laid on horizontal joint reinforcing and lifted out and cleaned periodically. Provide weep holes of

open masonry head joints spaced 24 inches apart at base of wall cavity where cavity is closed over with masonry or flashing and at other locations as indicated. Parge inside face of outside wythe.

- e. Solid Brick Walls: Bond the two wythes in every sixth brick course with horizontal joint reinforcement. Provide additional bonding ties spaced not more than 3 feet apart around the perimeter of and within 12 inches of all openings.
- 3.1.6 Concrete Masonry Unit Work: Lay the first course in a full bed of mortar for the full width of the unit. Lay succeeding courses in running bond unless otherwise indicated. Form bed-joints by applying the mortar to the entire top surfaces of the inner and outer face shells. Form head joints by applying the mortar for a width of about one inch to the ends of the adjoining units laid previously. The mortar shall be smooth, not furrowed, and shall be of such thickness that it will be forced out of the joints as the units are being placed in position. Where anchors, bolts, and ties occur within the cells of the units, place metal lath in the joint at the bottom of such cells and fill the cells with mortar or grout as the work progresses. Use concrete brick for bonding walls, working out the coursing, topping out walls under sloping slabs, distributing concentrated loads, backing brick headers, and elsewhere as required. Do not dampen concrete masonry units before or during laying.
- 3.1.7 Bonding and Anchoring: Unless indicated otherwise, extend partitions from the floor to the bottom of the floor or roof construction above. Structurally bond or anchor walls and partitions to each other and to concrete walls, beams, and columns. Securely anchor non-load-bearing partitions and interior walls to the construction above in a manner that provides lateral stability while permitting unrestricted deflection of construction above. Completely embed anchors in mortar joints.
 - a. Corners of Load-bearing Walls: Provide a true masonry bond in each course, except where indicated or specified otherwise.
 - b. Intersections of Load-bearing Walls: Provide a true masonry bond in each course or anchor with rigid steel anchors not more than 2 feet apart vertically, unless otherwise indicated.
 - c. Intersections of Non-load-bearing Partitions with Other Walls or Partitions: Tie with wire mesh ties at vertical intervals of not more than 2 feet or with masonry bonding in alternate courses.
 - d. Masonry Walls Facing or Abutting Concrete Members: Anchor masonry to the concrete with dovetail or wire type anchors inserted in slots or inserts built into the concrete. Locate anchors not more than 18 inches on centers vertically and not more than 24 inches on centers horizontally.

- 3.1.8 Through-wall Flashing: Provide as indicated. Unless indicated otherwise, extend flashing from the exterior face of walls, upward across wall cavity not less than 6 inches and into mortar of bed joint for backing wythe. Flashing shall be terminated 3/4 inch back from interior face of walls and turned back on itself not less than 1/2 inch. Secure flashing in reglets in a manner that provides a permanent watertight joint. Provide flashing in lengths as long as practicable. Lap ends not less than 1-1/2 inches for interlocking type and 4 inches for other types. Seal laps as necessary to provide watertight construction.
- 3.1.9 Horizontal Joint Reinforcement: Provide reinforcement in every other course and in the first two courses above and below openings in walls and partitions of concrete masonry units. Reinforcement shall be continuous except at control joints and expansion joints. Reinforcement above and below openings shall extend not less than 24 inches beyond each side of openings. Provide reinforcement in the longest available lengths, utilizing the minimum number of splices. Overlap ends not less than 12 inches. Provide welded L-shaped assemblies not less than 40 by 48 inches and T-shaped assemblies not less than 32 by 32 inches, both of the same size members and the same construction as the straight reinforcement, at corners and intersections of walls and partitions. Place the reinforcement and apply mortar so as to provide mortar cover for the wire of at least 5/8 inch for exterior wall face and 1/2 inch for interior wall face.
- 3.1.10 Concrete Masonry Unit Lintels and Bond Beams: Provide special units, fill cells solidly with grout or concrete, and provide no less than two No. 5 reinforcing bars, unless indicated otherwise. Reinforcing shall overlap a minimum of 40 bar diameters at splices. Terminate bond beams and reinforcing on each side of expansion joints and control joints. Concrete masonry units used for lintels and bond beams shall have exposed surfaces of the same material and texture as the adjoining masonry units. Allow lintels to set at least 6 days before shoring is removed. Lintels shall be straight and true and shall have at least 8 inches of bearing at each end.
- 3.1.11 Control Joints: Provide where indicated in concrete masonry-unit walls. Provide control joints of the sawed type or the built-in type, as the case requires. Joints shall occur directly opposite each other on both faces of the wall and shall be filled with an approved nonstaining elastic calking compound as specified in Section 07920, "Calking and Sealants."
- 3.1.12 Grout Placement: Place grout from the interior side of walls, except as approved otherwise. Protect sills, ledges, offsets, and other surfaces from grout droppings. Remove grout from such surfaces immediately. Grout shall be well mixed to prevent segregation and shall be sufficiently fluid to flow into joints and around reinforcing without leaving voids. Keep pours at 1-1/2 inches below the top of masonry units in top course, except at the finish course. Puddle or agitate grout thoroughly to eliminate voids. Do not displace masonry from its original

position. Remove masonry displaced by grouting operation and re-lay in alignment with fresh mortar.

3.1.13 Forms and Shoring: Construct to the shape, lines, and dimensions of members indicated and make sufficiently rigid to prevent deflections which may result in cracking or other damage to supported masonry. Forms shall remain on girders and beams not less than 10 days after completion of the members. Not less than 16 hours shall elapse before uniformly distributed construction loads are applied to completed masonry members. Not less than 64 hours shall elapse before concentrated loads are applied.

3.2 CLEANING:

- 3.2.1 Protection: Protect work which may be damaged, stained, or discolored during cleaning operations.
- 3.2.2 Pointing: Upon completion of masonry work, cut out defective mortar joints and tuck point joints and all holes solidly with mortar.
- 3.2.3 Cleaning: Clean exposed masonry surfaces with clear water and stiff fiber brushes and rinse with clear water. Where stains, mortar, or other soil remain, continue cleaning as follows: Clean surfaces of light colored brickwork with non-acid or buffered-acid cleaners as recommended by the brick manufacturer. Use these cleaners in accordance with the instructions and recommendations of the brick and cleaner manufacturers. Immediately after cleaning each area, rinse thoroughly with clear water.

*** END OF SECTION ***

SECTION 05120

STRUCTURAL STEEL

PART 1 - GENERAL

1.1 APPLICABLE PUBLICATIONS: 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.

1.1.1 Federal Specifications (Fed. Spec.):

TT-C-490B Cleaning Methods and Pretreatment of Ferrous Surfaces for Organic Coatings

TT-P-645A Primer, Paint, Zinc Chromate, Alkyd Type

TT-V-51F Varnish: Asphalt

1.1.2 Military Specifications (Mil. Spec.):

DOD-P-15328D Primer (Wash), Pretreatment, (Formula No. 117 for Metals) (Metric)

DOD-P-21035A Paint, High Zinc Dust Content, Galvanizing Repair (Metric)

1.1.3 American Institute of Steel Construction (AISC) Publication:

Manual of Steel Construction, 8th Edition

1.1.4 American National Standards Institute (ANSI) Publication:

B18.22.1-65 Plain Washers (R 1975)

1.1.5 American Society for Testing and Materials (ASTM) Publications:

A 36-77a	Structural Steel
A 123-78	Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip
A 143-74 (R 1979)	Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement
A 153-80	Zinc Coating (Hot Dip) on Iron and Steel Hard-ware

A 307-80 Carbon Steel Externally Threaded Standard Fasteners

A 325-80a High-Strength Bolts for Structural Steel Joints

A 514-77 High-Yield-Strength Quenched and Tempered Alloy Steel Plate, Suitable for Welding

A 563-80 Carbon and Alloy Steel Nuts

C 827-78 Early Volume Change of Cementitious Mixtures

1.1.6 American Welding Society (AWS) Publication:

D1.1-81 Structural Welding Code, Steel

1.1.7 Corps of Engineers Publication:

CRD-C588-76 Nonshrink Grout

1.1.8 Steel Structures Painting Council (SSPC) Publications:

SSPC SP3-63 Surface Preparation Specification No. 3, Power Tool Cleaning

SSPC SP6-63 Surface Preparation Specification No. 6, Commercial Blast Cleaning

1.2 SUBMITTALS:

- 1.2.1 Shop Drawings: Submit shop drawings of all structural steel for approval prior to fabrication of structural steel. Include complete information necessary for the fabrication and erection of the component parts of the structure, including the location, type, and size of all rivets, bolts, and welds. Include all welds by standard welding symbols of the AWS.
- 1.2.2 Certificates of Conformance: Submit certificates of conformance for the following:
 - a. Common Bolts
 - b. Welding Electrodes and Rods
 - c. Paint
 - d. Galvanizing Repair Compound
 - e. Zinc-Coating Processes for Hardware and for Steel Products

- f. Testing for Embrittlement of Steel Shapes, Steel Castings, Threaded Articles, and Hardware Items
- q. Non-Shrink Grout
- h. Steel
- i. High-Strength Bolts and Nuts
- 1.3 DELIVERY AND STORAGE: Handle, ship, and store material in a manner that will prevent distortion or other damage. Store material in a clean, properly drained location out of contact with the ground. Replace all damaged material with new material or repair the damaged material in an approved manner.

PART 2 - PRODUCTS

- 2.1 STEEL: Materials shall conform to the respective specifications specified herein. Materials not otherwise specified herein shall conform to the AISC "Manual of Steel Construction."
 - 2.1.1 Carbon Grade Steel: ASTM A 36.
 - 2.2 BOLTS, NUTS, AND WASHERS:
 - 2.2.1 Common Bolts and Nuts: ASTM A 307.
 - 2.2.2 High-Strength Steel Bolts: ASTM A 325, Type 1 or 2.
- 2.2.3 Collar Bolts: Collar bolts consisting of head, shank, and collar shall have equivalent strength of ASTM A 325 bolts. Thread bolts for tensioning and locking with a special hand power tool.
 - 2.2.4 Circular Washers for Common Bolts: ANSI B18.22.1.
- 2.2.5 Beveled Washers for American Standard Beams and Channels: AISC Specification.
 - 2.2.6 Circular Washers for High-Strength Bolts ASTM A 325.
 - 2.2.7 Carbon and Alloy Steel Nuts: ASTM A 563.
 - 2.3 ACCESSORIES:
 - 2.3.1 Welding Electrodes and Rods: AWS Code D1.1.
- 2.3.2 Zinc-Coating: ASTM A 123 for steel and ASTM A 153 for threaded products.

- 2.3.3 Pins and Rollers: Steel, turned accurately to the dimensions shown, straight, smooth, and free from flaws. Pins and rollers more than 7 inches in diameter shall be forged and annealed; in pins larger than 9 inches in diameter, bore a hole not less than 2 inches in diameter full length along the axis after the forging has been allowed to cool to a temperature below the critical range under suitable conditions to prevent damage by too rapid cooling and before being annealed. The turned bodies of pins shall be long enough to extend not less than 1/4 inch beyond the outside faces of the parts connected.
- 2.3.4 Non-Shrink Grout: Corps of Engineers CRD-C588. Grout shall show no shrinkage when tested in the plastic state in accordance with ASTM C 827 and shall not break up under expansion due to moisture or gaseous releases.

PART 3 - EXECUTION

- 3.1 FABRICATION: Fabricate in accordance with the applicable provisions of the Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings as set forth in Part 5 of the AISC "Manual of Steel Construction."
 - 3.1.1 Welding of Structural Steelwork: AWS D1.1.
- 3.1.2 High-Strength Steel Bolts: Design and assemble structural joints using high-strength steel bolts according to the AISC Specification.
 - 3.1.3 Shop Painting: Except as otherwise specified, shop paint all structural steelwork, except zinc-coated surfaces and steelwork to be embedded in concrete or mortar. Surfaces to be welded shall not be coated within 1/2 inch from the specified toe of the weld prior to welding, except that paint will be allowed on surfaces on which metal decking or shear studs are to be welded. Insure that surfaces are thoroughly dry and clean when the paint is applied. Do not paint in freezing or wet weather except under cover. Do not apply paint when the temperature is below 40 degrees F, or expected to drop to 32 degrees F or below within 5 hours of completing the application, before the paint has completely dried. Do not apply paint to steel which is at a temperature that will cause blistering or porosity or will otherwise be detrimental to the life of the paint. Apply paint in a workmanlike manner, and coat all joints and crevices thoroughly. Prior to assembly, paint all surfaces which will be concealed or inaccessible after assembly.
- 3.1.3.1 Cleaning: Except as modified herein, blast clean surfaces in accordance with SSPC-SP6. Surfaces that will be exposed in spaces above ceilings, attic spaces, crawl spaces, furred spaces, and chases may be cleaned in accordance with SSPC-SP3 in lieu of being blast cleaned. Wash cleaned surfaces which become contaminated with rust, dirt, oil, grease, or other contaminants with solvents until thoroughly clean.

Insure that steel to be embedded in concrete is free of dirt and grease. Do not paint or galvanize bearing surfaces, including contact surfaces within friction—type joints, but coat them with an approved rust preventative applied in the shop. Remove such coating just prior to field erection using a remover approved by the rust preventative manufacturer. Insure that the surfaces, when assembled, are free from rust, grease, dirt, and other foreign matter.

- 3.1.3.2 Pretreatment: Except as modified herein, immediately after cleaning and before any rust has formed, coat surfaces with a pretreatment coating conforming to Mil. Spec. DOD-P-15328 applied to a dry film thickness of 0.3 to 0.5 mil or with a crystalline phosphate base coating conforming to Fed. Spec. TT-C-490, Method I, except apply phosphate base coating only to blast cleaned, bare metal surfaces.
- 3.1.3.3 Priming: Prime treated surfaces as soon as practicable after the pretreatment coating has dried. Except as modified herein, prime with zinc chromate primer conforming to Fed. Spec. TT-P-645, applied to a minimum dry film thickness of 1.0 mil. Prime surfaces that will be concealed after construction and will require no overpainting for appearance with a coat of asphalt varnish conforming to Fed. Spec. TT-V-51 applied to a minimum dry film thickness of 1.0 mil in lieu of zinc chromate primer. Repair damage to primed surfaces with primer.
- 3.1.4 Repair of Zinc-Coating: Repair zinc-coating that has been damaged in handling, transporting, or in welding, riveting, or bolting by the application of a galvanizing repair paint conforming to Mil. Spec. DOD-P-21035. Clean all areas to be repaired and remove slag from the welds. Do not heat surfaces to which the repair paint is applied.
- 3.1.5 Match Marking: Match mark members and component parts of structures prior to erection to insure proper position on final erection. Painted assembly markings shall be remote from any surface to be welded or riveted. Locate scratch or notch marks so as not to affect the strength of the member or cause concentrations of stress. Provide permanent torque marks on critical bolts of the structure.
- 3.2 ERECTION: Except as modified herein, erect steel in accordance with the AISC "Manual of Steel Construction." Where parts cannot be assembled or fitted properly as a result of errors in fabrication or of deformation due to handling or transportation, report such condition immediately to the Contracting Officer and obtain approval therefrom for the methods of correction before proceeding with making any corrections. Do not heat heat-treated parts for straightening, including members of steel conforming to ASTM A 514. Drain steelwork properly; fill pockets in structures exposed to the weather with an approved waterproof material. Provide safety belts and lines for workmen aloft on high structures unless safe working platforms or safety nets are provided. When calibrated wrenches are used for tightening bolts, calibrate them at least once each working day using not less than three typical bolts of each diameter. Do not use impact torque wrenches to tighten anchor bolts set in concrete.

- 3.2.1 Connections: Provide anchor bolts and other connections between the structural steel and foundations properly and build them into connecting work. Design connections for which details are not indicated in accordance with AISC "Manual of Steel Construction."
- 3.2.2 Base Plates and Bearing Plates: Provide column base plates for columns and bearing plates for beams, girders, and similar members. Provide base plates and bearing plates with full bearing after the supported members have been plumbed and properly positioned. Dry pack the area under the plate solidly with a non-shrinking type of grouting mortar. Grout in accordance with the printed instructions of the grouting mortar manufacturer.
- 3.2.3 Temporary Flooring: Provide wood planking or material of equivalent strength over the entire floor level in buildings where structural steel is being erected and at alternate floor levels between this level and the level at which permanent floor filling or floor filling forms have been provided. Insure that planks for temporary floors are free from protruding nails and splinters and are not less than 2 inches in nominal thickness. Lay planks close together with all ends over a solid bearing to prevent tipping and the ends overlapped at least 4 inches. Fasten planks securely to the framework of the structure. Provide permanent floor construction as the building progresses and as closely behind the erecting, riveting, welding, bolting, and painting as practicable. In no case shall the steel erection be more than eight stories above the uppermost permanent floor filling.
- 3.2.4 Tolerances: In accordance with the "Code of Standard Practice" of the AISC "Manual of Steel Construction," as modified herein.
- 3.2.5 Temporary Welds and Run-Off Plates and Backing Strips: Shall be removed.

3.3 TESTS AND INSPECTIONS:

- 3.3.1 Visual Inspection of Welding: Visually inspect welding while the operators are making the welds and again after the work is completed. After the welding is completed, hand or power wire brush welds, and thoroughly clean them before the inspector makes the check inspection. Inspect welds with magnifiers under strong, adequate light for surface cracking, porosity, and slag inclusions; excessive roughness unfilled craters; gas pockets; undercuts; overlaps; size; and insufficient throat and concavity. Inspect the preparation of groove welds for adequate throat opening and for snug positioning of back-up bars.
- 3.3.2 Testing High Strength Bolts: Test each high strength bolt connection as required by the AISC Specification.

3.3.3 Testing for Embrittlement: ASTM A 143 for structural steel products that are hot-dip galvanized after fabrication.

*** END OF SECTION ***

SECTION 05210

STEEL JOISTS

- APPLICABLE PUBLICATIONS: 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.
 - 1.1 American Welding Society (AWS) Publication:

D1.1-81

Structural Welding Code, Steel

1.2 Steel Joist Institute (SJI) Specifications:
(as printed in the SJI Publication - Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders, 1979)

Standard Specifications for Open Web Steel Joists, H-Series

Standard Specifications for Longspan Steel Joists, LH-Series and Deep Longspan Steel Joists, DLH-Series

1.3 Steel Structures Painting Council (SSPC) Specification:

SSPC-PS 14.01 Steel Joist Shop Paint System

- 2. SUBMITTALS: Submit the following information:
- 2.1 Shop Drawings: Shop drawings for all joists and accessories. Shop drawings shall show joist type and size, layout in plan, methods of anchoring, framing at openings, and spacing of bridging.
- 2.2 Certificates of Conformance or Compliance: Certificates of conformance and compliance for joists and accessories.
- 3. DELIVERY AND STORAGE: Handle, transport, and store joists at the job site in a manner to prevent permanent distortion of any part or other damages affecting their structural integrity. Replace damaged items that cannot be restored to like-new condition. Store all items of the ground in a well drained location protected from the weather and easily accessible for inspection and handling.
- 4. JOISTS AND ACCESSORIES: Except as otherwise specified herein, joists and accesories shall be in accordance with the applicable SJI Standard Specification for the joist series indicated.
- 4.1 Shop Painting: Clean and prime joists in accordance with SSPC PS 14.01, Steel Joist Shop Paint System, except that paint shall conform to SJI Specifications and shall be suitable for top coating.

4.2 Paint: Paints used for touchup and shop painting may contain toxic lead or zinc compounds. Appropriate measures shall be taken to control worker exposure to toxic substances during their use.

5. INSTALLATION:

- 5.1 Handling: Except as otherwise specified herein, handling and erection shall be in accordance with the applicable SJI Standard Specification for the joist series indicated.
- 5.2 Field Welding: Welding shall be performed in accordance with AWS D1.1 and shall be performed by welders qualified in accordance with the requirements specified therein.
- 5.3 Touch up Painting: After erection of joists, connections and areas of abraded shop coat shall receive touch up paint of the same type used for the shop coat.

*** END OF SECTION ***

SECTION 05311

STEEL ROOF DECKING

- APPLICABLE PUBLICATIONS: The publications listed below for a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.
 - 1.1 Military Specification (Mil. Spec.):

DOD-P-21035A Paint, High Zinc Dust Content, Galvanizing (Navy) Repair (Metric)

1.2 American Iron and Steel Institute (AISI) Publication:

Specifications for the Design of Cold-Formed Steel
Structural Members (1968 Edition) and Add. 2 (February 1977)

1.3 American Society for Testing and Materials (ASTM) Publication:

A525-78 Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, General Requirements

1.4 American Welding Society (AWS) Publication:

B3.0-77 Welding Procedure and Performance Qualification

- 2. SUBMITTALS:
- 2.1 Samples: Submit for approval one sample of the proposed deck units and each type of accessory, along with the manufacturer's design calculations, before work is started.
- 2.2 Shop Drawings: Submit shop drawings for all deck units and accessories before work is started. The drawings shall show a large-scale cross-sectional details of the decking, various connections, bearing on structural supports, methods of anchoring, attachment of accessories, roof layouts, placement directions, and other pertinent details.
- 2.3 Certificates of Conformance or Compliance: Submit for approval certificates from the manufacturer attesting that materials meet the requirements specified herein.
- 3. DELIVERY AND STORAGE: Deliver, store and handle steel deck in a manner to protect it from corrosion, deformation, and other types of damage. Exercise special care not to damage the material or overload the decking during the entire construction period. The maximum uniform distributed storage load shall not exceed the design live load. All damaged material shall be replaced by the Contractor.

4. DESIGN:

- 4.1 Steel Roof Deck: Steel roof deck shall be non-cellular and designed in accordance with the AISI "Specifications for the Design of Cold-formed Steel Structural Members," except as specified otherwise herein. Simple short spans shall be avoided, and all deck units shall extend over three or more supports unless absolutely impractical. Deck and accessories shall be the products of a manufacturer regularly engaged in the manufacture of steel roof deck. Ribbed deck, characterized by longitudinal bearing ribs, shall also be in accordance with SDI Design Manual for Floor Decks and Roof Decks, except as specified otherwise herein.
- 4.3 Design Loads: The roof deck shall be designed to support a live load of 40 pounds per square foot. Dead load shall be assumed as 10 psf. The maximum allowable deflection under total loading shall be 1/240 of the clear span. Roof deck having a cross-sectional configuration that differs from the units indicated may be used, provided that the properties of the proposed units are equal to, or greater than, the properties of the units indicated. Side edges of deck units shall be designed to lap or interlock with adjoining deck units.

5. MATERIALS:

- 5.1 Steel: Flat rolled carbon steel sheets of structural quality, properties conforming to AISI "Specifications for the Design of Cold-Formed Steel Structural Members."
- 5.2 Zinc-coated Steel: Provide zinc-coated steel deck and accessories conforming to ASTM A525 G90. Zinc-coated steel will not require shop painting.
- 5.3 Accessories: Accessories shall be the same material as the deck and not lighter than 20-gage, unless specified otherwise herein. Provide accessories of the manufacturer's standard type, as specified herein.
- 5.3.1 Adjusting Plates: Provide adjusting plates or segments of roof units in locations too narrow to accommodate full-size roof units. As far as practicable, provide plates of the same gage and configuration as the roof units. Plates of predetermined sizes shall be factory cut.
- 5.3.2 End Closures: Provide end closures of minimum 22 gage to close the open ends at openings through the roof.
- 5.3.3 Sump Pans: Provide sump pans of minimum 14 gage at drains as indicated.
- 5.3.4 Miscellaneous Accessories: Provide cant strips, ridge and valley plates, and various types of plates and closures as indicated or as necessary to complete the work. Provide all accessories required for a finished installation.

- 6. INSPECTION OF SUPPORT STRUCTURE: Prior to starting installation of any steel roof deck and accessories, inspect the support structure to verify that the structure will permit the indicated field installation of the steel roof deck system without modification.
- 7. INSTALLATION: Install steel roof deck units in accordance with the approved shop drawings. Place units on structural supports, properly adjusted, leveled, and aligned at right angles to supports. Report inaccuracies in alignment or leveling to the Contracting Officer and make necessary corrections before deck units are anchored permanently in place. Locate end laps over supports only, with minimum lap of 2 inches. Simple short spans shall be avoided, and all deck units shall extend over three or more supports unless absolutely impractical. Do not use unanchored deck units as a work or storage platform. Permanently anchor all units placed by the end of each working day.
- 7.1 Anchorage Methods: Immediately after placement and alignment, and after inaccuracies have been corrected, permanently fasten steel roof deck units in place by welding for the narrow rib type deck and self-drilling stainless steel screws with neoprene washer for the 3-inch rib type deck as recommended by the steel roof deck manufacturer and subject to approval. Length of side and end laps of deck and intervals of fastening shall be as recommended by the steel deck manufacturer. Clamp or weight deck units to provide firm contact between deck units and structural supports while welding or fastening is being performed.
- 7.1.1 Welding: Perform all welding in accordance with AWS D1.1 using methods and electrodes as recommended by the manufacturers of the base metal alloys being used. Welds shall be made only by operators previously qualified by test prescribed in AWS B3.0 to perform the type of work required. Location, size and spacing of welds shall be as shown on the approved shop drawings. Clean welds immediately by chipping and wire brushing. Heavily coat welds, cut edges and damaged portions of shop finish with zinc-dust paint conforming to Mil. Spec. MIL-P-21035.
- 7.1.2 Fasteners and Screwed: Fasteners for anchoring the deck to structural supports and adjoining units shall be designed to withstand the design loads specified herein and standard with the manufacturer. Fasteners shall be of a positive locking type and approved prior to installation.
- 7.2 Accessories: Install cover plates, finish strips, closures and closure sheets as necessary to complete the work. Install finish strips and closure sheets so as to lap one support a minimum of 2 inches.
- 7.3 Openings: Reinforce and frame openings through roof as necessary for rigidity and load-carrying capacity. Holes or other openings required for the work of other trades shall be drilled or cut and adequately reinforced by the respective trade; such holes or other openings larger than 6 inches in diameter shall be approved by the deck manufacturer.

7.4 Inspection: Inspect the decking top surface for flatness after installation. Place a 4-foot straightedge across the decking ribs over the structural supporting members at all locations. If the straightedge fails to touch the entire top surface of the decking or if top surfaces of abutting units are not in alignment, corrective measures or replacement shall be provided. After corrective measures or replacement has been performed, the decking shall be reinspected.

*** END OF SECTION ***

SECTION 05500

METAL FABRICATIONS

PART 1 - GENERAL

1.1 APPLICABLE PUBLICATIONS: 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.

1.1.1 Federal Specifications (Fed. Spec.):

L-S-125B	Screening, Nonmetallic, Insect
FF-H-111C	Hardware, Builders, Shelf and Miscellaneous
FF-P-395B	Pin, Drive, Guided and Pin, Drive, Power Actuated
FF-S-85C & Am-1	Screws, Cap, Slotted and Hexagon Head
FF-S-92B	Screws, Machine: Slotted, Cross Recessed or Hexagon Head
FF-S-111D	Screw, Wood
FF-S-325 & Int. Am-3	Shield, Expansion; Nail, Expansion; and Nail, Drive Screw (Devices, Anchoring, Masonry)
FF-W-84A & Am-2	Washers, Lock (Spring)
QQ-F-461C & Am-1	Floor Plate, Steel, Rolled
RR-G-661D	Grating, Metal, Bar Type (Floor, Except for Naval Vessels)
TT-P-645A	Primer, Paint, Zinc-Chromate, Alkyd Type
TT-P-664C & Am-2	Primer Coating, Synthetic, Rust-Inhibiting, Lacquer-Resisting
TT-V-51F	Varnish; Asphalt

GGG-D-777B

Driver, Projectile Unit, Powder Actuated (High Velocity) (Above Water Only); Pin, Drive, Powder Actuated; and Cartridge, Powder Actuated Tool

1.1.2 Military Specifications (Mil. Spec):

MIL-M-17194C & Am-2 Metal, Expanded, Steel

DOD-P-21035A

Paint, High Zinc Dust Content, Galvanizing

Repair (Metric)

1.1.3 Military Standard (Mil. Std.):

MIL-STD-889B

Dissimilar Metals

1.1.4 The Aluminum Association (AA) Publications:

Standards for Anodized Architectural Aluminum (1979)

Designation System for Aluminum Finishes (1979)

1.1.5 American Institute of Steel Construction (AISC) Publication:

M011-80

Manual of Steel Construction, 8th Edition

S326-78

Specification for the Design, Fabrication and Erection of Structural Steel for Buildings,

Nov. 1, 1978

1.1.6 American National Standards Institute (ANSI) Standards:

A10.3-77

Safety Requirements for Powder Actuated

Fastening Systems

A14.3-74

Safety Requirements for Fixed Ladders

B18.2.1-72

Square and Hex Bolts and Screws

B18.2.2-72

Square and Hex Nuts

B18.5-78

Round Head Bolts

1.1.7 American Society for Testing and Materials (ASTM) Standards:

A 36-77a

Structural Steel

A 48-76

Gray Iron Castings

A 53-79	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
A 123-78	Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed and Forged Steel Shapes, Plates, Bars, and Strip
A 153-78	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
A 386-78	Zinc-Coating (Hot-Dip) on Assembled Steel Products
A 500-78	Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
A 501-76	Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
A 525-79	Steel Sheets, Zinc-Coated (Galvanized), by the Hot-Dip Process, General Requirements
B 210-79	Aluminum-Alloy Drawn, Seamless Tubes
B 221-80	Aluminum-Alloy Extruded Bar, Rod, Wire, Shape, and Tube
В 584-79	Copper Alloy Sand Castings for General Applications

1.1.8 American Welding Society (AWS) Publication:

D1.1-81 Structural Welding Code, Steel

1.1.9 National Association of Architectural Metal Manufacturers (NAAMM) Publication:

AA-M43 Metal Finishes Manual, Third Edition (Revised) 1975

1.2 SUBMITTALS:

- 1.2.1 Certificates of Compliance: Submit manufacturer's certificates for the following:
 - a. Carbon Steel
 - b. Steel Pipe and Tubing
 - c. Cast Iron Gratings
 - d. Floor Plate
 - e. Floor Grating

- 1.2.2 Shop Drawings: Submit shop drawings along with catalog cuts, templates, and erection and installation details, as appropriate, for all miscellaneous metal items listed below. Submittals shall be complete in detail; shall indicate thickness, type, grade, class of metal, and dimensions; and shall show construction details, reinforcement, anchorage, and installation with relation to the building construction.
 - a. Access Doors and Panels
 - b. Cover Plates and Frames
 - c. Expansion Joint Covers
 - d. Floor Gratings and Frames
 - e. Guard Posts
 - f. Railings
 - g. Ladders
 - h. Trench Covers and Frames
 - i. Ships Ladders (with or without guards)
 - j. Safety Nosing
 - k. Thresholds
- 1.2.3 Samples: Samples may be installed in the work, provided each sample is clearly identified and its location recorded. Submit samples of the following items:
 - a. Fasteners
 - b. Safety Nosings
 - c. Thresholds
 - d. Gratings
- 1.3 QUALIFICATION OF WELDERS: Welding shall be performed by certified welders qualified in accordance with AWS D1.1 using procedures, materials, and equipment of the type required for the work.
- 1.4 DELIVERY, STORAGE AND HANDLING: Deliver, store and handle all miscellaneous metal items in a manner to protect them from corrosion, deformation, and other types of damage. Store all miscellaneous items in an enclosed area free from contact with soil and weather. All damaged items shall be replaced by the Contractor.

PART 2 - PRODUCTS AND EXECUTION

- 2.1 CONFORMANCE TO REQUIREMENTS: Products shall conform to the requirements specified for the particular item; and where these requirements are not specified in detail, the materials shall be suitable for the intended usage of the item. The products listed below shall conform to the respective specifications and other requirements specified herein.
- 2.1.1 Aluminum: Aluminum components shall be in standard mill finish. When anodic coatings are specified herein, the coatings shall conform to the AA Standards for Anodized Architectural Aluminum, Class I with treatment to a coating thickness not less than that specified in the

AA Designation System for Aluminum Finishes. Items to be anodized shall receive a polished-satin-finish pretreatment and a clear-lacquer overcoating conforming to the AA Standards for Anodized Architectural Aluminum. Aluminum surfaces to be placed in contact with wood, concrete, or masonry construction, except where the aluminum is to be embedded in concrete, shall be given a heavy coat of an alkali-resistant bituminous paint before installation.

- 2.1.2 Steel and Iron: If not specified otherwise, use standard mill finished structural steel shapes or bar iron in compliance with AISC Specifications for Design, Fabrication and Erection of Structural Steel for Buildings.
- 2.1.3 Structural Carbon Steel: Riveted, bolted or welded work shall conform to ASTM A 36.
- 2.1.4 Structural Tubing: Riveted, bolted or welded work shall conform to ASTM A 500 or ASTM A 501.
- 2.1.5 Steel Pipe: Steel pipe for structural use shall conform to ASTM A 53, Type E or S, Grade B.
 - 2.1.6 Fittings for Steel Pipe: Standard malleable iron fittings.
- 2.1.7 Cast Iron Gratings: Cast iron gratings shall be gray cast iron conforming to ASTM A 48, Class 40.
 - 2.1.8 Floor Plates: Fed. Spec. QQ-F-461, thickness as indicated.
- 2.1.9 Hardware: Hardware provided as an integral part of miscellaneous metal items shall conform to Fed. Spec. FF-H-111.
- 2.1.10 Expanded Metal: Expanded metal shall conform to Mil. Spec. MIL-M-17194, Type II, Class I or Class II.
- 2.1.11 Anchors and Fasteners: Anchors and fasteners, where exposed, shall be of the same material, color, and finish as the metal to which applied.
- 2.1.11.1 Expansion Shields: Expansion shields shall conform to Fed. Spec. FF-S-325, of group, type, class, and style best suited for the purpose. Shields shall be recessed not less than 2-1/2 inches into concrete or masonry, unless indicated otherwise. Devices of Groups IV, V, VI, and VII shall not be used in sizes greater than 3/8-inch unless so indicated.
- 2.1.11.2 Lag Screws And Bolts: Lag screws and bolts shall conform to ANSI B18.2.1, type and grade best suited for the purpose.
- 2.1.11.3 Toggle Bolts: Toggle bolts shall conform to ANSI B18.2.1 and ANSI B18.5.

- 2.1.11.4 Bolts, Nuts, Studs And Rivets: Bolts, nuts, studs, and rivets shall conform to ANSI B18.2.2, as applicable.
- 2.1.11.5 Powder Driven Fasteners: Fed. Spec. FF-P-395 or Fed. Spec. GGG-D-777. Powder driven fasteners shall be used only when permitted by ANSI A10.3. Follow safety provisions of ANSI A10.3.
- 2.1.11.6 Screws: Fed. Spec. FF-S-85, Fed. Spec. FF-S-92, and Fed. Spec. FF-S-111. Provide as best suited for the use intended.
- 2.1.11.7 Washers: Circular washers shall be flat and smooth and conform to ANSI B18.22.1. Beveled washers for American Standard beams and channels shall be square or rectangular, shall taper in thickness, and shall be smooth. Washers shall conform to Fed. Spec. FF-W-84.
 - 2.1.12 Extruded Aluminum Alloy: ASTM B 221.
- 2.2 DISSIMILAR MATERIALS: Where dissimilar metals as defined by Mil. Std. MIL-STD-889 are in contact, or where aluminum is in contact with concrete, mortar, masonry, wood, or absorptive materials subject to wetting, protect the surfaces with a coat of bituminous paint or a coat of varnish conforming to Fed. Spec. TT-V-51 or a coat of zinc chromate primer conforming to Fed. Spec. TT-P-645 or Fed. Spec. TT-P-664 to prevent galvanic or corrosive action.
- 2.3 ANCHORAGE: Provide anchorage where necessary for fastening miscellaneous metal items securely in place. Anchorage not otherwise specified or indicated shall include slotted inserts, expansion shields, and powder-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine and carriage bolts for steel; through bolts, lag bolts, and screws for wood. Slotted inserts shall be of types required to engage with the anchors.
- 2.4 FABRICATION: Verify all measurements and take 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, shall be hot-dip processed after fabrication. Galvanizing shall be in accordance with ASTM A 123, ASTM A 153, ASTM A 386, and ASTM A 525, as applicable. Exposed fastenings shall be compatible materials, shall match in color and finish, and shall harmonize with the material to which fastenings are applied. Include materials and parts necessary to complete each item, even though such work is not definitely shown or specified. Provide all bolts, anchors, supports, braces, connections and other items necessary for completion of the miscellaneous metalwork. The necessary rebates, lugs, and brackets shall be provided so that the work can be assembled in a neat and substantial manner. Holes for bolts and screws shall be drilled or punched. Poor matching of holes shall be cause for rejection. Fastenings shall be concealed where practicable. Thickness of metal and details of assembly and supports shall give ample strength and stiffness. Joints exposed to the weather shall be formed to exclude water.

2.5 WORKMANSHIP: Miscellaneous metalwork shall be fabricated in accordance with approved drawings, cuts, details, and samples. 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 welds shall be ground smooth. Exposed surfaces of work in place shall have a smooth finish, and exposed riveting shall be flush. Where tight fits are required, joints shall be milled to a close fit. 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.

2.6 MISCELLANEOUS ITEMS:

- 2.6.1 Access Doors and Access Panels: Access doors and access panels shall be flush type. Fabricate frames for access door of not lighter than 16-gage steel with welded joints and anchorage for securing into construction. Access doors shall be a minimum of 14 by 20 inches and of not lighter than 14-gage steel, with stiffened edges and welded attachments. Access doors shall be hinged to frame and provided with a flush-face turn-screw-operated latch.
- 2.6.2 Expansion Joint Covers: Expansion joint covers for floors, ceilings, and other locations where indicated, shall be the standard products of a manufacturer regularly engaged in the manufacture of such products. Floor assemblies shall be furnished in 6063-T5 aluminum alloy, mill finished. Ceiling assemblies shall be 6063-T5 alloy with clear anodized finish. Give all surfaces in contact with concrete, plaster, or masonry one shop coat of zinc-chromate primer at the factory. Protect all anodized surfaces with manufacturer's standard protective masking tape. Provide floor covers with suitable vinyl strips as standard with the manufacturer. Install in accordance with approved shop drawings.
- 2.6.3 Cover Plates and Frames: Cover plates shall be fabricated of galvanized 1/4-inch thick rolled steel. Shall have smooth dull edges and selected raised pattern nonslip top surfaces and shall weigh not less than 70 nor more than 100 pounds each. Reinforce as necessary to sustain a live load of 200 pounds per square foot. Flush type, U-shaped bar steel, lifting handles centered not more than 3 inches from the edge shall be provided in the ends of each plate. Provide holes and openings with 1/2-inch clearance as necessary for pipes and equipment. Support cover plates on structural steel angle frames anchored in place securely with one-inch by 3/16-inch by 12-inch bars bent at one end and welded to the frames 2 feet on centers. Butt-joint frames tightly in straight runs, miter at corners, and install level and in true alignment. Weld all connections and grind top surface smooth. Provide bar stops 1/4-inch thick by one-inch wide, welded or riveted every 6 inches on the frames for the cover plates. Provide 1/8-inch clearance between cover plates and bar stops.
- 2.6.4 Floor Gratings and Frames: Grating shall conform to Fed. Spec. RR-G-661, Type I or II plain surface constructed of galvanized steel or aluminum. Design floor gratings to support a live load of 200 pounds

per square foot for the spans indicated. The deflection shall be not greater than 0.10 inch, except that an increase of 0.03 inch will be permitted for each 6-inch increase in span length for spans greater than 2 feet. Band edges of gratings with bars of the same size as bearing bars. Weld banding in accordance with the manufacturer's standard for trim. The tops of bearing bars and cross or intermediate bars shall be in the same plane and shall provide practically smooth but nonfinished to match grating, shall be provided as indicated. Frames shall be provided with welded-on anchors. Floor gratings and frames shall be galvanized.

- 2.6.5 Frames and Covers for Pits and Trenches: Frames and covers shall be structural steel shapes and plates, with steel straps welded to frame for anchoring to concrete. Weld all corners and frames. Frame construction shall be such that tops of frames and coverplate will finish flush with floor. Cover shall be checkered steel floor plate as specified. Provide holes for removal tools. Remove sharp edges and burrs from cover plates and exposed edges of frames. Reinforce covers with structural steel channels where clear spans exceed 24 inches. Reinforcing channels shall be 24 inches on centers where required. Frames, covers, and reinforcing shall be shop painted.
- 2.6.6 Guard Posts: Guard posts shall be 4-inch prime coated standard weight steel pipe as specified in ASTM A 53. Posts shall be anchored in concrete as indicated and filled solidly with minimum 2500 psi concrete conforming to Section 03300, "Cast-in-Place Concrete."

2.6.7 Railings:

- 2.6.7.1 Steel Rails, Including Pipe Inserts: Steel rails, including pipe inserts in concrete, shall be standard weight steel pipe conforming to ASTM A 53. Pipe shall be 1-1/2-inch size.
- 2.6.7.1.1 Fabrication: Jointing of posts, rail, and corners shall be by one of the following methods:
- 2.6.7.1.1.1 Flush-type rail fittings of commercial standard, welded and ground smooth with railing splice locks secured with 3/8-inch hexagonal-recessed-head setscrews.
- 2.6.7.1.1.2 Mitered and welded joints made by fitting post to top rail and intermediate rail to post, mitering corners, groove welding joints, and grinding smooth. Railing splices shall be butted and reinforced by a tight fitting interior sleeve not less than 6 inches long.
- 2.6.7.1.1.3 Railings may be bent at corners in lieu of jointing, provided bends are made in suitable jigs and that the pipe is not crushed.
- 2.6.7.2 Aluminum Railings: Aluminum railings shall be shop fabricated of 1-1/2-inch tubing conforming to ASTM B 210 and shall be installed at the locations indicated. Exposed fittings and fastenings shall be cast or extruded aluminum except where corrosion-resisting steel is employed as

a standard fabricator's item for use. Rail joints shall be finished flush and shall occur only at supports. Fittings and brackets shall be designed for concealed pin fastenings or welding. Railings shall be anodized satin finish. Provide anchors as required for a rigid installation.

2.6.7.3 Installation:

- 2.6.7.3.1 In Concrete: Install rails by means of steel pipe sleeve inserts set and anchored in the concrete as indicated. Insert posts into the steel pipe sleeves, leveled, plumbed, and aligned. Fill solid the annular space between pipe posts and pipe sleeve insets with molten lead, sulphur or a quick-setting hydraulic cement, and tightly calk. Cover anchorage joint with pipe collar pinned to post. Secure ends of rails by means of standard steel pipe flange anchored to concrete walls by expansion shields and bolts.
- 2.6.7.3.2 In Masonry or Wood: Install rails by means of standard steel pipe flange secured to wood with screws or secured to masonry with expansion shields and bolts or toggle bolts. Anchor rail ends with a standard steel pipe flange through-bolted at the wall into a back plate or by 1/4-inch lag bolts to study or solid blocking.
- 2.6.7.3.3 In Steel: Install rails by means of base plates bolted to stringers or structural framework.
- 2.6.7.3.4 Provide for the support of wall rails substantial cast metal wall brackets spaced not more than 5 feet apart; also provide cast metal brackets not more than 11 inches from the end of rail.
 - 2.6.7.3.5 Furnish removable sections as indicated on the drawings.
- 2.6.8 Insect Screen: Fed. Spec. L-S-125, Type II, bronze or aluminum color, 18 by 18 mesh.
- 2.6.9 Ladders: Fabricate vertical ladders conforming to ANSI A14.3 of 2-1/2 inches by 3/8-inch steel flats for strings and 3/4-inch diameter steel rods for rungs. Rungs shall be not less than 16 inches wide, spaced one foot apart, plug welded or shouldered and headed into strings. Install ladders so that the distance from the runs to the finished wall surface will not be less than 7 inches. Secure to the adjacent construction with heavy clip angles riveted or bolted to the string and secured to masonry or concrete with not less than two 1/2-inch diameter expansion bolts. Install intermediate clip angles not over 48 inches on centers. Install brackets as required for securing of ladders welded or bolted to structural steel and built into the masonry or concrete.
- 2.6.10 Ladder, Ships: Fabricate strings and framing of steel plate or shapes. Bolt, rivet or weld connections and anchor to supporting construction. Treads shall be as specified for safety treads with non-slip surface. Aluminum ladders may be provided, subject to approval of treads, materials, and shop drawings. Requirements shown or specified for steel

shall apply, except that all anchor items shall be zinc-coated steel. Entire assembly, including tread connections and methods of attachment shall support a live load of 200 pounds per tread.

- 2.6.11 Miscellanous Plates and Shapes: Provide 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 to complete the work, and shall conform to ASTM A 36.
- 2.6.11.1 Built-Up Lintels: Bolt or rivet together built-up lintels with separators if required. End bearings shall be not less than one inch per foot of span; with maximum bearing 8 inches and minimum bearing 6 inches. Set lintel with clearance of 1/2 inch above head of buck or frame.
- 2.6.11.2 Loose Lintels: Provide loose lintels over openings in masonry walls and partitions as indicated and as required to support wall loads over openings. Lintels shall be complete with necessary connections and welds. Construct lintels to have at least 8 inches bearing on masonry at each end.
- 2.6.11.3 Angle Lintels: Masonry furring shall have angle lintels not less than 1/4 inch by width and depth of leg 1/2 inch greater than thickness of furring. For clear spans exceeding 5 feet, support lintels by intermediate wall anchors spaced at intervals of not more than 4 feet.
- 2.6.12 Safety Chains and Guard Rails: Construct safety chains of galvanized wrought iron. Chains shall be straight link type, 3/16-inch diameter, with at least twelve links per foot, and with snap hooks on each end. Snap hooks shall be boat type and eye bolts for attachment of chains shall be galvanized 3/8-inch bolt with 3/4-inch eye diameter, anchored as indicated on the drawings. Two chains, 4 inches longer than the anchorage spacing, shall be supplied for each guarded area. Locate guard rails where indicated on the drawings. The top chain or rail shall be mounted 3 feet 6 inches above the floor and the lower chain or rail shall be mounted 2 feet above the floor.
- 2.6.13 Safety Nosings: Safety nosings shall be of cast aluminum with cross-hatched or abrasive-surfaces nosing or extruded aluminum with abrasive inserts at least 4 inches wide and 1/4-inch thick and terminating at not more than 6 inches from the ends of treads for stairs and as indicated for platforms and landings. Safety nosings shall be provided with anchors for embedding into concrete and shall be flush with the top of the traffic surface.
- 2.6.14 Sleeves: Fit all pipes passing through concrete or masonry construction with pipe sleeves. Each sleeve shall extend through its respective wall and shall be cut flush with each surface. The sleeves shall be at least one inch greater in diameter than the pipe passing through them, and sleeve and pipe shall be calked with a bituminous cement after the piping is installed and tested.

2.6.15 Thresholds: Thresholds shall be cast iron not less than 1/4 inch thick and shall have nonslip upper surfaces to within 3 inches of jambs. Thresholds at pairs of doors shall have countersunk strikes for door bolts. Thresholds shall be fastened by expansion screws, two at each end and intermediate ones staggered not over 12 inches on centers. Exterior thresholds shall be bedded in a mastic compound as they are set.

2.7 ANCHORAGE, FASTENINGS, AND CONNECTIONS:

- 2.7.1 Anchorage: Provide anchorage for fastening work securely in place. Set anchors in concrete as the work progresses and space not more than 2 feet on centers unless indicated otherwise. Sizes, kinds, and spacings of anchors not indicated or specified shall be as necessary for the purpose, as approved. Anchorage not otherwise specified or indicated includes slotted inserts, expansion shields, and powder-driven fasteners, when approved, for concrete; toggle bolts and through bolts for masonry; machine and carriage bolts for steel; through bolts, lag bolts, and screws for wood. Provide inserts of suitable and approved types where required for support or anchorage of equipment and finish construction. Inserts shall be gray or malleable iron castings or galvanized steel unless indicated or specified otherwise. Slotted inserts shall be of types required to engage with anchors. Except where specified otherwise, all anchors and anchor bolts in exterior walls shall be zinc-coated and all other anchors and anchor bolts shall be heavily coated with bituminous paint.
- 2.7.1.1 Fastenings: Wood plugs shall not be used in any material. Use non-ferrous attachments for non-ferrous metal. Make exposed fastenings of compatible materials, generally matching in color and finish, and harmonizing with the material to which fastenings are applied. Conceal fastenings where practicable. Drilling and punching shall produce clean true lines and surfaces. Countersink metalwork to receive hardware.
- 2.7.1.2 Threaded Connections: Threaded connections made up tight so that treads are entirely concealed. Bolted work shall be made up tight and the threads nicked or the stem bushed to prevent loosening. Rivet, bolt, and screw heads shall be flat and countersunk in exposed work and elsewhere as required. Removable members shall be carefully machined, fitted and secured by means of screws or bolts of proper size and approved spacing.
- 2.7.1.3 Build anchors and connecting members which occur in concrete or masonry into the concrete or masonry as the work progresses, to avoid unnecessary cutting and drilling. Cut, fit, and drill as necessary so all materials are properly set in place and to permit engaging work to be properly installed.
- 2.7.1.4 Design Connections: Details shall be in accordance with AISC Manual of Steel Construction. Make bolted connections with common steel bolts. Provide necessary holes for securing work to building. Use lock washers under all nuts.

- 2.7.2 Built-In Work: All metal work built-in with concrete or masonry shall be formed for anchorage, or be provided with suitable anchoring devices as shown or as required. Metal work shall be furnished in ample time for securing in place as the work progresses.
- 2.8 WELDING: Perform all welding, welding inspection, and corrective welding, in accordance with AWS D1.1. Welding shall be accomplished so as to prevent permanent distortion of the connected parts. Weld continuously along the entire area of contact. Grind smooth all welds that will be visible in the finished installation.

2.9 FINISHES:

- 2.9.1 Galvanizing: Hot-dip galvanize items specified to be zinc-coated, after fabrication where practicable. Galvanizing: ASTM A 123, ASTM A 153, ASTM A 386, and ASTM A 525, as applicable.
- 2.9.1.1 Galvanize anchor bolts, grating fasteners, washers, and parts or devices necessary for proper installation unless indicated otherwise.
- 2.9.1.2 Repair of Zinc-Coated Surfaces: Repair zinc coated surfaces damaged by welding or other means with galvanizing repair paint conforming to Mil. Spec. DOD-P-21035 or by the application of stick or thick paste material specifically designed for repair of galvanizing, as approved. Clean areas to be repaired and remove the slag from the welds. Surfaces to which stick or paste material is applied, shall be heated with a torch to a temperature sufficient to melt the metallics in stick or paste; spread the molten material uniformly over surfaces to be coated and wipe the excess material off.

2.9.2 Shop Cleaning and Painting:

- 2.9.2.1 Cleaning: Clean steel and iron work by power wire brushing or other approved manual or mechanical means, for removal of rust, loose paint, scale, and deleterious substances. Wash cleaned surfaces which become contaminated with rust, dirt, oil, grease, or other foreign matter, with solvents until thoroughly clean. The cleaning of steel to be embedded in concrete is not required.
- 2.9.2.2 Shop Painting: Give surfaces of miscellaneous metal work except nonferrous metal, corrosion-resisting steel, and zinc-coated work one coat of an approved rust-resisting treatment and metallic primer in accordance with manufacturer's standard practice. Apply primer to a minimum dry film thickness of 1.0 mil. Apply an additional shop coat of the specified paint, to which a small amount of tinting material has been added, on surfaces that will be concealed in the finished construction or that will not be accessible for finish painting. Accomplish painting in dry weather or under cover, and on steel or iron surfaces that are free from moisture and frost. Do not paint surfaces of items to be embedded in concrete. Recoat damaged surfaces upon completion of work. Prime-coat

steelwork immediately after cleaning. Do not apply bituminous protective coatings to items to be finish painted.

- 2.9.3 Nonferrous Metal Surfaces: Protect by plating, anodic, organic, or other coatings as specified.
 - 2.9.4 Aluminum Surfaces:
- 2.9.4.1 Surface Condition: Before finishes are applied, exposed aluminum sheets, plates, and extrusions shall be free of roll marks, scratches, rolled-in scratches, kinks, stains, pits, orange peel, die marks, structural streaks, and any other defects which will affect uniform appearance of finished surfaces.
- 2.9.4.2 Aluminum: Unexposed sheet, plate and extrusions may have mill finish as fabricated. Castings shall have sandblast finish, medium, equal to NAAMM, Metal Finishes Manual, Designation AA-M43.

*** END OF SECTION ***

SECTION 06201

CARPENTRY AND WOODWORK

PART 1 - GENERAL

- 1.1 APPLICABLE PUBLICATIONS: 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.
 - 1.1.1 Federal Specifications (Fed. Spec.):

FF-B-588C & Am 1	Bolt, Toggle: and Expansion Sleeve, Screw
FF-N-105B & Am 4	Nails, Brads, Staples and Spikes: Wire, Cut and Wrought
FF-S-325 & Am 3	Shield, Expansion; Nail-Expansion; and Nail, Drive Screw (Devices, Anchoring; Masonry)
FF-T-1813	Tack

1.1.2 U. S. Department of Commerce, Product Standards (PS):

1-74	Construction and	Industrial Plywood
20-70	American Softwood	Lumber Standard
& Am 1		

1.1.3 American National Standards Institute (ANSI) Publications:

В 18.2.1-72	
B 18.2.2-72	Square and Hex Nuts
B 18.6.1 (R 77)	Wood Screws

1.1.4 American Society for Testing and Materials (ASTM) Publication:

A 687-79 High-Strength Nonheaded Steel Bolts and Studs

1.1.5 American Wood Preservers' Bureau (AWPB) Publications:

LP-2 Standard for Softwood Lumber, Timber and Plywood Pressure Treated with Water-born Preservatives for Above Ground Use

1.1.6 National Forest Products Association (NFPA) Publication:

1982 Edition National Design Specification for Wood Construction. Supplement-1982 Design Values for Wood Construction.

1.2 DELIVERY AND STORAGE: Deliver lumber and plywood to the job site in an undamaged condition. Stack materials to insure proper ventilation and drainage and protect against dampness before and after delivery. Store materials under cover in a well-ventilated enclosure and protect against extreme changes in temperature and humidity. Do not store materials in the building until concrete and masonry are dry. Replace defective or damaged materials.

1.3 GRADEMARKING:

- 1.3.1 Lumber: Each piece or each bundle shall be identified by the grade mark of a recognized association or independent inspection agency that specializes in the particular species used. Such association or independent inspection agency shall be certified by the Board of Review, American Lumber Standards Committee, to grade the species used.
- 1.3.2 Plywood: Each sheet of plywood shall bear the mark of a recognized association or independent inspection agency that maintains continuing control over the quality of the plywood. The mark for softwood plywood shall identify the plywood by species group or identification index, and shall show glue type, grade, and compliance with U. S. Department of Commerce PS 1.
- 1.4 SIZES AND PATTERNS OF WOOD PRODUCTS: Yard and board lumber sizes shall conform to U. S. Department of Commerce PS 20. Except as indicated or specified otherwise, sizes are nominal. Provide shaped lumber and millwork in the patterns indicated and which conform to standard patterns of the association recognized as covering the species used. 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.
- 1.5 MOISTURE CONTENT OF WOOD PRODUCTS: Air-dry or kiln-dry lumber. The maximum moisture content of wood products at time of delivery to the job site shall be as follows:
 - a. Exterior treated or untreated finish lumber and trim 4-inch or less in nominal thickness: 15 percent
 - b. Moisture content of other materials: 19 percent
 - 1.6 PRESERVATIVE TREATMENT OF WOOD PRODUCTS:
- 1.6.1 Pressure Treatment: Pressure treat lumber and plywood in accordance with AWPB LP-2.

PART 2 - PRODUCTS

2.1 #00D:

- 2.1.1 Lumber: Lumber shall be any of the species and grades listed in NFPA National Design Specification for Wood Construction and Design Values for Wood Construction that have allowable unit stresses not less than 575 psi unit stress in bending (Fb) with 1,400,000 psi modulus of elasticity (E).
- 2.1.2 Trim and Finish Lumber: Southern Pine, Ponderosa Pine, White Pine, or Douglas Fir, second grade of the species for paint finish. Casings, bases, and other trim shall be molded with hollow backs. Exposed edges of boards shall be eased. Trim to receive opaque finish may be finger jointed.
- 2.1.3 Softwood Plywood: U.S. Department of Commerce PS 1, A-C grade with exterior glue.

2.2 MISCELLANEOUS:

- 2.2.1 Hardware: Provide sizes, types, and spacings of manufactured building materials recommended by the product manufacturer except as otherwise indicated or specified. Provide hot-dipped galvanized steel or aluminum nails and fastenings where used on the exterior or exposed to the weather.
- 2.2.2 Expansion Shields: Fed. Spec. FF-S-325. Except as shown otherwise, maximum size of devices in Groups IV, V, VI, and VIII shall be 3/8 inch.
 - 2.2.3 Toggle Bolts: Fed. Spec. FF-B-588.
 - 2.2.4 Wood Screws: ANSI B 18.6.1.
 - 2.2.5 Wire Nails and Staples: Fed. Spec. FF-N-105.
 - 2.2.6 Tacks: Fed. Spec. FF-T-1813.
- 2.2.7 Bolts, Nuts, and Studs: ANSI B 18.2.1, ANSI B 18.2.2, and ASTM A 687.
 - 2.2.8 Lag Screws and Lag Bolts: ANSI B 18.2.1.

PART 3 - EXECUTION

3.1 INSTALLATION:

3.1.1 General Carpentry: Fit closely, set accurately to the required lines and levels, and secure in place in a rigid and substantial manner.

Spiking, nailing, and bolting shall be done in an approved manner; spikes, nails and bolts shall be of the proper size, and care shall be taken so as not to split the members. Members shall be drilled accurately for bolting; suitable washers shall be provided under heads; and nuts and bolts shall be drawn up tight.

*** END OF SECTION ***

ROOF INSULATION

PART 1 - GENERAL

- 1.1 APPLICABLE PUBLICATIONS: 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.
 - 1.1.1 Federal Specification (Fed. Spec.):

HH-I-530A Insulation Board, Thermal (Polyurethane and & Int Am 3 Polyisocyanurate)

1.1.2 American Society for Testing and Materials (ASTM) Publications:

C 552-73 Cellular Glass Block and Pipe Thermal Insulation
C 612-77 Mineral Fiber Block and Board Thermal Insulation

C 726-72 Mineral Fiber Roof Insulation Board (R-1979)

C 728-72 Perlite Thermal Insulation Board

D 41-78 Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing

D 312-78 Asphalt Used in Roofing

E 84-79 Surface Burning Characteristics of Building Materials

1.1.3 Factory Mutual Engineering Corporation (FM) Publications:

Approval Standard for Class I Insulated Steel Deck Roofs, August 1977

1.1.4 Underwriters' Laboratories, Inc. (UL) Publication:

Building Materials Directory, 1979

1.2 SUBMITTALS:

1.2.1 Samples: Submit one sample not larger than 12 inches square of each type of proposed insulating material. Also submit two samples each of nails and mechanical fasteners, when used to apply insulation.

- 1.2.2 Certified Test Reports: Submit certified copies of test reports for test determining the flame spread and smoke developed rating for insulation in accordance with ASTM E 84.
- 1.2.3 Manufacturer's Certificates of Conformance or Compliance: Submit certificates for the following:
 - a. Roof insulation
 - b. Steep asphalt
 - c. Adhesive
 - d. Asphalt roof cement
 - e. Asphalt felt
- 1.2.4 Manufacturer's Recommendations: Submit two current copies of insulation manufacturer's recommendations for the following:
 - a. Application of adhesive for insulation
 - b. Minimum thickness of insulation for steel decks
 - 1.3 DELIVERY AND STORAGE:
- 1.3.1 Delivery: Deliver materials to the site in original sealed containers or packages bearing manufacturer's name and brand designation. Where materials are covered by a referenced specification, containers or packages shall bear specification number, type, and class as applicable. Each container of asphalt shall bear flash point (FP), equiviscous temperature (EVT), and finished blowing temperature (FBT) or this information shall be shown on the accompanying bills of lading. Deliver materials in sufficient quantity to allow continuity of work.
- 1.3.2 Storage: Store, handle, and install materials in a manner to protect them from damage and from wetting and moisture absorption during entire construction period. For 24 hours immediately before laying, store felt rolls on ends in an area maintained at a temperature no lower than 50 degrees F. Replace damaged material with new material.
- 1.4 ENVIRONMENTAL CONDITIONS: Do not install roof insulation during inclement weather or when air temperature is below 40 degrees F or is expected to go below 40 degrees F, within 24 hours after installation, or when there is ice, frost, or dampness visible on the roof deck.
- 1.5 PROTECTION OF PROPERTY: Provide protection as specified in Section 07511, "Aggregate Surfaced Bituminous Built-Up Roofing".

PART 2 - PRODUCTS

- 2.1 MATERIALS: Materials shall conform to the respective specifications and standards and to requirements specified herein.
 - 2.1.1 Roof Insulation:
 - 2.1.1.1 Roof insulation shall be one of the following materials:
 - a. Composite boards: Composite board insulation shall consist of polyurethane board factory bonded to either expanded perlite or mineral fiber board insulation. The other surface of the polyurethane board shall be covered with a layer of glass fiber mat or asphalt saturated felt securely bonded to polyurethane during manufacture. Polyurethane shall conform to Fed. Spec. HH-I-530, Type I, Grade 2, except that the minimum density shall be 1.7 pounds per cubic foot and the Grade 2 polyurethane shall be the manufacturer's standard flame retarded type in lieu of Grade 2 requirements of Fed. Spec. HH-I-530. The perlite component shall conform to ASTM C 728 and the mineral fiber board shall conform to ASTM C 726 or ASTM C 612.
- 2.1.1.2 Insulation Thickness: As necessary to provide a thermal conductance ("C" value) of 0.05 Btu/hr./sq.ft./degree F or less.
- 2.1.1.3 Fire Safety Requirements: Roof insulation shall have a flame spread rating not greater than 75 and a smoke developed rating not greater than 150, exclusive of covering, when tested in accordance with ASTM E 84. Insulation bearing the UL label and listed in the UL Building Materials Directory as meeting the flame spread and smoke developed ratings specified, will be accepted in lieu of copies of certified test reports. Compliance with flame spread and smoke developed ratings will not be required when the insulation has been tested as a part of a roof construction assembly of the type used for this project and the construction is listed as being Fire-Acceptable in the UL Building Materials Directory, or listed as Class I roof deck construction in the FM Approval Guide. Insulation tested as a part of a roof construction assembly shall be provided with UL or FM labels attesting to the ratings specified herein.
- 2.1.2 Cants and Tapered Edge Strips: Preformed cants and tapered edge strips shall be of the same material as the roof insulation, unless unavailable. If cants or edge strips of the same material as the roof insulation are unavailable, provide pressure preservative treated wood or rigid perlite board cants and edge strips.
 - 2.1.3 Asphalt Primer: ASTM D 41.
 - 2.1.4 Steep Asphalt: ASTM D 312, Type III or IV.

3.1 CONDITION OF SURFACES:

- 3.1.1 Inspection of Surfaces: Surfaces on which insulation is to be installed shall be clean, smooth, and dry. Condition of surfaces will be inspected and approved by the Contracting Officer immediately before installation is started.
- 3.1.2 Preparation of Surfaces: Check roof deck surfaces, including surfaces sloped to roof drains and outlets, for defects before work is started; correct defects and inaccuracies in roof deck surface to eliminate poor drainage, hollow, and low spots. Examine precast concrete decks to assure that joints between precast units are properly grouted and leveled to provide suitable surfaces for the installation of insulation.
- 3.2 APPLICATION: Keep roof insulating materials dry before, during, and after installation. Keep insulation 1/2 inch clear of vertical surfaces penetrating and projecting from the roof surface.
- 3.2.1 Temperature of Steep Asphalt: When installing insulation, apply asphalt when temperature of asphalt is within 25 degrees F of equiviscous temperature (EVT). Do not heat asphalt to or above flash point (FP). Do not heat asphalt above the finish blowing temperature (FBT) for longer than 4 consecutive hours. Use thermometers to check temperatures during heating and application. Have kettlemen in attendance at all times during heating process to insure that maximum temperatures specified are not exceeded.

3.2.2 Insulation:

- 3.2.2.1 Insulation Installation: Install insulation directly to roof deck surface primed as specified herein for the specific deck. Lay insulation so that end joints of each course break with those of adjoining courses. When using multiple layers of insulation, joints of each succeeding layer shall be parallel and broken in both directions with respect to the layer below. Firmly embed each layer in a solid steep asphalt mopping; mop only sufficient area to provide complete embedment of one board at a time. Use not less than 25 pounds of asphalt per 100 square feet of roof deck for mopping each layer of insulation in place.
- 3.2.2.1.1 Insulation on Poured Concrete Decks: Solidly apply asphalt primer at the rate of one gallon per 100 square feet of roof surface.
- 3.2.2.1.2 Insulation on Precast Concrete Decks: Solidly apply asphalt primer at the rate of one gallon per 100 square feet of roof surface, except keep priming and steep asphalt mopping back approximately 4 inches from joints between precast units. Place felt strips, 4 inches or more in width, over joints (2 inches on each side) in a cold-applied asphalt roof cement and mop solidly before roof insulation is installed.

- 3.2.3 Cant Strips: Where indicated, provide cant strips at intersections of the roof with walls, parapets, and curbs extending above the roof. The face of cant strips shall have an incline of 45 degrees. Cant strips shall bear on the wood nailers and fit flush against vertical surfaces. Where possible, nail cant strips to adjoining surfaces. Where cant strips are installed against non-nailable materials, install cant strips in a heavy mopping of steep asphalt or set in asphalt roof cement.
- 3.2.4 Tapered Edge Strips: Where indicated, provide edge strips in the right-angle formed by the junction of the roof and wood nailing strips that extend above the level of the roof. Edge strips shall be tapered from top of wood nailing strips to approximately 1/8 inch at a slope of one to 1-1/2 inches per foot. Install edge strips flush against vertical surfaces of wood nailing strips. Where possible, nail edge strips to adjoining surfaces. Where installed against non-nailable materials, install edge strips in a heavy mopping of steep asphalt or set in asphalt roof cement.
- 3.3 PROTECTION OF APPLIED INSULATION: Completely cover each day's installation of insulation with finished roofing specified in Section 07511, "Built-Up Roofing" or a glaze coat of hot bitumen of the same type of bitumen as specified in Section 07511, "Built-Up Roofing" for the application of the first ply of roofing felts. Apply glaze coat at the rate of 10 pounds per 100 square feet of area. Protect open ends of each day's work with temporary water cut-offs then remove when work is resumed. Protect open spaces between insulation and parapets or other walls and spaces at curbs, scuttles, and expansion joints, until permanent roofing and flashing is applied. Storing, walking, wheeling, or trucking will not be permitted directly on insulation or on roofed surfaces. Provide smooth, clean board or plank walkways, runways, and platforms near supports, as necessary, to distribute weight to conform to indicated live load limits of roof construction.

*** END OF SECTION ***

MASONRY WALL INSULATION

- 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:
 - 1.1 Federal Specifications (Fed. Spec.):

HH-I-574B Insulation, Thermal (Perlite) & Int Am 1

HH-1-585C Insulation, Thermal (Vermiculite) & Int Am 1

2. SUBMITTALS:

- 2.1 Certificates of Conformance or Compliance: Submit certificates attesting that the materials meet the requirements specified.
 - 2.2 Samples: Submit samples of the following:
 - a. Loose Fill Insulation: Two pint size containers
- 2.3 Manufacturer's Data: Submit current copies of the manufacturer's data with samples, including descriptive literature, insulating characteristics, and instructions for installation and protection of insulation.
- 3. DELIVERY AND STORAGE: Deliver materials to the site in the original sealed containers or packages bearing the manufacturer's name and brand designation. The containers or packages shall bear the referenced specification number, type, and class as applicable. Inspect materials delivered to the site for damage and unload and store with a minimum of handling. Storage spaces shall be dry locations, not subject to open flame or sparks, and permitting easy access for inspection and handling.
- 4. MATERIALS: Provide materials conforming to the respective specifications and requirements specified herein.
- 4.1 Insulation: Provide loose fill type insulation conforming to one of the following referenced specifications:
 - a. Perlite Loose Fill: Fed. Spec. HH-1-574.
 - b. Vermiculite Loose Fill: Fed. Spec. HH-I-585, Type I, Class 2

- 4.1.1 Thermal Resistance: All exterior walls shall be insulated as indicated on contract drawings providing total "R" value of not less than 10.
- 5. CONDITION OF SURFACES: Wall surfaces of cavities against which insulation is to be applied shall be clean and dry. Check surfaces for protruding mortar, concrete, or other obstacles that may interfere with the installation of the insulation. Remove such obstacles, if present, before insulation is applied.
- 6. INSTALLATION: Install insulation in accordance with the manufacturer's approved instructions and the requirements specified herein. Insulate exterior cavity walls, where shown, by completely filling the cavity between the wythes and completely filling the cells of the inner wythe with loose-fill insulation. Bring up insulation completely to the elevations indicated for the underside of window sills, bond beams, lintels, through-wall flashing, and similar interruptions through the cavity before installing these items. Extend insulation over entire surface to be insulated.
- 6.1 Loose-fill Insulation: Bring up insulation alternately with the masonry, with not more than a 2-foot-high section of wall completed before insulation is poured into the cells of the masonry units. Completely fill cells with insulation. Pour the insulation from the top of each height of wall section completed, allowing it to assume its natural density. Do not tamp insulation. Maintain inspection ports to show presence of insulation at the extremities of each pour area. Close ports as directed after complete coverage has been confirmed.
- 7. FIELD INSPECTION: Following installation of loose-fill insulation, insure that all exterior walls are filled to the top, all electrical outlet boxes and fixtures are sealed, and insulation has not leaked through unsealed openings.

*** END OF SECTION ***

PERIMETER INSULATION

PART 1 - GENERAL

- 1.1 APPLICABLE PUBLICATIONS: 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.
 - 1.1.1 Federal Specifications (Fed. Spec.):

FF-N-105B & Int Am 4	Nails, Brads, Staples and Spikes: Wire, Cut and Wrought
HH-1-524C	Insulation Board, Thermal (Polystyrene)
HH-1-530A & Int Am 3	Insulation Board, Thermal (Urethane)

1.2 SUBMITTALS:

- 1.2.1 Samples: Submit one sample of each type of proposed insulating material. Do not submit insulation samples larger than 12 inches by 12 inches. Submit samples of adhesives and mechanical fasteners, if such products are to be used in the application of insulation.
- 1.2.2 Manufacturer's Certificates of Conformance or Compliance: Submit manufacturer's certificates for the following:
 - a. Insulation
 - b. Asphalt roof cement
- 1.2.3 Manufacturer's Data: Submit manufacturer's data, including descriptive literature, and recommended instructions on installation methods and procedures for the following:
 - a. Insulation
 - b. Asphalt roof cement
- 1.3 DELIVERY AND STORAGE: Deliver materials to the site in the original sealed containers or packages. The containers or packages shall bear the manufacturer's name and designation. Where materials are covered by a referenced specification, the containers or packages shall bear the specification number, type, and class, as applicable. Store and handle materials in a manner that will afford protection against damage during construction.

PART 2 - PRODUCTS

2.1 MATERIALS:

- 2.1.1 Insulation: Insulation shall be 1-1/2 inches thick and one of the following materials meeting the respective specification and the requirements specified herein:
 - a. Polystyrene board: Fed. Spec. HH-I-524, Type II, III, or IV.
 - b. Urethane board: Fed. Spec. HH-I-530, Type I, Grade 2, Class 1, except that the minimum density shall be 1.7 pounds per cubic foot.
- 2.1.2 Masonry Nails: Fed. Spec. FF-N-105, Type II, Style 11, 17, or 27.
- 2.1.3 Clips: Type as recommended by insulation manufacturer and approved.

PART 3 - EXECUTION

3.1 INSTALLATION:

- 3.1.1 Insulation on Foundation Walls: Provide insulation on the interior side of the perimeter foundation walls that are backfilled and have slab on grade. Fasten insulation to the wall with masonry nails, asphalt roof cement, or clips.
- 3.1.2 Insulation Under Slab: Provide insulation horizontally under slab on grade a distance of 3 feet from the inside surface of the exterior foundation walls. Insulation shall be firmly supported on top of the subgrade under slab and at slab edge.

*** END OF SECTION ***

AGGREGATE SURFACED BITUMINOUS BUILT-UP ROOFING

PART 1 - GENERAL

1.1 APPLICABLE PUBLICATIONS: 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.

1.1.1 Federal Specification (Fed. Spec.):

SS-C-153C Cement; Bituminous, Plastic

1.1.2 American Society for Testing and Materials (ASTM) Standards:

D 41-78	Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
D 312-78	Asphalt Used in Roofing
D 517-70 (R 1976)	Asphalt Plank
D 1863-80	Mineral Aggregate for Use On Built-Up Roofs

D 2178-76 Asphalt-Impregnated Glass Mat Used in Roofing and Waterproofing

Kinematic Viscosity of Asphalt (Bitumen)

1.2 PRE-ROOFING CONFERENCE: Prior to starting the application of the roofing system and insulation, there will be a pre-roofing conference with the Contracting Officer to assure a clear understanding of drawings and specifications. The conference shall be attended by the Contractor, roofing and insulation subcontractor, flashing and sheetmetal subcontractor, mechanical subcontractor, and the electrical subcontractor.

1.3 SUBMITTALS:

D 2170-76

- 1.3.1 Certificates of Conformance or Compliance: Submit certificates from the manufacturers certifying that materials to be provided comply with the physical and chemical properties and values required by the referenced publications.
- 1.3.2 Descriptive Literature: Submit manufacturers' application instructions and technical data sheets or catalog cuts on materials specified herein.

- 1.3.3 Bill of Lading for Roofing Asphalt: Submit 2 copies of the bill of lading for the roofing asphalt when labels of asphalt containers do not bear the flash point, finish blowing temperature, and equiviscous temperature.
 - 1.4 DELIVERY, STORAGE, AND HANDLING:
- 1.4.1 Delivery: Deliver materials in manufacturers' original unopened containers and rolls with manufacturer's labels intact and legible. Where materials are covered by a referenced specification, the container shall bear the specification number, type, and class, as applicable. Labels or bill of lading for roofing asphalt shall indicate bitumen type, flash point (FP), finish blowing temperature (FBT), and equiviscous temperature (EVT), i.e., the temperature at which the viscosity is 125 centistokes when tested in accordance with the requirements of ASTM D 2170. Deliver materials in sufficient quantity to allow continuity of work.
- 1.4.2 Storage: Protect roll materials against moisture absorption. Store roll materials on end on clean raised platforms in dry locations with adequate ventilation. Do not store roll materials in buildings under construction until concrete, mortar, and plaster work is finished and dry. Immediately before application, store roll materials for 24 hours in an area maintained at temperatures above 50 degrees F. Completely cover felt stored outdoors with waterproof protective coverings. Tie covering securely to the pallets in such a way as to be completely weathertight and yet provide sufficient ventilation to prevent condensation. Polyethylene coverings are not permitted. Do not store more materials on the roof than can be installed the same day. Locate materials temporarily stored on the roof in approved areas and distribute the load to stay within the live load limits of the roof construction.
- 1.4.3 Handling: Select and operate material handling equipment so as not to damage existing construction and applied roofing. Handle roll materials in a manner to prevent damage to edges and ends.
- 1.5 ENVIRONMENTAL CONDITIONS: Application will not be permitted during inclement weather or when air temperature is below 40 degrees Fahrenheit (F) or is expected to go below 40 degrees F within 24 hours after application, or when there is ice, frost, surface moisture, or visible dampness on the roof deck. The restriction on the application of roofing materials below 40 degrees F will be waived if the Contractor devises some artificial means, satisfactory to the Contracting Officer, of: (1) maintaining the surrounding temperature above 40 degrees F; and (2) maintaining the application temperature of heated materials without exceeding the maximum specified kettle temperature. Maximum kettle temperature shall not be exceeded under any conditions.

1.6 PROTECTION OF PROPERTY:

- 1.6.1 Protective Coverings: Install protective coverings at paving and building walls adjacent to hoist and kettles prior to starting the work. Lap protective coverings not less than 6 inches, secure against wind, and vent to prevent collection of moisture on covered surfaces. Protective coverings shall remain in place for the duration of the roofing work.
- 1.6.2 Flame-heated Equipment: Locate and use flame-heated equipment at locations that will not endanger the structure or other materials on the site or adjacent property. Do not place flame-heated equipment on the roof. Provide and maintain one fire extinguisher of appropriate type and size adjacent to flame-heated equipment.
- 1.7 WARRANTY: The Contractor shall warrant for 5 years from the Beneficial Occupancy Date (BOD) that the built-up roofing is free of defective materials and workmanship. Repairs that become necessary because of defective materials and workmanship while the roofing is under warranty shall be performed by the Contractor within 72 hours of notification, unless additional time is approved by the Contracting Officer. Failure to perform repairs within the specified period of time will constitute grounds for having repairs performed by others and the cost billed to the Contractor.

PART 2 - PRODUCTS

- 2.1 DESCRIPTION OF ROOFING SYSTEMS: Provide the following roofing system:
 - 2.1.1 SYSTEM GAA: Glass mat, asphalt bitumen, aggregate surfaced.

C	
Components:	Quantity:
Plying Felt (GA)	4 Plies
Asphalt:	
Between Substrate and First Ply	20-30 Lbs/100 sq. ft.
Between Adjacent Plies	20-30 Lbs/100 sq. ft.
Top Coat	55-65 Lbs/100 sq. ft.
Surfacing:	
Gravel	400 Lbs/100 sq. ft.
or other	
Aggregate	300 Lbs/100 sq. ft.

- 2.2 MATERIALS: Shall conform to the respective specifications and to the requirements specified herein.
 - 2.2.1 Asphalt: ASTM D 312, Type II.

Roof Slope (in./ft.)	Specification	Softening Point (deg. F)
1/4 or more but not more than 1/2	ASTM D 312, Type II	158–176

2.2.2 Felts: Felts for built-up roofing and flashing shall conform to the specifications and requirements listed in the following table:

Designation	Use	Felt or Mat	Saturant or Impregnant	Coating	Specification
GA	Plying Felt	Glass	Asphalt	None	ASTM D 2178, Type IV
FF	Flashing Felt				None (see Note (1))

- Note (1) Flashing felt shall be of a type specifically prepared in the manufacturing process for use in two-ply base flashing construction and shall be one of two types; (A) A single thickness of glass felt conforming to the properties listed in ASTM D 2178, for Type IV, modified as described below or (B) Felt reinforced with a woven glass fiber scrim or cotton fabric manufactured with a single thickness of asbestos felt impregnated with asphalt. Both types, i.e., (A) and (B) are then coated in the manufacturing process on both sides with an asphaltic coating which may include a fine mineral stabilizer insoluble in water and surfaced on both sides with a fine mineral surfacing.
 - 2.2.3 Primer: ASTM D 41 for asphalt.
- 2.2.4 Bituminous Plastic Cement: Fed. Spec. SS-C-153, Type I, for asphalt saturated or coated materials.
- 2.2.5 Aggregate for Surfacing Built-up Roofing: Water-worn gravel, crushed stone, crushed slag, all conforming to ASTM D1863, or marble, expanded slag, or expanded shale, all conforming to ASTM D 1863 except that density is not less than 55 pcf. Aggregate shall be opaque.
- 2.2.6 Unsaturated Felt or Rosin-sized Building Paper: Minimum weight, 5 pounds per 100 square feet.
- 2.2.7 Fasteners: Provide fasteners of nonferrous metal or galvanized steel, except for fastening metal items of copper, aluminum, and stainless steel. Use hard copper fasteners for copper items, aluminum or stainless steel fasteners for aluminum items, and stainless steel fasteners for stainless steel items. For roofing felts, use fasteners flush-driven through metal disc, or one-piece composite fasteners with heads not less than one inch in diameter or one inch square with rounded or 45-degree tapered corners.

- 2.2.7.1 Fasteners for Securing Felts and Metal Items to Masonry or Concrete Walls and Vertical Surfaces: Hardened steel nails with flat heads, diamond shaped points, and mechanically deformed shanks not less than 1-1/2 inches long. Power-driven fasteners may be used only when approved in writing.
- 2.2.8 Metal Discs (Tin-caps): Flat discs or caps of zinc-coated sheet metal not lighter than 28-gage and not less than 1-3/8 inches in diameter. Discs shall be formed to prevent dishing. Bell or cup-shaped caps are not acceptable. Omit disc when one-piece composite fasteners are used.
- 2.2.9 Asphalt Plank: ASTM D 517, Type B, of thickness not less than 1/2 inch.

PART 3 - EXECUTION

- 3.1 CONDITION OF SURFACES: Insure that the following conditions exist prior to application of the roofing materials:
 - a. Drains, curbs, cants, control joints, expansion joints, perimeter walls, roof penetrating components, and equipment supports are in place.
 - Surfaces are rigid, dry, smooth, and free from cracks, holes, and sharp changes in elevation.
 - c. The plane of the substrate does not vary more than 1/4 inch within an area 10 feet by 10 feet.
 - d. Substrate is sloped as indicated to provide drainage.
 - e. Walls and vertical surfaces are constructed to receive counterflashing, and will permit nailing of the base flashing.
 - f. Treated wood nailers are securely fastened in place at eaves, gable ends, openings, and intersections with vertical surfaces for securing of felts, edging strips, gravel stops, and roof fixtures. Nailers are the same thickness as the insulation.
 - g. Cants are securely fastened in place in the angles formed by walls and other vertical surfaces. The angle of the cant is 45 degrees and the height of the vertical leg is not less than nominal 4 inches. Cants are constructed of wood or insulation board.
 - h. Venting is provided in accordance with the following:

- (1) Edge Venting: Perimeter nailers are kerfed across the width of the nailers to permit escape of gaseous pressure at roof edges.
- Insulation boards are installed smooth and even, and are not broken, cracked, or curled.
- 3.2 PREPARATION: Coordinate the work with that of the other trades to assure that components which are to be secured to or stripped into the roofing system are available and that flashing and counterflashing is installed as the work progresses.

3.2.1 Priming of Surfaces:

- 3.2.1.1 Priming of Vertical Surfaces: Coat concrete and masonry surfaces which are to receive base flashing uniformly with primer. Allow the primer to dry thoroughly prior to application of the flashing materials.
- 3.2.1.2 Priming of Metal Surfaces: Prime flanges of metal gravel stops, edging strips, flashing collars, and accessories with bituminous plastic cement prior to stripping into the roofing system.
- 3.2.2 Heating of Asphalt: Break up solid bitumen on a surface free of dirt and debris. Heat bitumen in a kettle or tanker designed to prevent contact of flame with surfaces in contact with the bitumen. Kettles and tankers shall have visible thermometer and thermostatic controls set to the temperature limits specified herein. Maintain controls in working order and calibrated. Use immersion thermometer accurate to "plus or minus 2 degrees" to check temperatures of the bitumen frequently. If temperatures exceed maximums specified, the bitumen shall be removed from the site. Upon determination that the temperature of the bitumen, at the instant of application, is below the minimum specified, the affected roofing shall be removed and replaced with new material. Cutting back, adulterating, or fluxing of bitumen is not permitted.
- 3.3 APPLICATION: Apply roofing materials as specified herein unless specified or recommended otherwise by the manufacturer's printed application instructions. Keep roofing materials dry before, during, and after application. Apply only as much roofing in one day as can be protected the same day. Maintain the specified temperatures for the bitumen. Do not apply top surfacing until the other roofing application procedures specified herein are completed.
- 3.3.1 Bitumen Stops: Provide bitumen stops at roof edges, openings, and at vertical projections prior to application of the felts. Form bitumen stops with two 12-inch wide strips of plying felt. Strips shall be laminated with, and set into, a coating of bituminous plastic cement with one half of the width overhanging the edge of the roof or opening. Where nailers are provided, nail the strips with roofing nails spaced 12 inches o.c. in addition to embedding in bituminous plastic cement. After

the plies of felt are in place, fold the free portion of the strips back over the roofing membrane and embed in a continuous coating of bituminous plastic cement. Secure with roofing nails spaced 3 inches o.c. The optional use of sheet metal bitumen stops is permitted as approved.

- 3.3.2 Plying Felts: Apply plying felts shingle fashion in hotmoppings of bitumen, and back-nail as specified herein. Apply felts in a continuous operation. Phased construction is not permitted. Provide starter sheets of felt to maintain the specified number of plies of felt throughout the roofing. Apply felts of 36-inch widths, as specified herein, with side laps not less than 24-2/3 inches and starter sheets not less than 12, 24, and 36 inch widths. Provide end laps of not less than 6 inches and staggered a minimum of 12 inches. Extend felts approximately 2 inches above the tops of cant strips and fasten at approximately 8 inches o.c. Trim felts to a neat fit around vent pipes, roof drains, and other projections through the roof.
- 3.3.2.1 Hot-Mopping of Plying Felts: Use hot bitumen for bonding of plies of felt to each other and to the substrate. Apply the felts immediately following the application of the hot bitumen. Working ahead with the bitumen is not permitted. The bitumen shall be completely fluid, with mop temperatures within the range specified, at the instant the felts come into contact with the bitumen. Embed felts in the bitumen. As felts are being rolled into the hot bitumen, immediately and thoroughly broom down to eliminate trapped air and to provide tight smooth laminations resulting in a composite roofing membrane without wrinkles, buckles, kinks, and fish mouths. The completed roofing system shall be free of pockets and blisters. The practice of laying the felts dry and turning back the laps for mopping between plies is not permitted.
- 3.3.2.2 Temperature Limitations for Bitumen: Heat and apply bitumen at the temperatures specified below unless specified otherwise by the manufacturer. Use thermometer to check temperature during heating and application. Have kettleperson in attendance at all times during heating process to insure that temperatures specified are maintained.
- 3.3.2.2.1 Asphalt: Do not heat asphalt more than 25 degrees F above the finish blowing temperature (FBT), and do not heat asphalt above the FBT for longer than 4 consecutive hours. Do not heat asphalt above the flash point (FP). Apply asphalt and embed roofing felts when the temperature of the asphalt is not lower than 25 degrees F below the equiviscous temperature (EVT) and not higher than 25 degrees F above the EVT. Before heating and application of the asphalt refer to the asphalt manufacturer's label or bill of lading for the FBT, FP, and EVT of the asphalt used.
- 3.3.3 Flashing: Provide built-up bituminous flashing in the angles formed where the roof deck abuts walls, curbs, ventilators, pipes, and other vertical surfaces, and where necessary to make the work watertight. Install flashing after plies of felt have been applied but before the top surfacing is applied. Metal flashing collars and cap flashings are specified under Section 07600, "Flashing and Sheet Metal."

- 3.3.3.1 Base Flashing: Use one of the following base flashing systems as recommended by the manufacturer of the plying felt used in the roofing membrane:
- 3.3.1.1 Three-ply Bituminous Built-up Base Flashing: Provide three plies of AA15 plying felt conforming to the requirements specified herein. Embed each ply in a uniform trowelling of bituminous plastic cement not less than 1/8 inch thick. Smooth and press felts firmly into place so that a uniformly attached and completely laminated membrane results. Extend felts not less than 6, 9, and 12 inches, respectively, over the roofing membrane beyond the toe of the cant, and not less than 4 inches or more than 10 inches above the top of the cant on vertical surfaces. Lap ends of felts not less than 12 inches and seal watertight with bituminous plastic cement. Stagger end laps. Nail top edges of base flashing to wood nailers with large head roofing nails through metal discs or one-piece composite fasteners spaced not more than 8 inches o.c. on a line 1-1/2 inches below the top edge of the base flashing. Coat the finished base flashing with bituminous plastic cement 1/8 inch thick. extending from one inch above the top of the base flashing on the vertical surface to one inch beyond the edge of the base flashing on the roofing membrane.
- 3.3.1.2 Two-ply Bituminous Built-up Base Flashing: Provide one ply of plying felt, AA15 or GA, and one ply of flashing felt, FF, in accordance with the manufacturer's printed installation instructions.
- 3.3.2 Strip Flashing: Set flanges of sheet metal work to be incorporated into the roofing system into a uniform coating of bituminous plastic cement not less than 1/16 inch thick, and strip—in with two layers of plying felt cemented to the tops of the flanges, roofing membrane, and to each other with coatings of bituminous plastic cement not less than 1/16 inch thick. Extend felts 3 and 6 inches, respectively, beyond the edges of the flanges and onto the roofing membrane. Coat the finished strip flashing with bituminous plastic cement 1/8 inch thick.
 - 3.3.4 Protection of Applied Roofing:
- 3.3.4.1 Protection Against Moisture Absorption: When precipitation is imminent and at the end of each day's work, protect applied felts as follows:
- 3.3.4.1.1 Glaze Coat: Apply a glaze coat of hot bitumen of the type used with the plying felts. Apply the glaze coat at the rate of 10 pounds per 100 square feet. When glass felts are used for the roofing membrane, the glaze coat may be left off the membrane for up to 90 days.
- 3.3.4.1.2 Water Cut-offs: Apply water cut-offs consisting of two strips of plying felt applied to exposed edges of the insulation. Extend the first strip 6 inches on the roof deck, up the vertical edge of the insulation, and 6 inches on top of the applied felts. The second strip shall lap the first strip by 3 inches on each side. Hot-mop the strips to

the roof deck, applied felts, and to each other. Withhold moppings of hot bitumen from the edges of the insulation. When the application of the insulation and roofing system is resumed, cut the strips of felt along the vertical edges of the insulation, exposing the edges of the insulation.

- 3.3.4.1.3 Temporary Flashing: Provide temporary flashing at drains, curbs, walls, and other penetrations and terminations of roofing felts until the roofing membrane is complete, and permanent flashings are applied. Temporary flashings shall consist of one ply of plying felt applied in a trowel coat of bituminous plastic cement, applied to a primed surface, and finished with a surface coat of bituminous plastic cement. Remove temporary flashing before applying permanent flashing.
- 3.3.4.2 Temporary Walkways, Runways, and Platforms: Storing, walking, wheeling, and trucking is not permitted directly on applied materials. Provide temporary walkways, runways, and platforms of smooth clean boards or planks as necessary to avoid damage to applied roofing materials, and to distribute weight to conform to indicated live load limits of roof construction. Use rubber-tired equipment for roofing work.
- 3.3.4.3 Damaged Work: Restore work damaged during the application of the roofing system to original condition or replace with new materials.
- 3.3.5 Top Surfacing: Provide aggregate surfacing materials after felt flashings, tests, repairs, and corrective action have been completed and approved. Embed aggregate surfacing in a top coat of hot bitumen poured from a dipper or approved bitumen spreading device. Remove loose aggregate from the roof.
- 3.4 FIELD TESTS: Field tests shall be performed in the presence of the Contracting Officer. Notify the Contracting Officer one day prior to the date of performing tests.
- 3.5 CLEANUP: Each day remove from the job site debris, scraps, containers, and other rubbish and trash resulting from the installation of the roofing system.
- 3.6 INFORMATION CARD: Provide a typewritten card, framed under glass, in a weathertight frame, for each roof. This card shall contain the information listed on the attached Form 1. Install the card near the point of access to the roof, as directed. Submit a duplicate card to the Contracting Officer.

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FLASHING AND SHEET METAL

- 1. APPLICABLE PUBLICATIONS: 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.
 - 1.1 Federal Specifications (Fed. Spec.):

O-F-506C Flux Soldering; Paste and Liquid		
QQ-S-571E & Am 2	Solder; Tin Alloy; Lead-Tin Alloy; and Lead Alloy	
QQ-S-775E	Steel Sheets, Carbon, Zinc-coated	
SS-C-153C	Cement; Bituminous, Plastic	
UU-B-790A & Am 1	Building Paper, Vegetable Fiber; (Kraft, Waterproofed, Water Repellent and Fire Resistant)	

1.2 American Society for Testing and Materials (ASTM) Publications:

A167-77	Stainless and Heat Resisting, Chromium-Nickel Steel Plate, Sheet and Strip
B101-40(1971)	Lead Coated Copper Sheet
B370-77	Copper Sheet and Strip for Building Construction
D41-73	Primer for Use with Asphalt in Dampproofing and Waterproofing

1.3 Sheet Metal and Air Conditioning Contractors National Association, Incorporated (SMACNA) Publication:

Architectural Sheet Metal Manual (Second Edition 1968).

2. SUBMITTALS:

2.1 Shop Drawings: Submit shop drawings for approval indicating thicknesses, dimensions, fastenings and anchoring methods, expansion joints, and other provisions necessary to provide for thermal expansion and contraction. Scaled catalog cuts may be submitted for factory fabricated items. Submit shop drawings for the following items:

Building expansion joints.

Gravel stops and fascias.

Sumps for roof drains.

Pitch pockets.

Base and cap flashing (counterflashing).

Flashing at roof penetrations.

- 2.2 Certificates of Conformance or Compliance: Submit for approval certificates from the manufacturer attesting that materials meet the requirements specified herein.
- 3. DELIVERY, HANDLING, AND STORAGE: Materials shall be adequately packaged and protected during shipment and shall be inspected for damage, dampness, and wet-storage stains upon delivery to the job site. Damaged or permanently stained materials that cannot be restored to like-new condition shall be removed from the site and replaced. Carefully handle sheet metal items to avoid damage to surfaces, edges, and ends. Crated materials shall not be uncrated until ready for use. Store materials in dry, weather-tight, ventilated areas until immediately before installation.
- 4. MATERIALS: Materials shall conform to the respective specifications and to the requirements specified herein. Furnish sheet metal items in 8 to 10 foot lengths. Single pieces less than 8 feet long may be used to connect to factory fabricated inside and outside corners, and at ends of runs. Accessories and other items essential to complete the sheet metal installation shall be provided and shall be of the same materials as the items to which they are applied.
 - 4.1 Copper, Sheet and Strip: ASTM B370 cold-rolled temper.
 - 4.2 Soldering Flux: Fed. Spec. O-F-506, type I, form A or B.
 - 4.3 Solder: Fed. Spec. 00-S-571, composition Sn 50 for copper.
- 4.4 Bituminous Plastic Cement: Fed. Spec. SS-C-153, type I with asphalt roofing felts and type II with coal-tar roofing felts.
 - 4.5 Building Paper: Fed. Spec. UU-B-790, style 4, grade B.
 - 4.6 Asphalt Primer: ASTM D41.
- 4.7 Through-Wall Flashing: Through-wall flashing for masonry is specified in Section 04200, "Unit Masonry". Through-wall flashing includes flashing that is above and below the roofline. It includes sill and lintel.
- 4.8 Fasteners: Fasteners shall be the same metal or a metal compatible with the item fastened. Use bronze or hard copper to fasten copper materials.

5. SHEET METAL: Provide flashing in the angles formed where roof decks abut walls, curbs, ventilators, pipes or other vertical surfaces and wherever indicated and necessary to make the work watertight. All sheet metal shall have mill finish unless specified otherwise herein. Tempers of metals shall be suitable for their respective forming conditions. Fabricate sheet metal items to the gage, thickness or weight shown in Table I and join multiple lengths of items together as shown in Table II.

6. INSTALLATION:

- 6.1 General: Surfaces to receive sheet metal must be plumb and true, clean, even, smooth, dry and free from defects and projections which might affect the application. Installation of items not shown in detail or not covered by specifications shall meet the applicable requirements of the SMACNA Architectural Sheet Metal Manual.
- 6.2 Workmanship: Install sheet metal work with lines, arrises, and angles sharp and true. Exposed surfaces shall be free from visible wave, warp, and buckle, and tool marks. Exposed edges shall be folded back neatly to form a 1/2-inch hem on the concealed side. Sheet metal exposed to the weather shall be watertight with provisions for expansion and contraction.
- 6.3 Nailing: Nailing of sheet metal shall be confined generally to sheet metal having a maximum width of 18 inches. Nailing or flashings shall be confined to one edge only. Nails shall be evenly spaced not over 3 inches on centers and approximately 1/2-inch from edge unless otherwise specified or indicated. Face nailing will not be permitted. Where sheet metal is applied to other than wood surfaces, detailed shop drawings shall include locations for sleepers and nailing strips required to properly secure the work. Sleepers and nailing strips are specified in Section 06201, "Carpentry and Woodwork".
- 6.4 Cleats: Provide cleats for sheet metal 18 inches and over in width. Space cleats evenly not over 12 inches on centers unless otherwise specified or indicated. Unless otherwise specified, cleats shall be not less than 2 inches wide by 3 inches long and of the same material and thickness as the sheet metal being installed. One end of the cleat shall be secured with two nails and the cleat folded back over the nailheads. The other end shall be locked into the seam. Cleats for soldered seams shall be pretinned.
- 6.5 Bolts, Rivets, and Screws: Install bolts, rivets, and screws where indicated or required. Provide compatible washers where required to protect surface of sheet metal and to provide a watertight connection.
- 6.6 Seams: Straight and uniform in width and height with no solder showing on the face.
 - 6.6.1 Flat-lock Seams: Finish not less than 3/4-inch wide.

- 6.6.2 Lap Seams: Finish soldered seams not less than one inch wide. Overlap seams not soldered, not less than 3 inches.
- 6.6.3 Loose-lock Expansion Seams: Not less than 3 inches wide and shall provide minimum one inch movement within the joint. Joint shall be completely filled with the specified sealant, applied at not less than 1/8-inch thick bed. Sealants are specified in Section 07920, "Sealants and Calking".
- 6.6.4 Standing Seams: Not less than one inch high, double locked without solder.
 - 6.6.5 Flat Seams: Make seams in the direction of the flow.
- 6.7 Soldering: Pretin edges of sheet metals, except lead coated material, before soldering is begun. Soldering shall be done slowly with well heated soldering irons so as to thoroughly heat the seams and completely sweat the solder through the full width of the seam. Edges of lead-coated material to be soldered shall be scraped or wire-brushed to produce a bright surface, and seams shall have a liberal amount of flux brushed in before soldering is begun.
 - 6.8 Protection from Contact of Dissimilar Materials:
- 6.8.1 Copper or Copper-bearing Alloys: Surfaces in contact with dissimilar metal shall be painted with heavy-bodied bituminous paint, or shall be separated by means of moisture proof building felts.
- 6.8.2 All Metal: Surfaces in contact with mortar, concrete, or other masonry materials shall be painted with alkali-resistant coatings such as heavy-bodied bituminous paint.
- 6.8.3 Wood or Other Absorptive Materials: Surfaces that may become repeatedly wet and in contact with metal shall be painted with two coats of aluminum paint or a coat of heavy-bodied bituminous paint.
- 6.8.4 Exposed Copper: Shall be lead coated if drainage from it passes over exposed masonry, stonework, or other metal surfaces.
- 6.9 Provision for Expansion and Contraction: Provide expansion and contraction joints at not more 40-foot intervals, except that where the distance between the last expansion joint and the end of the continuous run is more than half the required interval spacing an additional joint shall be provided. Space joints evenly.
- 6.10 Gravel Stops and Roof Edge Fascias: Prefabricate in the shapes and sizes indicated and in lengths not less than 8 feet. Extend flange at least 4 inches onto roof deck. Provide prefabricated mitered corners for internal and external corners. Install gravel stops and fascias after all plies of the roofing membrane have been applied, but before the flood coat of bitumen is applied. Prime roof flange of gravel

stops and fascias on both sides with an asphalt primer. After primer has dried, set flange on top of the roofing felts in a 1/8-inch thick bed of plastic cement. Nail flange securely to wood nailer with large-head barbed-shank roofing nails 1-1/2 inches long spaced not more than 3 inches on centers.

- 6.10.1 Hook Strips: The lower edge of fascias shall be hooked at least 3/4-inch over a continuous hook strip of the same material bent outward at an angle of 45 degrees to form a drip. Nail hook strip to a wood nailer at 6 inches maximum on centers. Where fastening is made to concrete or masonry, screws spaced 12 inches 0.C. shall be used and shall be driven in expansion shields set in the concrete or masonry. Where horizontal wood nailers are slotted to provide for insulation venting, install hook strips in such a manner that vent slots are not obstructed. Where necessary, install hook strips over 1/16-inch thick compatible spacer or washers.
- 6.10.2 Joints: Section ends of gravel stops and fascias shall be left open 1/4-inch and backed with a formed flashing plate, mechanically fastened in place and lapping each section end a minimum of 4-inches; set laps in plastic cement. Face nailing will not be permitted.
- 6.11 Downspouts: The corrugated type, of the shapes and sizes indicated, and provided complete including elbows and offsets. Downspouts shall be provided in approximately 10-foot lengths; end joints shall telescope not less than 1/2-inches, and longitudinal joints shall be locked. Gutter outlets shall be provided with wire ball strainers of a standard type for each outlet. Strainers shall fit tightly into outlets and shall be of the same material used for gutters. Downspouts shall be kept not less than one inch away from walls and shall be fastened to the walls at top, bottom, and at not to exceed 5 foot centers intermediately between, with approved type leader straps or concealed rack-and-pin type fasteners; straps and fasteners shall be formed from metal compatible with the downspouts. Downspouts terminating in splash blocks shall be provided with elbow-type fittings. Splash blocks shall be concrete as indicated on drawings and as specified in Section 03302, "Cast-In-Place Concrete".
- 6.12 Expansion Joints: Expansion joints for roofs, walls, and floors shall be provided where indicated and shall conform to the requirements of Table I.
- 6.12.1 Roof Expansion Joints: Shall consist of curb with wood nailing members on each side of joint, bituminous base flashing, metal counterflashing, and metal joint cover. Bituminous base flashing is specified in Section 07511, "Aggregate Surfaced Built-Up Bituminous Roofing". Counterflashing shall be provided and installed as specified in paragraph "Counterflashing", except as follows: The vertical leg of counterflashing shall be of suitable depth to enable forming into a horizontal continuous cleat. The inner edge shall be secured to the nailing member. The outer edge projection shall be not less than one inch for flashing on one side of the expansion joint and shall be less than the width of the expansion

joint plus one inch for flashing on the other side of the joint. The expansion joint cover shall be hooked over the projecting outer edges of counterflashing. Roof joint shall be provided with a joint cover of the width indicated. One edge of the joint cover shall be hooked and locked over the shorter projecting flange of the continuous cleat, and the other edge shall be hooked over and loose locked with the longer projecting flange. Joints shall be as specified in Table II.

- 6.13 Flashing at Roof Penetrations and Equipment Supports: Provide metal flashing for all pipes, ducts, and conduits projecting through the roof surface and for equipment supports, guy wire anchors and similar items supported by or attached to the roof deck. Power roof ventilators are specified in Section 15801, "Heating, Ventilating and Air Conditioning".
- 6.13.1 Single Pipe Vents: Flash with a 2-1/2 lb. minimum lead sleeve having a 4 inch flange. Set flange in bituminous plastic cement and nail 3 inches 0.C. Top of sleeve shall be bent over and extended down into the vent pipe a minimum of 2 inches. For long runs or long rise above the deck, where it is impractical to cover the vent pipe with lead, a two-piece formed metal housing of the specified sheet metal shall be used. Metal housing shall consist of a metal sleeve having a 4-inch roof flange set in bituminous plastic cement and nailed 3 inches 0.C. Sleeve shall extend a minimum of 8 inches above the roof deck and shall be lapped a minimum of 3 inches by a metal hood secured to the vent pipe by a draw band. Area of hood in contact with vent pipe shall be sealed with an approved sealant. Sealants are covered under Section 07920, "Sealants and Calking".
- 6.14 Bitumen Stops: May be provided at eaves and rakes in lieu of felt envelopes. Bitumen stops shall be either (a) the rigid type with a 3/4-inch minimum vertical leg extending up into the gravel stops or (b) the folded type with a 3-inch minimum vertical leg folding back over the roofing felts. Provide bitumen stops in the form of a vertical sleeve 3 inches high with flange for all pipes projecting through roof. Horizontal flanges of bitumen stops shall be not less than 4 inches wide. Prior to installation of roofing felts, bitumen stops shall be nailed to wood nailers at not more than 3 inches on centers.
- 7. PAINTING: Sheet metal work shall be field painted as required for the separation of dissimilar metals.
- 8. CLEANING: Clean all exposed sheet metal work at completion of installation. Grease and oil films, handling marks, contamination from steel wool, fittings and drilling debris shall be removed, and the work scrubbed clean. All exposed metal surfaces shall be free of dents, creases, waves, scratch marks, and solder or weld marks.

TABLE 1. SHEET METAL WEIGHTS, THICKNESSES, AND GAGES

	Copper, Ounces per Square Foot
Building expansion joints	
Cap	16
Waterstop-bellows or flanged-U-type	16
Downspouts and leaders	16
Downspout straps, 2-inch	48(a)
Flashings:	
Base	20
Eave	16
Bond barrier	16
Gravel stops and fascias:	
Extrusions	
Sheets, corrugated	16
Sheets, smooth	20
Edge strip	24
Gutters:	
Gutter section	16
Continuous cleat	16
Hangers, dimensions	1" x 1/8" (a)
Cover plates	16
Bitumen stops:	
Rigid	16
Folded	20

(a) Brass.

TABLE II. SHEET METAL JOINTS

TYPE OF JOINT

Item Designation	Copper
Joint cap for building expansion joint at roof.	1-1/4" single lock, standing seam, cleated.
Flashings:	
base.	One-inch flat locked, soldered, 3-inch lap for expansion joint.
Edge strip.	Butt.
Gravel stops:	
Sheet, smooth.	Butt with space.
Sheet, corrugated.	Butt with space.

*** END OF SECTION ***

SEALANTS AND CALKINGS

PART 1 - GENERAL

- 1.1 APPLICABLE PUBLICATIONS: 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.
 - 1.1.1 American Society for Testing and Materials (ASTM) Publication:

C 920-79 Elastomeric Joint Sealants

- 1.2 SUBMITTALS:
- 1.2.1 Certificates of Conformance or Compliance: Submit certificates from the manufacturers attesting that materials meet the specified requirements.
- 1.2.2 Manufacturers' Descriptive Data: Submit complete descriptive data for each type of material. Clearly mark data to indicate the type the Contractor intends to provide. Data shall state conformance to specified requirements. Data for sealant and calking shall include application instructions, shelf life, mixing instructions for multicomponent sealants, and recommended cleaning solvents.
- 1.3 SAMPLE JOINTS: Before sealant and calking work is started, provide a sample of each type of finished joint where directed. The sample shall show the workmanship, bond, and color of sealant or calking. The workmanship, bond, and color of sealant or calking work throughout the project shall match the approved sample joints.
- 1.4 ENVIRONMENTAL CONDITIONS: The ambient temperature shall be within the limits of 40 and 100 degrees F when the sealant and calking are applied.
- 1.5 DELIVERY AND STORAGE: Deliver materials to the job site in the manufacturers' external shipping containers, unopened, with brand names, date of manufacture, and material designation clearly marked thereon. Containers of elastomeric sealant shall be labeled as to type, class, grade, and use. Carefully handle and store all materials to prevent inclusion of foreign materials or subjection to sustained temperatures exceeding 100 degrees or less than 40 degrees F.

PART 2 - PRODUCTS

2.1 MATERIALS: Products shall conform to the reference documents listed for each use. Color of sealant and calking shall match adjacent surface color unless specified otherwise. For ASTM C 920 sealants, use a sealant that has been tested on the type(s) of substrate to which it will be applied.

- 2.1.1 Interior Calking or Sealant: ASTM C 920, Type M, Grade NS, Class 12.5, Use NT. Color of calking or sealant shall be white.
- 2.1.2 Exterior Sealant: For joints in vertical surfaces, provide ASTM C 920, Type M, Grade NS, Class 25, Use NT. For joints in horizontal surfaces, provide ASTM C 920, Type M, Grade P, Class 25, Use T. Color of sealant shall be white.
- 2.1.3 Floor Joint Sealant: ASTM C 920, Type S or M, Grade P, Class 25, Use T. Color of sealant shall be gray.
- 2.1.4 Primer for Sealant: Use a non-staining, quick-drying type and consistency recommended by the sealant manufacturer for the particular application.
- 2.1.5 Bond Breakers: Use the type and consistency recommended by the sealant manufacturer for the particular application.
- 2.1.6 Backstops: Use glass fiber roving or neoprene, butyl, polyurethane, or polyethylene foams free from oil or other staining elements as recommended by the sealant manufacturer. Backstop material shall be compatible with the sealant. Do not use oakum and other types of absorptive materials as backstops.

PART 3 - EXECUTION

- 3.1 SURFACE PREPARATON: Surfaces shall be clean, dry to the touch, and free from frost, moisture, grease, oil, wax, lacquer, paint, or other foreign matter that would tend to destroy or impair adhesion. Where adequate grooves have not been provided, clean out grooves to a depth of 1/2 inch and grind to a minimum width of 1/4 inch without damage to the adjoining work. No grinding shall be required on metal surfaces.
- 3.1.1 Steel Surfaces: Remove loose mill scale by sandblasting or, if sandblasting is impractical or would damage finish work, scraping and wire brushing. Remove protective coatings by sandblasting or using a solvent that leaves no residue.
- 3.1.2 Aluminum or Bronze Surfaces: Remove temporary protective coatings from surfaces that will be in contact with sealant. When masking tape is used as a protective coating, remove tape and any residual adhesive just prior to sealant application. Use non-staining solvents recommended by the item manufacturer.

3.2 SEALANT PREPARATION: Do not modify the sealant by addition of liquids, solvents, or powders. Mix multicomponent elastomeric sealants in accordance with manufacturer's printed instructions.

3.3 APPLICATION:

- 3.3.1 Backstops: Where joint cavities are constructed deeper than indicated, tightly pack the back or bottom with backstop material to provide a joint of the depth indicated. Install backstops dry and free of tears or holes.
- 3.3.2 Primer: Just prior to application of the sealant or calking compound, clean out all loose particles from joints. Apply primer in accordance with compound manufacturer's directions. Do not apply primer to exposed finish surfaces.
- 3.3.3 Bond Breaker: Provide bond breakers as recommended by the sealant manufacturer for each type of joint and sealant used.
- 3.3.4 Sealant and Calking Compounds: Use a compound that is compatible with the material to and against which it is applied. Do not use a compound that has exceeded its shelf life or has become too jelled to be discharged in a continuous flow from the gun. Apply the compound in accordance with the manufacturer's printed instructions. Force the compound into joints with sufficient pressure to fill the joints solidly. Compound shall be uniformly smooth and free of wrinkles.
- 3.3.4.1 Interior Sealant and Calking: Provide sealant or calking at all exposed joints in the building and at all joints indicated to receive sealant or calking (new construction).
- 3.3.4.2 Exterior Sealant: Provide sealant at all joints around the perimeter of openings and at all exposed joints on the building and at all joints indicated to receive sealant (new construction).
- 3.3.4.3 Floor Joint Sealant: Provide sealant in all control joints and in other floor joints indicated or specified (new construction).

3.4 PROTECTION AND CLEANING:

- 3.4.1 Protection: Protect areas adjacent to joints from compound smears. Masking tape may be used for this purpose if removed 5 to 10 minutes after the joint is filled.
- 3.4.2 Cleaning: Immediately scrape off fresh compound that has been smeared on masonry and rub clean with a solvent as recommended by the compound manufacturer. Upon completion of compound application, remove all remaining smears and stains resulting therefrom and leave the work in a clean and neat condition.

*** END OF SECTION ***

HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

- 1.1 APPLICABLE PUBLICATIONS: 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.
 - 1.1.1 Federal Specification (Fed. Spec.):

HH-I-524C Insulation Board, Thermal (Polystyrene)

1.1.2 Military Specification (Mil. Spec.):

DOD-P-21035A Paint, High Zinc Dust Content, Galvanizing Repair (Metric)

- 1.1.3 American Society for Testing and Materials (ASTM) Publications:
 - A 526-80 Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Commercial Quality
 - D 1621-73 Compressive Properties of Rigid Cellular Plastic (R 1979)
 - D 1622-63 Apparent Density of Rigid Cellular Plastics (R 1975)
 - D 1623-78 Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics
 - D 2126-75 Response of Rigid Cellular Plastics to Thermal and Humid Aging
 - D 2863-77 Measuring the Minimum Oxygen Concentration to Support Candle-Like Combustion of Plastics (Oxygen Index)
- 1.1.4 American National Standards Institute, Inc. (ANSI) Publications:
 - A115.1-76 Door and Frame Preparation for Mortise Door Locks for 1-3/4-Inch Doors
 - A115.14-75 Preparation for Standard Steel Doors for Open Back Strikes

1.1.5 The Steel Door Institute (SDI) Publications:

100-80 Recommended Specifications - Standard Steel

Doors and Frames

107-72 Hardware on Steel Doors

(Reinforcement-Application)

1.2 SUBMITTALS:

- 1.2.1 Catalog Data: Submit manufacturer's descriptive literature for all doors and frames. Include data and details on door construction, panel (internal) reinforcement, insulation, and door edge construction.
- 1.2.2 Shop Drawings: Submit shop drawings for doors and frames showing elevations, construction details, metal gages, hardware provisions, method of glazing, and installation details. Include a schedule showing door and frame locations.
- 1.2.3 Certificates of Conformance or Compliance: Submit manufacturer's certificates attesting that doors, frames, and accessories meet the requirements specified herein.
- 1.2.4 Samples: Submit two color samples of each color for prefinished doors. Where colors are not indicated, submit manufacturer's standard colors and patterns to the Contracting Officer for selection.
- 1.3 DELIVERY AND STORAGE: Deliver doors, frames, and accessories undamaged and with protective wrappings or packaging. Strap welded frames in pairs, with one frame inverted, or provide temporary steel spreaders securely fastened to the bottom of each frame. Store doors and frames on platforms under cover in clean, dry, ventilated, and accessible locations, with 1/4-inch air space between doors. Remove damp or wet packaging immediately and wipe all affected surfaces dry. Replace damaged materials with new.

PART 2 - PRODUCTS

2.1 STANDARD HOLLOW METAL DOORS: SDI-100, except as specified otherwise for Type II and III doors. Prepare doors to receive hardware specified in Section 08710, "Finish Hardware." Exterior doors shall have top edge closed flush. Doors shall be 1-3/4 inches thick, unless otherwise indicated.

2.1.1 Door Types:

2.1.1.1 Heavy Duty Doors: SDI-100, Type II, Style 3 or 4, of sizes and designs indicated. Plastic foam panel reinforcement shall be as specified herein. Fill exterior doors with mineral fiber insulation or plastic foam panel reinforcement.

2.2 CUSTOM HOLLOW METAL DOORS: Provide custom hollow metal doors where non-standard hollow metal doors are indicated. At the Contractor's option, custom hollow metal doors may be provided in lieu of Type II standard hollow metal doors. Door sizes, design, materials, gages, and finish shall be as specified for standard hollow metal doors. Provide panel reinforcement consisting of continuous vertical formed steel stiffeners, not lighter than 22 gage, spaced not more than 6 inches apart, and welded to both face sheets at not more than 5 inches o.c. Fill spaces between stiffeners of exterior doors with insulation. Close top and bottom edges with steel channels not lighter than 16 gage. Close tops of exterior doors flush with an additional channel. Prepare doors to receive hardware specified in Section 08710, "Finish Hardware." Doors shall be 1-3/4 inches thick, unless otherwise indicated.

2.3 LOUVERS AND MOLDINGS FOR DOORS:

- 2.3.1 Louvers: Louvers for exterior doors shall be inverted Y type. Weld or tenon louver blades to frame and fasten the entire louver assembly to the door with moldings. Moldings on the room or nonsecurity side of the door shall be detachable; moldings on the security side shall be an integral part of the louver. Form louvers of 16 gage steel for exterior doors and panels. Louvers for exterior doors shall have steel-framed insect screens secured to louvers in a rigid manner to permit ready removal. Provide aluminum wire cloth, 18 by 16 regular mesh for insect screens. Louvers for exterior door(s) shall have a minimum of 30 percent net free opening.
- 2.3.2 Moldings: Provide moldings around glazed or louvered panels for a rigid and secure installation. Provide nonremovable panel moldings on the outside of exterior doors and on the corridor side of interior doors. Other moldings around side panels may be stationary or removable. Secure moldings on the inside of glass and louver panels to the stationary moldings and muntins with ovalhead countersunk sheet metal or machine screws having small heads. At the Contractor's option, snap-on moldings may be used on the inside of glazed panels. Muntins shall interlock at intersections and shall be fitted by coping or mitering and welded to stationary panel moldings.
- 2.4 PLASTIC FOAM PANEL REINFORCEMENT: Provide plastic foam core panel reinforcement by one of the following methods:
 - a. A continuous rigid polyurethane plastic foam core, foamed-inplace or in board form bonded to the steel face sheets, and free of voids or other defects that could affect serviceability. The foam shall have the following properties when tested in accordance with the listed test methods:

Property

Requirement

Test Method

Flammability (Oxygen Index) 24 percent min.

ASTM D 2863

Density, core	2 lb. per cu. ft., nom.	ASTM D 1622
Compressive strength	20 psi, min., at 10 percent deformation or at yield point, whichever occurs first	ASTM D 1621, Pro- cedure A
Tensile strength	20 psi, min., and not greater than foam to steel face sheet bond strength	ASTM D 1623, Type B Specimen (Board form polyurethane shall be bonded with adhesive used for bonding in door.)
Dimensional stability	Plus or minus 5 percent volume change, max., and no visible distortion after 7 days exposure at minus 15 degrees F and 200 degrees F	ASTM D 2126, dimen- sions and visual examination measure- ments only
Holes and voids	No single hole or void larger than 1/4 inch in any direction, and no more than 8 holes up to 1/4 inch in size in any direction per 8 square feet of surface area	Visual examination

b. A rigid, molded polystyrene plastic foam bead board core bonded to the steel face sheets with a thermosetting adhesive. The foam core shall have the following properties when tested in accordance with the listed test methods:

Property	Requirement	Test Method
Flammability (Oxygen Index)	AEB 60 mm. max., ATB 50 Sec. max.	ASTM D 2863
Density	1.0 lb. per cu. ft., nom.	ASTM D 1622
Compressive strength	10 psi, min., at 10 percent deformation or at yield point, whichever occurs first	ASTM D 1621, Procedure A
Tensile strength	18 psi, min., and not greater than foam to steel face sheet bond strength	ASTM D 1623, Type B specimen (Polystyrene foam shall be bonded with adhesive used for bonding in door.)

Dimensional stability

Plus or minus 5 percent volume change, max., and no visible distortion after 7 days exposure at minus 15 degrees F and 165 degrees F ASTM D 2126, dimensions and visual examination measurements only

Holes and voids

No single hole or void larger than 1/4 inch in any direction, and no more than 8 holes up to 1/4 inch in size in any direction per 8 square feet of surface area Visual examination

Bead fusion

Essentially fused bead structure indicated by an excess of broken or sheared beads

Fed. Spec. HH-1-524, bead fusion test

2.5 HOLLOW METAL FRAMES: SDI-100, except as otherwise specified. Form frames for standard and custom hollow metal doors to sizes and shapes indicated, with full-welded unit type construction at corners. Provide hollow metal frames for doors and transoms where indicated.

2.5.1 Joints:

- 2.5.1.1 Welded-Type Frames: Miter or butt and face weld corner joints from the outside. Head and jamb rabbets shall have mechanically interlocked or welded joints with all contact edges closed tight. Dress welds flush and smooth.
- 2.5.2 Mullions and Transom Bars: Mullions and transom bars shall be closed or tubular construction and shall member with heads and jambs butt-welded thereto. Bottom of door mullions shall have adjustable floor anchors and spreader connections.
- 2.5.3 Stops and Beads: Form stops and beads from 20 gage steel for interior glazed openings and other locations where louvers, panels, or fixed glass is indicated in hollow metal frames. Provide synthetic rubber or felt gaskets where indicated. Secure beads to frames with oval-head, countersunk Phillips-head self-tapping sheet metal screws or concealed clips and fasteners. Space fasteners approximately 12 to 16 inches on centers. Miter molded shapes at corners. Butt or miter square or rectangular beads at corners.
- 2.5.4 Anchors: Provide anchors to secure the frame to adjoining construction. Provide steel anchors zinc-coated or painted with rust-inhibitive paint, not lighter than 18 gage.

- 2.5.4.1 Wall Anchors: Provide a minimum of three anchors for each jamb. Locate anchors opposite top and bottom hinges and midway between.
 - a. Masonry: Provide anchors of corrugated or perforated steel straps or 3/16-inch diameter steel wire, adjustable or "T" shaped.
- 2.5.4.2 Floor Anchors: Provide floor anchors at bottom of each jamb member. Provide fixed anchors, drilled for 3/8-inch diameter anchor bolts.
- 2.5.4.3 Fasteners: Provide concealed type fasteners for trim applied to rough bucks.
- 2.6 WEATHERSTRIPPING: For each exterior hollow metal frame, provide one of the following types:
- 2.6.1 Metal Spring: Spring temper bronze, aluminum, or stainless steel not less than 0.006 inch thick, (cushion) type with hemmed edges. Fasten to frame with wafer-head, No. 4 drive screws 2 inches o.c.
- 2.6.2 Plastic Spring: High impact plastic, V (cushion) type, with pressure sensitive adhesive. Apply only to clean, dry, finish-painted frames above 55 degrees F.
- 2.6.3 Stop Applied: Extruded aluminum retainer not less than 0.070-inch wall thickness with vinyl, neoprene, or polyurethane insert. Aluminum shall be clear (natural) anodized. Fasten to finish-painted frame with color-matched sheet metal screws not more than 6 inches o.c.
- 2.6.4 Integral Gasket: Black synthetic rubber gasket with tabs for factory fitting into factory slotted frames, or extruded neoprene foam gasket made to fit into a continuous groove formed in the frame. Insert gasket in groove after frame is finish painted.
- 2.7 HARDWARE PREPARATION: Reinforce, drill, and tap doors and frames to receive finish hardware. Prepare doors and frames for hardware in accordance with the applicable requirements of ANSI Al15.1 through Al15.14 and SDI-107. Drill and tap for surface-applied hardware at the project site. Build additional reinforcing for surface-applied hardware into the door at the factory. Locate hardware in accordance with the requirements of SDI-100, as applicable. Punch door frames to receive a minimum of two rubber or vinyl door silencers on lock side of single doors and one silencer for each leaf in heads of double door frames. Set lock strikes out to provide clearance for silencers.

2.8 FINISHES:

2.8.1 Factory-Primed Finish: Unless specified otherwise, phosphate treat and factory prime metal doors and frames as specified in SDI-100.

- 2.8.2 Hot-Dip Zinc-Coated and Factory-Primed Finish: Fabricate doors and frames from galvanized steel, ASTM A 526, Coating Designation G60 or A60 (galvannealed). Repair damaged zinc-coated surfaces by the application of zinc dust paint conforming to MIL Spec. DOD-P-21035. Phosphate treat and factory prime zinc-coated surfaces as specified in SDI-100. Provide for door openings No. 1, 2, 3, 4, and 5 at the wastewater treatment plant.
- 2.9 FABRICATION AND WORKMANSHIP: Finished doors and frames shall be strong and rigid, neat in appearance, and free from defects, waves, scratches, cuts, dents, ridges, holes, warp, and buckle. Molded members shall be clean cut, straight, and true, with joints coped or mitered, well formed, and in true alignment. Dress exposed welded and soldered joints smooth. Design door frame sections for use with the wall construction indicated. Corner joints shall be well formed and in true alignment. Conceal fastenings where practicable. Design frames in exposed masonry walls or partitions to allow sufficient space between the inside back of trim and masonry to receive calking compound. All door frames in exterior walls shall be double-rabbeted design to receive screens or storm doors.

PART 3 - EXECUTION

3.1 INSTALLATION:

- 3.1.1 Hollow Metal Frames: Set frames accurately in position and plumb, align, and brace securely until permanent anchors are set. Anchor bottoms of frames securely to floors with expansion bolts or powder—actuated fasteners. Build in or secure wall anchors to adjoining construction. Backfill frames in masonry construction with mortar. When an additive is provided in the plaster or mortar, coat inside of frames in the field with corrosion inhibiting bituminous material.
- 3.1.2 Hinged Doors: Calk metal-to-metal joints in exterior framing members as specified in Section 07920, "Sealants and Calking," and remove excess calking. Hang doors in accordance with clearances specified in SDI-100. After erection and glazing, clean and adjust hardware.
- 3.2 PROTECTION: Protect doors and frames from damage. Repair damaged doors and frames prior to completion and acceptance of the project or replace with new, as directed. Wire brush frames that have rusted until all rust is removed, clean thoroughly, and apply an all-over coat of rust-inhibitive paint of the same type used for shop coat.
- 3.3 CLEANING: Upon completion, clean exposed surfaces of doors and frames thoroughly. Remove all mastic smears and other unsightly marks.

OVERHEAD METAL DOORS

2.8.2 Hot-Difference doors and frames from 660 or A60 (galvant application of zirch Phosphate treat are subjected from the subject freatment of th

scratches, cuts.

3.1 INSTALL

PART 1 - GENERAL

1.1 APPLICABLE PUBLICATIONS: 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.

1.1.1 Federal Specifications (Fed. Spec.):

QQ-A-250/9C Aluminum Alloy Bar, Rod, Shapes, Tube, and ome wire, Extruded, 6063 Policy of the Conceal fastenings
QQ-A-250/2D Aluminum Alloy 3003, Plate and Sheet of the wire and Sheet of the wire and Sheet of the Walls shall be and Sheet of the Walls a

RR-C-271 Chain and Attachments

1.1.2 American Society for Testing and Materials (ASTM) Publications:

A 227-77 Steel Wire, Hard-drawn for Mechanical Springs
A 229-77 Steel Wire, Oil-Tempered for Mechanical Springs
A 386-78 Zinc Coating (Hot Dip) on Assembled Steel Dos Products

A 525-81 Steel Sheet, Zinc-Coated (Galvanized) by the

Hot-Dip Process, General Requirements and months are as a second and the second second

1.1.3 National Association of Architectural Metal Manufacturers (NAAMM) Publication:

(1975) Metal Finishes Manual (Finish Designation)

1.1.4 American National Standards Institute (ANSI) Publication:

A216.1-77 Specifications for Sectional Overhead Type Doors

1.2 SUBMITTALS:

1.2.1 Manufacturer's Certificates of Conformance: Submit certificates attesting that the overhead roll-up door and operator conforms to all requirements of this specification and of reference documents.

- 1.2.2 Catalog Data: Submit complete descriptive literature for each type of each of the following items:
 - a. Overhead Roll-up Door
 - b. Operator

Clearly mark data that describe more than one type, size, model, or item to indicate which type, size, model, or item is to be provided. Include data sufficient to show conformance to specified requirements and include both installation drawings and instructions. Installation drawings shall include actual conditions that will exist for the project.

1.3 DELIVERY AND STORAGE: Deliver doors to the job site wrapped in a protective covering with the brands and names clearly marked thereon. Store doors in dry locations with adequate ventilation, free from dust and water, and in such a manner to permit easy access for inspection and handling. Handle doors carefully to prevent damage to the faces, edges, and ends. Remove damaged items that cannot be restored to like-new condition and provide new items.

PART 2 - PRODUCTS

- 2.1 MATERIALS:
- 2.1.1 Chain: Fed. Spec. RR-C-271.
- 2.1.2 Steel Sheet: ASTM A 525.
- 2.1.3 Aluminum Extrusions: Fed. Spec. QQ-A-200/9, Alloy 6063-T5.
- 2.1.4 Aluminum Sheets and Strips: Fed. Spec.QQ-A-250/2, Fed. Spec.QQ-A-250/8, or Fed. Spec. QQ-A-250/11; alloy and temper best suited for the purpose.
- 2.2 DOORS: Metal roll-up door shall consist of interlocking flat faced slat sections with operation and travel so arranged that sections will roll up at top of opening when fully open. Door components and methods of installation shall be designed in accordance with AISC M011 and AA "Specifications for Aluminum Structures". Minimum design wind load shall be 20 psf. Maximum wind load deflection of the door shall not exceed the door height in inches divided by 120 and the door width in inches divided by 120. Door shall be designed to be operable during design wind loads.
- 2.3 FABRICATION: Door sections shall have vertical and horizontal door section members constructed of extruded aluminum; interlocking, flat faced sections.
- 2.3.1 Guides: Shall be formed of steel angles or plates not less than 3/16 inch thick and attached to jambs with 3/8 inch steel bolts.

- 2.3.2 Counterbalance Assembly: Steel pipe barrel of size capable of carrying curtain load with maximum deflection of 0.03 inch per foot of opening width with heat-treated helical torsion springs encased in steel pipe barrel, ball bearings at rotating support points, and wheel for applying initial spring torque and for future adjustments, located outside end bracket.
- 2.3.3 Hood: Shall be of 24 gauge steel formed to fit contour of brackets.
- 2.3.4 Hardware: Provide brackets, locking devices, and all other hardware required for a complete installation. Doors shall be provided with a positive locking device and cylinder lock with two keys.
 - 2.4 OPERATION: Door shall be manual chain hoist operated.
- 2.4.1 Manual Chain Hoist Operation: Doors shall be provided with chain hoist actuated by an endless galvanized chain mounted on inside of building. Gear reduction shall be calculated to prevent racking of doors. Suitable gear reduction ratio shall be obtained by means of a gear train. Provide chain cleat and pin for securing operator chain. Operator housing shall be steel with sheaves or drums of cast iron, cast aluminum, or malleable iron having machined grooves. Operator drums or sheaves shall be mounted on precision ball bearings, with provision for lubrication. Hoist shall be designed to allow for installation of power operators at a future date. The pull required to operate the door shall not exceed 35 pounds.
- 2.5 WEATHER SEALS AND SAFETY DEVICE: Exterior doors shall be provided with weatherproof joints between sections by means of tongue-and-groove joints, rabbitted joints, shiplap joints or wool pile, vinyl or rubber weatherstripping; a rubber, wool pile, or vinyl, adjustable weatherstrip at the top and jambs; and a compressible neoprene, rubber, wool pile, or vinyl weather seal attached to the bottom of the door.

2.6 FINISH:

- 2.6.1 Steel: Concealed surfaces shall be provided with a galvanized finish. Exposed surfaces shall be provided with a shop-primed galvanized finish. Galvanizing shall conform to ASTM A 525, coating designation G60 or G90, for steel sheets, and to ASTM A 386 for assembled steel products. Prior to receiving primer, all surfaces shall be cleaned thoroughly and phosphate treated to assure maximum paint adherence. Primer shall be a metallic oxide or synthetic resin primer of the manufacturer's standard type and shall be applied by dipping or spraying.
- 2.6.2 Aluminum: All surfaces shall receive a clear anodized finish, AA-M10-C22-A41, in accordance with NAAMM "Metal Finishes Manual.

PART 3 - EXECUTION

- 3.1 INSTALLATION: Doors shall be installed by the manufacturer or his authorized representative in accordance with approved installation drawings and instructions. Accurately locate all anchors and inserts for guides, brackets, and other work. Upon completion, doors shall be weathertight; free from warp, twist, or distortion; and lubricated and properly adjusted to operate freely.
- 3.2 TESTING: After installation is complete, operate doors to demonstrate proper installation and proper functioning of operators, safety features, and controls. Correct all deficiencies.

STEEL WINDOWS

- 1. APPLICABLE PUBLICATIONS: 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.
 - 1.1 Federal Specifications (Fed. Spec.):

RR-C-271B	Chains and Attachments, Welded and Weldless
RR-W-365 & Am 2	Wire Fabric (Insect Screening)
TT-R-266D	Resin. Alkyd: Solutions

1.2 American National Standards Institute (ANSI) Publications:

B18.6.3-72 (R-1977)	Machine	Screws	and	Machine	Screw	Nuts	
B18.6.4-66 (R-1975)	Slotted Metallic	and Rec	esse	ed Head	Tapping	Screws	and

1.3 American Society for Testing and Materials (ASTM) Publications:

(R 1978)	Iron or Steel Articles
A123-78	Zinc (Hot-galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip
A153-78	Zinc Coating (Hot-dip) on Iron and Steel Hardware
A165-71	Electrodeposited Coatings of Cadmium on Steel
A167-77	Stainless and Heat Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
A239-73 (R-1978)	Locating the Thinnest Spot in a Zinc (Galvanized) Coating on Iron or Steel Articles by the Preece Test (Copper Sulfate Dip)
A386-78	Zinc-coating (Hot-dip) on Assembled Steel Products
A525-78	Steel Sheet Zinc-Coated (Galvanized) by the Hot-Dip Process

A526-71 (R-1975)	Steel Sheet Zinc-Coated (Galvanized) by the Hot-Dip Process, Commercial Quality
A569-72 (R-1979)	Steel Carbon (0.15 maximum percent), Hot Rolled Sheet and Strip, Commercial Quality
E283-73	Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors
E331-70 (R-1975)	Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference

1.4 Steel Window Institute (SWI) Publication:

Recommended Specifications for Steel Windows, Current Edition

- 2. SUBMITTALS: Submit the following information:
- 2.1 Samples: One complete, full-size window of each type proposed for use, complete with hardware, anchors, and other accessories, and glazed. Where screens or weatherstripping are required, fit sample windows with such items that are to be used. After approval, install each sample in the work, clearly identified, and record its location.
- 2.2 Shop Drawings and Window Schedules: Shop drawings shall indicate elevations of windows, full-size sections, thicknesses and gages of metal, fastenings, proposed method of anchoring, the size and spacing of anchors, details of construction, method of glazing, details of operating hardware, method and materials for weatherstripping, method of attachment of screens, other related items, and installation details.
- 2.3 Certified Test Reports: Certified test reports are required for each type window to be supplied.
- 2.3.1 Test Reports of Air and Water Infiltration: ASTM E283 and ASTM E331. Air infiltration shall not exceed one-half cubic foot per minute per foot of crack length when subjected to a static pressure of 1.56 pounds per square foot (equivalent to a wind velocity of 25 miles per hour). The amount of water penetration shall be "zero" when tested in accordance with ASTM E331.
- 2.4 Manufacturer's Catalog Data and Certificates of Compliance: For hardware, fasteners and accessories, operators and screens, submit description of window and hardware finishes. Submit color chart of factory color coatings if factory finished color coating is to be provided in lieu of field painting.

- 3. DELIVERY AND STORAGE Deliver windows to project site in a undamaged condition. Use car in handling and hoisting windows during transportation and at the job site. Store windows and components at the site on edge, out of contact with the ground, and under a weathertight covering. Arrange storage to avoid bending, warping, or otherwise damaging the windows.
- 4. MATERIALS: Shall conform to the requirements of the specifications listed below:
 - 4.1 Steel Bars: SWI Recommended Specifications for Steel Windows.
 - 4.2 Sheet Steel: ASTM A569.
 - 4.3 Zinc-Coated Sheet Steel: ASTM A525 or A526.
 - 4.4 Zinc-Coated Steel: ASTM A90, ASTM A123, ASTM A153 or ASTM A386.
 - 4.5 Corrosion Resisting Sheet Steel: ASTM A167.
- 4.6 Screws and Bolts: ASTM A165, ANSI B18.6.3 or ANSI B18.6.4 as applicable.
 - 4.7 Steel Chains: Fed. Spec. RR-C-271.
- 5. FABRICATION: Construct window units to produce the results herein specified and to assure a neat appearance. Form permanent joints by welding or by mechanically fastening as specified for each type window. Use joints of strength to maintain the structural value of members connected. Weld joints solid, remove excess metal, and dress smooth on exposed and contact surfaces. Closely fit joints formed with mechanical fastenings and make permanently watertight. Assemble frames and sash, including ventilators, at the plant and ship as a unit with hardware unattached. Provide the following construction:
- a. Where fixed window sections adjoin or are used in combination with ventilator sections, provide fixed sash, fabricated from similar frame members, and of the manufacturer's standard type suitable for the purpose.
- b. Roll weathering surfaces integrally to provide two-point parallel-surface contact with an overlap at both inside and outside points of closure.
- c. Provide drips and weep holes as required to return water to outside.
- d. Design glazed windows and rabbets suitable for glass thickness specified.

- e. Use flathead, cross recessed type, exposed head screws and bolts with standard threads on windows, trim and accessories. Screw heads shall finish flush with adjoining surfaces. Self tapping sheet-metal screws are not acceptable.
- f. Fabricate windows with hot-dipped galvanized finish using stainless steel or hot-spun galvanized steel fasteners. Use heavily cadmium plated steel fasteners for windows with painted finish or electrogalvanized to withstand one, one minute preece dip, in accordance with ASTM A239. Finish exposed heads of fasteners to match finish of windows.
- 5.1 Conformance to Industry Specifications: Where compliance with industry specifications is specified, furnish a certificate from the window manufacturer certifying that the windows provided are in accordance with the requirements of the applicable industry specifications. However, such certification shall not relieve the contractor from the responsibility of complying with the additional requirements of this specification. The requirements specified herein govern where there is a difference between this specification and the referenced industry specifications.
- 5.2 Provisions for Glazing: Design sash for outside single glazing and for securing glass with glazing clips and glazing compound. Glass and glazing is specified in Section 08800, "Glazing."
- 5.3 Metal to Metal Joints: Set in mastic metal to metal joint between members of metal windows, metal frames, mullions, and mullion covers. Use type recommended by the window manufacturer to provide completely weathertight joints. Remove excess mastic before it hardens.
- 5.4 Accessories: Provide windows complete with necessary hardware, fastenings, clips, fins, anchors, glazing beads, and other appurtenances necessary for complete installation of windows and for the operation of ventilators.
- 5.4.1 Anchors: Use hot-dip zinc-coated steel anchors. Build into, bolt to, or otherwise secure anchors and fastenings to the heads, jambs, and sills of openings, and fasten securely to the windows or frames. Use anchors of the type recommended by window manufacturer for the specific type of construction and conceal. Use cadmium or zinc-coated screws, nuts, bolts, and other fasteners for ferrous material. Use fasteners for nonferrous materials compatible with the fastened materials. Anchor each frame at jambs with a minimum of three adjustable steel anchors. Provide perforated anchor stems for mortar keying with anchor flanges of sufficient width to provide a sliding friction fit inside frames. Extend perforated stems not less than 4 inches into masonry. For anchorage at concrete walls and prepared openings, equip frames with manufacturer's standard bent-clips located approximately 6 inches from each end and at midpoint.

- 5.4.2 Provide weatherstripping for ventilating sections of all windows to insure a weather-tight seal meeting the infiltration tests specified herein. Use easily replaceable factory applied weatherstripping of manufacturer's stock type. Use molded vinyl, molded or molded-expanded neoprene for weatherstripping for compression contact surfaces. For sliding surfaces, use treated woven pile or wool, or polypropylene or nylon pile with nylon fabric and metal backing strip weatherstripping.
- 5.4.3 Hardware: Equip all operable sash with a locking or latching device which can be secured from the inside. The item, type, and function of hardware required is specified under each individual window type. Provide hardware of suitable design and of sufficient strength to perform the function for which it is used. Attach hardware securely to the windows with corrosion resisting bolts or machine screws; sheet metal screws shall not be used. Where fixed screens are specified, adapt hardware to permit satisfactory operation of ventilators. Fit and test hardware for each window at the factory to insure satisfactory operation and security, then remove, buff, and clean.
- 5.4.3.1 Material and Finish: Except as specified otherwise for each individual window type, provide non-magnetic type stainless steel exposed hardware with a satin finish; white bronze with satin finish; yellow bronze with a dull (oxidized) finish; or red bronze (US 20) finish. Use steel hinges, or malleable iron hinges, with nonferrous pins, or with steel pins and non-ferrous bushings or washers. Finish on hinges shall match the windows.
- 5.4.4 Fasteners: Stainless steel with stainless steel or aluminum materials. Use zinc-coated or cadmium plated steel fasteners elsewhere. Prime exposed heads of coated or plated fasteners and finish to match material which they secure.
- 5.4.5 Metal Sub-frames and Stools: Manufacturer's standard type designed to suit the particular window. Use finish standard with the manufacturer, with exposed surfaces matching windows.

5.5 Window Finish:

- 5.5.1 Shop Primed Finish: After fabrication, clean all surfaces of windows, fins, mullions, cover plates, and screen frames and provide a hot-dip galvanized, phosphate-treated and shop primed finish. The methods of cleaning, chemical treatments, galvanizing, and painting shall conform to the SWI recommended specifications. Windows shall receive finish paint coats as specified in Section 09910, "Painting of Buildings (Field Painting)."
- 5.5.2 Optional Shop Finish: In lieu of shop prime finish specified above, a shop prime coat and factory applied finish color coating may be provided using the following method, in which case finish field painting will not be required:

- a. Chemically clean and bonderize windows and apply a dip coat of epoxy primer baked on for not less than 15 minutes at not less than 300 degrees F, followed by a factory applied finish coat of alkyd-amine enamel, (modified for exterior use with specific reference to Fed. Spec. TT-R-266, Type III) of not less than one mil thickness, baked on for 15 minutes at not less than 300 degrees F.
- b. Color of prime coat shall be manufacturer's standard. Select finish coat color from manufacturer's standard color chart.
- c. Touch up abraded surfaces with enamel as specified for factory finish coat except that it shall be Class A (air-drying) and same as original.
- 6. WINDOW TYPES: Types specified herein complete with hardware necessary for installation and operation, shall conform to the SWI Recommended Specifications for Steel Windows, except as modified herein. Provide windows of combinations, types and sizes indicated or specified. Each window shall consist of a unit including frame, sash, hardware, trim, casing, insect screen, and anchors complete. Windows indicated to have screens shall be designed to accommodate the items to be furnished.
 - 6.1 Projected Windows: Heavy intermediate type as modified herein.
- 6.1.1 Operators: Equip ventilators under 48 inches wide with one cam-type lever handle fastener; equip ventilators 48 inches wide and over, and not pole operated, with two fasteners. Where fixed screens occur at projected-out ventilators, provide underscreen push bar operators. Provide ventilators with locking rails more than 6 feet above the floor with hardware designed for pole operation.
- 7. SCREENS: Provide one insect screen, for each operable exterior sash or ventilator. Locate screen units either inside or outside, depending upon window type and method of operation. Provide full-length tophung type screens. Design screens to fit closely around entire perimeter of each ventilator or opening, to be rewirable, easily removable from inside building, and interchangeable for same size ventilators of similar type windows, with a minimum of exposed fasteners and latches. Provide all guides, stops, clips, bolts, and screws, as necessary, for a secure and insect—tight attachment to window. Insofar as practicable, design screens without the necessity of wickets for hardware access. Where wickets are necessary, use the sliding or hinged type, with friction catches, framed and trimmed for durability and for tight fit. Provide wicket opening frames of similar material and cross—section as the screen frames. Provide continuous framing bar between the two sides of the screen frames.
- 7.1 Construction: Provide screen frames of steel with finish matching that of the windows. Screens shall conform to SWI Recommended Specifications for Steel Windows as modified herein. Equip frames with removable splines of steel or vinyl. Form special groove in frame for holding

screen cloth in place with noncylindrical splines. Make spline and groove assembly so that cloth cannot be removed from groove by pressure on cloth. Make splines of such size and shape that rotation of spline in groove will be prevented and spline will tightly hold cloth in place. Remove splines only by means of a tool.

7.2 Screening: Provide 18 by 16 or 18 by 14 mesh Fed. Spec. RR-W-365, Type II, III or VI. Install screening with weave parallel to frames and stretch sufficiently tight to present a smooth appearance. Conceal edges of screening in the spline channel.

8. INSTALLATION:

- 8.1 Method of Installation: Install in strict accordance with the window manufacturer's printed instructions and details, except as specified otherwise herein. Build in windows as the work progresses or install without forcing into prepared window openings. Set windows at proper elevation, location, and reveal; plumb, square, level, and in alignment; and brace, strut, and stay properly to prevent distortion and misalignment. Protect ventilators and operating parts against accumulation of dirt and building materials by keeping ventilators tightly closed and wired fast to frame. Bed screws or bolts in sill members, joints at mullions, contacts of windows with sills, built-in fins, and subframes in mastic sealant of a type recommended by the window manufacturer. Install windows in a manner that will prevent entrance of water. Fasten insect screens securely in place. Fasten hardware to windows.
- 8.2 Anchors and Fastenings: Make ample provision for securing units to each other, to masonry, and to other adjoining construction. Windows installed in direct contact with masonry shall have head and jam members designed to enter into masonry not less than 0.438 inch. Where windows are set in prepared masonry openings, place the necessary anchorage or fins during progress of wall construction. Build in anchor or bolt anchors and fastenings to the jambs of openings and fasten securely to the windows or frames and to the adjoining construction. Space anchors not more than 18 inches apart on jambs and sills, and install a minimum of two anchors on each side of each opening. Anchors and fastenings shall have sufficient strength to hold the member firmly in position. Where type, size, or spacing of anchors for securing windows or fixed sash, sash equipment, and accessories to building construction is not shown or specified, use expansion or toggle bolts or screws as best suited to construction material. Provide expansion shiel and bolt assemblies of type designed to give holding power beyond tensile and shearing strength of bolt. Minimum fastener penetration shall be not less than that recommended by manufacturer for type fastener and wall material involved.
- 9.3 Operators: Install operators before glazing. Plumb and level shaft risers and runs and properly adjust ventilators for free opening and tight closing. Secure housings and adjustable supports for horizontal runs to wall with suitable anchors and alignment brackets. Anchor operator

parts to steel window mullions with 0.50 inch bolts. Couple individual lengths of shafting with steel rivets or bolts. Leave mechanical equipment and ventilators in proper operating condition.

8.4 Weatherstripping:

- 8.4.1 Provide weatherstripping at head, jambs, sill, and meeting-rails of sash of double-hung windows and at impost and at sill adapters for hopper-vent windows. Use bronze, spring-brass, or stainless steel weatherstripping and secure with non-ferrous screws. Secure weatherstripping or rubbing-blocks to parting-strip and each end of meeting-rails.
- 8.4.2 Use manufacturer's standard weatherstripping inserted into a groove for windows constructed from solid bar stock.
- 8.5 Adjustments After Installation: After installation of windows and completion of glazing and field painting, adjust all ventilators and hardware to operate smoothly and to provide weathertight sealing when ventilators are closed and locked. Lubricate hardware and operating parts as necessary. Adjustments shall include the following:
- a. Adjust casements equipped with friction hinges or friction holders to proper tension.
- b. Weatherstripping shall make weathertight contact with frames when ventilators are closed and locked. Weatherstripping shall not prevent closing and locking of the ventilator.
- 9. TESTS: After adjustment, all nonweatherstripped steel windows, except security and commercial projected steel windows, shall comply with the feeler gage tests specified herein. Remove windows that fail to comply with the tests and replace with new windows, or correct and restore to approved condition, meeting the required tests. When ventilators are closed and locked, the metal-to-metal contacts between ventilators and their frames shall conform to the following requirements:
- a. Projected-in Horizontal Ventilators: It shall not be possible to freely insert a steel feeler gage, 2 inches wide by 0.031 inch thick, between the bottom rail outside contacts, or between the top and side rail inside contacts. Nor shall it be possible to freely insert a similar feeler gage, 0.020 inch thick, between more than 40 percent of such contacts.
- 10. CLEANING: Clean metal surfaces of windows, inside and outside, of mortar, plaster, paint spattering spots, and other foreign matter to present a neat appearance and to prevent fouling of weathering surfaces and weatherstripping, or interference with the operation of hardware. Wash off zinc-coated steel windows, that are not to be painted, with soap and water and a stiff-fiber brush, and thoroughly rinse with clear water. Clean and touch up abraded surfaces of steel

windows. Replace with new windows any stained, discolored, or abraded windows that cannot be restored to their original condition.

FINISH HARDWARE

PART 1 - GENERAL

1.1 APPLICABLE PUBLICATIONS: 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.

1.1.1 American National Standards Institute, Inc. (ANSI) Publications:

A156.1-1976 Butts and Hinges

A156.2-1976 Locks and Lock Trim

A156.4-1980 Door Controls (Closers)

1.2 SUBMITTALS:

1.2.1 Hardware List and Catalog Cuts: Submit for approval a hard-ware list, in triplicate, listing each item of builders' hardware accompanied by manufacturers' catalog cuts for each different item of hardware. Submit hardware list in the following form:

		Mfr.		
		Name	UL Mark	ВНМА
	Reference	and	(If fire-	Finish Hardware
Hardware	Publication	Catalog	rated and	Designa-
Item	Type No.	No.	listed)	tion

- 1.2.2 Hardware Schedule: Submit for approval a hardware schedule. Include for each item quantities, manufacturer's catalog numbers, descriptive information and location and hardware set identification, corresponding reference publication type number to manufacturer's catalog number, size, finish, list of abbreviations, and key control symbols indicating keying system.
- 1.2.3 Certified Test Reports: Submit concurrently with the hardware list, certified test reports for all items listed under Hardware Items indicating that each item meets the standard listed for that item. A copy of the listing of proposed hardware items in the current applicable BHMA directory of certified products may be submitted in lieu of test reports.
- 1.2.4 Keying System Submission: Before locks are delivered to job site, submit complete keying system to and have approved by the Contracting Officer. Provide locks specified to be master keyed with keying

bitting charts which shall be submitted to and approved by Contracting Officer prior to completion of the contract.

1.3 DELIVERY AND MARKING: Deliver items of hardware to job site in their original individual containers, complete with necessary appurtenances including screws, keys, and instructions. Mark each individual container with manufacturer's name and catalog number as they appear in hardware schedule.

PART 2 - PRODUCTS

- 2.1 HARDWARE MANUFACTURERS AND MODIFICATIONS: Provide, as far as practicable, locks of one lock manufacturer's make, hinges of one hinge manufacturer's make, and door—closing devices of one door—closing device manufacturer's make. Modifications to hardware that are necessary to conform to construction shown or specified shall be provided as required for the specified operative and functional features.
- 2.2 HARDWARE DESIGNATIONS: Hardware items covered by ANSI or BHMA standards are specified by BHMA designations. Items covered by Federal Specifications are specified by federal designations.
- 2.3 TEMPLATE HARDWARE: Hardware to be applied to metal and to prefinished doors shall be made to template. Promptly furnish template information or templates to metal door and frame manufacturers in order to avoid delay in door and frame manufacturing. Effect proper coordination between manufacturers of different hardware items in order that each manufacturer may furnish templates which allow installation of hardware without interference to installation and operation of other hardware.
- 2.4 HARDWARE FOR LABELED FIRE DOORS AND EXIT DOORS: Hardware shall conform to requirements of NFPA No. 101 for exit doors, as well as to other requirements specified. Labeling and listing by UL Building Materials Directory, for class of door being used will be accepted as evidence of conformance to these requirements. Install minimum latch throw as specified on label of individual door. Provide hardware listed by UL except where heavier materials, larger sizes, or better grades are specified herein under paragraph entitled "Hardware Sets." In lieu of UL labeling and listing, test reports from a nationally recognized testing agency may be submitted showing that hardware has been tested in accordance with UL test methods and that it conforms to NFPA requirements.
- 2.5 HARDWARE ITEMS: Hardware items shall conform to respective specifications and standards and to requirements specified herein.
- 2.5.1 Hinges: ANSI A156.1. Construct loose pin hinges for exterior doors and reverse—bevel interior doors so that pins will be nonremovable when door is closed. Nylon or oil impregnated bearing hinges may be provided in lieu of ball—bearing hinges. Hinges shall bear name or trademark of manufacturer. Provide types of hinges, sizes, finish, design

options, and quantity per door for specific openings as specified herein under paragraph entitled "Hardware Sets."

- 2.5.2 Locks and Latches: ANSI A156.2, series 1000, grade 2. Locks and latchsets of the same series shall be the product of the same manufacturer. Lock cylinders shall have not less than 6 pin tumblers. Provide trim for locks and latchsets of wrought construction and of commercial plain design. Legibly mark on the lock and latches where it can be seen after installation the name of the manufacturer, or a trademark by which it can be readily identified. Provide series, grade(s) and function of locks and latchsets for specific openings as specified herein under paragraph entitled "Hardware Sets."
- 2.5.3 Exit Devices and Auxiliary Items: ANSI A156.3. Lock cylinders shall have not less than 6 pin tumbler cavities. Trim shall be of commercial design. Provide trim items with straight, beveled or smoothly rounded sides, corners, and edges. Provide escutcheons, minimum size 7 inches by 2-1/4 inches with a bearing minimum length of 1/4 inch. Cut escutheons to suit lock requiring cylinder. Adjustable strike to be provided. Legibly mark on the exit devices where it can be seen after installation, the name of the manufacturer, or a trademark by which it can be readily identified. Provide types of panic and fire exit devices and auxiliary items for specific openings as specified herein under the paragraph entitled "Hardware Sets."
 - 2.5.4 Door Closing Devices: ANSI A156.4.
- 2.5.4.1 Surface Door Closers: Type CO2011 w/o.f. PT-4(C) for surface applications, and CO9353 for screen and storm doors. Provide types, optional features (o.f.), and sizes of closers for specific openings as specified herein under the paragraph entitled "Hardware Sets."
- 2.5.4.2 Identification Marking: Clearly and permanently mark on the body, or on a nameplate securely attached to the body of the closer, the manufacturer's name or trademark, or other marking by which the source of manufacture can be readily identified. In addition, the manufacturer's size designation shall be permanently marked or cast in the case, cover, arm, or cap for overhead surface-mounted closers, so as to be visible after installation, upon removal of cover or finish plates.
- 2.5.4.3 Special Tools: Provide special tools for adjustment of door closing devices, such as spanner or a socket wrench.
 - 2.5.5 Miscellaneous Hardware:
- 2.5.5.1 Kick plates shall conform to requirements of ANSI A156.6, door stops, and door silencers shall conform to requirements of ANSI A156.16. Provide types and sizes of miscellaneous hardware, except for sizes of kick plates, as specified herein under the paragraph entitled "Hardware Sets."

- 2.5.5.2 Sizes of Kick Plates: Width of plates for single doors shall be 2 inches less than width of door. Provide kick plates approximately one inch less than height of bottom rail of recessed-panel doors.
- 2.6 KEYING SYSTEM: Provide keyed cylinders to provide master keying system.
 - 2.6.1 Provide keys as follows:

Lock, Group or Set of Locks	Quantity of Keys
Each Cylinder Lock (except Keyed-alike Locks)	3
Control Keys for Interchangeable Cylinders and Removable Core System	3

Provide change keys in individual envelopes for each cylinder delivered. Envelopes shall have respective door identification numbers. Stamp each change key with change number and stamp set symbol, and stamp each master key with set symbol as applicable. In addition to change number, stamp keys "U.S. Property, Do Not Duplicate" and tag.

- 2.7 FASTENERS: Supply fasteners of proper type, quality, size, quantity, and finish with hardware. Supply fasteners exposed to weather of nonferrous metal or stainless steel and match finish of trim as closely as possible.
- 2.8 FINISHES: Hardware shall have BHMA 630 finish (satin stainless steel), unless specified otherwise herein. Provide items not normally manufactured in stainless steel in BHMA 626 finish (satin chromium plated) over brass or bronze, except surface type door closers which shall have aluminum lacquer finish. Panic and fire exit devices may be provided in BHMA 626 finish in lieu of BHMA 630 finish. Exposed parts of concealed overhead door closers and of checking floor hinges shall have finish to match lock and door trim. Hardware showing on interior of bathrooms shall shall have BHMA 629 or BHMA 625 finish, depending on base metal being used. BHMA finishes are defined in BHMA 1301.

PART 3 - EXECUTION

3.1 INSTALLATION OF HARDWARE: Install hardware following manufacturers' instructions. Except as indicated or specified otherwise, use fasteners furnished with hardware to fasten hardware in place. Fasten hardware to wood surfaces with full-threaded wood screws or sheet metal screws. Use machine screws set in expansion shields for fastening hardware to solid concrete and masonry surfaces. Use toggle bolts where required for fastening to hollow core construction. Use through bolts

where indicated or specified and where necessary for satisfactory installation.

- 3.2 ACCEPTANCE: After installation, protect hardware from paint, stains, blemishes, and other damage until acceptance of work. Submit notice of operation testing 10 days before scheduled, so that the testing can be witnessed. Hinges, locks, latches, bolts, holders, closers, and other items shall be adjusted to operate properly. Also demonstrate that tagged keys operate respective locks. After hardware is checked, deliver tagged keys to the Contracting Officer. Correct, repair, and finish as directed errors in cutting and fitting and damage to adjoining work.
- 3.3 LOCATION OF HARDWARE ON HINGED DOORS: Locate as follows, unless indicated or specified otherwise herein:
 - a. Locks: Locate knobs so that center line of strike is 40-5/16 inches (nominal) above bottom of door frame.
 - b. Fire Exit (Panic) Devices: Locate so that center line of lock strike is 40-5/16 inches (nominal) above bottom of door frame. Where knob, pull, or pull with thumb piece is used as outside trim with panic devices, height of strike will determine position of outside trim.
 - c. Kick Plates: Locate kick plates on push sides of singleacting doors.
 - d. Hinges: Locate as follows:

Top Hinge

Not over 11-3/4 inches from inside of frame rabbet at head to center line of

hinge

Bottom Hinge

Not over 13 inches above bottom of door frame to center line of hinge

Center Hinge

Midway between top and bottom hinges

- 3.4 DOOR SILENCERS: On hollow metal frames for single doors, locate silencers directly opposite hinges. On frames for double doors, locate silencers on head rabbet of door frame, approximately 6 inches each side of center line of door opening.
 - 3.5 HARDWARE SETS:

EXTERIOR DOORS

HW-1

1-1/2 pairs

A5112 (temp.) 4-1/2" x 4-1/2" BHMA 630

1	each	Panic	Exit	Type 1,	Function	F05
				없이 보고 없이면서 없어졌다. 그린데이		

HW-2, HW-3, HW-5, HW-6

1-1/2 pairs	A5112 (temp.)
	4-1/2" x 4-1/2" BHMA 630

INTERIOR DOORS

HW-4

1-1/2	pairs,	Hinges	A8111	(temp.)	Se ari	
			4-1/211	x 4-1/211	ВНМА	600

GLAZING

- 1. APPLICABLE PUBLICATIONS: 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.
 - 1.1 Federal Specifications (Fed. Spec.):

DD-G-451D	Glass, Float or Plate, Sheet, Figured, (Flat, for Glazing, Mirrors and Other Uses)
TT-G-410E & Am 1	Glazing Compound, Sash (Metal) for Back Bedding and Face Glazing (Not for Channel or Stop Glazing)
TT-P-00791B & Am 2	Putty, Linseed-Oil Type, (for Wood-sash Glazing)
TT-S-00227E & Am 3	Sealing Compound, Elastomeric Type, Multi- component (for Calking, Sealing, and Glazing in Buildings and Other Structures)
TT-S-00230C & Am 2	Sealing Compound, Elastomeric Type, Single Component (for Calking, Sealing, and Glazing in Buildings and Other Structures)
TT-S-001543A	Sealing Compound, Silicone Rubber Base (for Calking, Sealing, and Glazing in Buildings and Other Structures)
TT-S-001657	Sealing Compound Single Component, Butyl Rubber Based, Solvent Release Type (for Buildings and Other Types of Construction)

1.2 Consumer Products Safety Commission (CPSC) Standard:

16 CFR Safety Standard for Architectural Glazing
Part 1201 Materials, January 1977

1.3 Flat Glass Marketing Association (FGMA) Publications:

Glazing Manual (1974 Edition)

Glazing Sealing Systems Manual (First Edition, 1970)

2. MATERIALS:

- 2.1 Glass: Fed. Spec. DD-G-451, unless specified otherwise. In all doors provide safety glazing material conforming to CPSC 16 CFR Part 1201.
- 2.1.1 Plate or Float Glass: Type I, Class 1, Quality q3, 13/64 inch thick. Provide plate or float glass for all exterior window glazing.
- 2.2 Setting Materials: Provide setting materials of the types required for the applicable setting method specified in the FGMA Glazing Sealing Systems Manual, unless specified otherwise herein. Do not use metal sash putty, nonskinning compounds, nonresilient preformed sealers or impregnated preformed gaskets. Materials which will be exposed to view and unpainted shall be gray or neutral color.
- 2.2.1 Linseed-Oil Putty: Fed. Spec. TT-P-00791. Use for face glazing primed wood sash.
- 2.2.2 Glazing Compound: Fed. Spec. TT-G-410. Use for face glazing metal sash.
- 2.2.3 Elastomeric Sealant: Fed. Spec. TT-S-00227, TT-S-00230, TT-S-001543, TT-S-001657, Type II, Class A or B. Use for channel or stop glazing metal sash. Sealant shall be chemically compatible with setting blocks, edge blocks, and sealing tapes.
- 2.2.4 Preformed Channels: Neoprene, vinyl, or rubber, NAAMM SG-1, as recommended by the glass manufacturer for the particular condition.
- 2.2.5 Sealing Tapes: Preformed, semisolid, polymeric based material of proper size and compressibility for the particular condition. Use only where glazing rabbet is designed for tape and tape is recommended by the glass or sealant manufacturer. Provide spacer shims for use with compressible tapes.
- 2.2.6 Setting Blocks and Edge Blocks: Lead, or neoprene of 70 to 90 Shore "A" durometer hardness, chemically compatible with sealants used, and of sizes recommended by the glass manufacturer.
- 2.2.7 Accessories: As required to provide a complete installation, including glazing points, clips, shims, angles, beads, and spacer strips. Provide noncorroding metal accessories. Provide primer-sealers and cleaners as recommended by the glass and sealant manufacturers.

3. INSTALLATION:

3.1 Precautions and Procedures: Determine the sizes to provide the required edge clearances by measuring the actual opening to receive the glass. Grind smooth all edges of glass that will be exposed in finish work. Leave labels in place until the installation is approved, except remove applied labels on heat-absorbing glass and on insulating glass

units as soon as glass is installed. Securely fix movable items or keep in a closed and locked position until glazing compound has thoroughly set.

- 3.2 Glass Setting: Items to be glazed shall be either shop or field glazed using glass of the quality and thickness specified or indicated. Preparation and glazing, unless otherwise specified or approved, shall conform to applicable recommendations in the FGMA Glazing Manual and Glazing Sealing Systems Manual. Handle and install glazing materials in accordance with the manufacturer's instructions. Use beads or stops which are furnished with the items to be glazed to secure the glass in place.
- 3.3 Cleaning: Thoroughly clean glass surfaces and remove labels, paint spots, putty, and other defacement. Glass shall be clean at the time the work is accepted.

ACOUSTICAL TREATMENT

- 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:
 - 1.1 Federal Specifications (Fed. Spec.):

QQ-W-461G	Wire, Steel, Carbon (Round, Bare and Coated)
SS-S-118A	Sound-Controlling Blocks and Boards (Acoustical
& Am-3	Tiles and Panels, Prefabricated)

1.2 American Society for Testing and Materials (ASTM) Publications:

A164-71	Electrodeposited Coatings of Zinc on Steel
A366-72	Steel Sheets, Carbon, Cold-Rolled, Commercial Quality
c635-76	Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings
c636-76	Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels

2. SUBMITTALS:

- 2.1 Manufacturer's Data: Submit manufacturer's standard catalog data for acoustical units and suspension systems.
- 2.2 Certified Test Reports: Submit test reports for the following tests specified herein.
 - a. Sound absorption, flame spread and smoke developed tests for acoustical units.
 - b. Structural classification of suspension system.

Listing or labeling by Underwriters Laboratories attesting to conformance of the proposed materials to flame spread, smoke developed and fire endurance tests will be accepted in lieu of certified test reports.

2.3 Manufacturer's Instructions: Submit three copies of the manufacturer's maintenance instructions for acoustical units.

- 2.4 Extra Stock: Furnish one spare acoustical unit for each 100 units installed.
- 3. DELIVERY AND STORAGE: Deliver acoustical units in the manufacturer's original unopened containers with brand name and type clearly marked. Handle materials carefully and store them under cover in dry, watertight enclosures. Immediately before installation, store acoustical units for not less than 24 hours at the same temperature and relative humidity as the space where they will be installed.
- 4. ENVIRONMENTAL CONDITIONS: Maintain a uniform temperature of not less than 60 degrees F nor more than 85 degrees F and a relative humidity of not more than 70 percent continuously before, during, and after installation of acoustical units. Interior finish work such as plastering, concrete and terrazzo work shall be completed and dry before installation. Mechanical, electrical and other work above the ceiling line shall be completed and approved prior to the start of acoustical ceiling installation.
- 5. MATERIALS shall conform to the specifications, standards and other requirements listed below:
- 5.1 Acoustical Units: Fed. Spec. SS-S-118, and the following requirements.
- 5.1.1 Composition Lay-in Panels (use in all areas not specified otherwise):
 - a. Type: Mineral or glass fiber composition with factory applied white paint finish.
 - b. Class: 25.
 - c. Pattern: Fissured or fissured and finely perforated.
 - d. Noise Reduction Coefficient (NRC): 0.55 minimum when tested on Mounting No. 7.
 - e. Light Reflectance (LR) Coefficient: 0.75 or greater.
 - f. Nominal Size: 24 by 24 inches.
 - g. Edge Detail Square.
 - h. Joint Detail: Trimmed and butt.
- 5.1.2 Humidity Resistant Composition Lay-in Panels (use in toilet and shower rooms):
 - a. Type: Mineral or glass fibers bonded with ceramic, moisture resistant thermo-setting resin, or other moisture resistant

material and having a factory applied white paint finish. Panels shall not sag or warp under conditions of heat, humidity or chemical fumes.

- b. Class: 25.
- c. Pattern: Fissured.
- d. Noise Reduction Coefficient (NRC): 0.50 minimum when tested on Mounting No. 7.
- e. Light Reflectance: 0.75 or greater.
- f. Nominal Size: 24 by 24 inches.
- g. Edge Detail: Square.
- h. Joint Detail: Trimmed and butted.
- 5.2 Suspension System: ASTM C635 and the following requirements:
 - a. Type: Exposed grid, direct hung, concealed, upward access.
 - b. Structural Classification: Intermediate duty.
 - c. Finish: Surfaces exposed to view shall be of uniform width and shall be aluminum or steel with factory applied white baked enamel finish. Zinc coated steel shall receive a phosphate treatment prior to painting.
 - d. Accessories: Provide manufacturer's standard hold down clips and wall or edge moldings.
- 5.3 Hangers:
- 5.3.1 Wires: Fed. Spec. QQ-W-461, composition 1010, soft annealed, light zinc coated finish, 0.1055 inches in diameter (12 gage).
- 5.3.2 Straps: One-inch by 3/16 inch galvanized steel conforming to ASTM A526, with a light commercial zinc coating or ASTM A366 with an electrodeposited zinc coating conforming to ASTM A164, type RS.
- 5.3.3 Rods: 3/16-inch diameter threaded steel rods, zinc or cadmium coated.
 - 6. INSTALLATION:
- 6.1 Suspended Ceilings: Install the suspension system in accordance with ASTM C636 and the following additional requirements.

- 6.1.1 Hangers: Space hangers 4 feet on centers each direction. Hangers shall be laid out for each individual room or space. Install additional hangers where required to support framing around beams, ducts, columns, grilles and other penetrations through the ceiling.
- 6.1.2 Suspension Members: Keep main runners and carrying channels clear of abutting walls and partitions. Provide at least two main runners for each ceiling span.
- 6.1.3 Acoustical Units: Edges of ceiling tiles shall be in close contact with metal supports and in true alignment. Arrange units so that units less than 1/2 width are minimized.
- 6.1.4 Wall or Edge Molding: Install wall moulding at intersection of suspended ceiling and vertical surfaces. Miter corners where wall mouldings intersect or install corner caps.
- 7. CLEANING: Clean soiled or discolored unit surfaces after installation. Touch up scratches, abrasions, voids and other defects in painted surfaces. Remove damaged or improperly installed units and install new materials.

PAINTING OF BUILDINGS (FIELD PAINTING)

PART 1 - GENERAL

- 1.1 APPLICABLE PUBLICATIONS: 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.
 - 1.1.1 Federal Specifications (Fed. Spec.):

TT-E-489G	Enamel, Alkyd, Gloss (for Exterior and Interior Surfaces)
TT-E-496B & Am 2	Enamel, Heat-Resisting (400 Degrees Fahrenheit), Black
TT-E-509B & Am 2	Enamel, Odorless, Alkyd, Interior, Semigloss, White and Tints
TT-E-545B & Am 1	Enamel, Odorless, Alkyd, Interior Undercoat, Flat Tints and White
TT-E-1593B	Enamel, Silicone Alkyd Copolymer, Gloss (For Exterior and Interior Use)
TT-P-19C & Am 2	Paint, Acrylic Emulsion, Exterior
TT-P-28F	Paint, Aluminum, Heating Resisting (1200° F)
TT-P-29J & Am 1	Paint, Latex-base, Interior, Flat, White and Tints
TT-P-55B & Am 2	Paint, Polyvinyl Acetate Emulsion, Exterior
TT-P-102E	Paint, Oil, Alkyd, Modified, Exterior
TT-P-645A	Primer, Paint, Zinc-chromate, Alkyd Type
TT-P-1728A & Am 1	Paint, Latex-base, Flat, Deep Tone

1.1.2 Federal Commercial Item Description (Fed. CID):

A-A-1500 Latex (Water Reducible) Block Filler

1.1.3 Military Specifications (Mil. Spec.):

MIL-R-10036D Rust Arresting Coating (for Treatment of Rusted Metal)

DOD-P-15328D Primer (Wash), Pretreatment (Formula No. 117) for Metals)(Metric)

MIL-P-28582 Primer Coating, Exterior, Lead Pigment-free, (Undercoat for Wood, Ready-mixed, White and Tints)

1.1.4 Federal Standard (Fed. Std.):

Fed. Std. 595A Colors & Notice 4

1.1.5 Military Standard (Mil. Std.):

MIL-STD-101B Color Code for Pipelines and for Compressedgas Cylinders

1.1.6 Occupational Safety and Health Administration (OSHA) Publication:

29 CFR 1910 Safety and Health Standards

1.1.7 American Society for Testing and Materials (ASTM) Publications:

D 96-73 (R77)	Test Method for Water and Sediment In Crude Oils
D 523-78	Test Method for Specular Gloss
D 1640-69 (R74)	Test Method for Drying, Curing, or Film Formation of Organic Coatings at Room Tempera- ture
D 1737-62 (R79)	Test for Elongation of Attached Organic Coatings With Cylindrical Mandral Apparatus
D 3273-76	Test Method for Resistance to Growth of Mold in the Surface of Interior Coatings in an Environmental Chamber

1.1.8 Steel Structures Painting Council (SSPC) Publication:

SSPC-SP-10-63T Surface Preparation Specification, Near-White Metal Blast Cleaning

1.2 SUBMITTALS:

- 1.2.1 Certificates of Conformance: Submit certificates of compliance from the manufacturer stating that previously manufactured materials have been tested by recognized laboratories; that such materials meet testing requirements in referenced specifications; and that the material furnished for this project is of the same type, quality, manufacture, and make as that tested. Copies of the test reports need not be submitted except as specifically requested by the Contracting Officer. The Government will take one pint samples from coatings being used on the job for testing by the Government.
- 1.2.2 Qualification Data: Submit data as required by paragraph "QUALIFICATION OF AIRLESS SPRAY APPLICATORS."
- 1.3 QUALIFICATION OF AIRLESS SPRAY APPLICATORS: Application of paint by airless spray shall be accomplished by firms or persons possessing the experience set forth herein. Prior to any application of coating by airless spray, submit data for approval by the Contracting Officer that indicates that the Contractor has successfully applied paint by airless spray or has a firm contractual agreement with a subcontractor having such required experience. The data shall include the names and locations of not less than two sites where the Contractor or subcontractor referred to herein has applied paint by airless spray. Indicate the type and design of the equipment, including safety devices, and certify that the method of applying coating has been performed satisfactorily.
- 1.4 APPROVAL OF MATERIALS: Do not apply any coating before required test reports, certificates, and requests for substitutions have been submitted and the respective material approved for use on this project. Submit all requests for substitutions to the Contracting Officer. Each such request shall include specific identification of the proposed substitute; justification for the necessity of the substitution; certified test reports of the proposed substitute, including all tests required by the specification for the substituted material; and a tabulation of the specified material compared to the proposed substitute. The tabulation shall include all tests, composition of both pigment and vehicle, and quantitative and qualitative requirements for both the specified and the proposed material; clearly indicate any deviations from specified requirements.
- 1.5 DELIVERY AND STORAGE: Deliver coatings and coating materials in unbroken original packages bearing the manufacturer's name and brand designation, specification number, batch number, color, date of manufacture, and manufacturer's instructions for application. Restrict storage of coatings and coating materials and the mixing of coatings to the locations directed.
- 1.6 SELECTION OF COLORS: Colors of finish coats shall be as indicated. Match existing color scheme in areas of renovation. Where colors are not indicated, the colors shall be as selected by the Contracting Officer from Fed. Std. No. 595. Manufacturers' names and color

designations, if indicated, are used for the purpose of color designations only and are acceptable for use on this project only if they conform to all specified requirements. Products of other manufacturers are acceptable if the colors closely approximate colors indicated and the product conforms to all specified requirements.

- 1.7 DESCRIPTION OF WORK: Surfaces concealed by portable objects and by surface mounted articles readily detachable by removal of fasteners such as screws and bolts are included in the work. Surfaces concealed and made inaccessible by panelboards, fixed ductwork, machinery, and equipment fixed in place are not included. Remove articles obstructing access to those surfaces specified to be included in the work and restore to their original position on completion. Do not coat surfaces in concealed spaces unless specifically so stated. Concealed spaces are defined as spaces above suspended ceilings, furred spaces, attic spaces, crawl spaces, and chases. Do not coat surfaces of steel to be imbedded in concrete. Do not coat copper, stainless steel, and aluminum except where specifically so stated and except where surfaces have existing coatings. Do not coat new factory finished materials except those that require identification or color coding and those factory-finished surfaces which are damaged during installation. Restore damaged factory-finished surfaces to their original condition. Do not paint zinc-coated ducts, zinc-coated pipe, or copper pipe under insulation or in concealed spaces.
- 1.7.1 Exterior Painting: Includes new surfaces and existing previously coated surfaces damaged during performance of the work, including items on or a part of the roofs.
- 1.7.2 Interior Painting: Includes new surfaces and existing previously coated surfaces damaged during performance of the work of the buildings and appurtenances of the types listed. Where a space or surface is indicated to be painted, include the painting of exposed piping, ductwork, and all other contiguous surfaces in the work unless indicated otherwise.
- 1.7.3 Mechanical and Electrical Painting: Includes the field coating of interior and exterior new and existing piping, conduit, ductwork, supports, hangers, air grilles, registers, miscellaneous metalwork, and insulation coverings, except as specified otherwise herein. Do not coat new zinc-coated, aluminum and copper surfaces under insulation. Coat new exterior ferrous piping prior to insulating.
- 1.7.4 Exterior Painting of Site Work Items: Includes the coating of the following items as specified for exterior surfaces:
 - a. All exterior miscellaneous ferrous metal
 - b. All exterior process equipment

PART 2 - PRODUCTS

- 2.1 MATERIALS: Conform to the respective specifications and standards listed for use in PART 3 and to the following requirements.
 - 2.1.1 Latex Block Filler: Fed. CID A-A-1500 (see Appendix A).
- 2.1.2 Deep Tone Colors: Where deep tone colors are indicated or specified and Fed. Spec. TT-P-29 is specified, modify the specifications to deep tone latex, Fed. Spec. TT-P-1728, in lieu of Fed. Spec. TT-P-29.
- 2.1.3 Eggshell Finish: Where eggshell finish is indicated or specified and the specified material does not have an eggshell finish, modify the specification for the finish coat material to require a gloss range of five to 20 using 60 degree glossmeter geometry when tested in accordance with ASTM D 523.
- 2.1.4 Lead Content: Do not use coatings having a lead content of over 0.06 percent by weight of nonvolatile content.

PART 3 - EXECUTION

- 3.1 PROTECTION OF AREAS AND SPACES: Remove, mask, or otherwise protect prior to surface preparation and painting operations such items as hardware, hardware accessories, machined surfaces, radiator covers, plates, lighting fixtures, and similar items in contact with coated surfaces. Following completion of painting, reinstall removed items utilizing workmen skilled in the trades involved for such removal and reinstallation. Protect from contamination by coating materials all surfaces not to be coated. Restore surfaces that are contaminated by painting materials to original condition.
- 3.2 PREPARATION OF SURFACES: Remove all dirt, rust, scale, splinters, loose particles, disintegrated coatings, grease, oil, and other deleterious substances from all surfaces which are to be coated or otherwise finished. Allow putty to set one week before coating. Calking and glazing compounds shall be allowed to cure for times stated in manufacturers' literature prior to being coated. Sandpaper entire surface of existing enamel and other glossy surfaces before application of any coatings. Inspect surfaces after preparation and receive approval before application of any coatings. On surfaces to be coated with water thinned coatings, spot prime with a brush all exposed nails and other ferrous metal with zinc chromate primer, Fed. Spec. TT-P-645.
- 3.2.1 Defects in Existing Surfaces: Repair, smooth, sand, spackle, or otherwise treat to render practically imperceptible in the finished work defects such as scratches, nicks, cracks, gouges, spalls, alligatoring, and irregularities due to partial peeling of previous paint coatings.

- 3.2.2 Wiping of Surfaces: On all previously painted surfaces that are to receive oil-based coatings, except stucco and similarly rough surfaces, after all other cleaning operations and wire brushing and sanding are completed, wipe down with clean rags saturated with mineral spirits and allow to dry. Such wiping shall immediately precede the application of the first coat of any coating, unless specified otherwise.
- 3.2.3 Concrete and Masonry: Remove dirt, fungus, grease, and oil prior to application of coatings. Wash new and previously unpainted surfaces with a solution composed of from 2 to 8 ounces of trisodium phosphate per gallon of hot water and then rinse thoroughly with fresh water. Wash previously coated surfaces with a suitable detergent and rinse thoroughly. Remove glaze, all loose particles, and scale by wire brushing. Remove efflorescence by scraping, wire brushing, and washing with a 5- to 10-percent by weight aqueous solution of hydrochloric (muriatic) acid and then wash thoroughly with fresh water, removing all traces of the acid. Give all new surfaces to be painted with other than cement-water paint a neutralizing treatment consisting of 2 pounds of zinc sulphate in one gallon of warm water. Apply the neutralizer liberally and allow to dry, then rinse the surfaces thoroughly with clean water and allow to dry for not less than 48 hours before paint is applied.
- 3.2.4 New Unprimed Nonsubmerged Metal Surfaces, Except Hot Metal Surfaces: Solvent clean zinc-coated surfaces with mineral spirits and wipe dry with clean, dry cloths. Treat aluminum surfaces to be painted with a 10 percent aqueous solution of chromic acid at a temperature of not less than 140 degrees F for 3 to 5 minutes and rinse thoroughly with clean warm water. Immediately after cleaning and treating, apply pretreatment wash primer, Mil. Spec. DOD-P-15328, to a dry film thickness of 0.2 to 0.5 mil on zinc-coated, aluminum, brass, copper, and ferrous surfaces. Apply primer as soon as practicable after pretreatment has dried.
- 3.2.5 Submerged and Intermittently Submerged Metal: Sand blast to SSPC SP-10-63T near white. Apply primer or finish coat as soon as practicable. Do not allow clean surface to re-oxidize.
- 3.2.6 Existing Metal Surfaces to be Coated, Except Hot Metal Surfaces: Remove all deleterious substances from surfaces as specified herein; sand-paper, wire brush, or rub with steel wool over their entire surfaces and scrape where necessary to remove loose paint. Clean all rusted spots down to bare metal including spots where rust discoloration appears through the existing coating. Remove to the extent that only rust discoloration in deep pits remains. Otherwise, clean the surfaces to bright metal. Immediately after such cleaning and before any new rust has formed, coat the bare surfaces with rust arresting compound, Mil. Spec. MIL-R-10036. After the compound is thoroughly dry and hard, apply primer coats specified for new metal surfaces.

3.2.7 New Hot Metal Surfaces:

- 3.2.7.1 Surfaces Subject to Temperatures of 120 to 400 Degrees F: Clean new surfaces down to clean bare metal free of mill scale, rust, oil, oxides, dust, coatings, and other contaminates. Apply new coatings before any new oxidation or contamination begins.
- 3.2.7.2 Surfaces Subject to Temperatures Above 400 Degrees F: Clean new surfaces down to clean bare metal free of mill scale, rust, oil, oxides, dust, paint, and other contaminates. Apply new coatings before any oxidation or contamination begins.
- 3.3 APPLICATION: Provide finished surfaces free from runs, drops, ridges, waves, laps, brush marks, and variations in colors. Avoid contamination of other surfaces and public and private property in the area; repair all damage thereto. Allow sufficient time between coats to permit thorough drying and provide each coat in proper condition to receive the next coat. Each coat shall cover the surface of the preceding coat or surface completely; there shall be an easily perceptible difference in shades of successive coats. Thoroughly clean surfaces to be coated. Interior areas shall be broom-clean and dust-free before and during the application of coating material. Prior to erection, use two coats of the designated primer to treat and prime wood and metal surfaces which will be inaccessible after erection. Thoroughly work painting materials into all joints, crevices, and open spaces. Finished surfaces shall be smooth, even, and free of defects. Retouch damaged painting before applying succeeding coats of paint. Spray painting operations shall comply with OSHA 29 CFR 1910, Sections .94, .107, .134, and .1000. Procure and utilize the engineering controls and/or personal protective equipment necessary for safe and effective application of specified paint systems.
- 3.3.1 Equipment: Apply coatings carefully with good, clean brushes or approved spray equipment, except as specified otherwise. Spray areas made inaccessible to brushing by ducts and other equipment. Use airless type spray equipment. Use approved rollers for the application of flat latex coatings to interior walls and ceilings.
- 3.3.2 Thinning of Paints: Reduce paints to proper brushing consistency by adding fresh paint, except that when thinning is mandatory for the type of paint being used, obtain written permission from the Contracting Officer to use thinners. The written permission shall include quantities and types of thinners to use.
- 3.3.3 Environmental Conditions: Do not apply exterior coating in foggy or rainy weather or when the temperature of the air at the surface is below 45 degrees F or over 95 degrees F, unless approved by the Contracting Officer. Apply interior coatings when the surfaces to be painted are dry and the temperature can be kept above 45 degrees F and below 95 degrees F during the application of ordinary paints and between 65 degrees F and 95 degrees F during the application of enamels and varnishes.

- 3.3.4 Special Requirements for Coating Concrete Masonry Surfaces With Acrylic Emulsion Paint (Fed. Spec. TT-P-19) or Polyvinyl Acetate Emulsion Paint (Fed. Spec. TT-P-55): Fed. Spec. TT-P-19 and Fed. Spec. TT-P-55 requires containers be marked for the formulation and mixing of fill coat. The fill coat shall conform to these markings except as specified herein.
- 3.3.4.1 Mixing of Fill Coat: The formula given in Fed. Spec. TT-P-19 and Fed. Spec. TT-P-55 for the content of the fill coat requires a definite amount of water to be added in preparation of the mixture. This requirement shall not apply. Deliver the sand, cement, and mixing liquids preproportioned and packaged so that field proportioning will not be required. Field mix the mixing liquid with the sand and cement; after this mixture is thoroughly blended, add water as necessary to produce a rich, creamy mixture of proper brushing consistency. Mix the fill coat materials by hand but do not vigorously agitate. After mixing, allow to set for 10 minutes to permit air to escape before applying. The fill coat mixture will gradually thicken with time; add small amounts of water, when necessary, to keep the mixture a rich brushing consistency. Do not begin mixing more than one hour before application.
- 3.3.4.2 Wetting of Surfaces: Before applying filler coat, thoroughly wet the masonry and concrete to control surface suction and provide a reserve of moisture to aid in curing the paint. A garden hose nozzle adjusted to a fine spray is adequate for the purpose. Do not dampen with a brush dipped in water. Dampen the masonry and concrete in one operation not more than one hour nor less than 30 minutes before painting. Apply the spray in such manner that each part is sprayed three or four times for about 10 seconds. Allow time between applications for the water to soak into the surface. If the surface tends to dry rapidly, as in hot weather, redampen slightly just in advance of painting. The surface shall be moist but without free water when paint is applied.
- 3.3.4.3 Application: Do not paint when the paint may be exposed to temperatures below 40 degrees F within 48 hours after application or when the temperature is over 95 degrees F. Rub the filler coat into the surface in such a manner as to fill all depressions, holes voids, joints, and hollows. Apply the filler coat with stiff fiber bristle brushes with bristles not longer than 2-1/2 inches, using a circular motion. Give the surface a final stroke parallel to the course of block. Provide uniform coverage and laps well brushed out. Apply the first finish coat at a rate of not less than one gallon per 250 square feet; apply the second finish coat at the rate of not less than one gallon per 300 square feet. apply finish coats, except that behind large ducts and similar locations inaccessible to a brush they may be applied by rollers. Spray application will not be permitted. Deliver all paint to the job site prior to application. Compute the amount of finish coat paint required and submit calculations for approval. Do not begin painting until this amount has been approved and delivered to the job site. Apply all delivered paint. Keep paint in tightly covered containers when not in use; keep stirred to maintain uniform color and consistency during application. At least 24

hours shall lapse between coats; do not start another coat until the preceding coat has become so hard that it cannot be marked with the brushes used. In hot weather, slightly moisten the prior coat before applying the succeeding coat. Covering is not necessary.

3.3.5 Paint Systems: New surfaces, existing surfaces made bare by cleaning operations, and existing unpainted surfaces shall receive the following coatings conforming to the respective specifications listed. Existing surfaces to be painted shall receive the following coatings conforming to the respective specifications listed, except that pretreatments, sealers, fillers, and primers need not be provided on surfaces where existing coatings are firmly adhered and in good condition. Apply paints, primers, varnishes, enamels, undercoats, and other coatings to a dry film thickness of not less than 1.0 mil each coat except as specified otherwise. Where coating thickness is specified, it is the minimum dry film thickness.

3.3.5.1 Exterior Surfaces:

a. Wood Surfaces, Including Top, Bottom, and Edges of Doors:

One coat of primer, Mil. Spec. MIL-P-28582 Two coats of alkyd paint, Fed. Spec. TT-P-102

- b. Metal Surfaces:
 - (1) Nonsubmerged:

Touch up shop prime coat on shop primed surfaces
Primer, Fed. Spec. TT-P-645, two coats on surfaces not
shop primed, one coat on shop primed surfaces
Two coats of alkyd enamel, Fed. Spec. TT-E-489 or
Two coats of silicon alkyd enamel, Fed. Spec. TT-E-1593

(2) Submerged and Intermittently Submerged:

Two coats Sherwin Williams Sher Tar Epoxy, Tnemec Tenme Tar Coal Tar Epoxy, or equal (8.0 mils dry per coat)

- 3.3.5.2 Interior Surfaces Not Specified Otherwise:
 - a. Wood Surfaces Not Specified Otherwise:

One coat of alkyd enamel undercoat, Fed. Spec. TT-E-545 One coat of alkyd semigloss enamel, Fed. Spec. TT-E-509

b. Metal Surfaces:

Touch up shop primer coat on shop primed surfaces

One coat of alkyd primer, Fed. Spec. TT-P-645, on surfaces not shop primed
One coat of alkyd enamel undercoat, Fed. Spec. TT-E-545
One coat of alkyd semigloss enamel, Fed. Spec. TT-E-509

c. Concrete Surfaces, Except Floors:

One coat of latex paint, Fed. Spec. TT-P-29
One coat of alkyd enamel undercoat, Fed. Spec. TT-E-545
One coat of alkyd semigloss enamel, Fed. Spec. TT-E-509

d. Concrete Masonry:

One coat of latex block filler
One coat of alkyd enamel undercoat, Fed. Spec. TT-E-545
One coat of alkyd semigloss enamel, Fed. Spec. TT-E-509

3.3.5.3 Cloth and Paper Covering on Insulation:

One coat of glue size
One coat of suitable primer
One finish coat to match adjacent surfaces

3.3.5.4 Existing Surfaces Damaged During Performance of the Work (including new patches in existing surfaces):

One coat of suitable primer
One coat of undercoat or intermediate coat
One finish coat to match adjacent surfaces

3.3.5.5 Mechanical, Electrical, and Miscellaneous Metal Items, Except Hot Metal Surfaces and New Prefinished Equipment: Prefinishing of new mechanical and electrical equipment is specified in the section covering the particular item. Paint copper pipe exposed in interior spaces.

Coating systems as specified hereinbefore Color of finish coat to match adjacent surfaces

a. Surfaces Not Adjacent to Painted Surfaces:

One coat of primer, Fed. Spec. TT-P-645
Two coats of enamel, Fed. Spec. TT-E-489 or Fed. Spec.
TT-E-1593, or of same coating as used for coating metal in same space

b. New Exterior Ferrous Piping, Not Zinc-Coated, Under Insulation:

Two coats of primer, Fed. Spec. TT-P-645

c. New Exterior Ferrous Piping, Not Zinc-Coated, In Concealed Spaces:

Two coats of primer, Fed. Spec. TT-P-645

- d. Piping and Conduit Identification, Including Surfaces In Concealed Spaces: Conform to MIL-STD-101. Place stenciling in clearly visible locations. Stencil all piping and conduits not covered by MIL-STD-101 with approved names or code letters, not less than 1/2 inch high for piping and not less than 2 inches high elsewhere. Paint arrowshaped markings on the lines to indicate the direction of flow. Provide two copies of the complete color and stencil codes used.
- 3.3.5.6 Hot Metal Surfaces, Including New Piping Under Insulation and New Piping in Concealed Spaces:
 - a. Surfaces Subject to Temperatures of 120 to 400 Degrees F:

 Two coats heat resistant enamel, Fed. Spec. TT-E-496, Type
 - b. Surfaces Subject to Temperatures Over 400 Degrees F: Two coats of heat resistant paint, Fed. Spec. TT-P-28
- 3.3.5.7 Coat other surfaces for which the type of coating has not been specified herein as specified for surfaces having similar conditions of exposure.

APPENDIX A Salient Characteristics and Certification Required for CID A-A-1500

Salient characteristics.

The filler shall be readily dispersible by hand stirring to form a homogeneous mixture. The filler shall brush easily and without pulling and shall not sag when applied at the rate of 50 square feet per gallon to vertical surfaces. The film shall be smooth and uniform and without pin holes or craters. The color shall be white or a tint as specified. The total solids shall be at least 60 percent by weight.

- (1) Viscosity. The viscosity shall be between 110 and 125 K.U. (ASTM D 562).
- (2) Drying time. 1/ The dry-to-touch time shall be within 1 hour and dry-hard time within 2 hours (ASTM D 1640).
- (3) Adhesion. 2/ The filler shall not separate from the substrate at less than 150 psi when tested with an Elcometer adhesion tester.
- (4) Appearance. 1/ There shall be no lifting, pinholes, craters, or other irregularities when an exterior 100% acrylic house paint (TT-P-19) is applied at a spreading rate of 300 square feet per gallon over the filler.
- (5) Flexibility. 2/ The filler shall bend over 1/4 in mandrel without cracking, chipping, or flaking (ASTM D 1737).
- (6) Fungus resistance. The maximum disfigurement rating shall be 9 (ASTM D 3273, D 3274).
- (7) Permeability. The filler shall have a maximum permeance of 0.003 perms (ASTM D 96, (Procedure A)).
- (8) Accelerated storage stability. When the filler is exposed for 2 weeks at 50 ± 2 degrees C followed by 8 hours at 25 ± 1 degrees C, the increase in viscosity shall be less than 8 K.U. and when brushed to wallboard the coating shall be smooth and uniform.
- (9) Freeze-thaw resistance. When exposed to three cycles consisting of 16 hours at minus 9 ± 1 degree C followed by 8 hours at 25 ± 1 degree C, the increase in viscosity shall be less than 8 K.U. and when brushed to wallboard the coating shall be smooth and uniform.
- (10) Alkali resistance. 1/ The coating shall be unchanged after immersion for 14 days in 0.5 percent aqueous sodium hydroxide

solution to such a depth that the coated surface is 4 mm above the solution level.

The issue of the ASTM test method in effect on the date of the solicitation shall be used to determine compliance with the stated requirements.

Certification. The contractor shall certify that the product offered meets the salient characteristics of this description and that the product conforms to the producer's own drawings, specifications, standards, and quality assurance practices and is the same product offered for sale in the commercial marketplace. The Government reserves the right to require proof of such conformance prior to first delivery and thereafter as may be otherwise provided for under the provisions of the contract.

ASTM standards are available from the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

Notes: Procedures for the preparation of block filler relative to the above salient characteristics.

1/ Brush the filler to patio blocks at a spreading rate of 50 square feet per gallon and allow to cure for 24 hours at standard conditions.

2/ Apply the filler with a draw-down blade to electrolitic tin panels at a rate of 100 square feet per gallon and allow to cure for 48 hours at standard conditions followed by two hours in an oven at 50 + 2 degrees C.

*** END OF SECTION ***

SECTION 11210

WATER PUMPS

PART 1 - GENERAL

- 1.1 APPLICABLE PUBLICATIONS: 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.
 - 1.1.1 American Society for Testing and Materials (ASTM) Publication:

A 48-76 Grey Iron Casting

- 1.1.2 American Water Works Association (AWWA) Publication:
 - E101-77 Vertical Turbine Pumps Line Shaft and Submersible Types
- 1.1.3 American National Standard Institute (ANSI) Publication:

B16.1-78 Iron Pipe Flanges

- 1.2 DESCRIPTION: The water pumps included are as follows:
- 1.2.1 Deep Well Pump:
- 1.2.1.1 New Well:
 - a. Performance Conditions
 - 1. Capacity/Head 300 GPM at 131 ft. TDH
 - 2. Speed not greater than 1800 RPM
 - 3. Efficiency not less than 80%
 - NOTE: Pump head calculated from discharge head of pump. Final design conditions shall account for dynamic losses in pump column and intake.
 - b. Pump Characteristic
 - 1. Number of Stages 7
 - 2. Impeller Type semi-enclosed bronze
 - 3. Pump Column 6" diameter threaded coupling type
 - 4. Discharge Outlet 6 inch diameter
 - 5. Motor Horsepower 15 HP
 - 6. Motor Operating Voltage 230 volts, 3 phase
 - 7. Motor speed not greater than 1800 RPM
 - 8. Type Line Shaft Lubrication water
 - 9. Equipped with Right Angle Drive

- 1.2.1.2 Existing Well BB-220: Existing pump is Layne & Bowler vertical turbine Model 90976B, 8 EDM. The pump presently operates at 150 GPM at 78 feet TDH. Under this contract the Contractor shall add one additional stage to the pump to have a new design capacity of 150 GPM at 104 feet TDH and replace the existing 7.5 HP motor with the 10 HP motor removed from well BB-221. Make necessary modifications to coupling and base mounting. The 7.5 HP motor removed from well BB-220 shall be salvaged and stored at a location designated by the Contracting Officer.
- 1.2.1.3 Existing Well BB-221: Existing pump is Layne & Bowler vertical turbine Model 90976B, 8 RM. The pump presently operates at 300 GPM at 82 feet TDH. Under this contract the Contractor shall add two additional stages to the pump to have a new design capacity of 300 GPM at 123 feet TDH and replace the existing 10 HP motor with a new 15 HP, 230 volt, 3 phase motor at 1800 RPM.

1.2.2 Filter Pump: Split case centrifugal type.

- a. Performance Conditions
 - 1. Capacity/Head 545 GPM at 95 TDH
 - 2. Speed not greater than 1770 RPM
 - Efficiency not less than 74.5%
- b. Pump Characteristics
 - Frame Type Horizontal on integral frame with motor, flexible coupling and open guard
 - Impeller Type Bronze ASTM B145-836
 - 3. Suction Opening 6", flanged 125 lb. ANSI
 - 4. Discharge Opening 4" diameter, flanged 125 lb. ANSI
 - . Maximum Solid Sphere Capability (min) 1/2" diameter
 - 6. Motor Horsepower 20 HP
 - 7. Motor Speed 1800 RPM (nominal)
 - 8. Motor Operating Voltage 208 V, 3 phase, 60 cycle reduced voltage auto transformer starting
- 1.2.3 Electrical Motors, Controllers, Contactors, and Disconnects: Furnish motors, controllers, contactors, and disconnects with their respective pieces of equipment. Motors, controllers, contactors, and disconnects shall conform to and shall have electrical connections provided under Section 16402, "Interior Wiring Systems". Controllers and contactors shall have a maximum of 120 volt control circuits and auxiliary contacts for use with the controls furnished. When motors and equipment furnished are larger than sizes indicated, the cost of providing additional electrical service and related work shall be included under this section.
- 1.2.4 Electrical Work: Work associated with this section shall be provided under Section 16402, "Interior Wiring Systems".
- 1.3 GENERAL REQUIREMENTS: Section 15011, "General Requirements, Mechanical" applies. Post operation and maintenance instructions with

each unit. Refer to Section 02581, "Rotary Drilled Water Well" for coordination with deep well pump. Refer to Section 15271, "In-Plant Piping and Accessories" for coordination with other work. The Contractor shall provide all systems complete and ready for operation. All incidental piping, controls, and accessories required for complete operating systems shall be at the expense of the Contractor. Provide all control wiring and accessories in accordance with NFPA 70.

1.4 SUBMITTALS: Partial submittals will not be acceptable. Annotate descriptive data to show the specific model, type, and size of each item the Contractor proposes to furnish. Prepare shop drawings on sheets not smaller than 30 inches by 42 inches, and include data essential to the proper installation of each system. Do not commence work until the design of each system and the various components have been approved. The submittal requirements of Section 15011, "General Requirements, Mechanical" applies to the following lists. Items in the following lists (which are followed by (CO)) shall be approved by the Contracting Officer.

1.4.1 Manufacturer's Data:

- a. Pumps, drivers, and controllers (CO)
- b. Pipe and fittings, and couplings (CO)
- c. Valves including gate, check, and relief valves (CO)
- d. Gages (CO)
- e. Devices and associated equipment (CO)
- f. Suction bell and shaft for vertical turbine pump (CO)

1.4.2 Shop Drawings:

- a. Pumps, drivers, and controllers (CO)
- 1.4.3 Certificates of Compliance:
 - Pumps, drivers, and controllers including subbase plate assembly required (CO)
 - b. Pipe and fittings, and couplings (CO)
 - c. Valves (CO)
 - d. Devices and associated equipment (CO)

1.4.4 Certified Data:

- a. Manufacturer's pump discharge curves (CO)
- 1.4.5 Operation and Maintenance Manuals:
 - a. Pumps, drivers, and controllers
 - b. Spare parts catalog (CO)
- 1.4.6 Posted Operating Instructions:
 - a. Pumps, drivers, and controllers

2.1 VERTICAL TURBINE PUMPS:

- 2.1.1 Pump Construction: Pumps shall be of the centrifugal water-lubricated, vertical shaft turbine type conforming to AWWA E101, except as modified herein. Each pump capacity at rated head shall be not less than that indicated.
- 2.1.1.1 Bowl Assembly: The pump bowls shall be of close grained cast iron complying with ASTM A48, Class 35, free from blow holes, sand holes, and all other faults; accurately machined and fitted to close dimensions.
- 2.1.1.2 Impeller Shaft: The pump shaft shall be of sufficient diameter to withstand the maximum allowable combined shear stress under any operating condition at the smallest net diameter. The impeller shaft shall be of Type 416 stainless steel of not less than 12% chrome content and shall be supported by bronze bearings located on both sides of each impeller.
- 2.1.1.3 Impellers: The impellers shall be of the semi-open type and shall be of SAE 63 bronze, of heavy construction, carefully finished all over, accurately fitted and perfectly balanced both mechanically and hydraulically. They shall be locked securely to the impeller shaft with a tapered lock bushing. The bowls and impellers shall be designed with smooth passages to assure efficient operation. The impellers shall be adjustable by means of a nut in the pump head. Long skirts shall be provided to eliminate by passing under any adjustment. Impellers shall be non-overloading and have head characteristics as steep as possible so that an increase or decrease in the operating head will not cause an excessive decrease or increase in pump capacity.
- 2.1.1.4 Suction Bell: The suction bell entrance shall be of close grained cast iron complying with ASTM A48, Class 35. The diameter of the bell shaped entrance shall be at least equal to the maximum pump bowl dimension and of such diameter that the inlet velocity will not exceed 3 feet per second. The opening between the outer edge and the impeller suction eye shall be smooth and continuous.

2.1.2 Column and Shaft:

2.1.2.1 Discharge Column: The discharge column shall be ASTM A53 or ASTM A120, Schedule 40, hot-dip galvanized pipe of sufficient length to set pump a minimum of 20 feet below pumping water level. For bid purposes, use a column length of 52 feet. The column pipe shall be of the diameter and weight indicated in the respective pump data. The pipe shall be furnished in interchangeable sections not over 10 feet in length. The sections shall either have rabbeted flanged connections with bronze or cadmium plated bolts and nuts or be connected with threaded, sleeve—type couplings as indicated in the respective pump data. Provide ANSI B16.12 hot-dip galvanized threaded fitting for threaded pipe.

2.1.2.2 Line Shafting: The line shafting shall be turned, ground, and polished precision shafting of ample size to operate the pump without distortion or vibration. The shafts shall be furnished in interchangeable sections not over 10 feet in length and shall be coupled with extra strong threaded steel couplings machined from solid bar steel capable of transmitting 100% of line shaft strength. The shaft shall be fitted with hardened Type 316 stainless steel journals. The column assembly shall have bronze guides fitted into the coupling and secured in place by the butted pipe ends. Each guide shall contain a water lubricated rubber bearing designed for vertical turbine pump service.

2.1.3 Discharge Head:

- 2.1.3.1 Discharge Head: The discharge head shall be constructed of close grained cast iron, drilled and faced for pump mounting and motor support mounting. The design shall insure maximum rigidity to support the extra weight of the pump. The bottom shall be square machined to match the surface of the bed plate. The discharge head shall be designed to withstand all pressure, strains, and stresses that may be required at design conditions. The discharge outlet shall be of the size indicated in pump data; flanges shall be drilled for 125 pounds ANSI B16.1. Provide 1/4" drilled and tap connections for pressure gauge connection on discharge.
- 2.1.3.2 Coupling: The coupling which connects the line shaft and the motor shaft shall be of the same material as the shaft and shall be either threaded or flanged type. A separate close grained cast iron high ring base shall be provided for suitable two piece tap construction.
- 2.1.3.3 Bed Plates: The pump unit shall be mounted on fabricated steel base or bed plate of sufficient thickness to support the pump without distortion. The plates shall be of the dimensions indicated on the plans or a minimum of 6 inches beyond the pump base whichever is greater and shall be dowelled to the concrete pad by four anchor bolts. The plate shall be leveled using leveling nuts. The plate shall be machined to match the surface of the discharge head. The discharge head shall be bolted to the bed plate by a minimum four anchor bolts.
- 2.1.4 Gear Drive: A heavy duty right angle combination gear drive shall be provided in order to drive the pump with the standby diesel engine. Coordinate with Section 15649, "Diesel Engine". The gear drive shall have continuous thrust capacity suitable for the installation. All gears and bearings shall be of ample size and the drive shall be rated to handle safely and continuously the full output of the standby engine without overheating. The drive shall be equipped with oil reservoir in the housing and an oil pump forcing oil to all gears and all bearings together with an outside marine type oil cooler. The gear ratio of the drive shall be 1 to 1, speed input 1750 RPM and output 1750 RPM. The drive shall be equipped by the manufacturer with a heavy duty and rigid cast iron motor stand to support the electric motor and shall become an integral part of pump head assembly. All accessory parts required for combination drive shall be furnished. The horizontal gear shaft and the engine shaft shall shall be connected through a flexible jointed shaft. This shaft shall

have a sufficient horsepower rating for the service intended. Connecting flanges shall be supplied with the flexible shaft. Provide an OSHA approved shaft guard. Head shaft shall be provided so that either the motor or engine may be removed and the pumping unit be operable. The gear drive as manufactured by Johnson, Amarillo, Fairbanks Morse Company, meets the requirements of this specification.

2.1.5 Motor and Controls:

- 2.1.5.1 The motor shall be built to form an integral part of the pump head assembly. The thrust bearing shall have ample capacity to carry the weight of all the rotating parts plus any unbalanced hydraulic thrust of the pump impeller and have an ample safety factor. The motor shall be of the vertical hollow shaft, squirrel cage, induction type, drip proof. The motor shall be suitable for use on the voltage and starting characteristics indicated in the respective pump data and shall have adequate capacity to drive the pump continuously under the head specified with a safe temperature rise and of not more than 40°C above the ambient temperature at the nameplate rating. Motor shall be equipped with a non-reverse ratchet and built-in space heating elements suitable for operation. Motor horsepower shall be not less than pump horsepower requirements at all points on pump operating curve.
- 2.1.6 Suction Pipe: A suction pipe of same diameter as pump column and 10 feet long shall be provided.
- 2.1.7 Air Release Valve Discharge Piping: Provide a 1-inch diameter deep well type automatic air release valve in discharge piping as indicated. Pipe to outside of building. Use ASTM A53 or ASTM A120, Schedule 40, hot-dip galvanized, threaded end connections; with ANSI B16.12 hot-dip galvanized threaded fittings.
- 2.1.7.1 Air Release Valve: Provide a large orifice type automatic air release valve, cast—iron bodies, with the only moving part being a stainless steel buoy ball. The area throughout the valve body must be equal to full pipe area. The valve must be guaranteed not to stick or leak in a closed position. The valve shall be suitable for operating under a working pressure of 150 pounds per square inch WOG. The valve shall be designed such that when the large orifice is open, the ball remains in the throat area without the possibility of the valve blowing shut or collapsing the ball. The valve shall close when water rises in the valve to lift the ball to the orifice seat.
- 2.1.8 Water Level Indicator: Provide a 3/8-inch soft drawn copper tube from bottom of bowl assembly to well house level. The copper tubing shall be ASTM B88, Type K, with ANSI B16.18 or ANSI B16.22 solder joint fittings using ASTM B32, 50-50 tin-lead solder; or with ANSI B16.26 flared joint fittings. The top of the tubing shall contain an air valve and 4-1/2 inch diameter altitude gage reading in feet of water. The altitude gage shall be ANSI B40.1, single style pressure gage for water with 4.5-inch dial, brass or aluminum case, bronze tube, gage cock, and syphon. Provide scale range suitable for intended service.

2.1.9 Controls: The new well will be controlled automatically by signal generated at water plant. Make connections at the existing control panel terminals.

2.2 SPLIT CASE CENTRIFUGAL PUMP:

- 2.2.1 Pump Construction: Pumps shall meet Mil. Spec. MIL-P-17552D, Type I, General Service, Style 1, horizontal split case, electric motor driven, single suction, and as specified herein.
- 2.2.1.1 Impeller: The impeller shall be single or double suction as required, enclosed, statically, and dynamically balanced of SAE 63 bronze. The impeller is to be secured against rotation on the shaft by means of a key.
- 2.2.1.2 Shaft Assembly: Shafting shall be made from high quality steel of sufficient diameter to carry maximum loads imposed and to prevent vibration and fatigue. The shaft will be accurately machined along its entire length. The shaft is to be reversible to provide for opposite rotation. Maximum diameter shall occur where the shaft passes through the impeller hub. A keyway is to be provided at the coupling end. Renewable type bronze shaft sleeves to protect the shaft through the stuffing box area shall be provided. The shaft sleeves shall also serve to accurately position the impeller on the shaft and within the casing. Sleeve nuts threaded on the shaft will maintain this position by ensuring that the sleeves are firmly butted against the impeller hub. Sufficient rings of packing per stuffing boxes are to be provided along with a split water seal case. Single-row, deep groove ball bearings contained in cartridge type bearing housing are to be pressed on the shaft at the outboard (thrust) and inboard (radial) areas. Bearing housings shall be positioned by means of dowel pins in the lower half casing.
- 2.2.1.3 Casing: Casing shall be of A48 Class 35 cast iron, dowelled, single volute and axially split along the shaft centerline. Suction and discharge flanges are to be cast in the lower half casing. Flanges shall meet ANSI standards for 125 pound rating. Upper and lower casing shall be bolted together along with bearing housing caps and line bored to assure accurate bearing alignment. Bearing brackets are to be machined integral with the lower housing to maintain accurate and permanent shaft alignment. The upper half casing is to be tapped at the stuffing box area to provide for sealing fluid. The lower half casing shall be provided with drain holes.
- 2.2.1.3.1 Split glands with swing bolts shall be provided as a packing retainer in the stuffing boxes.
- 2.2.1.3.2 Casing to be designed to allow for complete removal of the shaft assembly without disturbing piping or driver mounting.
- 2.2.1.3.3 Pump mounting feet are to be cast integrally into the lower half casing.

- 2.2.1.3.4 Suction and discharge gauge connection shall be provided on the nozzles. A tap at the high point of the upper half casing to be provided to serve as an air release or volute priming connection.
- 2.2.1.4 Wearing Rings: Wearing rings of the annular type, designed to minimize casing recirculation, are to be provided for both impeller and casing. Wearing rings shall be locked against rotation. Impeller wear rings shall be of bronze. Casing wear rings shall be of cast iron.
- 2.2.1.5 Baseplate, Coupling, and Guard: A fabricated structural steel base for pump and driver shall be provided. The base shall be designed to resist torsional movement and support the combined weight of both pump and driver without deflection while at rest or under load. After alignment, the base shall be grouted in using openings provided in its top. A flexible coupling shall be supplied. An open type coupling guard bolted to the base shall be provided.

2.2.2 Electric Drive Motor:

- 2.2.2.1 The electric drive motor shall be solid shaft, squirrel cage, induction—type open drip proof. Motor horsepower shall be such to provide ample power to drive the unit to operate over the entire operating curve without overloading. Motors shall be no less than the motor horse—power indicated. Connection between the pump and drive motor shall be by flexible coupling.
- 2.2.3 Controls: The filter pumps are controlled automatically by signal of low water in the existing clear well. Make connection at the existing control panel terminals.

PART 3 - EXECUTION

3.1 INSTALLATION:

- 3.1.1 Pumps shall be mounted on bases as indicated on the drawings, plumbed and leveled, and firmly grouted in place with a non-shrink grout.
- 3.1.2 Pressure and vacuum gages shall be mounted as indicated on the darwings on the suction and discharge piping as required for each of the respective pump installations. The gage face shall be 4-1/2 inch in diameter and graduated in feet of water.
- 3.1.3 Air release piping shall be provided where indicated on the drawings, suitably connected to the top of the volute and discharging to the drain.
- 3.2 START-UP SERVICES: The services of a factory representative of the equipment manufacturer shall be provided to check the equipment after installation and to supervise initial start-up. A minimum of two separate trips to the plant site will be required, each consisting of a minimum of one 8-hour working day.

- 3.3 PAINTING: The surface preparation and painting shall be in accordance with Section 09910, "Painting" of these specifications. The equipment shall be delivered to the job site with the shop coat primer applied.
- 3.4 NAMEPLATES: Provide laminated plastic nameplates for equipment, gages, thermometers, and valves; stop valves in supplies to fixtures will not require nameplates. Laminated plastic shall be 0.125 inch thick Melamine plastic conforming to Fed. Spec. L-P-387, black with white center core. Surface shall be a matte finish. All corners shall be square. Accurately align lettering and engrave into the white core. Minimum size of nameplates shall be one inch by 2.5 inches. Lettering shall be minimum of 0.25-inch high normal block lettering. Key the nameplates to a chart and schedule for each system. Frame charts and schedules under glass and place where directed near each system. Furnish two copies of each chart and schedule. Each inscription shall identify its function. Equipment nameplates shall show the following information:
 - a. Manufacturer, type, and model number
 - b. Contract number and accepted date
 - c. Capacity or size
 - d. System in which installed
 - e. System which it controls
- 3.5 FLUSHING: Flush all new pump suction and discharge piping at 150 percent of rated pump capacity. Where the pump installation involves more than one pump, the flushing volume shall be the total quantity of water flowing when all pumps are discharging at 150 percent of their rated capacities. The new pumps may be used to attain the required flushing volume. Continue flushing operations until water is clear, but for not less than 10 minutes. Submit a signed and dated flushing certificate with a request for field testing.
 - 3.6 TEST:
- 3.6.1 Manufacturer's certified performance test shall be performed on each pump in accordance with AWWA Standard E101-77.
- 3.6.2 Field Testing: Hydrostatically test each piping system at 200 psig for a period of 2 hours. Perform tests on pumps, drivers, and equipment, including visual equipment checks to insure compliance with approved shop drawings; pump start—run to insure proper operation and to detect any leakage of piping, valves, and fittings; sequence of operation check; verification that all required pump accessories have been provided; and additional inspections and tests necessary to insure that the entire pump installation is correct, complete, and ready for operation.

*** END OF SECTION ***

SECTION 11233

WATER SOFTENERS

PART 1 - GENERAL

- 1.1 APPLICABLE PUBLICATIONS: 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.
 - 1.1.1 American Water Works Association (AWWA) Publication:

C 601-81	Disinfecting Water Mains
C 701-78	Cold-Water Meters, Turbine Type for Customer Service
D 102-78	Painting Steel Water Storage Tanks

1.1.2 American Society of Mechanical Engineers (ASME) Publication:

1980 Boiler and Pressure Vessel Codes & Am 1980

1.1.3 American Society for Testing and Materials (ASTM) Publication:

A 123–78	Zinc (Hot-Galvanized) Coatings on Products
	Fabricated from Rolled, Pressed, and Forged
	Steel Shapes, Plates, Bars, and Strip
B 43-78	Seamless Red Brass Pine Standard Size

B 43-78 Seamless Red Brass Pipe Standard Size

D 1785-76 Polyvinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 180

D 2467-74 Socket-Type Polyvinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80

1.1.4 Military Specification (Mil. Spec.):

MIL-W-17121E Water Softener Unit, Zeolite Pressure Type

1.2 GENERAL REQUIREMENTS: Section 15011, "General Requirements, Mechanical" applies. Related sections include Section 11240, "Pressure Water Filters", Section 15271, "In-Plant Piping and Accessories", and Section 02050, "Demolition and Removal". The Contractor shall provide all systems complete and ready for operation. All incidental piping, controls, and accessories required for complete operating systems shall be at the expense of the Contractor. Provide all control wiring and accessories in accordance with NFPA 70.

- 1.3 DESCRIPTION: The work under this section includes the following:
- 1.3.1 The provision of four 5'-0" diameter ion exchange softeners including totalizers, motor operated multiport valve, regeneration controller, brine tank, and brine pumps. The following data is applicable:
 - a. Number of Softener Units 4
 - b. Diameter of Softener Shell 60 inches
 - c. Straight Side Height 72 inches (minimum)
 - d. Design Operating Pressure 20 psig at tank inlet
 - e. Raw Water Hardness as CaCO3 200 ppm
 - f. Finished Water Hardness as CaCO₃ 50 ppm (combined)
 - g. Resin Exchange Value see specs below
 - h. Resin Volume per unit 49 cu.ft.
 - i. Maximum Pressure Drop 8 psi
 - j. Normal Flow Rate Each Unit 102 GPM
 - k. Maximum Flow Rate Each Unit 136 GPM
- 1.3.2 The system shall have a softening capacity of not less than 75,000 gallons between regenerations at a salting rate of 6 pounds per cubic foot.
- 1.3.3 The demolition of the existing two softeners, brine tank, and brine pumps.
- 1.4 SCHEDULING: Schedule work such that the plant will remain in operation during construction. Obtain approval of Contracting Officer 48 hours prior to removing units from service. Construction schedule shall clearly indicate work requiring scheduling down time.

1.5 SUBMITTALS:

1.5.1 Shop Drawings: Submit shop drawings showing details of the softeners. Show elevations and sections of complete installation. Indicate construction areas which will require plant down time. Drawings shall show both the existing systems as well as the new systems. Indicate all material types, fittings, valves, and other accessories on the drawings.

1.5.2 Manufacturer's Data:

- 1.5.2.1 Submit manufacturer's installation instructions for the water softeners, including final connections into the softeners.
 - a. Brine pumps
 - b. Brine tank
 - c. Regeneration controller
 - d. Motor operated multiport valve
 - e. Softener controls
 - f. Softeners
 - g. Accessories

- 1.5.3 Manufacturer's Certified Reports:
 - a. Pressure vessels
 - b. Pumps, drivers, and controllers
 - c. Resin exchange capacity
 - d. Painting system
- 1.5.4 Operation and Maintenance Manual: Furnish equipment operation and maintenance manual as specified in Section 15011, "Mechanical General Requirements".
- 1.5.5 All submittals as specified herein shall be approved by the Contracting Officer.
- PART 2 PRODUCTS: The water softeners and accessories shall conform to Mil. Spec. MIL-W-17121 and the requirements specified herein.
- 2.1 SOFTENER VESSELS: The softener vessel shall be constructed of tank quality carbon steel with dished heads. The shells shall be of welded construction and fitted with reinforced openings for piping connections, resin cleanout connection, and manhole in top head. Sufficient free-board above the ion exchanger bed shall be provided to allow for full and free expansion, minimum 75%, of the ion exchanger. Shell supports shall be of screw-jack leg type. The softener shells shall be protected on the outside with rust-preventive paint before shipment. The vessels shall be ASME Code tested to withstand a hydrostatic pressure of 50% in excess of the working pressure of 100 psig.
- 2.2 UNDERDRAIN SYSTEM: The underdrain system shall consist of a dished and spacing false bottom with strainers. Strainers and fastenings for the strainer assemblies are to be Type 316 stainless steel with Type 316 stainless steel T-bolts for maximum corrosion resistance and shall be a minimum of 3-1/2 inches in diameter. Strainer assemblies shall be designed to retain ion exchanger without the use of supporting beds.
- 2.3 BRINE DISTRIBUTION: The brine distribution system shall be an internal system designed to uniformly distribute the brine over the entire ion exchanger bed. Internal brine piping shall be red brass, ASTM B 43, regular weight.
- 2.4 RAW WATER DISTRIBUTION: The raw water distribution system shall be an internal system designed to uniformly distribute the raw water over the entire ion exchanger bed. Internal distribution piping shall be red brass, ASTM B 43, regular weight.
- 2.5 BACKWASH COLLECTOR: The backwash collector system shall be designed to provide for proper backwashing without the loss of resin and shall be of the plastic disc type. The distance from the surface of the bed to the wash water collector (freeboard) shall be not less than 75% of the depth of the resin bed.

2.6 OPERATING VALVES AND PIPING:

- 2.6.1 Each softener shall be equipped with one automatic multiport valve to control all service, wash, brine, and rinse steps. The valve shall have a rotating disc and stationary port plate. The valve gear reduction shall be such as to permit easy manual operation of the valve with a single, simple crank. For automatic operation as specified, the valve rotating disc shall be driven through the gear train by a fractional H. P. 120 V motor. The valve shall be manufactured by the same manufacturer as the softener.
- 2.6.2 Gate valves shall be provided as shown on the drawings. These valves and piping shall meet the requirements of Section 15271, "Inplant Piping".

2.7 ION EXCHANGE RESIN:

- 2.7.1 The ion exchange material shall be high capacity styrene vinyl-benzene containing sulfonic acid groups cation exchange resin with an effective size of 0.45-0.60 millimeters and a uniformity coefficient not greater than 1.8. The resin shall have a capacity rating of 18 kilograins per cubic foot at a salt dosage of 6 pounds per cubic foot and a capacity rating of 30 kilograins per cubic foot at a salt dosage of 15 pounds per cubic foot. The resin shall be steamed for potable use.
- 2.7.2 Each softener tank shall be provided with 49 cubic feet of ion exchange resin.
- 2.7.3 The loss of ion exchange resin due to attrition shall not exceed 3% per year for a period of three years.

2.8 SOFTENER ACCESSORIES: Accessories shall include:

- a. One pressure gauge each softener influent and effluent. Gauges shall be 4-1/2 inch minimum size and shall read in psi, ANSI B40.1, single style pressure gage for water, brass or aluminum case, bronze tube, gage cock, pressure snubber, and syphon. Provide scale range suitable for intended service.
- b. Two sample cock connections for softener influent and softener effluent.
- c. Impact tube flow rate indicators having a maximum indicated capacity of 150 GPM of water. The flow rate indicator shall be equipped with an integral shut-off valve so that flow is indicated only when desired. The glass tubes and the orifice shall be readily removable from the body for cleaning without dewatering the pipeline.
- d. One automatic air relief valve shall be located in the top of the tank or top inlet piping in order to automatically

release entrapped air. The discharge from the air release valve shall be piped to a drain.

- e. One AWWA C701 turbine type water meter with batch totalizer and indicator of the same size as the softener influent piping each softener. Each meter shall be equipped with an automatic reset register. Integrate with control system.
- 2.9 CONTROLS: On reaching the predetermined through put, the "regeneration required" light on the control panel specified in Section 11240, "Pressure Water Filter" will annunciate. If filters are not being backwashed or another softener regenerating, then the softener will automatically regenerate. The red regeneration light will then annunciate on the control panel. If filters are being backwashed or another softener regenerating, then the softener will continue softening (remain on hold). The yallow "hold" light will annunciate this condition.

2.10 BRINE MEASURING TANK:

- 2.10.1 The brine measuring tank shall be a 54 inch diameter \times 48 inch high tank of galvanized steel in accordance with ASTM A 123 construction specially designed for the use intended.
- 2.10.2 The tank shall be provided with a brine level gage to indicate the amount of brine available for regeneration.
- 2.10.3 The tank shall be provided with an automatic float switch which will autuate the brine pumps at preset levels for pump on and pump off to refill the brine tank.
- 2.10.4 Hydraulic ejectors of brass or bronze construction shall be furnished in correct size to draw the saturated brine from brine measuring tank and apply it to the resin in proper concentration and at proper flow rate. All necessary piping for brine lines is to be included.
- 2.10.5 Brine piping shall be Schedule 80 polyvinyl chlorine meeting ASTM D 1785 and ASTM D 2467 Schedule 80 fittings. Brine valves, including check valves, shall be of brass or bronze construction.

2.11 BRINE FEED PUMPS:

- 2.11.1 Provide two new brine transfer pumps to replace the existing. The new pumps shall be capable of pumping 10 GPM at 25 feet, 1 HP. Pump body shall be cast iron with bronze impeller. The motor shall be 1/3 HP, non-overloading capable of operating on 120 V, 1 phase at a speed not greater than 1800 RPM.
- 2.11.2 The pumps shall be controlled automatically by the level switch located in the brine tank. Pumps shall be mechanically alternated after each operating cycle.

PART 3 - EXECUTION

3.1 INSTALLATION: All equipment shall be installed in accordance with the manufacturer's instructions.

3.2 PAINTING:

- 3.2.1 Shop Paint: The softeners shall be cleaned to SSPC 10 on interior and shop painted with two coats (10 mil total thickness) in accordance with AWWA D102-78 inside paint system No. 1. The exterior shall be cleaned to remove loose mill scale and rust and prime coated compatible with finish coat.
- 3.2.2 Field Paint: Touch up all scratches on interior of the softeners to conform to paragraph 3.2.1 above. Paint exterior as specified in Section 09910, "Painting of Buildings".
- 3.3 STERILIZATION: All piping in contact with finished water, including water softener prior to installation of resin, shall be sterilized in accordance with AWWA C601 standards. After completion of the work and prior to sterilization, all work shall be thoroughly cleaned of all loose particles of cement, mud, and other debris. After completion of the sterilization, make bacteriological tests of the water. If the results are satisfactory, the sterilization will be considered complete. If not, sterilize the system again until satisfactory bacteriological results are obtained.
- 3.4 SERVICE: The Contractor shall provide the services of a representative of the softening equipment manufacturer for not less than three days in two trips to supervise the installation and initial start-up and instruct operating personnel in the proper maintenance and operation of the equipment.

3.5 TESTING:

- 3.5.1 Performance Test: Each unit, after being put into operation, shall be tested by the service representative to determine conformance with this specification. With a raw water analysis of approximately that specified in the procurement documents, the effluent analysis shall fall within the limits specified in the procurement documents.
- 3.5.2 Operating Tests: Before the test is started, each softener shall be run to exhaustion and then regenerated to full capacity in accordance with manufacturer's instructions. The softener shall be put through two complete cycles at the actual demand rate for working test. During the capacity tests, the softened water will be sent to the sewer, if necessary, to maintain the required flow rate. After each run, the unit shall be regenerated with use of salt brine delivered from the measuring tank in the amount called for by the operating instructions. At the end of the brine rinse and beginning of production of softened water, a 1/2-pint sample of softened water shall be taken every 15 minutes and used to make up a complete sample. From each test run composite sample, a 1 quart

sample shall be taken which shall be tested, and the result of the test shall fall within the limits specified in the procurement documents.

3.5.3 Color and Turbidity: Under actual operating conditions, the exchange material shall not be washed out of the apparatus and turbidity, and color of the softened water shall not exceed the turbidity and color of the hard water. During any softening run, slugs of dirty or turbid water shall not be delivered regardless of the change of demand rate up to the maximum on the apparatus. During a run, the sampling petcock shall remain open, allowing a stream of treated water to be collected in a widemouth bottle set against a white background, so that the color and turbidity may be under observation at all times. If the turbidity and color of the treated water exceeds the turbidity and color of the untreated water, the Government reserves the right to reject the equipment in its entirety and required installation of other equipment that will meet the specification requirements.

*** END OF SECTION ***

SECTION 11240

PRESSURE WATER FILTERS

PART 1 - GENERAL

1.1 APPLICABLE PUBLICATIONS: 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.

1.1.1 American Water Works Association (AWWA) Publications:

B100-72 Filtering Material
C504-80 Rubber Seated Butterfly Valves
C601-81 Disinfecting Water Mains
D102-78 Painting Steel Water Storage Tanks

1.1.2 American Society of Mechanical Engineers (ASME) Publication:

1980 Boiler and Pressure Vessel Code & Am 1980

- 1.2 GENERAL REQUIREMENTS: Section 15011, "General Requirements, Mechanical" applies. Related sections include Section 11233, "Water Softeners" and Section 15271, "In-Plant Piping and Accessories". The Contractor shall provide all systems complete and ready for operation. All incidental piping, controls, and accessories required for complete operating systems shall be at the expense of the Contractor. Provide all control wiring and accessories in accordance with NFPA 70.
- 1.3 DESCRIPTION: The work under this section includes the following:
- 1.3.1 The provision of six 7.5-foot diameter pressure filters and semi-automatic backwash controls and valves as indicated on the drawings. The operating characteristics of the filters are as follows:
 - a. Number of Units 6
 - b. Size of Unit 7.5-foot diameter x 4-foot straight sidewall
 - c. Surface Filtration Rate (Nominal) 2.05 gpm/sq.ft.
 - d. Filter Media (Dual) 12-inch anthracite, 18-inch sand
 - e. Terminal Pressure Differential 12-15 psi
 - f. Backwash Rate 10-12 gpm/sq.ft.
- 1.3.2 The demolition of three existing pressure filters indicated on the drawings. Reference Section 02050, "Demolition and Removal".
- 1.3.3 The new equipment shall include filter vessels, underdrains, filter media operating valves, and miscellaneous accessories.

1.4 SCHEDULING: Schedule work such that the plant will remain in operation, producing water, during construction. Submit schedule of work to Contracting Officer for approval. Schedule should clearly indicate scheduled down times required in connection with the filter installation. Down times shall not be greater than four hours during the normal work day. Notify Contracting Officer in writing 48 hours prior to requiring down time. Approval must be obtained on each occurrence.

1.5 SUBMITTALS:

1.5.1 Shop Drawings: Submit shop drawings showing details of the filters. Show elevations and sections of complete installation. Indicate construction areas which will require plant down time. Drawings shall show both the existing systems as well as the new systems. Indicate all material types, fittings, valves, and other accessories on the drawings.

1.5.2 Manufacturer's Data:

- 1.5.2.1 Submit manufacturer's installation instructions for the pressure water filters, including final connections into the filters.
 - a. Motor operated multiport valves
 - b. Automatic valve operators
 - c. Controls
 - d. Pressure filters
 - 1.5.3 Manufacturer's Certified Reports:
 - a. Pressure vessels
 - b. Filter media
- 1.5.4 Operation and Maintenance Manual: Furnish equipment operation and maintenance manual as specified in Section 15011, "Mechanical General Requirements".
- 1.5.5 All submittals as specified herein shall be approved by the Contracting Officer.

PART 2 - PRODUCTS

- 2.1 FILTER VESSELS: Tanks shall be of welded steel construction with flanged outlet and inlet as indicated and dished heads to a radius equal to the diameter of the tank. The vessels shall be ASME Code tested to withstand a hydrostatic pressure of 50% in excess of the working pressure of 100 psig. Each tank shall be equipped with a 12" x 16" access manhole located on the top. The tank shall be supported by six adjustable jack legs.
- 2.2 FILTER UNDERDRAIN: The underdrain system shall provide for uniform collection of filtered water and distribution of backwash water. The underdrain system shall be the double dish type complete with 3-1/2 inch diameter Type 316 stainless steel strainers equally spaced across the

bottom. The dish shall be filled with a clean durable pea gravel support for the filter media.

- 2.3 FILTER MEDIA: The filter media shall consist of a dual bed consisting of 12 inches of anthracite and 18 inches of filter sand. The media shall meet the physical characteristic requirements of AWWA B100. The anthracite shall have an effective size of 0.65 to 0.76 mm and a uniformity coefficient of 1.85 maximum. The sand shall have an effective size of 0.45 to 0.6 mm and a uniformity coefficient of 1.60 maximum. Both media shall be shipped to the job site in unbroken bags and shall be clean and free of extraneous matter.
- 2.4 AUTOMATIC VALVES: Each filter shall be provided with one automatic filter inlet valve and one wash outlet valve in addition to the manual isolation valves. The filtered water header shall be fitted with one automatic valve. The automatic valves provided shall be iron bodied butterfly valves meeting the requirements of AWWA C504 for both valve and operator. Valve ends shall be flanged and drilled for 125 pound ANSI. Valves must use full AWWA 504, Class 150B single or double flange wafer type.
 - 2.4.1 Valve Materials:
 - a. Body: Cast iron
 - b. Seat: 18-8 stainless steel to rubber
 - c. Shaft: Stainless steel
 - d. Disc: High strength cast or ductile iron
- 2.4.2 Operator: Pneumatic cylinder operated at 15 psi. Operation control by 120 volt, 12.3 watt solenoid valve mounted to cylinder operator.
- 2.5 ACCESSORIES: Provide the following accessories with each tank located as indicated on the drawings.
 - a. Impact type flow indicator 0-150 qpm
 - b. Sample cocks and drains where indicated
 - c. Automatic air release valve, discharge to drain
 - d. Pressure gages 0-50 psi, 4-1/2 inch diameter face, ANSI B40.1, single style pressure gage for water, brass or aluminum case, bronze tube, gage cock, pressure snubber, and syphon
- 2.6 CONTROLS: Provide a complete semi-automatic backwash control system integrated with the softener controls as indicated on the drawings. The system shall operate on 120 V power and shall be NEMA 1 enclosure.
- 2.6.1 Filter Mode: Each filter status shall be displayed as indicated. The yellow light indicating the preset time for filtering has lapsed and that filter requires backwashing. The green light indicates filtering status. The yellow light will show and alarm sound when time is lapsed and the filter is filtering. The red light indicates that filter is backwashing or off line. The timers are 0-99.00 hr. lapsed timers with manual reset.

- 2.6.2 Backwash Mode: The controls shall be designed to allow for either manual or semi-automatic backwash sequencing as indicated on the drawings. In the manual mode, the operator would manually control the valves or the filter selected for backwash to step the filter through backwash. In semi-automatic mode, the operator would be required to initiate the backwash sequence. The backwash would proceed automatically in the steps indicated on the drawings. The sequencer shall be a mechanical step timer located within the control panel.
- 2.6.3 Softener Annunciation: The softener status shall be displayed on the control panel as indicated. The green light shall indicate softening. The red light shall indicate regeneration of the softener. The yellow light and alarm sound shall indicate the softener requires regeneration but in hold position until the unit regenerating is placed back on line. The softeners shall also be interlocked to prevent regeneration while the filters are being backwashed.

PART 3 - EXECUTION

- 3.1 FILTERS: Install filters as directed by manufacturer.
- 3.2 PAINTING:
- 3.2.1 Shop Paint: The filters shall be cleaned to SSPC 10 on interior and shop painted with two coats (10 mil total thickness) in accordance with AWWA D102-78 inside paint system No. 1. The exterior shall be cleaned to remove loose mill scale and rust and prime coated compatible with finish coat.
- 3.2.2 Field Paint: Touch up all scratches on interior of the filters to conform to paragraph 3.2.1 above. Paint exterior as specified in Section 09910, "Painting of Buildings".
- 3.3 STERILIZATION: After completion of the work and prior to sterilization, all work shall be thoroughly cleaned of all loose particles of cement, mud, and other debris. The sterilization process shall conform to AWWA C601 and consist of filling the pipe or filter with treated water to which chlorine is added to bring the concentration to not less than 50 ppm after 24 hours. At the end of the 24-hour period, the pipe or filter is drained and then refilled with treated water. The water shall then be bacteriologically tested and if found satisfactory, the sterilization process is considered complete. If the water does not test satisfactorily, the process is repeated until a satisfactory test is obtained. The Government will furnish the water for sterilization and make the bacteriological tests of the water. The Contractor shall furnish the chlorine and all labor, equipment, materials, and supervision required.
- 3.4 START-UP SERVICES: Provide the services of a manufacturer's field representative for a period of two 8-hour days to assist in the initial operation of the system.

*** END OF SECTION ***

SECTION 11310

SEWAGE PUMPS

PART 1 - GENERAL

- 1.1 APPLICABLE PUBLICATIONS: 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.
 - 1.1.1 American Society for Testing and Materials (ASTM) Publication:

A 48-76 Gray Iron Castings

1.1.2 American National Standards Institute (ANSI) Publication:

A21.10 Cast Iron Fittings 2 inches through 48 inches for (1971) Water and Other Liquids

1.1.3 American Water Works Association (AWWA) Publication:

E100 Pumps

1.1.4 National Electrical Manufacturers Association (NEMA):

ICS 2-78 Industrial Control Devices, Controllers and (Rev 2-80) Assemblies

MGI-78 Motors and Generators

- 1.2 DESCRIPTION: The Contractor shall provide complete the pumps, motors, and pump controls as indicated on the drawings and/or as specified herein. The Contractor shall provide all systems complete and ready for operation. All incidental piping, controls, and accessories required for complete operating systems shall be at the expense of the Contractor. Provide all control wiring and accessories in accordance with NFPA 70. Work specified under this section includes, but is not limited to, the following:
 - 1.2.1 Courthouse Bay Lift Station Pumps (Building BB-1):
 - 1.2.1.1 Pumps and motors shall be as follows:
 - Type Vertical non-clog centrifugal with flooded suction (2 required)
 - b. Capacity 625 gpm
 - c. Total Dynamic Head 72 feet
 - d. Minimum Pump Efficiency 69%
 - e. Minimum Motor Horsepower 25 HP
 - f. Minimum Allowable Shut-Off Head 95 feet
 - g. Minimum Sphere Size 3 inches

- h. Impeller Type Non-clog 2 vanes
- i. Suction Flange Diameter 6 inches
- j. Discharge Flange Diameter 4 inches
- . Pump and Motor Speed 1750 rpm
- 1. Motor Operating Current 240 V, 3 phase, 60 Hz

1.2.1.2 Controls shall include but not be limited to the following:

- a. Air Bubbler Type Liquid Level Control System
- b. Pump Mode Selection Switches
- c. Air Pump Alternator, Automatic
- d. Thermal Magnetic Air Circuit Breaker for Control Systems
- e. High Wet Well Level Alarm
- f. Low Wet Well Level Alarm and Shut-Down
- g. Failure to Pump Shut-Down
- h. High Pump Temperature Shut-Down
- i. Pilot Lights and Elapsed Time Meters
- j. Starters and Overload Protection for Each Pump

1.2.2 Trickling Filter Lift Pumps:

1.2.2.1 Pumps and motors shall be as follows:

- a. Type Two speed suction lift centrifugal, L = low speed condition, H = high speed condition (three required)
- b. Capacity 1 at 75 (L)/150 (H) gpm, 2 and 3 at 200 (L)/400 (H) gpm
- c. Total Dynamic Head 1 at 12.5' (L)/15' (H) TDH, 2 and 3 at 13' (L)/17' (H) TDH
- d. Suction Lift Capacity 10 feet
- e. Minimum Pump Efficiency 1 at 47% (H), 2 and 3 at 53% (H)
- f. Minimum Motor Horsepower 1 at 2 HP, 2 and 3 at 5 HP
- g. Minimum Allowable Shut-Off Head 1 at 22 feet, 2 and 3 at 30 feet
- h. Minimum Sphere Size 1 at 2-1/2", 2 and 3 at 3"
- Suction Flange Diameter 1 at 3", 2 and 3 at 4"
- j. Discharge Flange Diameter 1 at 3", 2 and 3 at 4"
- k. High Pump Speed 1 at 950 (H) RPM, 2 and 3 at 1050 (H) RPM
- Low Pump Speed as needed to meet conditions
- m. Motor Operating Current 480 V, 3 phase, 60 Hz

1.2.2.2 Controls shall include but not be limited to the following:

- a. Mercoid Switch on Rocker Arm with Float and Weight Wet Well Level Sensor (8 rockers required)
- b. Pump Mode Selection Switch
- c. Thermal Magnetic Air Circuit Breaker for Control Systems
- d. High Wet Well Level Alarm
- e. Low Wet Well Level Alarm and Shut-Down
- f. High Pump Temperature Shut-Down
- g. Pilot Lights and Elapsed Time Meters
- h. Starters and Overload Protection for Each Pump

- 1.2.3 Secondary Clarifier Sludge Recirculation Pumps:
- 1.2.3.1 Pumps and motors shall be as follows:
 - a. Type Two speed suction lift centrifugal, L = low speed condition, H = high speed condition (two pumps required)
 - b. Capacity 100 (L)/200 (H) gpm
 - c. Total Dynamic Head 10 (L)/14 (H) feet
 - d. Suction Lift Capability 10 feet
 - e. Minimum Pump Efficiency 46%
 - f. Minimum Motor Horsepower 2 HP
 - g. Minimum Allowable Shut-Off Head 20 feet
 - h. Minimum Sphere Size 2-1/2 inch
 - i. Suction Flange Diameter 3 inch
 - j. Discharge Flange Diameter 3 inch
 - k. High Pump Speed 850 RPM (maximum)
 - 1. Low Pump Speed as needed to meet conditions
 - m. Motor Operating Current 480 V, 3 phase, 60 Hz
- 1.2.3.2 Controls shall include but not be limited to the following:
 - a. Pump "ON-OFF" Switch, Each Pump
 - b. Pump "HI-LOW" Speed Selector Switch, Each Pump
 - c. Thermal Magnetic Air Circuit Breaker for Control Systems
 - d. Low Wet Well Level Alarm and Shut-Down
 - e. High Pump Temperature Shut-Down
 - f. Pilot Lights and Elapsed Time Meters
 - g. High Water Level Shut-Down via Float in Aerobic Digester No. 1
 - h. Starters and Overload Protection for Each Pump
- 1.2.4 Waste Sludge Pumps:
- 1.2.4.1 Pumps and motors shall be as follows:
 - a. Type Suction lift centrifugal (two pumps required)
 - b. Capacity 200 gpm
 - c. Total Dynamic Head 4 feet
 - d. Suction Lift Capability 10 feet
 - e. Minimum Pump Efficiency 40%
 - f. Minimum Motor Horsepower 1 HP
 - g. Minimum Allowable Shut-Off Head 11 feet
 - h. Minimum Sphere Size 2-1/2 inch
 - i. Suction Flange Diameter 3 inch
 - j. Discharge Flange Diameter 3 inch
 - k. Pump Speed 650 RPM (maximum)
 - 1. Motor Operating Current 480 V, 3 phase, 60 Hz

- 1.2.4.2 Controls shall include but not be limited to the following:
 - a. Automatic Timer Controls
 - b. Pump Mode Selection Switch
 - c. Thermal Magnetic Air Circuit Breaker for Control Systems
 - d. High Pump Temperature Shut-Down
 - e. Pilot Lights and Elapsed Time Meters
 - f. Starters and Overload Protection for Each Pump
- 1.2.5 Primary Clarifier Scum Pumps:
- 1.2.5.1 Pumps and motors shall be as follows:
 - Type Centrifugal non-clog, reversible, submersible grinder pumps suitable for primary clarifier scum (two pumps required)
 - b. Capacity 50 gpm at 14 ft. TDH
 - c. Minimum Allowable Shutoff Head 80 feet
 - d. Motor HP 2 HP (non-overloading throughout pump operating range)
 - e. Cutter Blade Hardness 550 Brinell (minimum)
 - f. Impeller non-clogging type
 - g. Discharge Piping 2 inch
 - h. Operating Voltage 480 V, 3 phase, 60 cycle
- 1.2.5.2 Controls shall include but not be limited to the following:
 - a. Float Type Liquid Level Control System (4 required)
 - b. Pump Mode Selection Switch
 - c. Thermal Magnetic Air Circuit Breaker for Control Systems
 - d. High Wet Well Level Alarm
 - e. Low Wet Well Level Alarm and Shut-Down
 - f. Pilot Lights and Elapsed Time Meters
 - g. Pump Alternator and Alternator Override
 - h. Pump Rotation Reversing Switch
 - i. Starters and Overload Protection for Each Pump
- 1.2.6 Aerobic Digester Supernatant Pumps:
- 1.2.6.1 Pumps and motors shall be as follows:
 - Type Centrifugal non-clog submersible (two pumps required, one as a standby)
 - b. Capacity 50 gpm at 12 ft. TDH
 - c. Minimum Allowable Shutoff Head 80 feet
 - d. Motor HP 1/2 HP (non-overloading throughout pump operating range)
 - e. Impeller non-clogging type
 - f. Discharge Piping 2 inch
 - g. Operating Voltage 480 V, 3 phase, 60 cycle
 - h. One pump to be installed; the other to be stored for standby use
 - i. Minimum Sphere Size=2 inch

- 1.2.6.2 Controls shall include but not be limited to the following:
 - a. Manual Stop-Start Switch with 0-4 hour Adjustable Timer to Stop Pump Automatically
 - b. Low Water Shut-Down
 - c. Thermal Magnetic Air Circuit Breaker for Control System
 - d. Pilot Light and Elapsed Time Meter
 - e. Starters and Overload Protection for Each Pump
- 1.2.7 Electrical Motors, Controllers, Contactors, and Disconnects: Furnish motors, controllers, contactors, and disconnects with their respective pieces of equipment. Motors, controllers, contactors, and disconnects shall conform to and shall have electrical connections provided under Section 16402, "Interior Wiring Systems". Controllers and contactors shall have a maximum of 120 volt control circuits and auxiliary contacts for use with the controls furnished. When motors and equipment furnished are larger than sizes indicated, the cost of providing additional electrical service and related work shall be included under this section.
- 1.3 GENERAL REQUIREMENTS: Section 15011, "General Requirements, Mechanical" applies to this section. Post operation and maintenance instructions with each unit. Refer to Section 02050, "Demolition Removal" for additional requirements.
- 1.4 SUBMITTALS: Partial submittals will not be acceptable. Annotate descriptive data to show the specific model, type, and size of each item the Contractor proposes to furnish. Prepare shop drawings on sheets not smaller than 30 inches by 42 inches and include data essential to the proper installation of each system. Do not commence work until the design of each system and the various components have been approved. The submittal requirements of Section 15011, "General Requirements, Mechanical" applies to the following lists. Items in the following lists (which are followed by (CO)) shall be approved by the Contracting Officer.
 - 1.4.1 Manufacturer's Data:
 - a. Pumps, drivers, and controllers (CO)
 - b. Pipe and fittings, and couplings (CO)
 - c. Valves including gate, check, and relief valves (CO)
 - d. Gages (CO)
 - e. Devices and associated equipment (CO)
 - f. Suction bell and shaft for vertical turbine pump (CO)
 - 1.4.2 Shop Drawings:
 - a. Pumps, drivers, and controllers (CO)
 - 1.4.3 Certificates of Compliance:
 - Pumps, drivers, and controllers including subbase plate assembly required (CO)

- b. Pipe and fittings, and couplings (CO)
- c. Valves (CO)
- d. Devices and associated equipment (CO)

1.4.4 Certified Data:

- a. Manufacturer's pump discharge curves (CO)
- 1.4.5 Operation and Maintenance Manuals:
 - a. Pumps, drivers, and controllers
 - b. Spare parts catalog (CO)
- 1.4.6 Posted Operating Instructions:
 - a. Pumps, drivers, and controllers
- 1.5 EQUIPMENT STORAGE: The Contractor shall provide on-site protection and storage as recommended by the manufacturer unless otherwise prearranged with the Contracting Officer.

PART 2 - PRODUCTS

- 2.1 PUMPS AND MOTORS:
- 2.1.1 Vertical Non-Clog Centrifugal Pumps:
- 2.1.1.1 General: Pumps shall be of the vertical, non-clog, centrifugal type specifically designed for handling raw sewage. Openings and passages of the pump shall be large enough to permit the passage of the specified sphere diameter and typical trash or stringy material associated with the intended use.
- 2.1.1.2 Impeller: The impeller shall be of one piece, single suction, enclosed, radial flow-design, constructed of close grained cast iron complying with ASTM A48, Class 35, radial flow design. The impeller is to be statically and dynamically balanced and secured to a straight fit on the shaft by means of a key and locknut with setscrew. Wiper vanes are not allowed. The impeller waterways and clearance between the impeller periphery and volute cutwater shall be capable of passing a sphere of the size indicated in the pump data.
- 2.1.1.3 Volute: The volute shall be of one piece design with bottom suction and side tangential discharge, constructed of close grained cast iron complying with ASTM A48, Class 35. Volute cleanout, prime, drain flush and gauge connections shall be provided. Volute will allow for back pull out and rotation in 45° increments to accommodate piping orientation independent of base location. Discharge flanges shall be 125 pound per ANSI Standard A21.10.

- 2.1.1.4 Base and Elbow: A rugged heavy duty base of close grained cast iron shall be bolted directly to the volute. Base design shall incorporate integrally cast lateral members to maintain rigidity of the four legs. A suction elbow bolted directly to a common casing/base flange is required and is to be flanged, with 125 pound rating per ANSI Standards. The elbow shall have a cleanout port and gauge connection. On 4 inch units an integral base elbow may be supplied meeting the outlined requirements.
- 2.1.1.5 Backhead: A separately cast backhead with integral stuffing box and box bushing shall be provided, constructed of the same material as the volute. The design shall be such to aid in back pullout of the rotating assembly. The stuffing box shall be designed to allow use of packing or mechanical seals without U-matching. The box is to have taps of sufficient size for clear water connection. Packing shall be as the number and size required. Provide a two piece split interlocking gland with studs and nuts as required.
- 2.1.1.6 Adapter: An adapter with extra large access openings to the stuffing box shall be supplied and further serve to connect frame and backhead to the volute. Provide a tap for external drainage.
- 2.1.1.7 Frame: Frame shall be of rugged design, completely enclosing the shaft between bearings constructed of the same material as the volute. Bearing housing shall be of dust proof design incorporating lip seals in contact with the shaft. Provisions for external impeller adjustment is required. Grease taps for bearing lubrication shall be supplied at top and bottom bearing housings.
- 2.1.1.8 Shaft Assembly: Shaft shall be made from high quality manganese steel of sufficient diameter to carry maximum loads imposed and to prevent vibration and fatigue. Keyways shall be provided at both ends. Shaft shall be accurately machined to a runout less than 0.003 inch along its entire length. A renewable shaft sleeve of stainless steel having a Brinell hardness of 350 shall be provided where the shaft passes through the stuffing box. Provide intermediate supports as recommended by the manufacturer. A flexible connection shall be provided between the pump and the motor.
- 2.1.1.9 Shaft Seals: The pump shafts shall be sealed against leakage by double mechanical seals. The seals shall be pressurized and lubricated by water.
- 2.1.1.10 Ball Bearings: Single or double row grease lubricated ball bearings shall be provided at the inboard and outboard shaft journals as required. The outboard bearing shall carry pump hydraulic axial and dead load thrust. Inboard bearings shall carry hydraulic radial load only.
- 2.1.1.11 Component Connections: The main components of the pump units shall be manufactured with concentric shoulder fits to assure accurate centering.

- 2.1.1.12 Drive Shaft: Drive shaft shall be a steel tube with universal joints on each end with one end splined to the tube. Connection of universal joint shall be by flanged shaft connectors. Universals shall be heavy duty industrial type with needle bearings. Length shall be as indicated on the drawings. The entire drive shaft assembly shall be balanced at the factory. An OSHA approved shaft guard shall be provided around the drive shaft from pump to within 6 inches of the pump room ceiling.
- 2.1.1.13 Motors: NEMA MG-1. The motors shall be open, dripproof, general purpose, squirrel cage, induction type with ball bearings. Motor horsepower shall not be less than pump horsepower requirements at all points on the pump operating curve. Motors shall be no less than the horsepower indicated in the pump description. Connection between the pump and motor shall be by use of a drive shaft with universals at each end of the drive shaft.

2.1.2 Suction Lift Non-Clog Centrifugal Pumps:

- 2.1.2.1 General: Pumps shall be of the horizontal self-priming type specifically designed for the handling of raw, unscreened, sanitary domestic sewage. Openings and passages of pump shall be large enough to permit the passage of the specified sphere diameter and any trash or stringy material which can pass through the average house collection system. Pump volute or casing shall contain no openings, such as recirculating ports, of a lesser diameter than sphere size specified. Screens or any internal devices that create a maintenance nuisance or interferes with priming and performance of the pump shall not be permitted. Pump must be equipped with an easily removable cover plate, allowing complete access to pump interior to permit the clearance of stoppages and to provide simple access for service and repairs without disturbing suction or discharge piping. Pump shall be fitted with a replaceable wear plate. Replacement of wear plate, impeller, and seal shall be accomplished through the removable cover plate. Entire rotating assembly, which includes bearings, shaft, seal, and impeller, shall be removable as a unit without disturbing pump casing or piping.
- 2.1.2.2 Impeller: Impeller shall be 2 vaned, semi-open, non-clog, cast in ductile iron, with integral pump-out vanes on the back shroud. Impeller shall thread onto a pump shaft of high carbon steel and be secured with an impeller lock screw. Means shall be provided for external adjustment of the impeller to the wear plate.
- 2.1.2.3 Shaft and Bearings: Pump shaft shall be high quality manganese steel and shall be covered and protected with a removable sleeve. Shaft shall be contained within a bearing pedestal of ample size to contain heavy duty ball thrust bearing and radial bearing of adequate size to withstand all imposed loads. Bearings shall be oil lubricated, with the bearing pedestal cooled by pumped liquids.
- 2.1.2.4 Seal: Pump shaft shall be sealed against leakage by a mechanical seal. Both the stationary sealing member and mated rotating

member shall be of tungsten-titanium carbide alloy. To insure seal, faces are in full contact at all times, stationary seal seat shall be double floating and self-aligning during periods of shock loads that will cause deflection, vibration, and axial or radial movement of the pump shaft. Mechanical seal shall be installed within a seal housing adjacent to an oil filled reservoir in the pump pedestal, the oil serving as both lubricating and cooling media. Seal must be removable and replaceable through cover plate opening. Should the seal fail within the first year, the manufacturer is obligated upon notification to furnish a new seal at no charge to the Government, FOB factory.

- 2.1.2.5 Suction Check Valve: Pump shall incorporate suction check valve that can be removed or installed through removable cover plate opening, without disturbing the suction piping. Sole function of check valve shall be to eliminate repriming with each cycle.
- 2.1.2.6 Motors: Pump motors shall be horizontal, open dripproof, cast iron frame, induction type, with normal starting torque and low starting current characteristics. Motors shall not be overloaded at design pump operating conditions or at any head on the pump operating curve. Each motor shall be of cast iron frame construction and shall be of current NEMA design.

2.1.3 Submersible Pumps - Grinder Type:

- 2.1.3.1 General: Pump shall be of the grinder type designed to handle all objects that normally pass through a home sewage system. Pump body, stator housing, and reducer shall be of gray iron castings Class 35 conforming to ASTM Specification A48. Pump stator shall be constructed of material resistant to wear and chemical action. Pump rotor shall be of ANSI Type 417 stainless steel with hard chrome plate surface. Drive shaft shall be of ANSI Type 416 stainless steel. Bearings shall be prelubricated ball bearings. Shaft seal shall be mechanical and end face seal with carbonceramic "super lapped" mating faces; metal parts of seals shall be of 304 stainless steel. The grinder shall consist of gray cast iron impeller with replacement tungsten carbide teeth, rotating within a slotted hardened tool steel cutter ring. Stationary cutting teeth mounted above the cutter ring shall be of tungsten carbide. All cutter teeth shall be removable, interchangeable, and attached with stainless steel screws. Cutter ring shall be removable and turnable to afford a maximum life. Pump shall be suitable for reversing. Pump shall be provided with a mounting flange constructed to accept a NEMA 56 "C" flange mount with keyway drive. The pump shall be removable from the pit without requiring entrance into the wet well by personnel. The pump shall be easily placed back into position without entrance into the wet well.
- 2.1.3.2 Motor: Motors shall be mounted directly to the pump and shall operate on the voltage previously specified. Motor shall be capacitor start, totally enclosed, hermetically sealed, overload protection. Motor shall be suitable to drive the pump furnished. Motor shall be reversible at the pump control. The power cable shall be sealed inside

of the motor end bell. The cable shall be neoprene covered with a flexible metal cover over it for its full length.

2.1.3.3 Quick Disconnect System: The quick disconnect system shall consist of a steel base plate for supporting the pumps, pump guide rails and the discharge pipe supports. The two guide rails shall be galvanized steel. A lifting chain shall be provided for raising and lowering the pump in the basin. Guides shall be built onto the pump housing to fit the guide post in order to assure perfect alignment between the pump and guide rails.

2.1.4 Submersible Pump:

- 2.1.4.1 General: Pump shall be a submersible type pump designed for drain sump type duty. Pump body and motor housing shall be of cast iron construction. Impeller shall be of bronze or cast iron construction and attached to the motor by a stainless steel motor shaft. The motor shall be sealed from the pumped liquid at the motor shaft by a heavy duty ceramic seal faced to a flatness of one lightband. All springs and other seal parts shall be stainless steel. All rubber gaskets and seals shall be Buna N. The lower bearing shall take the full radial and down—thrust loads. The upper bearing shall take full radial and up—thrust loads. The total system shall be completely free of leaks and coated with a corrosion resistant epoxy paint suitable for the service intended.
- 2.1.4.2 Float Switch: The pump shall be equipped with a low water shut-down float switch mounted so that the pump will not pump dry.
- 2.1.4.3 Motor: Motor shall be directly mounted to the pump and shall operate on the voltage previously specified. The motor shall be capacitor start, totally enclosed, hermetically sealed, water cooled with built—in thermal overload protection. Motor shall be suitable to drive the pump furnished. The power cable shall be sealed inside the motor end bell. The cable shall be neoprene covered with a flexible metal cover over it for the full length of the cable.

2.2 CONTROLS:

- 2.2.1 Courthouse Bay Lift Station Pump Controls (Two Pumps):
- 2.2.1.1 General: The control assembly shall provide means to operate each pump manually or automatically. When operated in the automatic mode, the control assembly shall provide means to automatically alternate the position of the "lead" and "lag" pumps after each pumping cycle. The controls shall include reduced voltage starters, circuit breakers, level sensing, pump mode selection switch for each pump (HOA), high and low wet well level alarms, low wet well level pump shutdown switch, 2 pump on switches, pilot lights, elapsed time meters, automatic pump alternation with manual override and enclosure.
- 2.2.1.2 Control Enclosure: The electrical control equipment shall be mounted within a NEMA Type 3R enclosure. Control compartment shall

incorporate a removable back panel on which control components shall be mounted. Back panel shall be secured to enclosure with collar studs. All penetrations of the control panel shall be made watertight by gaskets or silicone rubber caulk.

2.2.1.3 Operation: An air bubbler type liquid level control system shall continuously monitor wet well liquid level and control operation of the pumps according to level variations. The system shall actuate pump motors of an alternating "lead" - "lag" basis, with independently adjustable lead pump and lag pump start levels. One pump motor shall be actuated when wet well liquid rises to preset "lead pump start" level, second pump motor shall be actuated, and both pump motors shall continue to operate in parallel until wet well liquid falls to preset "stop" level. Pump starting shall be delayed by an adjustable timed relay for each pump. Relay shall be adjustable to two minutes. "Lag" pump operation shall be independent of "lead" pump operation. Circuitry which provides "lag" pump operation contingent on proper "lead" pump circuit operation is not acceptable.

2.2.1.4 Components:

- 2.2.1.4.1 All circuit breakers and control relays shall be securely fastened to the removable back panel with screws and lock washers. Back panel shall be tapped to accept all mounting screws. Self-tapping screws shall not be used to mount any component.
- 2.2.1.4.2 Pump alternator relay shall be of electrical/mechanical industrial design.
- 2.2.1.4.3 Two vibrating reed type air pumps shall be furnished and wired in such a manner that one air pump shall operate continuously to deliver free air at a rate of approximately 5 cubic feet per hour at a pressure not to exceed 7 psi. The air pumps shall pump into a one gallon reservoir equipped with a pressure regulator and pump control switch. Each air pump discharge line shall be equipped with a valve, and each air pump shall be wired in such a manner as to allow either air pump to be removed for service while the other remains in operation. An H-O-A and pump selector switch shall be furnished to control the use of the air pumps. An air bell shall be supplied for installation in the wet well.

2.2.1.5 Operating Controls and Instruments:

- 2.2.1.5.1 Liquid level shall be controlled by pressure operated switching device with adjustments for "lead", "lag", and pump "OFF" levels. Pressure switch shall have an operating range of 0-150 inches and minimum differential of 6 inches. Minimum repeatability accuracy shall be plus or minus 1% of full range span. Contacts shall be rated 10 amps continuous.
- 2.2.1.5.2 Switches shall be furnished to alternate air pumps and to select mode of operation for each pump. They shall be military type toggle switches with contacts rated at 15 amps at 115 volt AC, non-inductive. Air pump selector switch shall be connected in such a manner

that either air pump may be selected to operate continuously. Pump mode selector switches shall be HAND-OFF-AUTO type to permit manual or automatic control of either pump motor. Operation of pumps in manual mode shall bypass all safety shutdown circuits except pump motor overload.

- 2.2.1.5.3 Panel shall be equipped with elapsed time meters to indicate the total running time of each pump in "hours" and "tenths of hours". Elapsed time meters shall have six digits and be of the non-reset type.
- 2.2.1.5.4 A thermal magnetic air circuit breaker shall provide overcurrent protection for control circuits and shall be connected in such a manner as to allow electrical power to be disconnected from all control circuits.
- 2.2.1.5.5 A high wet well level alarm shall be provided by adding an additional contact to the level control pressure switch and shall be independently adjustable. The control gauges shall also have sufficient contacts to cause automatic low water shutdown of both pumps. High level or low level fault shall cause the illumination of a red indicator light and operation of a general alarm relay. The indicator and the general alarm relay shall remain in the alarm mode until the circuit is manually reset. A low water fault shall also cause interruption of electrical service to both pump motors. However, electrical service shall automatically be restored to the motors, without manual reset, when the wet well level rises above the low level. An alarm silencing switch shall be provided to disable the alarm device while corrective action is underway. There shall be an alarm horn and light located as indicated in the drawings which will activate upon any alarm function. The alarm horn shall be a 6-inch diameter horn and shall emit 120 dB at 10 feet. The alarm light shall be a flashing red light with long life bulb in a guarded enclosure.
- 2.2.1.5.6 An air flow indicator shall be connected to a 1/2" copper air bubbler line and indicate rate of air flow in "Standard Cubic Feet per Hour". The air flow indicator shall be a floating pipe type encased in an acrylic block housing and shall be mounted on the front of the level control panel.
- 2.2.1.5.7 Include in the motor control center a pilot light for each pump motor which shall illuminate when the motor is running.
- 2.2.1.5.8 A 3-position toggle switch shall be provided which shall override the automatic alternator and provide manual selection of either Pump No. 1 or No. 2 as the lead pump.
 - 2.2.2 Trickling Filter Lift Pump Controls (Three Pumps):
- 2.2.2.1 General: The controls shall consist of a single control assembly based upon mercoid switches on rocker arms which are tripped by cams. The cams shall be adjustable on a single rotating shaft driven by a float with offsetting weight. The unit shall be housed in a weatherproof enclosure mounted above the pump floor. The system shall be electrically compatible with the motor control center and capable of providing the

control points shown on the drawings. The control assembly shall provide mercoid switches for each pump to start at low speed, change to high speed, and stop and for high wet well and low wet well level alarms. The alarms shall report to the central monitoring panel in the control building. The low wet well level alarm will also cause all pumps to shut down.

- 2.2.2.2 Enclosure: The control assembly shall be housed in a gasketed weatherproof cast metal enclosure. The access to make adjustments shall be by removing the cover. The enclosure shall be mounted above the pump room floor allowing sufficient clearance for the operation of the offsetting weight. The rotating arm shall be lubricated from outside the enclosure leaving the interior free of lubricants.
- 2.2.2.3 Float Assembly: The float assembly shall be a ball float or cylinder float suspended by a metal cable or tape. Positive means shall be provided to eliminate slippage of the cable or tape over the drive sheave.
- 2.2.2.4 Cam Drive: The cams shall be rotated by the float rise and fall in the wet well. The cams for each activation shall be fully adjustable to provide accurate tripping of the mercoid switches. A means of positively locking the cams to the drive shall be provided on each cam.
- 2.2.2.5 Offsetting Weight: A weight of sufficient size shall be provided to keep the cam drive steady and smooth in operation. The weight shall provide a counter rotation from the float on a sheave of the proper size to allow full operation above the pump room floor.
- 2.2.3 Secondary Clarifier Sludge Recirculation Pump Controls (Two Pumps):
- 2.2.3.1 General: The controls shall consist of a "ON-OFF" and "HI SPEED-LOW SPEED" control for each pump, a low wet well level alarm, high aerobic digester level shut off, starters and overloads for both pumps, pilot lights, elapsed time meters and control circuit overload protection. The alarm shall report to the central monitoring panel in the control building.
- 2.2.3.2 Enclosure: The control assembly shall be enclosed in a gasketed weatherproof metal enclosure. The switches, resets, pilot lights and elapsed time meters shall be mounted on the panel door in a weatherproof manner. All connections from outside the enclosure shall be made to a labeled terminal block.
- 2.2.3.3 Float Assembly Description: The device shall be a direct acting float switch consisting of a normally-open mercury switch enclosed in a float. The float assembly shall be pipe mounted. The float shall be molded of rigid high-density polyurethane foam, color-coded and coated with a durable, water and corrosion-resistant jacket of clear urethane. The connecting cable and support pole shall be as shown. A cast aluminum NEMA Type 4 junction box shall be provided to connect the float assembly. The box shall have a gasketed cover with a tapped float fitting and

conduit entrance pipe threaded opening. The floats shall be mounted at fixed elevations as shown. When the liquid level being sensed rises or falls past the float, the floats shall tilt and operate their switches thus causing deactivation of the pumps or alarms.

- 2.2.4 Waste Sludge Pump Controls (Two Pumps):
- 2.2.4.1 General: The controls shall consist of a Hand-Off-Automatic selector switch for each pump. In the automatic position the pumps shall operate from a 24-hour clock timer that is settable to within 15 minute intervals. The high water float switch provided in aerobic digester No. 1 to prevent overflowing the aerobic digester shall also deactivate these pumps.
- 2.2.4.2 Enclosure: The control assembly shall be enclosed in a gasketed weatherproof metal enclosure. The switches, resets, pilot lights and elapsed time meters shall be mounted on the panel door in a weatherproof manner. All connections from outside the enclosure shall be made in a labeled terminal block.
 - 2.2.5 Primary Clarifier Scum Pumps (Two Pumps):
- 2.2.5.1 General: The controls shall consist of a self-contained duplex pump control. The control shall include starters, circuit breakers, float switches, pump mode selector switch (HAND-OFF-AUTOMATIC), high and low wet well level alarms and low wet well level pump shut-down, pilot lights, elapsed time meters, automatic pump alternator and manual alternator override, and manual pump reversing switch.
- 2.2.5.2 Enclosure: The control assembly shall be enclosed in a gasketed weatherproof metal enclosure. The selector switch, pilot lights, resets, and elapsed time meters shall be mounted through the door in a weatherproof manner. All connections from outside the enclosure shall be made to a labeled terminal block.
- 2.2.5.3 Float Assembly Description: The device shall be a direct acting float switch consisting of a normally-open mercury switch enclosed in a float. The float assembly shall be pipe mounted. The float shall be molded of rigid high-density polyurethane foam, color-coded and coated with a durable, water and corrosion-resistant jacket of clear urethane. The connecting cable and support pole shall be as shown. A cast aluminum NEMA Type 4 junction box shall be provided to connect the float assembly. The box shall have a gasketed cover with a tapped float fitting and conduit entrance pipe threaded opening. The floats shall be mounted at fixed elevations as shown. When the liquid level being sensed rises or falls past the float, the floats shall tilt and operate their switches thus causing sequential turn-on turn-off of the pumps.
- 2.2.5.4 Control Sequence: The pumps shall activate upon rise of water to a preset pump on level. Upon pumping down to a preset level, a second float switch will cause the pump to shut down. If the level rises above the pump on level to a preset high water alarm, an alarm will sound.

If the level falls below the shut-off point to a preset level, an alarm will sound. Upon shut-down of the pump, an alternator will cause the controls to activate the other pump upon reaching the pump on level. The alarm points will also cause a visible/audible alarm to activate on the monitor panel in the control building.

- 2.2.5.5 Alternator: Provide an alternator control switch to operate in connection with each float. Alternator control switch shall alternate the operation of the pumps and operate both pumps if the water level rises above the second high water level. A time delay function and devices shall be incorporated in the alternator controls such that both sewage pumps cannot be started simultaneously for an adjustable period of 10 to 120 seconds after shutdown. The delay function shall operate in any condition of start-up in either normal or emergency operational mode.
 - 2.2.6 Aerobic Digester Supernatant Pump (One Pump):
- 2.2.6.1 General: The controls shall consist of a self-contained simplex control. The control shall include starters, circuit breakers, a "hand-off-timer" selector switch, timer, pilot light, and elapsed time meter.
- 2.2.6.2 Enclosure: The control assembly shall be enclosed in a gasketed weatherproof metal enclosure. The selector switch, pilot lamp, and elapsed time meter shall be mounted through the door in a weatherproof manner. All connections from outside the enclosure shall be made to labeled terminal block.
- 2.2.6.3 Timer: An adjustable timer shall be provided to shut down the pump automatically. The timer shall have a 0-8 hour range settable in at most 15 minute intervals. Upon completing an automatic shut-down of the pumps, the timer shall automatically reset for the next cycle. The pump controlled by this controller shall be equipped with a self-contained low water shut-off.
- 2.2.6.4 Control Sequence: The pump shall be manually started from the control panel and may be placed in either the manual or the timed mode. In case of low water, a self-contained switch will cause the pump to shut down until the water level returns to a safe level. Upon completion of the timed cycle, the control will automatically reset to the ready position.
- 2.3 PRESSURE GAUGES: Each pump shall be provided with two 4-1/2 inch glycerine filled pressure or pressure/vacuum gauges reading in feet of water column. The gauges shall be equipped with a stop cock, pigtail, and an isolator for use with sewage. The gauges shall be mounted on a volute boss provided by the manufacturer or on the discharge flange and on the suction elbow boss or suction flange.

3.1 INSTALLATION:

- 3.1.1 Pumps shall be mounted on bases where indicated on the drawings, plumbed and leveled, and firmly grouted in place with a nonshrink grout.
- 3.1.2 Pressure and vacuum gages shall be mounted as indicated on the drawings on the suction and discharge piping as required for each of the respective pump installations. The gage face shall be 4-1/2 inches in diameter and graduated in feet of water.
- 3.1.3 Air release piping of one inch ASTM A53 or A120, Schedule 80, galvanized steel shall be provided where indicated on the drawings, suitably connected to the top of the volute and discharging to the drain.
- 3.2 START-UP SERVICES: The services of a factory representative of the equipment manufacturer shall be provided to check the equipment after installation and to supervise initial start-up. A minimum of two separate trips to the plant site will be required, each consisting of a minimum of one 8-hour working day for each manufacturer of pumps.
- 3.3 PAINTING: The surface preparation and painting shall be in accordance with Section 09910, "Painting of Buildings (Field Painting)" of these specifications. The equipment shall be delivered to the job site with the shop coat primer applied.

3.4 TEST:

3.4.1 The pumps shall be run under actual field service and demonstration be made that the pump installed performs to the criteria set forth in this specification. During the field test, adjustments shall be made to correct the problems noted. All adjustments or parts renewal shall be at the Contractor's expense.

*** END OF SECTION ***

SECTION 11334

COMMINUTOR

PART 1 - GENERAL

- 1.1 APPLICABLE PUBLICATIONS: 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.
 - 1.1.1 American Gear Manufacturers Association (AGMA) Publication:

460.05-71 Practice for Gearmotors Using Spur, Helical, Herringbone and Spiral Bevel Gears

1.1.2 American Society for Testing and Materials (ASTM) Publications:

A48-76 Gray Iron Castings

A153-80 Zinc Coating (Hot Dip) on Iron and Steel Hardware

B108-80b Aluminum Alloy Permanent Mold Castings

1.1.3 Anti-Friction Bearing Manufacturers Association (AFBMA) Standards:

9-78 Load Ratings and Fatigue Life for Ball Bearings

11-78 Load Ratings and Fatigue Life for Roller Bearings

1.1.4 National Electrical Manufacturers Association (NEMA)
Publications:

ICS 2-78 Industrial Control Devices, Controllers and (Rev 2-80) Assemblies

MG 1-78 Motors and Generators (Rev 5-80)1

1.2 DESCRIPTION: The comminutor shall be of the rotating or oscillating type for use in a sewage treatment plant. It shall consist of an electric motor-driven mechanical shredder or cutter with gear motor capable of continuous and automatic operation. The cutting and screening mechanism shall cut or shred all sewage solids, including sticks, rags and stringy material, without removing them from the sewage flow, without clogging the screen, and without binding, jamming, or stalling the moving parts. The Contractor shall provide all systems complete and ready for operation. All incidental piping, controls, and accessories required for complete operating systems shall be at the expense of the Contractor. Provide all control wiring and accessories in accordance with NFPA 70.

- 1.2.1 Electrical Motors, Controllers, Contactors, and Disconnects: Furnish motors, controllers, contactors, and disconnects with their respective pieces of equipment. Motors, controllers, contactors, and disconnects shall conform to and shall have electrical connections provided under Section 16402, "Interior Wiring Systems". Controllers and contactors shall have a maximum of 120 volt control circuits, and auxiliary contacts for use with the controls furnished. When motors and equipment furnished are larger than sizes indicated, the cost of providing additional electrical service and related work shall be included under this section.
 - 1.3 SUBMITTALS:
 - 1.3.1 Shop Drawings:
 - a. Comminutor
 - b. Concrete channel, to and from comminutor
 - c. Accessories
- 1.3.2 Certified Test Reports: Shop test the complete assembly of the control system simulating full operation. Submit to the Contracting Officer certified copies of the tests showing that the complete electrical control system has been successfully shop tested prior to field installation.
- 1.3.3 Operation and Maintenance Manual: Furnish equipment operation and maintenance manual. Furnish three copies of the manual bound in hardback binders or an approved equivalent. Furnish one complete manual prior to the time that equipment tests are performed, and furnish the remaining manuals before the contract is completed. Inscribe the following identification on the cover: the words OPERATION AND MAINTENANCE MANUAL, the name and location of the equipment or the building, the name of the Contractor, and the contract number. The manual shall include the names, addresses, and telephone numbers of each subcontractor installing the equipment, and of the local representatives for the equipment. The manual shall have a table of contents and be assembled to conform to the table of contents, with tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in. The manual shall include: wiring and control diagrams with data to explain detailed operation and control of each item of equipment; a control sequence describing start-up, operation, and shutdown; description of the function of the item of equipment; the procedure for starting; the procedure for operating; shutdown instructions; installation instructions; maintenance instructions; lubrication schedule including type, grade, temperature range, and frequency; safety precautions, diagrams, and illustrations; test procedures; performance data; and parts list. The parts lists for equipment shall indicate the sources of supply, recommended spare parts, and the service organization which is reasonably convenient to the project site. The manual shall be complete in all respects for equipment, controls, accessories, and associated appurtenances provided.

1.4 INSTRUCTION TO GOVERNMENT PERSONNEL: Furnish the services of a competent instructor who will give full instruction to designated personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the equipment or system provided. The instructor shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. Provide two man-days (16 hours) of instruction.

PART 2 - PRODUCTS

- 2.1 MATERIALS AND EQUIPMENT: Unless otherwise specified, materials and equipment shall essentially duplicate the regularly manufactured commercial products in production by the manufacturer for the required service. Selection of comminutor shall be from one of three types currently in production as herein described and at the Contractor's option.
- 2.1.1 Equipment Types: The rotating drum type comminutor shall include a slotted drum that functions as a screen and support for the rotating cutters, a casing supporting the stationary cutters, and a drive assembly. Evenly spaced cutting teeth shall pass through a stationary comb section cutting against it as the drum rotates. The oscillating type comminutor shall include a stationary semi-circular screen, a stationary cutter bar mounted on a support casing, an oscillating cutter bar, and a drive assembly. Cutter bars shall be adjustable and readily removable for inspection, sharpening, or replacement. Actuate the oscillation by mechanical conversion of the driver rotation. The rotating disc type comminutor shall include a stationary grid frame cutter-comb support with cutter combs, a rotating cutter plate with adjustable cutter teeth, and a drive assembly. The cutter plates shall be fixed and keyed to the center drive shaft, permitting only one cutter tooth and cutter comb to be engaged at one time for load power saving. All cutting elements shall be individually replaceable.
- 2.1.2 Design: The comminutor shall reduce the sewage solids to particle sizes between 1/4 inch and 3/8 inch. The comminutor shall operate automatically and continuously; it shall be capable of passing a minimum pumped flow of 1.15 million gallons per day (mgd) and a maximum pumped flow of 1.80 mgd, and shall be capable of operating satisfactorily at zero flow conditions. The head loss at maximum flow shall not exceed 8 inches of water. Design comminutor for free discharge.
 - 2.1.3 Drive Assembly: Shall be gear motor as specified herein.
 - 2.1.3.1 Gear Motor Drive:

- 2.1.3.1.1 Gear Motor: Drive comminutor with an electric motor. constant speed, totally enclosed, fan-cooled, horizontal or vertical type, suitable for outdoor service, and conforming to NEMA MG-1. The motor shall be of adequate horsepower to drive the comminutor continuously at the maximum load encountered under operating conditions without overloading or exceeding the nameplate rating of the motor. Motor shall be suitable for operation on 480-volt, 3-phase, 60 hertz service. Power transmission from motor to rotating element shall be through a vertical or right-angle reduction unit provided as an integral part of the motor. Reduction ratio shall be such as to produce the proper operating speed for the comminutor mechanism. The unit shall be capable of withstanding any loadings produced by the thrust, out-of-balance, and vibration forces resulting from operating conditions and shall operate from zero revolutions per minute (rpm) to a speed compatible with the drive shaft or oscillator speed. Design components to withstand continuously the full load motor horsepower. Gearing shall be spur, helical, spiral, bevel, worm, or a combination thereof. Gears shall be wrought or alloy steel, except that worm gears shall be bronze. The gear teeth shall be throughhardened, contour-induction hardened, nitrided, or carburized. Flamehardened gears will not be acceptable. The housing shall be close-grained cast iron, fabricated steel, or aluminum alloy. Design gear reduction unit in accordance with AGMA 460.05
- 2.1.3.1.2 Gear Motor Mounting: Mount comminutor gear motor closecoupled with the comminutor on an open stand with universal shaft to the comminutor.
- 2.1.4 Cutting Elements: Secured elements, combs, teeth, and bars shall be corrosion— and wear—resistant chrome—tungsten type alloy, or equal, possessing Brinell Hardness of 450 or better. Elements shall be readjustable to compensate for wear and removable for sharpening or for replacement when fully worn.
- 2.1.5 Drum and Support Casing for Rotating Drum Type Comminutor: The rotating drum and the support casing shall be close-grained cast iron or aluminum alloy. Cast iron shall conform to ASTM A 48, Class 30 minimum, and aluminum alloy shall conform to ASTM B 108. Casing may be composed of one or more parts.
- 2.1.6 Support Casing and Screen and Oscillating Arm for Oscillating Type Comminutor: Casing shall be close-grained cast iron or aluminum alloy of adequate strength and rigidity to withstand all loads imposed on it from the operation of the comminutor and drive assembly. Cast iron shall conform to ASTM A 48, Class 30 minimum, and aluminum alloy shall conform to ASTM B 108. The casing shall have the manufacturer's recommended semicircular screen of stainless steel attached to it.
- 2.1.7 Frame, Screen Grid, and Discs for the Rotating Disc Type Comminutor: The frame, screen, grid, and discs shall be of close-grained cast iron or aluminum alloy. Cast iron shall conform to ASTM A 48, Class 30 minimum, and aluminum alloy shall conform to ASTM B 108.

- 2.1.8 Bearings: All bearings shall be of the antifriction type having a rating-life expectancy (L-10) of 100,000 hours when equipment is operating continuously at the rated load horsepower and speed as specified in paragraph entitled "Design". Load rating and fatigue life shall be based on AFBMA 9 and AFBMA 11, as applicable.
- 2.1.9 Lubrication: Bearings shall be either oil or grease lubricated. Gear reduction unit shall be oil lubricated. Oil lubricated bearings and reduction units shall have sight glass or other positive means of determining oil level. Grease-lubrication pressure-line fittings and oil fill and drain lines shall be easily accessible when comminutor is in place.
- 2.1.10 Anchorage for Installation Within a Channel: The comminutor, motor, power unit, guide bearings, and all equipment requiring attachment to structural supporting members shall be furnished complete with bolts, nuts, anchors, washers, sole plates, or any other type of supports necessary for the installation of the equipment. Anchor bolts and nuts for the comminutor, motor, or power unit shall be Type 316 stainless steel. All other type of supports shall be of steel or iron, galvanized in accordance with ASTM A 153. Concrete for channels is specified under Section 03302, "Cast-in-Place Concrete".
- 2.1.11 Bar Screen: The bar screen shall be constructed as indicated and shall be hot dipped galvanized after construction in accordance with ASTM A123.

2.2 ELECTRICAL REQUIREMENTS:

- 2.2.1 General Electrical: The control panel shall be weatherproof securely mounted near the motor where indicated. The attendant automatic control devices shall be integral with the control panel, prewired, and tested at the factory, necessitating only power line connection to the main terminal block when installed in the field. Electrical work is specified in Division 16, "Electrical".
- 2.2.2 Motor Controller: The motor controller shall be rated as indicated and conform to NEMA ICS 2. Provide a control system that includes an automatic motor starter reset for power failure protection and an automatic drive motor reversal with time delay for jamming protection in the event of hard particle entrapment in the comminutor cutters. Provide audible and visual alarm system to signal both the field operator and the area office in case of a malfunction. The controller shall have a thermal overload and short circuit protection in each electrical phase.
- 2.3 MATERIALS PROTECTION: The comminutor and related appurtenances shall be cleaned thoroughly, prime-coated, and given two factory finish coats of paint, total of 5 mils thickness, in accordance with the manufacturer's recommendations. Do not coat stainless steel, stellite, and non-ferrous metals. Field painting shall be as specified in Section 09910, "Painting of Buildings (Field Painting)".

2.4 TOOLS AND SPARE PARTS: Furnish in a hardwood or metal tool box special tools necessary for the proper adjustment and maintenance of the comminutor. Furnish a complete set of manufacturer's recommended spare parts, including cutting teeth and combs or other cutting elements.

PART 3 - EXECUTION

- 3.1 INSTALLATION: Shall be in accordance with the recommendations of the manufacturer of the comminutor. Correctly align comminutor shaft connections before startup.
 - 3.2 FIELD TESTS:
- 3.2.1 Scheduling: Give the Contracting Officer 14 calendar days notice of the dates and times scheduled for tests.
- 3.2.2 Tests: Test comminutor mechanism in the operation mode to demonstrate correct alignment, smooth operation, proper adjustment, freedom from vibration, and freedom from noise and overheating of moving machinery. The test period shall include one hour of operation in each specified range and not less than 10 cycles of automatic stop, reversal, and restart as required by paragraph, "Motor Controller". Head losses at the specified flow ranges will be measured during the tests to assure that the requirements are met. Test operate installed controls to assure that that all operational requirements of paragraph, "Motor Controller", are satisfied. Make two complete cycles to verify that the system continues to function satisfactorily under all requirements.

*** END OF SECTION ***

SECTION 11361.2.1

CIRCULAR CLARIFIER EQUIPMENT FOR PRIMARY CLARIFIER

- 1. APPLICABLE PUBLICATIONS: 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.
 - 1.1 Military Specification (Mil. Spec.):

MIL-P-24441 Paint, Epoxy-Polyamide (SHIPS) & Am 3

1.2 American Gear Manufacturer's Association (AGMA) Publications:

210.02-1965	Surface Durability (Pitting) of Spur Gear Teeth
211.02-1969 (R1974)	Surface Durability (Pitting) of Helical and Herringbone Gear Teeth
215.01-1966 (R1974)	Information Sheet for Surface Durability (Pitting) of Spur, Helical, Herringbone and Bevel Gear Teeth
220.02-1966	Rating the Strength of Spur Gear Teeth
221.02-1965	Rating the Strength of Helical and Herringbone Gear Teeth
225.01-1967	Information Sheet for Strength of Spur, Helical, Herringbone and Bevel Gear Teeth
226.01-1970	Information Sheet - Geometry Factors for Determining the Strength of Spur, Helical, Herringbone and Bevel Gear Teeth
240.01-1972	Gear Materials Manual
260.02-1974	Design of Components - Enclosed Gear Drives - Bearings, Bolting, Keys and Shafting
390.03-1973	AGMA Gear Handbook - Volume 1 - Gear Classification, Materials and Measuring Methods for Unassembled Gears
420.04-1975	Practice for Enclosed Speed Reducers or Increasers using Spur, Helical, Herringbone and Spiral Bevel Gears

	440.04-1971	Practice for Single and Double-Reduction Cylindrical-Worm and Helical-Worm Speed Reducers		
	460.05-1971	Practice for Gearmotors Using Spur, Helical, Herringbone and Spiral Bevel Gears		
	461.01-1966 (R1974)	Practice for Worm Gearmotors		
	511.02-1969	Bore and Keyway Sizes for Flexible Couplings		
	512.03-1974	Keyways for Flexible Couplings		
	513.01-1969	Taper Bores for Flexible Couplings		
	514.02-1971	Load Classification and Service Factors for Flexible Couplings		
	515.02-1977	Balance Classification for Flexible Couplings		
1.3	American Inst	itute of Steel Construction (AISC) Publication:		
		Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings (1969)		
1.4	American National Standards Institute (ANSI) Publications:			
	817.1-1967 (R1973)	Keys and Keyseats		
	B17.2-1967 (R1978)	Woodruff Keys and Keyseats		
	829.1-1975	Precision Power Transmission Roller Chains, Attachments and Sprockets		
1.5	American Society for Testing and Materials (ASTM) Publications:			
	A 36-77a	Structural Steel (ANSI/ASTM A36)		
	A 48-76	Gray Iron Castings (ANSI/ASTM A48)		
	A 53-79	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless (ANSI/ASTM A53)		
	A 120-79	Pipe, Steel, Black and Hot-dipped Zinc-Coated (Galvanized) Welded and Seamless for Ordinary Uses (ANSI/ASTM A120)		
	A 153-78	Zinc Coating (Hot-Dip) on Iron and Steel Hardware (ANSI/ASTM A153)		

	A 307-78	Carbon Steel Externally Threaded Standard Fasteners (ANSI/ASTM A307)	
	A 325-79	High Strength Bolts for Structural Steel Joints (ANSI/ASTM A325)	
	A 449-78a	Quenched and Tempered Steel Bolts and Studs (ANSI/ASTM A449)	
	A 563-78a	Carbon and Alloy Steel Nuts (ANSI/ASTM A563)	
1.6	American Water Works Association (AWWA) Publications:		
	C104-80	Cement-Mortar Lining for Ductile-iron Pipe and Fittings for Water	
	C110-82	Gray-Iron and Ductile-Iron Fittings, 3 in. Through 48 in. for Water and Other Liquids	
	C111-80	Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings	
	C115-75	Flanged Ductile-Iron and Gray-Iron Pipe with Threaded Flanges	
1.7 ions:	Anti-Friction	Bearing Manufacturers Association (AFBMA) Publica-	
	Std 9	Load Ratings and Fatigue Life for Ball Bearings, 1978 edition (ANSI/AFBMA Std 9)	
	Std 11	Load Ratings and Fatigue Life for Roller Bearings, 1978 edition (ANSI/AFBMA Std 11)	
1.8 ions:	National Electrical Manufacturers Association (NEMA) Publica-		
	ICS 1-1978	General Standards for Industrial Control and Systems	
	ICS 2-1978	Industrial Control Devices, Controllers and Assemblies	
	MG-1-1978	Motors and Generators (ANSI/NEMA MG-1)	

1.9 Steel Structures Painting Council (SSPC) Publication:

SSPC-SP10-82T Near-White Blast Cleaning

2. DESCRIPTION: Equipment for the primary clarifiers shall include a bridge-supported clarifier mechanism with scum skimmer erected in the clarifier tank approximately as indicated. Equipment shall be of the mid-tank feed/peripheral overflow type with influent pipe entering through side of tank. The work also includes surfacing of clarifier tank floor.

- 3. GENERAL REQUIREMENTS: Section 15011, "General Requirements, Mechanical," with the following modifications, applies. Submittals shall include proof (including calculations) that gears and gearing meet the requirements specified herein; catalog cuts may be used, where applicable, to prove conformance to AGMA Standards. Posted operating instructions shall be either attached to, or placed adjacent to, the equipment at operating platform. The Contractor shall provide all systems complete and ready for operation. All incidental piping, controls, and accessories required for complete operating systems shall be at the expense of the Contractor. Provide all control wiring and accessories in accordance with NFPA 70.
- 3.1 Electrical Motors, Controllers, Contactors, and Disconnects: Furnish motors, controllers, contactors, and disconnects with their respective pieces of equipment. Motors, controllers, contactors, and disconnects shall conform to and shall have electrical connections provided under Section 16402, "Interior Wiring Systems". Controllers and contactors shall have a maximum of 120 volt control circuits, and auxiliary contacts for use with the control furnished. When motors and equipment furnished are larger than sizes indicated, the cost of providing additional electrical service and related work shall be included under this section.
- 3.2 SUBMITTALS: Partial submittals will not be acceptable. Annotate descriptive data to show the specific model, type, and size of each item the Contractor proposes to furnish. Prepare shop drawings on sheets not smaller than 30 inches by 42 inches, and include data essential to the proper installation of each system. Do not commence work until the design of each system and the various components have been approved. The submittal requirements of Section 15011, "General Requirements, Mechanical", applies to the following lists. Items in the following lists (which are followed by (CO)) shall be approved by the Contracting Officer.

3.2.1 Manufacturer's Data:

Drive components and bearings (CO)

b. Pipe, fittings, and couplings (CO)

Valves including gate, check, and relief valves (CO)

d. Gages (CO)

e. Devices and associated equipment (CO)

f. Suction bell and shaft for vertical turbine pump (CO)

3.2.2 Shop Drawings:

a. Bridge, scraper arm, drive cage, and scrapers (CO)

b. Controls (CO)

- 3.2.3 Operation and Maintenance Manuals:
 - a. Drive, scraper arm, and controls (CO)
 - b. Spare parts catalog (CO)
- 4. MATERIALS AND EQUIPMENT:
- 4.1 Materials and Equipment, General: Clarifier equipment shall include clarifier mechanism, weirs and baffles, and piping. Structural steel shall conform to ASTM A 36. Completely or intermittently submerged steel members shall have a minimum thickness of 1/4 inch. Cast iron shall conform to ASTM A 48, Class 30 minimum, except as otherwise specified.
- 4.2 Clarifier Mechanism: Clarifier mechanism shall include sludge collector assembly; drive assembly; supporting bridge; operating platform and access walkway thereto; influent well; scum removal assembly; overload protection and alarm; and electrical control equipment. The drive shall rotate the sludge collector assembly, which shall be designed to move settled sludge to a centrally located sludge hopper. Mechanism shall be so designed that there will be no chains, sprockets, bearings (except sleeve bearings when used), or operating mechanism below the liquid surface or in contact with the liquid. The mechanism shall be assembled in the shop to ensure proper fitting of parts, match-marked for erection, and disassembled for shipment.
- 4.2.1 Design: Clarifier mechanism shall be designed to have a minumum continuous output torque rating of 2000 foot-pounds with the scraper arms rotating at a constant speed which will produce a peripheral speed of 8 to 12 fpm. Clarifier mechanism and its component parts shall be designed, with a safety factor of 2.5, to withstand all structural and mechanical stresses brought about by the following loadings: continuous output rated torque load; dead load; wind load of 115 mph; ice load of 20 psf (except on scum skimmer); and a live load of 50 psf on the access bridge or on access section of supporting bridge. Under maximum load, deflection of access bridge shall not exceed 1/240 of span. Clarifier mechanism shall be designed for continuous 24-hour service under design load without excessive wear, damage, or failure. Stresses developed under aforementioned operating conditions and loads shall not exceed stresses allowed under AISC Specification for the Design, Fabrication and Erection of Structural Steel for Buildings.
- 4.2.2 Sludge Collector Assembly: Assembly shall include scraper arms, scraper blades, and center drive cage/drum.
- 4.2.2.1 Scraper Arms: Scraper arms shall be fabricated of structural steel, using welded truss construction of triangular or box section. Steel scraper blades, with attached squeegees, shall be welded or bolted to underside of scraper arms and shall be designed to move settled sludge to a centrally located sludge hopper. Scraper arms shall be connected to center drive cage/drum by bolted or welded connections. Scraper blades shall be steel plate having a minimum thickness of 1/4 inch. Squeegees

shall be of brass having a minumum thickness of 1/8 inch, and shall be connected to scraper blades with brass bolts and nuts with provision for vertical adjustment of not less than 2 inches.

- 4.2.2.2 Center Drive Cage/Drum: Center drive cage/drum shall be fabricated of structural steel, using box truss or cylindrical drum construction. Center drive cage/drum shall be connected to drive assembly with machine screws or by a bolted connection.
- 4.2.2.3 Center Shaft: Center shaft shall be a solid steel shaft or steel pipe conforming to ASTM A 53, Schedule 40. Steel pipe shall have solid shaft stub ends or machined flange at top and steel cap at bottom.
- 4.2.3 Drive Assembly: Assembly shall include motor, speed reduction and turntable gearing, turntable bearing assembly, drive assembly bearings, and chain drives and/or belt drives. Design of drive assembly shall be such as to permit sustained operation at the continuous output torque rating without excessive wear and to develop twice the continuous output torque rating without damage to or failure of drive assembly components.
- 4.2.3.1 Motor: Motor shall be constant speed, totally-enclosed, fan-cooled, horizontal or vertical type, suitable for outdoor service, and conforming to NEMA MG-1. Motor horsepower shall be one HP minimum. Motor shall be suitable for operation on 480 volt, 3 phase, 60 hertz service. Motor shall be protected against overload, low voltage, and unbalanced voltage. Motor shall provide the starting torque needed to move sludge collector assembly from a dead stop in a dewatered clarifier tank as well as torque needed to move it under the maximum loading specified in paragraph, "Design." Motor shall be close-coupled to or on input shaft of primary speed reducer; or shall drive speed reducer by a chain or belt drive. Flexible coupling for connecting shafts of close-coupled motor and speed reducer shall conform to the applicable requirements of AGMA 511.02, 512.03, 513.01, 514.02, and 515.02. When a belt drive is used, motor position shall be adjustable to increase or decrease belt tension.
- 4.2.3.2 Speed Reduction and Turntable Gearing: Gearing for primary speed reducer shall be worm or helical or a combination thereof. Gearing for turntable shall be a worm gear reduction unit. Speed reduction and turntable gearing shall be designed with a AGMA service factor as recommended in the applicable AGMA standard (AGMA 420.04 or 440.04) when drive is operating at full load motor horsepower, 24 hours day continuous running. Gearing shall be designed to withstand any loadings produced by thrust, out-of-balance, and vibration resulting from operating conditions and shall operate from zero rpm to a speed consistent with the maximum peripheral speed specified in paragraph, "Design." All component parts of the speed reduction and turntable gearing shall be designed to permit sustained operation at the continuous output torque rating for the life expectancy specified without excessive wear and to develop twice the continuous output torque without damage to or failure of any component part. Gears shall conform to applicable requirements of the following AGMA Standards: 210.02, 211.02, 215.01, 220.02, 221.02, 225.01, 226.01,

240.01. 390.03. 420.04. and 440.04. Gears for primary reducer shall be not less than AGMA Quality 10, AGMA 390.03. Gears for turntable shall be not less than AGMA Quality 6. AGMA 390.03. Gears shall be certified as meeting the specified quality. Worm gears shall be of cast bronze or shall have bronze rim with inner portion of cast steel or nodular cast iron. Worms shall be of hardened ground alloy steel or high-test heat treated nodular cast iron. Helical gears shall be of cast or forged alloy steel: helical angle shall not exceed 18 degrees. Spur gear shall be internal or external: shall be of cast iron, nodular cast iron, heat treated cast alloy steel, or heat treated forged steel; and shall have an endurance and strength rating of 1,000,000 cycles. Spur gear teeth shall be hardened by the through-hardening, contour-induction-hardening, nitriding, or carburizing processes; flame-hardened gears will not be acceptable. Shafts, bolting, and keys for gears shall conform to AGMA 260.02; shafts shall be of steel. An oil lubrication system shall be provided for speed reduction gearing. Bath lubrication using oil seals for containment or lubrication systems which rely upon an oil circulating pump shall include proven reliable means to stop drive motor in event of insufficient lubrication. Pressure indicating devices influenced by oil sludge or changes in oil viscosity will not be acceptable. Speed reduction and turntable gearing shall be fully enclosed in cast iron or fabricated steel housings provided with dust and oil seals.

- 4.2.3.3 Gearmotor: Where practicable, gearmotor may be used in lieu of separate motor and primary speed reducer. Motor component of gearmotor shall be as specified in paragraph, "Motor." Speed reducing component of gearmotor shall conform to the applicable requirements specified in paragraph, "Speed Reduction and Turntable Gearing," and in AGMA 460.05 and AGMA 461.01.
- 4.2.3.4 Turntable Bearing Assembly: Assembly shall include the turntable bearings upon which the turntable and attached sludge collector assembly are supported; the turntable; and the drive assembly/turntable support base. Assembly shall be designed for all radial and axial loads imposed by drive assembly and sludge collector assembly. Arrangement of component parts shall permit replacement of balls or rollers, or the bearing raceways, or complete bearing unit. Bearing raceway material shall have adequate strength to withstand all radial and axial loads and shall have a Rockwell "C" hardness of not less than 58. Turntable bearing assembly shall also be designed to support, where applicable, drive assembly, turntable, spur gear, and one end of access bridge. A bridgesupported clarifier mechanism may incorporate a submerged split-case, water-lubricated bottom guide bearing or an intermediate steady bearing where manufacturer's design requires use of such bearing in addition to turntable bearings. A design incorporating a bottom support bearing will not be acceptable. Bearing shall run in an oil bath or be greaselubricated. Turntable and drive assembly/turntable base shall be of cast iron, nodular cast iron, or steel; if of steel, these parts shall have sufficient thickness to provide the rigidity necessary to maintain alignment of sludge collector assembly. Turntable shall be cast integrally

with spur gear or be fastened to the spur gear with machine screws or bolts.

4.2.3.5 Drive Assembly Bearings: Bearings shall be ball or roller bearings having a minimum rated life expectancy (L₁₀) as specified in this paragraph when clarifier mechanism is operating continuously at torque rating specified in paragraph, "Design." Load rating and fatigue life shall be based on AFBMA Std 9 and AFBMA Std 11, as applicable.

Worm and primary helical gearbox bearings Gearmotor, direct drive Gearmotor, indirect drive

L₁₀ 100,000 hours L₁₀ 100,000 hours L₁₀ 17,000 hours

Bearings shall be either oil lubricated or grease lubricated.

- 4.2.3.6 Chain Drives and Belt Drives: Chain drives and belt drives incorporated in drive assembly shall include chain-and-sprocket and V-belt-and-pulley arrangements, except that belt drives shall not be used directly on the center drive cage/drum. Chain drives and belt drives shall be designed with a minimum safety factor of 4 as applied to ultimate breaking or transmission strength of the chain or belt with respect to loads transmitted at twice the continuous output torque rating of the clarifier mechanism. Chain shall be roller type conforming to ANSI B29.1 and shall have steel links. Sprockets shall conform to ANSI B29.1 and shall be of heat treated ground alloy steel or of high-test cast iron conforming to ASTM A 48, Class 40 minimum, cast in a chill mold; teeth bearing surfaces shall have a Brinell hardness of not less than 360 and a minimum hardened zone depth of 3/16-inch. Sprockets shall be stress relieved before machining. Sprocket teeth shall be accurately ground to fit the chain. Belts shall be rayon corded with heat- and oil-resistant rubber covering. Sprockets, pulleys, and other motive power transmitting connections shall be key mounted. Drive sprocket or drive pulley on output shaft of primary speed reducer shall be connected to shaft by a shear-pin hub arrangement designed to protect motor against overload; sprocket shall have a bronze bushing with grease lubrication. Design of shear-pin hub arrangement shall be such that it will not bind or freeze into position, preventing it from performing its intended function. Machinery guards shall be fabricated of steel and weatherproof.
- 4.2.4 Scum Removal Assembly: Assembly shall include skimmer assembly and scum trough. Skimmer assembly shall continuously move surface scum to tank periphery and automatically flush the scum into scum trough. Assembly shall discharge scum with a minumum discharge of water.
- 4.2.4.1 Skimmer Assembly: Assembly shall include a fixed skimming blade, a hinged or pivoting plow blade with wiper blades, and support legs. Skimming blade shall be of structural steel and shall extend from influent well to scum trough. Plow blade shall be structural steel, shall be the width of the scum trough, and shall have grease— and oil—resistant chloroprene wiper blades securely clamped in position with a brass or aluminum backing plate. The plow blade and its hinged or pivoted

connections shall be designed so as to assure proper alignment and continuous contact between wiper blades, scum trough approach ramp, and scum baffle. Plow blade shall have provision for field adjustment in the vertical plane. Suitable means shall be provided to carry plow blade smoothly over the scum trough. A readily adjustable plow blade which will accomplish the same results as the hinged or pivoted plow blade may be used in lieu of these types when approved. Corrosion-resistant materials shall be used for moving parts within the skimming assembly in such manner as to ensure that corrosion will not freeze joints, springs, and other moving parts into position. Blades shall be adequately supported from one scraper arm; bracing shall be provided where necessary to maintain rigidity of assembly. Support legs shall be of structural steel.

- 4.2.4.2 Scum Trough: Scum trough shall be welded structural steel, minumum thickness 1/4 inch; shall have a flanged connection for the scum discharge pipe; and shall be supported from the tank wall. The inclined approach ramp leading to discharge section of scum trough shall be shaped to contain the scum as it is moved up the incline to the trough by the plow blade.
- 4.2.5 Access Bridge, Walkway, and Operating Platform: Access bridge shall be of structural steel and shall extend from tank sidewall to the center and beyond sufficient to support walkway and operating platform. The supporting bridge shall be used as the access bridge. Walkway and operating platform shall be skidproof steel raised-pattern floor plate. Walkway and operating platform shall have a double railing not less than 3 feet 6 inches in height on both sides of walkway and around outside of operating platform; railing shall be of structural steel section or of standard 1-1/2-inch pipe conforming to ASTM A 53 or ASTM A 120. Walkway shall be not less than 30 inches wide. Raised-pattern floor plate shall be of a design and material thickness necessary to keep deflection to less than 1/4-inch with a uniform load of 100 pounds per square foot.
- 4.2.6 Supporting Bridge: Supporting bridge shall include two structural steel beams and braces of sufficient depth and thickness to support entire clarifier mechanism within the specified maximum allowable deflection.
- 4.2.7 Influent Well: The mid-tank influent well shall be structural steel, 3/16-inch minimum thickness, reinforced and stiffened with structural sections. The well shall project below the water level and shall be designed to radially diffuse and effectively still the influent liquid without short circuiting. A slot, with a baffle to prevent short circuiting, shall be provided at water level to permit escape of floating material. Where required by manufacturer's design, a standard bolted flange shall be provided for connection of the influent pipe.
- 4.2.8 Overload Protection and Alarm Device: Clarifier mechanism shall have an overload protection and alarm device designed to indicate load on the mechanism at all times, to sound an alarm in case of impending excessive load, and to stop the mechanism when such load is reached.

Device shall be of the torque-actuated or indicating-ammeter type, totally enclosed, except for alarm, in a NEMA 4 enclosure. Overload alarm shall include an industrial type horn, relay, reset button, and an independent On-Off switch in weatherproof metal housing with removable gasketed cover. Horn shall be constructed of noncorrodible material and shall be suitable for remote mounting.

- 4.2.9 Electrical Control Equipment: Electrical control equipment shall include motor starter; pushbutton station; disconnect switch; and all control divices, overload protection devices, and safety devices not otherwise specified but necessary for proper and safe operation of the clarifier mechanism. Electrical control equipment shall conform to NEMA ICS 1 and NEMA ICS 2. All electrical control equipment components shall be completely wired and mounted in a control panel at manufacturer's plant and tested prior to shipment. Enclosures for electrical controls shall be NEMA Type 4. Controls shall be located on access bridge at or near the drive assembly. Electric service available is 480 volts, 3-phase, 60 Hertz, 4 wire. Connecting electrical wiring and related equipment are specified in Section 16402, "Interior Wiring Systems".
- 4.2.9.1 Motor Starter and Pushbutton Station: A pushbutton actuated magnetic motor starter with overload and undervoltage protection shall be provided for the motor. Starter shall have thermal overload protection in each phase and short circuit protection. Overload protective devices shall give adequate protection to motor windings, shall be of thermal inverse-time-limit type, and shall include manual-reset type pushbutton on outside of motor starter enclosure. Pushbutton station shall be 2-button Start-Stop. Pushbuttons shall be clearly and properly marked.
- 4.2.9.2 Wiring: All control circuits shall be wired with No. 14 gauge stranded machine-tool wire with compression type lugs and number tags on both ends of all wires. Wires shall be secured in a neat workmanlike manner with plastic cable ties and/or in wiring duct.
- 4.2.10 Lubrication Fittings: Bearings and other moving parts subject to wear shall be provided with adequate means for lubrication. Except as otherwise specified in this section, lubrication shall be by grease or oil, as suitable. Greased bearings shall be provided with fittings suitable for grease gun service. Where grease fittings would not be easily accessible, grease tubing shall be extended to a convenient location. Grease fittings shall be of a type that prevents overlubrication and building-up of pressure injurious to the bearings. Each oil reservoir shall be liberal in size and provided with an opening for filling, an overflow opening at the proper location to prevent overfilling, an oil-level sight glass, and a drain at the lowest point.
- 4.2.11 Key Mounted Connections: Where connections between shafts and sprockets, gears, pulleys, and other component parts are specified to be key mounted, keys and keyways shall conform to ANSI B17.1 or ANSI B17.2.

- 4.2.12 Weir Plates and Scum Baffles: Weir plates and scum baffles shall be steel. Weirs shall be V-notched and of size and section as indicated. Scum baffles shall be of size and section as indicated. Weir plates and baffles or their supports shall have slotted or oversize holes and plate washers as indicated to permit horizontal and vertical adjustment of the weir and baffle. Weirs and baffles shall have overlapping splice plates as indicated to ensure proper alignment. There shall be no projection of bolts, nuts, or splice plates on inboard side of the scum baffle. Sealant for mounting weir plates shall be a two-component polysulfide-rubber-base sealant.
 - 4.3 Influent, Sludge Removal, Scum Removal, and Effluent Piping:
- 4.3.1 Sleeves and Wall Castings: Sleeves and wall castings shall conform to AWWA C110, with sizes and joints as indicated.
- 4.4 Anchor and Connecting Bolts, Nuts, and Washers: Iron and steel shall be attached with zinc-coated steel, stainless steel, or cadmium-plated steel machine bolts. Aluminum shall be attached with stainless steel machine bolts. Steel bolts shall conform to ASTM A 307, ASTM A 325, or ASTM A 449. Nuts shall conform to ASTM A 563, Grade as specified for the bolt material used. Zinc-coating shall be in accordance with ASTM A 153. Stainless steel shall be AISI Type 302. Bolt sizes and locations shall be as shown on the approved shop drawings for the equipment, except as otherwise indicated. Templates shall be furnished for accurate positioning of anchor bolts.
- 4.5 Grout Materials: Cement, fine aggregate, and water shall be as specified in Section 03302, "Cast-in-Place Concrete."
- 4.6 Spare Parts: Spare parts shall be identical and interchangeable with original parts and shall be furnished in clearly marked containers. Spare parts shall be the standard ones recommended be the manufacturer in his operation, maintenance, or instruction manual, furnished in the number recommended and shall include shear pins, scum plow wiper blade, and one year's supply of recommended lubricants.
- 4.7 Tools: Special tools necessary for the proper maintenance and operation of the equipment shall be furnished together with a properly identified hardwood or metal box for their storage.
- 5. MATERIALS PROTECTION: Except as specified otherwise herein, sandblast exposed surfaces of ferrous metals, including those to be submerged, in accordance with SSPC-SP10; and apply a four-coat system conforming to Mil. Spec. MIL-P-24441. Apply the system in the following order: one coat of Formula 150, one coat of Formula 151, one coat of Formula 156, and one coat of Formula 152. Final total dry film thickness shall be not less than 10 mils. Maximum time between coats shall be 72 hours. The following items shall be finished in accordance with the manufacturer's standard practice suitable for end use environment:

Motors, gearmotors, speed reducers, chains, sprockets, shafts, exposed drive train elements, and pushbutton stations.

6. INSTALLATION AND CONSTRUCTION:

- 6.1 General: Install clarifier equipment in accordance with the recommendations of the manufacturer of the clarifier mechanism, as approved. Take special care to correctly align equipment components. The Contractor shall procure the services of an engineer representative of the manufacturer of the clarifier mechanism to inspect the equipment after erection, for final inspection, startup, and acceptance tests. The representative shall also be available at the clarifier site for a period of not less than one day to instruct operating personnel during initial operation period.
- 6.2 Surfacing of Clarifier Tank Floor: Following installation of the clarifier mechanism, bring clarifier tank floor to finish grade by means of cement-mortar grout surfacing swept into place by use of the sludge collector arms, as herein specified. Do not begin surfacing operation until after the installed equipment has been inspected by the engineer representative of the manufacturer and scraper arms and scraper blades have been adjusted to give correct clearance above final floor Perform surfacing operation in accordance with the approved recommendations of the manufacturer of the clarifier equipment, except as otherwise specified in this paragraph. If grout proportions for the surfacing are not given in the manufacturer's recommendations, use a cementmortar grout composed of one part cement and three parts fine aggregate with sufficient water as needed for conditions of placement and with one teaspoon of powdered aluminum added per bag of cement. Immediately before the surfacing operation is begun, clean the floor thoroughly of all dirt, soil, and other substances which would prevent the proper bonding of the surfacing to the concrete subfloor. If the manufacturer's recommended procedure calls for use of straightedges attached to scraper arms, these may be rotated manually after the grout surfacing has been brought to finish grade as nearly as possible by hand; use of drive unit for sweeping in grout surfacing will not be permitted. Make provision to prevent grout from entering sludge cone; immediately remove any grout which falls in the sludge cone or on clarifier tank walls. Immediately after surfacing operation is complete, thoroughly clean clarifier tank floor and circular clarifier equipment of deposit of excess grout and other materials.
- 6.3 Weirs: Mount weir plates against a double bead of the sealant previously specified for this purpose. Use sufficient thickness of sealant to fill all voids between concrete tank and weir plates.

7. FIELD TESTS AND INSPECTIONS:

7.1 General: The Contractor shall perform all field tests and provide all labor, equipment, and incidentals required for tests, except that electric power and water needed for field tests will be furnished by

the Government as specified in Division 1. As an exception to requirements that may be set forth elsewhere in this contract, the Contracting Officer will witness all field tests and conduct all field inspections. The Contractor shall give the Contracting Officer ample notice of dates and times scheduled for tests.

7.2 Tests: Test circular clarifier mechanism as in operation to demonstrate correct alignment, smooth operation, proper adjustment of flow distribution, freedom from vibration, and freedom from noise and overheating of moving machinery. Include in test at least two full cycles of successful operational sequences to demonstrate that the system continues to function satisfactorily after meeting all operational requirements.

*** END OF SECTION ***

SECTION 11361.2.2

CIRCULAR CLARIFIER EQUIPMENT FOR SECONDARY CLARIFIER

- APPLICABLE PUBLICATIONS: 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.
 - 1.1 Military Specification (Mil. Spec.):

MIL-P-24441 Paint, Epoxy-Polyamide (SHIPS) & Am 3

1.2 American Gear Manufacturer's Association (AGMA) Publications:

210.02-1965	Surface Durability (Pitting) of Spur Gear Teeth
211.02-1969 (R1974)	Surface Durability (Pitting) of Helical and Herringbone Gear Teeth
215.01-1966 (R1974)	Information Sheet for Surface Durability (Pitting) of Spur, Helical, Herringbone and Bevel Gear Teeth
220.02-1966	Rating the Strength of Spur Gear Teeth
221.02-1965	Rating the Strength of Helical and Herringbone Gear Teeth
225.01-1967	Information Sheet for Strength of Spur, Helical, Herringbone and Bevel Gear Teeth
226.01-1970	Information Sheet - Geometry Factors for Determining the Strength of Spur, Helical, Herringbone and Bevel Gear Teeth
240.01-1972	Gear Materials Manual
260.02-1974	Design of Components - Enclosed Gear Drives - Bearings, Bolting, Keys and Shafting
390.03-1973	AGMA Gear Handbook - Volume 1 - Gear Classification, Materials and Measuring Methods for Unassembled Gears
420.04-1975	Practice for Enclosed Speed Reducers or Increasers using Spur, Helical, Herringbone and Spiral Bevel Gears

	440.04-1971	Practice for Single and Double-Reduction Cylindrical-Worm and Helical-Worm Speed Reducers	
	460.05-1971	Practice for Gearmotors Using Spur, Helical, Herringbone and Spiral Bevel Gears	
	461.01-1966 (R1974)	Practice for Worm Gearmotors	
	511.02-1969	Bore and Keyway Sizes for Flexible Couplings	
	512.03-1974	Keyways for Flexible Couplings	
	513.01-1969	Taper Bores for Flexible Couplings	
	514.02-1971	Load Classification and Service Factors for Flexible Couplings	
	515.02-1977	Balance Classification for Flexible Couplings	
1.3	American Insti	tute of Steel Construction (AISC) Publication:	
		Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings (1969)	
1.4	American National Standards Institute (ANSI) Publications:		
	B17.1-1967 (R1973)	Keys and Keyseats	
	B17.2-1967 (R1978)	Woodruff Keys and Keyseats	
	B29.1-1975	Precision Power Transmission Roller Chains, Attachments and Sprockets	
1.5	American Society for Testing and Materials (ASTM) Publications:		
	A 36-77a	Structural Steel (ANSI/ASTM A36)	
	A 48-76	Gray Iron Castings (ANSI/ASTM A48)	
	A 53-79	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless (ANSI/ASTM A53)	
	A 120-79	Pipe, Steel, Black and Hot-dipped Zinc-Coated (Galvanized) Welded and Seamless for Ordinary Uses (ANSI/ASTM A120)	
	A 153-78	Zinc Coating (Hot-Dip) on Iron and Steel Hardware (ANSI/ASTM A153)	

	A 307-78	Carbon Steel Externally Threaded Standard Fasteners (ANSI/ASTM A307)
	A 325-79	High Strength Bolts for Structural Steel Joints (ANSI/ASTM A325)
	A 449-78a	Quenched and Tempered Steel Bolts and Studs (ANSI/ASTM A449)
	A 563-78a	Carbon and Alloy Steel Nuts (ANSI/ASTM A563)
1.6	American Water	Works Association (AWWA) Publications:
	C104-80	Cement-Mortar Lining for Ductile-iron Pipe and Fittings for Water
	C110-82	Gray-Iron and Ductile-Iron Fittings, 3 in. Through 48 in. for Water and Other Liquids
	C111-80	Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings
	C115-75	Flanged Ductile-Iron and Gray-Iron Pipe with Threaded Flanges
1.7 tions:	Anti-Friction	Bearing Manufacturers Association (AFBMA) Publica-
	Std 9	Load Ratings and Fatigue Life for Ball Bearings, 1978 edition (ANSI/AFBMA Std 9)
	Std 11	Load Ratings and Fatigue Life for Roller Bearings, 1978 edition (ANSI/AFBMA Std 11)
1.8 tions:	National Electr	ical Manufacturers Association (NEMA) Publica-
	ICS 1-1978	General Standards for Industrial Control and Systems
	ICS 2-1978	Industrial Control Devices, Controllers and Assemblies
	MG-1-1978	Motors and Generators (ANSI/NEMA MG-1)
1.9	Steel Structure	s Painting Council (SSPC) Publication:
	SSPC-SP10-82T	Near-White Blast Cleaning
2. Include a	DESCRIPTION: Equ bridge—supported	uipment for the secondary clarifiers shall d clarifier mechanism with scum skimmer erected

05-81-1478 11361.2.2-3 in the clarifier tank approximately as indicated. Equipment shall be of the mid-tank feed/peripheral overflow type with influent pipe entering through side of tank. The work also includes surfacing of clarifier tank floor.

- 3. GENERAL REQUIREMENTS: Section 15011, "General Requirements, Mechanical," with the following modifications, applies. Submittals shall include proof (including calculations) that gears and gearing meet the requirements specified herein; catalog cuts may be used, where applicable, to prove conformance to AGMA Standards. Posted operating instructions shall be either attached to, or placed adjacent to, the equipment at operating platform. The Contractor shall provide all systems complete and ready for operation. All incidental piping, controls, and accessories required for complete operating systems shall be at the expense of the Contractor. Provide all control wiring and accessories in accordance with NFPA 70.
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3.2.1 Manufacturer's Data:

a. Drive components and bearings (CO)

3.2.2 Shop Drawings:

- a. Bridge, scraper arm, drive cage, scrapers, and skimmers (CO)
- b. Scum baffle and effluent weir plates (CO)
- c. Controls (CO)

- 3.2.3 Operation and Maintenance Manuals:
 - a. Drive, scraper arm, and skimmer (CO)
 - b. Spare parts catalog (CO)
- 4. MATERIALS AND EQUIPMENT:
- 4.1 Materials and Equipment, General: Clarifier equipment shall include clarifier mechanism, weirs and baffles, and piping. Structural steel shall conform to ASTM A 36. Completely or intermittently submerged steel members shall have a minimum thickness of 1/4 inch. Cast iron shall conform to ASTM A 48, Class 30 minimum, except as otherwise specified.
- 4.2 Clarifier Mechanism: Clarifier mechanism shall include sludge collector assembly; drive assembly; supporting bridge; operating platform and access walkway thereto; influent well; overload protection and alarm; and electrical control equipment. The drive shall rotate the sludge collector assembly, which shall be designed to move settled sludge to a centrally located sludge hopper. Mechanism shall be so designed that there will be no chains, sprockets, bearings (except sleeve bearings when used), or operating mechanism below the liquid surface or in contact with the liquid. The mechanism shall be assembled in the shop to ensure proper fitting of parts, match-marked for erection, and disassembled for shipment.
- 4.2.1 Design: Clarifier mechanism shall be designed to have a minumum continuous output torque rating of 2000 foot-pounds for bridge-supported units with the scraper arms rotating at a constant speed which will produce a peripheral speed of 8 to 12 fpm. Clarifier mechanism and its component parts shall be designed, with a safety factor of 2.5, to withstand all structural and mechanical stresses brought about by the following loadings: continuous output rated torque load; dead load; wind load of 115 mph; ice load of 20 psf (except on scum skimmer); and a live load of 50 psf on the access bridge or on access section of supporting bridge. Under maximum load, deflection of access bridge shall not exceed 1/240 of span. Clarifier mechanism shall be designed for continuous 24-hour service under design load without excessive wear, damage, or failure. Stresses developed under aforementioned operating conditions and loads shall not exceed stresses allowed under AISC Specification for the Design, Fabrication and Erection of Structural Steel for Buildings.
- 4.2.2 Sludge Collector Assembly: Assembly shall include scraper arms, scraper blades, and center drive cage/drum.
- 4.2.2.1 Scraper Arms: Scraper arms shall be fabricated of structural steel, using welded truss construction of triangular or box section. Steel scraper blades, with attached squeegees, shall be welded or bolted to underside of scraper arms and shall be designed to move settled sludge to a centrally located sludge hopper. Scraper arms shall be connected to center drive cage/drum by bolted or welded connections. Scraper blades shall be steel plate having a minimum thickness of 1/4 inch. Squeegees shall be of brass having a minimum thickness of 1/8 inch, and shall be

connected to scraper blades with brass bolts and nuts with provision for vertical adjustment of not less than 2 inches.

- 4.2.2.2 Center Drive Cage/Drum: Center drive cage/drum shall be fabricated of structural steel, using box truss or cylindrical drum construction. Center drive cage/drum shall be connected to drive assembly with machine screws or by a bolted connection.
- 4.2.2.3 Center Shaft: Center shaft shall be a solid steel shaft or steel pipe conforming to ASTM A 53, Schedule 40. Steel pipe shall have solid shaft stub ends or machined flange at top and steel cap at bottom.
- 4.2.3 Drive Assembly: Assembly shall include motor, speed reduction and turntable gearing, turntable bearing assembly, drive assembly bearings, and chain drives and/or belt drives. Design of drive assembly shall be such as to permit sustained operation at the continuous output torque rating without excessive wear and to develop twice the continuous output torque rating without damage to or failure of drive assembly components.
- 4.2.3.1 Motor: Motor shall be constant speed, totally-enclosed, fan-cooled, horizontal or vertical type, suitable for outdoor service, and conforming to NEMA MG-1. Motor horsepower shall be one HP minimum. Motor shall be suitable for operation on 480 volt, 3 phase, 60 hertz service. Motor shall be protected against overload, low voltage, and unbalanced voltage. Motor shall provide the starting torque needed to move sludge collector assembly from a dead stop in a dewatered clarifier tank as well as torque needed to move it under the maximum loading specified in paragraph, "Design." Motor shall be close-coupled to or on input shaft of primary speed reducer; or shall drive speed reducer by a chain or belt drive. Flexible coupling for connecting shafts of close-coupled motor and speed reducer shall conform to the applicable requirements of AGMA 511.02, 512.03, 513.01, 514.02, and 515.02. When a belt drive is used, motor position shall be adjustable to increase or decrease belt tension.
- 4.2.3.2 Speed Reduction and Turntable Gearing: Gearing for primary speed reducer shall be worm or helical or a combination thereof. Gearing for turntable shall be a worm gear reduction unit. Speed reduction and turntable gearing shall be designed with a AGMA service factor as recommended in the applicable AGMA standard (AGMA 420.04 or 440.04) when drive is operating at full load motor horsepower, 24 hours day continuous running. Gearing shall be designed to withstand any loadings produced by thrust, out-of-balance, and vibration resulting from operating conditions and shall operate from zero rpm to a speed consistent with the maximum peripheral speed specified in paragraph, "Design." All component parts of the speed reduction and turntable gearing shall be designed to permit sustained operation at the continuous output torque rating for the life expectancy specified without excessive wear and to develop twice the continuous output torque without damage to or failure of any component part. Gears shall conform to applicable requirements of the following AGMA Standards: 210.02, 211.02, 215.01, 220.02, 221.02, 225.01, 226.01, 240.01, 390.03, 420.04, and 440.04. Gears for primary reducer shall be

not less than AGMA Quality 10, AGMA 390.03. Gears for turntable shall be not less than AGMA Quality 6, AGMA 390.03. Gears shall be certified as meeting the specified quality. Worm gears shall be of cast bronze or shall have bronze rim with inner portion of cast steel or nodular cast iron. Worms shall be of hardened ground alloy steel or high-test heat treated nodular cast iron. Helical gears shall be of cast or forged alloy steel; helical angle shall not exceed 18 degrees. Spur gear shall be internal or external; shall be of cast iron, nodular cast iron, heat treated cast alloy steel, or heat treated forged steel; and shall have an endurance and strength rating of 1,000,000 cycles. Spur gear teeth shall be hardened by the through-hardening, contour-induction-hardening, nitriding, or carburizing processes; flame-hardened gears will not be acceptable. Shafts, bolting, and keys for gears shall conform to AGMA 260.02; shafts shall be of steel. An oil lubrication system shall be provided for speed reduction gearing. Bath lubrication using oil seals for containment or lubrication systems which rely upon an oil circulating pump shall include proven reliable means to stop drive motor in event of insufficient lubrication. Pressure indicating devices influenced by oil sludge or changes in oil viscosity will not be acceptable. Speed reduction and turntable gearing shall be fully enclosed in cast iron or fabricated steel housings provided with dust and oil seals.

- 4.2.3.3 Gearmotor: Where practicable, gearmotor may be used in lieu of separate motor and primary speed reducer. Motor component of gearmotor shall be as specified in paragraph, "Motor." Speed reducing component of gearmotor shall conform to the applicable requirements specified in paragraph, "Speed Reduction and Turntable Gearing," and in AGMA 460.05 and AGMA 461.01.
- 4.2.3.4 Turntable Bearing Assembly: Assembly shall include the turntable bearings upon which the turntable and attached sludge collector assembly are supported; the turntable; and the drive assembly/turntable support base. Assembly shall be designed for all radial and axial loads imposed by drive assembly and sludge collector assembly. Arrangement of component parts shall permit replacement of balls or rollers, or the bearing raceways, or complete bearing unit. Bearing raceway material shall have adequate strength to withstand all radial and axial loads and shall have a Rockwell "C" hardness of not less than 58. Turntable bearing assembly shall also be designed to support, where applicable, drive assembly, turntable, spur gear, and one end of access bridge. A bridgesupported clarifier mechanism may incorporate a submerged split-case, water-lubricated bottom guide bearing or an intermediate steady bearing where manufacturer's design requires use of such bearing in addition to turntable bearings. A design incorporating a bottom support bearing will not be acceptable. Bearing shall run in an oil bath or be greaselubricated. Turntable and drive assembly/turntable base shall be of cast iron, nodular cast iron, or steel; if of steel, these parts shall have sufficient thickness to provide the rigidity necessary to maintain alignment of sludge collector assembly. Turntable shall be cast integrally with spur gear or be fastened to the spur gear with machine screws or bolts.

4.2.3.5 Drive Assembly Bearings: Bearings shall be ball or roller bearings having a minimum rated life expectancy (L_{10}) as specified in this paragraph when clarifier mechanism is operating continuously at torque rating specified in paragraph, "Design." Load rating and fatigue life shall be based on AFBMA Std 9 and AFBMA Std 11, as applicable.

Worm and primary helical gearbox bearings Gearmotor, direct drive Gearmotor, indirect drive L₁₀ 100,000 hours L₁₀ 100,000 hours L₁₀ 17,000 hours

Bearings shall be either oil lubricated or grease lubricated.

- 4.2.3.6 Chain Drives and Belt Drives: Chain drives and belt drives incorporated in drive assembly shall include chain-and-sprocket and V-belt-and-pulley arrangements, except that belt drives shall not be used directly on the center drive cage/drum. Chain drives and belt drives shall be designed with a minimum safety factor of 4 as applied to ultimate breaking or transmission strength of the chain or belt with respect to loads transmitted at twice the continuous output torque rating of the clarifier mechanism. Chain shall be roller type conforming to ANSI B29.1 and shall have steel links. Sprockets shall conform to ANSI B29.1 and shall be of heat treated ground allow steel or of high-test cast iron conforming to ASTM A 48. Class 40 minimum, cast in a chill mold; teeth bearing surfaces shall have a Brinell hardness of not less than 360 and a minimum hardened zone depth of 3/16-inch. Sprockets shall be stress relieved before machining. Sprocket teeth shall be accurately ground to fit the chain. Belts shall be rayon corded with heat- and oil-resistant rubber covering. Sprockets, pulleys, and other motive power transmitting connections shall be key mounted. Drive sprocket or drive pulley on output shaft of primary speed reducer shall be connected to shaft by a shear-pin hub arrangement designed to protect motor against overload; sprocket shall have a bronze bushing with grease lubrication. Design of shear-pin hub arrangement shall be such that it will not bind or freeze into position, preventing it from performing its intended function. Machinery guards shall be fabricated of steel and weatherproof.
- 4.2.4 Access Bridge, Walkway, and Operating Platform: Access bridge shall be of structural steel and shall extend from tank sidewall to the center and beyond sufficient to support walkway and operating platform. The supporting bridge shall be used as the access bridge. Walkway and operating platform shall be skidproof steel raised-pattern floor plate. Walkway and operating platform shall have a double railing not less than 3 feet 6 inches in height on both sides of walkway and around outside of operating platform; railing shall be of structural steel section or of standard 1-1/2-inch pipe conforming to ASTM A 53 or ASTM A 120. Walkway shall be not less than 30 inches wide. Raised-pattern floor plate shall be of a design and material thickness necessary to keep deflection to less than 1/4-inch with a uniform load of 100 pounds per square foot.
- 4.2.5 Supporting Bridge: Supporting bridge shall include two structural steel beams and braces of sufficient depth and thickness to support

entire clarifier mechanism within the specified maximum allowable deflection.

- 4.2.6 Influent Well: The mid-tank influent well shall be structural steel, 3/16-inch minimum thickness, reinforced and stiffened with structural sections. The well shall project below the water level and shall be designed to radially diffuse and effectively still the influent liquid without short circuiting. A slot, with a baffle to prevent short circuiting, shall be provided at water level to permit escape of floating material. Where required by manufacturer's design, a standard bolted flange shall be provided for connection of the influent pipe.
- 4.2.7 Overload Protection and Alarm Device: Clarifier mechanism shall have an overload protection and alarm device designed to indicate load on the mechanism at all times, to sound an alarm in case of impending excessive load, and to stop the mechanism when such load is reached. Device shall be of the torque-actuated or indicating-ammeter type, totally enclosed, except for alarm, in a NEMA 4 enclosure. Overload alarm shall include an industrial type horn, relay, reset button, and an independent On-Off switch in weatherproof metal housing with removable gasketed cover. Horn shall be constructed of noncorrodible material and shall be suitable for remote mounting.
- 4.2.8 Electrical Control Equipment: Electrical control equipment shall include motor starter; pushbutton station; disconnect switch; and all control divices, overload protection devices, and safety devices not otherwise specified but necessary for proper and safe operation of the clarifier mechanism. Electrical control equipment shall conform to NEMA ICS 1 and NEMA ICS 2. All electrical control equipment components shall be completely wired and mounted in a control panel at manufacturer's plant and tested prior to shipment. Enclosures for electrical controls shall be NEMA Type 4. Controls shall be located on access bridge at or near the drive assembly. Electric service available is 480 volts, 3-phase, 60 Hertz, 4 wire. Connecting electrical wiring and related equipment are specified in Section 16402, "Interior Wiring Systems".
- 4.2.8.1 Motor Starter and Pushbutton Station: A pushbutton actuated magnetic motor starter with overload and undervoltage protection shall be provided for the motor. Starter shall have thermal overload protection in each phase and short circuit protection. Overload protective devices shall give adequate protection to motor windings, shall be of thermal inverse—time—limit type, and shall include manual—reset type pushbutton on outside of motor starter enclosure. Pushbutton station shall be 2—button Start—Stop. Pushbuttons shall be clearly and properly marked.
- 4.2.8.2 Wiring: All control circuits shall be wired with No. 14 gauge stranded machine—tool wire with compression type lugs and number tags on both ends of all wires. Wires shall be secured in a neat workmanlike manner with plastic cable ties and/or in wiring duct.

- 4.2.9 Lubrication Fittings: Bearings and other moving parts subject to wear shall be provided with adequate means for lubrication. Except as otherwise specified in this section, lubrication shall be by grease or oil, as suitable. Greased bearings shall be provided with fittings suitable for grease gun service. Where grease fittings would not be easily accessible, grease tubing shall be extended to a convenient location. Grease fittings shall be of a type that prevents overlubrication and building-up of pressure injurious to the bearings. Each oil reservoir shall be liberal in size and provided with an opening for filling, an overflow opening at the proper location to prevent overfilling, an oil-level sight glass, and a drain at the lowest point.
- 4.2.10 Key Mounted Connections: Where connections between shafts and sprockets, gears, pulleys, and other component parts are specified to be key mounted, keys and keyways shall conform to ANSI B17.1 or ANSI B17.2.
- 4.2.11 Weir Plates: Weir plates shall be steel. Weirs shall be V-notched and of size and section as indicated. Weir plates and baffles or their supports shall have slotted or oversize holes and plate washers as indicated to permit horizontal and vertical adjustment of the weir and baffle. Weirs and baffles shall have overlapping splice plates as indicated to ensure proper alignment. Sealant for mounting weir plates shall be a two-component polysulfide-rubber-base sealant.
 - 4.3 Influent, Sludge Removal, and Effluent Piping:
- 4.3.1 Sleeves and Wall Castings: Sleeves and wall castings shall conform to AWWA C110, with sizes and joints as indicated.
- 4.4 Anchor and Connecting Bolts, Nuts, and Washers: Iron and steel shall be attached with zinc-coated steel, stainless steel, or cadmium-plated steel machine bolts. Aluminum shall be attached with stainless steel machine bolts. Steel bolts shall conform to ASTM A 307, ASTM A 325, or ASTM A 449. Nuts shall conform to ASTM A 563, Grade as specified for the bolt material used. Zinc-coating shall be in accordance with ASTM A 153. Stainless steel shall be AISI Type 302. Bolt sizes and locations shall be as shown on the approved shop drawings for the equipment, except as otherwise indicated. Templates shall be furnished for accurate positioning of anchor bolts.
- 4.5 Grout Materials: Cement, fine aggregate, and water shall be as specified in Section 03302, "Cast-in-Place Concrete."
- 4.6 Spare Parts: Spare parts shall be identical and interchangeable with original parts and shall be furnished in clearly marked containers. Spare parts shall be the standard ones recommended be the manufacturer in his operation, maintenance, or instruction manual, furnished in the number recommended and shall include shear pins and one year's supply of recommended lubricants.

- 4.7 Tools: Special tools necessary for the proper maintenance and operation of the equipment shall be furnished together with a properly identified hardwood or metal box for their storage.
- 5. MATERIALS PROTECTION: Except as specified otherwise herein, sandblast exposed surfaces of ferrous metals, including those to be submerged, in accordance with SSPC-SP10; and apply a four-coat system conforming to Mil. Spec. MIL-P-24441. Apply the system in the following order: one coat of Formula 150, one coat of Formula 151, one coat of Formula 156, and one coat of Formula 152. Final total dry film thickness shall be not less than 10 mils. Maximum time between coats shall be 72 hours. The following items shall be finished in accordance with the manufacturer's standard practice suitable for end use environment: Motors, gearmotors, speed reducers, chains, sprockets, shafts, exposed drive train elements, and pushbutton stations.

6. INSTALLATION AND CONSTRUCTION:

- 6.1 General: Install clarifier equipment in accordance with the recommendations of the manufacturer of the clarifier mechanism, as approved. Take special care to correctly align equipment components. The Contractor shall procure the services of an engineer representative of the manufacturer of the clarifier mechanism to inspect the equipment after erection, for final inspection, startup, and acceptance tests. The representative shall also be available at the clarifier site for a period of not less than one day to instruct operating personnel during initial operation period.
- 6.2 Surfacing of Clarifier Tank Floor: Following installation of the clarifier mechanism, bring clarifier tank floor to finish grade by means of cement-mortar grout surfacing swept into place by use of the sludge collector arms, as herein specified. Do not begin surfacing operation until after the installed equipment has been inspected by the engineer representative of the manufacturer and scraper arms and scraper blades have been adjusted to give correct clearance above final floor elevation. Perform surfacing operation in accordance with the approved recommendations of the manufacturer of the clarifier equipment, except as otherwise specified in this paragraph. If grout proportions for the surfacing are not given in the manufacturer's recommendations, use a cementmortar grout composed of one part cement and three parts fine aggregate with sufficient water as needed for conditions of placement and with one teaspoon of powdered aluminum added per bag of cement. Immediately before the surfacing operation is begun, clean the floor thoroughly of all dirt. soil, and other substances which would prevent the proper bonding of the surfacing to the concrete subfloor. If the manufacturer's recommended procedure calls for use of straightedges attached to scraper arms, these may be rotated manually after the grout surfacing has been brought to finish grade as nearly as possible by hand; use of drive unit for sweeping in grout surfacing will not be permitted. Make provision to prevent grout from entering sludge cone; immediately remove any grout which falls in the sludge cone or on clarifier tank walls. Immediately after surfacing

operation is complete, thoroughly clean clarifier tank floor and circular clarifier equipment of deposit of excess grout and other materials.

6.3 Weirs: Mount weir plates against a double bead of the sealant previously specified for this purpose. Use sufficient thickness of sealant to fill all voids between concrete tank and weir plates.

7. FIELD TESTS AND INSPECTIONS:

- 7.1 General: The Contractor shall perform all field tests and provide all labor, equipment, and incidentals required for tests, except that electric power and water needed for field tests will be furnished by the Government in accordance with Division 1. As an exception to requirements that may be set forth elsewhere in this contract, the Contracting Officer will witness all field tests and conduct all field inspections. The Contractor shall give the Contracting Officer ample notice of dates and times scheduled for tests.
- 7.2 Tests: Test circular clarifier mechanism as in operation to demonstrate correct alignment, smooth operation, proper adjustment of flow distribution, freedom from vibration, and freedom from noise and overheating of moving machinery. Include in test at least two full cycles of successful operational sequences to demonstrate that the system continues to function satisfactorily after meeting all operational requirements.

*** END OF SECTION ***

SECTION 11600

PROPORTIONAL SAMPLERS

PART 1 - GENERAL

1.1 SCOPE: The Contractor shall provide complete the combination proportional samplers and refrigeration units at the locations indicated on the drawings.

1.2 DESCRIPTION:

- 1.2.1 The samplers shall be designed to be paced from time or from flow. Therefore, to assure successful operation of the samplers, they must be closely coordinated with the instrumentation suppliers. The Contractor shall provide all systems complete and ready for operation. All incidental piping, controls, and accessories required for complete operating systems shall be at the expense of the Contractor. Provide all control wiring and accessories in accordance with NFPA 70.
- 1.2.2 The samplers shall be taken with two stainless steel cups which will deliver one ounce each. The total volume range shall be from 70 ounces to 1000 ounces per 24 hours.
- 1.2.3 The sample shall be delivered to the sample refrigeration through a tube and there stored in plastic jugs until picked up by the operator.
 - 1.2.4 Location of Sampler Units (two units required total):
 - a. Inlet structure to be paced by timer.
 - b. Plant effluent from the chlorine contact chamber flow, to be paced by signal from plant effluent flow transmitter
- 1.3 SUBMITTALS: Partial submittals will not be acceptable. Annotate descriptive data to show the specific model, type, and size of each item the Contractor proposes to furnish. Prepare shop drawings on sheets not smaller than 30 inches by 42 inches, and include data essential to the proper installation of each system. Do not commence work until the design of each system and the various components have been approved. The submittal requirements of Section 15011, "General Requirements, Mechanical", applies to the following lists. Items in the following lists (which are followed by (CO)) shall be approved by the Contracting Officer.
 - 1.3.1 Manufacturer's Data:
 - a. Samplers and refrigerators (CO)

1.3.2 Shop Drawings:

- a. Loop drawings (CO)
- b. Mounting details (CO)

1.3.3 Operation and Maintenance Manuals:

- a. Sampler, refrigerator, and interconnection (CO)
- b. Spare parts catalog (CO)

PART 2 - PRODUCTS

2.1 SAMPLER:

2.1.1 Materials: The unit shall be constructed of stainless steel housing. Chain drive, sprockets, and sample bucket shall be type 304 stainless steel.

2.1.2 Design:

- 2.1.2.1 The devices shall be designed to provide programming capability proportionate to flow. They shall be equipped with a variable programming 8-stage mechanical cam rotor which can be set to lift one sample every 15, 7.15, 3.75, or 1.88 minutes. The programming module shall be designed to automatically deliver samples on the basis of time and/or flow. A manual override sampling activator shall be provided which does not alter preset cycling sequence. Panel light shall be provided to indicate whether unit is in operation and stage of sampling cycle.
- 2.1.2.2 The units shall contain a timer designed to produce from 4 to 32 cycling signals per hour which can be set to activate the gear-drive motor. Unit shall contain a gear-drive motor with built-in stop-brake mechanism on power cut-off and operating pilot light. The entire circuit shall be protected with a standard automotive type cartridge fuse replaceable from exterior of control panel.
- 2.1.2.3 Liquid discharge spout shall be of a size capable of accepting standard 1-inch I.D. plastic transfer tubing and designed so as not to obstruct gravity flow of the discharged sample. Two fiberglass angle brackets shall be provided for clamping unit in position and for adjusting height. The samplers shall discharge into a refrigerator unit. Tubing shall be provided as recommended by the manufacturer.
- 2.1.2.4 The samplers shall be capable of being mounted above the stream to be sampled and provide for gravity flow of collected samples to a refrigeration unit mounted adjacent to the stream and sampler.
- 2.1.2.5 Hand-off-automatic switches with relay shall be provided and mounted on the face plate to control each sampler. The switches shall each provide for three sampler operating modes: (1) Manual = ON, (2) OFF, (3) AUTOMATIC = "Paced from Flow".

- 2.1.2.6 Included with the hand-off-automatic switches will be a 120-volt relay to drive the sampler motors.
- 2.1.2.7 Provide a 120 volt, 200 watt space heater with thermostat set at 40°F mounted in sampler to protect unit from freezing.

2.2 REFRIGERATOR:

2.2.1 General: The refrigerator portion shall be equipped with two 5-gallon capacity plastic jugs and all sample transfer tubing. Refrigeration systems shall be a hermetically sealed cold-wall type with an adjustable thermostatic control ranging from 35°F to 50°F. It shall be suitable for outdoor operation and mounted on a concrete pad.

2.2.2 Materials:

- 2.2.2.1 Exterior face shall be of one piece, die formed type 304 stain ess steel.
- 2.2.2.2 Door interior shall be one piece, pressure formed, high impact plastic material with positive magnetic gasket seal.
- 2.2.2.3 The walls of the compartment shall be insulated with 2-inch blown-in polyurethane foam providing a 0.15 K factor completely devoid of seams.
- 2.2.2.4 Condensing unit to be hermetically sealed with capillary hook-up to forced air blower coil system installed at rear of unit.
- 2.2.2.5 A specially designed weather resistant cover for the compressor compartment shall be provided. It shall be designed to permit air circulation and to protect the compressor chamber from the elements. The entire back of the refrigerator, including the evaporator grill and compressor shall be painted in the factory with a dark color epoxy enamel.
- 2.2.2.6 The unit shall stand on 6-inch stainless legs with leveling adjustment. Power supply to be 115-volt, 60 cycle, 4 amp, total load. A 3-wire, 8-foot grounded cord and plug to be provided.

PART 3 - EXECUTION

3.1 INSTALLATION:

- 3.1.1 Samplers: The sampler shall be mounted in the flow stream where indicated at the influent to the plant and the discharge of the chlorine contact basin. Attachment to the concrete walls shall be by means of galvanized structural steel members and anchor bolts.
- 3.1.2 Refrigerator: The refrigerator shall be mounted on the indicated concrete pads. Provide hold down clamps as required.

- 3.2 TEST: After installation, the sampler shall be tested at several different time cycle rates and on a flow proportional basis. Make necessary adjustments for the unit to operate as specified.
- 3.3 START-UP SERVICE: The supplier shall furnish the services of a factory trained representative to check the equipment out after installation, supervise the initial start-up and to instruct operating personnel in the operation of the equipment. Service included shall be for a minimum of one 8-hour manday.

SECTION 11961

CHLORINATION EQUIPMENT

PART 1 - GENERAL

- 1.1 SCOPE: The Contractor shall provide chlorination equipment and all necessary accessories for the plant disinfection chlorination system, complete, as shown and/or specified herein.
 - 1.2 DESCRIPTION: Plant disinfection chlorination system:
- 1.2.1 The chlorinators (two required) shall be the cabinet mounted automatic proportioning solution feed, vacuum type, having the following capacity:
 - a. Maximum feed rate 100 lbs/day
 - b. Minimum feed rate 5 lbs/day
- 1.2.2 Pacing shall be automatically controlled to feed in proportion to the flow at the 18-inch rectangular weir at the effluent end of the chlorine contact basin by signal from the effluent flow meter. The Contractor shall be responsible for coordinating the flow meter with chlorinators for satisfactory automatic operation. The meters are specified in Section 13625, "Flow Measuring Equipment". The Contractor shall provide all systems complete and ready for operation. All incidental piping, controls, and accessories required for complete operating systems shall be at the expense of the Contractor. Provide all control wiring and accessories in accordance with NFPA 70.
- 1.2.3 Provide a distribution panel to permit either chlorinator to feed solution.
- 1.2.4 Provide an automatic changeover system for uninterrupted supply of gas flow to the chlorinators.
- 1.2.5 Provide chlorine solution distribution system including diffuser.
 - 1.3 REFERENCED STANDARDS:
 - 1.3.1 The Chlorine Institute. Inc:

Publication 60 Chlorine Pipelines (4/82)

- 1.3.2 American Society for Testing and Materials (ASTM) Publications:
 - A 53-80 Welded and Seamless Steel Pipe
 - D 1785-76 Polyvinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120

1.3.3 American National Standards Institute (ANSI) Publication:

B16.11-80 Forged Steel Fittings, Socket Welding and Threaded

1.3.4 Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS):

SP-78-1970 Cast Iron Plug Valves

SP-80-1974 Bronze Gate, Glove, Angle, and Check Valves

1.4 SUBMITTALS: Partial submittals will not be acceptable. Annotate descriptive data to show the specific model, type, and size of each item the Contractor proposes to furnish. Prepare shop drawings on sheets not smaller than 30 inches by 42 inches, and include data essential to the proper installation of each system. Do not commence work until the design of each system and the various components have been approved. The submittal requirements of Section 15011, General Requirements, Mechanical applies to the following lists. Items in the following lists (which are followed by (CO)) shall be approved by the Contracting Officer.

1.4.1 Manufacturer's Data:

- a. Chlorinators, distribution panel, and automatic changeover system (CO)
- b. Piping valves and fittings (CO)
- c. Chlorine handling and storage equipment (CO)
- d. Safety equipment (CO)
- e. Residual chlorine tester (CO)

1.4.2 Shop Drawings:

- a. Mounting and connection of chlorinator system and piping (CO)
- b. Mounting of chlorine handling and storage equipment (CO)
- c. Mounting of safety equipment (CO)

1.4.3 Certificates of Compliance:

- a. Chlorinators (CO)
- b. Safety equipment (CO)

1.4.4 Operation and Maintenance Manuals:

- a. Chlorinators, distribution panel, and automatic changeover system (CO)
- b. Safety equipment (CO)
- c. Spare parts catalog (CO)

1.5 SPARE PARTS:

- 1.5.1 Provide one set of spare parts normally required for one year's operation for each chlorinator, properly packaged for storage and marked for usage.
- 1.5.2 Provide one year's supply of chemical solution for the chlorine gas detectors.

PART 2 - PRODUCTS

2.1 GENERAL:

- 2.1.1 All equipment, piping, and valving shall be designed, manufactured and installed as a minimum in accordance with the latest recommendations of The Chlorine Institute's Standards, "Chlorine Pipelines".
- 2.1.2 The chlorination system specified shall be the product of one manufacturer.
 - 2.2 PLANT DISINFECTION CHLORINATION SYSTEM:

2.2.1 Chlorinators:

- 2.2.1.1 The chlorinators shall be the automatic proportioning, floor mounted, solution feed vacuum type of the capacities indicated. Flow rates shall have a 20 to 1 adjustable range.
- 2.2.1.2 The unit components shall be located in a chlorination module. The module shall be floor mounted free standing of fiberglass construction. The unit and its components shall be constructed of materials completely resistant to corrosive attack by chlorine gas or solution as recommended in "The Chlorine Manual" of the Chlorine Institute.
- 2.2.1.3 Pressure gauge (0-100 psig), injector vacuum gauge (0-30 inches), and rotometer feed rate adjuster shall be mounted on front of module. The gauges shall be diaphragm protected standard of the manufacturer.
- 2.2.1.4 Provide alarm contacts to activate at loss of vacuum and loss of pressure. These alarm signals shall activate alarm annunciators at the plant monitor panel in the control building. Provide switches to disengage alarm signals where chlorinator is in standby mode.
- 2.2.2 Distribution Panel: A two-in one-out distribution panel mounted on the wall, where shown, shall be provided to receive the chlorine solution lines from the chlorinators and distribute the solution to the point of chlorination. Chlorine is to be added as shown at the influent to chlorine contact chamber. Panel piping and valves shall be size 2-inch. Valves shall be Saunders type uscolite diaphragm valves. Fittings, piping, and hose adaptors shall be uscolite.

2.2.3 Automatic Changeover:

- 2.2.3.1 An automatic changeover system shall be provided to permit withdrawal of chlorine from the ton containers until the pressure reaches a predetermined low value (5 to 10 pounds). At that time, a signal from the pressure switch then reverses the position of two ball valves, shutting off the low supply and opening the full supply. The system shall also signal this change and hold this signal until the empty containers are replaced and the system has been reset. All necessary accessories for proper operation of the automatic changeover system complete shall be provided.
- 2.2.3.2 The automatic valves shall be motorized ball valves suitable for 120 volt operation.
- 2.2.3.3 Provide a local control box with indicator lights indicating cylinder set in use, in standby and empty.

2.3 PIPING AND VALVES:

- 2.3.1 General: Piping and valves shall be of the size indicated on the drawings.
- 2.3.2 Flexible Connectors: Flexible connectors shall be provided for connections of each of the active chlorine cylinders to the manifold piping. The connectors shall have cylinder isolating valves at one end and header valves at the other. Material of construction shall be 3/8-inch 0.D. cadmium-plated soft copper tubing.
 - 2.3.3 Manifold Piping and Gas Transport Piping:
 - 2.3.3.1 Piping shall be Schedule 80 seamless steel pipe, ASTM A 53.
- 2.3.3.2 Fittings shall be 3000 pound C.W.P. forged steel fittings, ANSI B16.11.
- 2.3.3.3 Unions shall be tongue and groove ammonia type with lead gasket.
- 2.3.3.4 Line valves shall be rising stem, threaded connection type with 5-1/2 inch diameter operator. Gate and check valves shall conform to MSS-SP-80 and plug valves shall conform to MSS-SP-78, except plug valves shall be constructed of bronze.
- 2.3.3.5 Solution Feed Lines: Piping for chlorine solution line and solution dilution water line shall be solvent weld joints or flanged joint conforming to ASTM D-1785, Schedule 80, with ASTM D2467 fittings and ASTM D2564 solvent cement for joining.
- 2.3.4 Pressure Reducing Valves: The pressure reducing valves shall be self-activated, diaphragm type in which the gas pressure is automatically regulated to a uniformly controlled valve and maintain a constant

flow within plus or minus 4 percent for any given setting of rate of feed. The pressure setting shall be field adjustable from 15-45 psig. The valve seat shall be constructed of non-metallic corrosion resistant material to provide positive seating action and absolute shut-off on valve closure.

- 2.3.5 Diffuser: Provide one open channel type diffuser to be bolted to the concrete floor perpendicular to the sewage flow. The diffuser shall be sized for the chlorine dosage indicated. The diffuser shall be of rigid PVC resistant to chlorine solution and perforated.
- 2.3.6 Ejector: The ejector shall receive all chlorine and make-up water and discharge the resulting solution to the chlorine contact tank at the location indicated. A check valve which will prevent water backing into the ejector suction line shall be provided. The vacuum regulator valve shall automatically close when ejector water supply or ejector vacuum is lost.
 - 2.4 CHLORINE SOLUTION WATER PUMP:
- 2.4.1 Pump Description: The chlorine solution water pump shall be a regenerative turbine type pump with the following characteristics:
 - a. Capacity 10 gpm (increase to match ejector if necessary)
 - b. Total dynamic head 75 feet
 - c. NPSH 5 feet
 - d. RPM 1750
 - e. Construction:
 - 1. Body bronze
 - 2. Cover bronze
 - 3. Liners bronze
 - 4. Impeller bronze
 - 5. Shaft stainless steel
 - 6. Glands bronze
 - 7. Packing graphite asbestos
 - 8. Gaskets neoprene
 - f. Motor 3/4 HP. TEFC
 - g. Electrical 120 volt, single phase, 60 Hz
- 2.4.2 Controls: The pump shall be controlled by a push button "on-off" switch in the chlorine room. Controls shall include motor starter, circuit breaker, disconnect switch, elapsed time meter, and local push button "on-off" switch in a weatherproof enclosure.
- 2.4.3 Spare Pump: Provide one spare pump as described in paragraph
 2.4.1 packaged for long-term storage.
 - 2.5 BULK CHLORINE STORAGE AND HANDLING:
 - 2.5.1 Chlorine:

- 2.5.1.1 The Contractor shall include in his work the provision of 12,000 pounds of chlorine in ton containers.
- 2.5.1.2 The Government shall provide the chlorine and all required cylinder deposits, etc.
- 2.5.2 Chlorine Lifting Bar: Provide one chlorine ton cylinder lifting bar. The bar shall be hot dipped galvanized in accordance with ASTM A123 after fabrication.

2.5.3 Trunnions:

- 2.5.3.1 Provide one set of chlorine cylinder trunnions for each ton cylinder indicated. The trunnions shall be hot dipped galvanized after fabrication.
- 2.5.3.2 Anchor bolts for the trunnions shall be stainless steel expansion sleeve type studs.
- 2.5.4 Dial Scale: Provide one heavy duty dial scale for the purpose of weighing the chlorine cylinders. The dial shall be a minimum of 12 inches in diameter graduated from 0 to 4,000 pounds. Weight measurement accuracy shall be plus or minus 5%. The scale shall be complete with lifting hook and D-ring.

2.6 SAFETY EQUIPMENT:

- 2.6.1 Self-Contained Breathing Apparatus: Provide one self-contained breathing apparatus, with full plate face mask, harness, regulator, and OSHA approved for chlorine gas, for use in emergency. The pressure tank shall be of the capacity to contain a minimum of a 30 minute air supply. An adjustable timer mounted on the harness shall sound a bell when time has expired. The air pack shall be mounted in a storage box outside the entrance door of the chlorine room.
- 2.6.2 Chlorine Gas Leak Detectors: Two chlorine gas leak detectors shall be provided complete where shown to continuously monitor the chlorine in the ambient air with a sensitivity of not less than 1 ppm chlorine. The unit shall consist of an electrolyte tank with a level indicator and an air filter. When chlorine-laden gas enters the sensor chamber, chlorine reacts with the electrolyte at the electrodes to produce an electrical current. The current is amplified in the solid state electronic unit to light a built-in red alarm and de-energize a double-pole, double-throw relay. The relay contacts shall be wired to a terminal strip and shall activate operation of the exhaust fan and closure of chlorine shut-off valve and activate the remote alarm in the plant monitor panel and a local alarm horn. Supply brackets for wall or steel rack mounting.

2.7 RESIDUAL CHLORINE TESTER:

2.7.1 Provide one portable amperametric titrator capable of determining the end point in titrations for chlorine residuals with accuracy to 0.01 mg/l in accordance with Standard Methods for the Examination of Water

and Wastewater. The unit shall be completely portable with self-contained rechargeable battery and also shall be capable of operating on 120 volts.

- 2.7.2 Provide suitable carrying case.
- 2.7.3 Provide 500 ml phenylarsine oxide titrant and 500 ml potassium iodide in droper bottle; phosphate buffer solution, pH = 7; acetate buffer solution, pH = 4.

3. TESTING:

- 3.1 Start-Up Services: The supplier shall furnish the services of a factory trained representative to check the equipment after installation, perform all tests specified herein, and to instruct operating personnel in the operation of the equipment. Services shall include two 8-hour mandays.
- 3.2 Chlorinator Equipment: The unit shall be operated for a period of not less than 6 hours. The tests to be performed shall be as follows:
 - a. The unit shall be checked for leaks. This shall be done by using an aqueous ammonia solution on a cotton or cloth swab on a wooden stick held close to all connections of the chlorinator.
 - b. Determine the amount of chlorine used during the test run to ascertain if the unit is functioning within the prescribed limits of 4 percent of the set feed rate.
 - c. The chlorinator shall be stopped when the water supply is interrupted or shut off.
 - d. When the gas supply is exhausted or shut off, there shall be no back-flow of water into the unit.

SECTION 13440

CENTRAL MONITORING PANEL

PART 1 - GENERAL

- 1.1 APPLICABLE PUBLICATIONS: 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.
 - 1.1.1 National Fire Protection Association (NFPA) Publication:

70-1981 National Electrical Code (NEC)

1.1.2 Underwriters' Laboratories, Inc. (UL) Publication:

57-1972 Electric Lighting Fixtures (Aug 80)

- 1.2 GENERAL REQUIREMENTS: Section 16402, "Interior Wiring Systems", applies to this section with additions and modifications specified herein.
 - 1.3 SUBMITTALS:
 - 1.3.1 Manufacturer's Data:
 - a. Lamps
 - b. Relays
 - c. Enclosure
 - 1.3.2 Shop Drawings:
 - a. Wiring schematic
 - b. Layout with parts indication

PART 2 - PRODUCTS

- 2.1 MATERIALS AND EQUIPMENT: All materials, devices, and equipment shall, as a minimum, meet the requirements of UL where UL standards are established for those items and requirements of NFPA 70. All items shall be new unless specified or indicated otherwise.
 - 2.2 GENERAL DESIGN CRITERIA:
- 2.2.1 Electrical components of the system shall operate on 24 volt, single-phase, 60 cycle current, except as otherwise noted in the specifications. The panel shall contain a 24/120 volt control transformer. Power to the panel shall be 120 volts.

- 2.2.2 Finish: Components shall be finished to the manufacturer's standard for the service intended unless otherwise indicated in the specifications or on the drawings. All components located in clusters or on the same panels shall be finished alike.
- 2.2.3 Completeness: These specifications cover the intended functions of the equipment, but do not necessarily cover all details necessary for a complete, operating, and functional system. The manufacturer shall supply the devices and appurtenances necessary to provide a complete, operable, and satisfactory system as indicated or specified.
- 2.2.4 Surge and Transient Protection: Equipment shall be fully protected against voltage surges or transient voltages.

2.3 SPECIFIC DESIGN CRITERIA:

2.3.1 General: The Contractor shall furnish and install the central monitoring status display panel as indicated on the drawings. The general arrangement as indicated on the attached Sketch 1 shall be followed in detail design of the panel to produce a coordinated panel system.

2.3.2 Panel:

- 2.3.2.1 Enclosure: The panel shall consist of a heavy duty steel enclosure, minimum 14 gauge steel, adequately braced for rigidity. Pan type access door shall be provided on the front with piano hinges and flush slotted latch. All exterior welds shall be ground and sanded to a smooth finish.
- 2.3.2.2 Wiring: All display lamps, nameplates, etc., shall be mounted on the panel front and wired to terminal blocks with identifying numbers. All wiring shall be neatly bundled with wire ties in related bundles of no greater than 12 wires each and all wiring shall be identified by color coding and numbering. All external electrical connections shall be made to pressure type terminal at the bottom of each panel section. A control circuit breaker of adequate size for the equipment within the panel shall be provided inside each panel section for disconnecting 115 volt control power. Fuses shall be provided in individual circuits as required for proper protection. Wiring shall be Type XHHW, flame retardant, cross linked polymer, 600 volt rating, sized per National Electrical Code for load requirements.
- 2.3.2.3 Relays: Relays where practical shall be of plug-in type with tract mounted Pc Board sockets. All field contacts shall be rated 10 amps.
- 2.3.2.4 Nameplates: Each lamp shall be marked for identification with permanently mounted, engraved white with black lettering laminated plastic nameplates stating name and/or function of device.

2.3.2.5 Status Lights: Annunciator and motor driven status light displays shall be furnished for mounting as indicated on the drawings. An acknowledged button shall be furnished for each alarm light. The alarm system shall function as follows:

Condition	Signal Lamp	Alarm (Audio/Visual)
Normal	Dim	OFF
Alert	Bright	ON
Acknowledged	Dim	OFF

The status lights shall consist of 1/2" diameter lamps. Lamps shall be dim when indicating the off condition and bright when indicating the on condition.

- 2.3.3 Alarm Horn: Provide an alarm horn suitable for mounting to a 3/4" nipple. Horn shall be 6 inches in diameter and emit 120 dB at 10 feet. The panel shall contain a pulsing mechanism for the alarm horn. The alarm horn shall be mounted on an exterior light pole. Alarm horn shall operate on 120 volt, single-phase, 60 cycle current.
- 2.3.4 Alarm Light: Alarm light shall be provided for mounting to a 3/4" nipple and shall be a fixture equal to Hubbell WB-270, Crouse Hinds, VXHBF22GP or Appleton VPWB10756 with red globe and guard and UL listed for wet locations. Light shall operate on 120 volt, single-phase, 60 cycle current.

PART 3 - EXECUTION

3.1 INSTALLATION:

- 3.1.1 All instrumentation and controls shall be securely mounted as recommended by the equipment manufacturer.
- 3.1.2 Electrical and control wiring shall be installed in accordance with Section 16402, "Interior Wiring Systems" unless otherwise indicated.
- 3.2 FIELD TESTS: The entire monitoring system shall be tested by simulation or actual operation of all equipment monitored. Simulations will require manual activation of the signal producing equipment and not short circuiting.

3.3 PAINTING:

- 3.3.1 All equipment shall be shop finished.
- 3.3.2 Provide sufficient touch-up paint to repair damage to the surface that may be incurred in shipping.

13440-4

*** END OF SECTION ***

R A 6 R 0 R 6 (6) (R) 0 ON OFF ON OFF ON OFF ON OFF ON OFF LAGOON PUMP Nº 1 LAGOON PUMP Nº 2 ORGANICS RETURN PUMP GRIT COMMINUTOR DRIVE 0 (1) 0 6 0 R 0 (9) (8) R R 6 OFF ON OFF ON OFF ON OFF ON OFF ON OFF ON PRIMARY CLARIFIER SCUM PUMP Nº 2 PRIMARY SECONDARY CLARIFIER Nº 2 PRIMARY CLARIFIER Nº 1 PRIMARY CLARIFIER Nº 2 CLARIFIER SCUM PUMP SECONDARY CLARIFIER Nº 1 (2) 6 0 R 0 R (1) 0 (1) 0 R 0 ON OFF ON OFF ON OFF ON OFF ON OFF ON OFF ENCLOSURE TRICKLING FILTER N°I LIFT PUMP N° 2 TRICKLING FILTER Nº I LIFT PUMP Nº 3 TRICKLING FILTER N°2 LIFT PUMP TRICKLING FILTER N°2 LIFT PUMP Nº 3 TRICKLING FILTER Nº I LIFT PUMP FILTER N°2 LIFT PUMP Nº2 Nel R 0 (8) 0 (8) 6 R (2) 6 R 6 0 OFF ON OFF OFF ON OFF ON OFF ON ON OFF ON PRIMARY CLARIFIER WASTE SLUDGE PUMP Nº I PRIMARY CLARIFIER WASTE SLUDGE PUMP Nº 2 SECONDARY CLARIFIER WASTE SLUDGE PUMP Nº1 SECONDARY CLARIFIER WASTE SLUDGE PUMP Nº2 AEROBIC DIGESTER SUPERNATE PUMP CHLORINE SOLUTION WATER PUMP 0 (8) 0 (8) 0 R 0 (8) ALARMS 0 SCUM PUMP WET WELL ON OFF ON OFF ON OFF ON OFF 0 AEROBIC DIGESTER BLOWER Nº I AEROBIC DIGESTER BLOWER Nº 2 SLUDGE DRYING BED UNDERDRAIN PUMP NºI SLUDGE DRYING BED UNDERDRAIN PUMP Nº2 TF PUMP WET WELL 0 ALARM TEST RESET SCS PUMP WET WELL 0

CENTRAL MONITORING PANEL

NOT TO SCALE

NOTE: LETTERING TO BE 0.40" HIGH LIGHTS TO BE 0.50" IN DIA.

> R = RED G = GREEN Y = YELLOW

SECTION 13625.1

FLOW MEASURING EQUIPMENT (SEWAGE TREATMENT PLANT) VARIABLE HEAD METER FOR OPEN CHANNEL

PART 1 - GENERAL

- 1.1 DESCRIPTION: The flow measuring equipment shall be the variable head meter type for open channel. The design shall permit ease of installation and shall not have any features hazardous to personnel or detrimental to the equipment. Align and adequately lubricate moving parts. Interior parts shall be easily accessible for adjustment, repair, and replacement. The flow meters shall include flow meters for the following:
 - a. Effluent flow meter at chlorine contact chamber
- 1.2 GENERAL REQUIREMENTS: For proper protection, one copy of all instruction sheets giving the proper field handling and installation requirements of the manufacturer shall be attached to, or accompany, each device. The Contractor shall provide all systems complete and ready for operation. All incidental piping, controls, and accessories required for complete operating systems shall be at the expense of the Contractor. Provide all control wiring and accessories in accordance with NFPA 70.

1.3 SUBMITTALS:

- 1.3.1 Manufacturer's Literature and Data: Submit and obtain approval for manufacturer's literature and data on all components of flow measuring equipment.
- 1.3.2 Certified Test Reports: Submit certified copies of the following:
 - a. Perform calibration and submit certified test report for flume in variable head meter for open channel.

PART 2 - PRODUCTS

- 2.1 MATERIALS AND EQUIPMENT: Unless otherwise specified, all materials and equipment shall be standard commercial products in regular production by the manufacturer and suitable for the required service.
- 2.1.1 Variable Head Meters for Open Channel: The meters shall include weirs as head producers, float and cable as head measurement, and an indicator, a recorder, and a totalizer as read-out devices. Remote transmission also shall be included. Provide meter for plant effluent flow where indicated.

- 2.1.1.1 Weirs: The weirs shall be of the rectangular type as indicated. The weirs shall measure the flow of 0 to 1.5 mgd. The upstream face of the weir plate shall be flat and smooth. Any bolts or rivets used to fasten the plate shall be countersunk flush with the plate. Bolt holes shall include provision for adjustment of height and level. The edges of the weir plate exposed to flow shall not exceed 1/8 inch in thickness; where thicker plates must be used, the edge shall be beveled 45 degrees or more to the required 1/8 inch. Make the weir plate of Type 316 stainless steel.
- 2.1.1.2 Float and Cable: The float and cable shall have a range as indicated below. Measure the crest level in a stilling well as indicated. The measuring system shall include a float, cable, drum, transfer gear assembly, and cam mechanism so as to result in uniformly graduated units of flow. The float shall be of polyester, stainless steel, or copper and of a weight and shape that conform to the application requirements. The cable shall be plastic-coated multi-strand stainless steel, stainless steel beads, or multi-strand monel. Groove the drum to prevent overlapping of the cable. Provide the float and cable with stops to prevent overranging and to provide a zero adjustment. All materials of construction shall be corrosion-resistant. Provide protection tubes for the cables. Accuracy shall be plus or minus 2 percent of the actual rate over a 5 to 1 range.

Flow Meter	Low	High	Weir	Maximum
	Range	Range	Width	Head
Effluent	0	1.5 MGD	18 inches	7 inches

- 2.1.1.3 Read-Out Device: Provide the head measuring device with the following read-out device which shall read from 0 to 1.5 mgd for plant influent and plant effluent and 0 to 0.6 mgd for recirculation flow. (For further detailed description, see paragraph entitled "Remote Read-Out".)
 - a. Local Read-Out and Remote Transmission: Provide the float and cable with an indicating transmitter, a recording transmitter, and a totalizer for local read-out and remote transmission of flow to the remote read-out. The scale graduations shall be uniform.
 - b. Remote Read-Out: This includes an indicator, recorder, and a totalizer for remote readout of flow.
 - 2.2 READ-OUT DEVICE: Provide the meter with the following:
- 2.2.1 Local Read-Out and Remote Transmission: The read-out shall be visible through a shatterproof clear window. Make the read-out transmission without creating any problem with taking the flow measurement. The read-out and transmission mechanism shall not be affected by the intended end use of environment. The transmission shall be impulse duration type or milliampere d.c. analog signal type or null-balance

inductance-bridge type to the remote read-out. Actuate all transmission by the output motion or the a.c. voltage signal of the meter. Power required shall be 115 volts, 60 hertz, a.c. When impulse duration type transmission is used, the system shall have a 15-second maximum cycle actuating a cam-operated contact. The contact shall be of the totally enclosed type. The read-out and transmission case shall be aluminum, fiberglass reinforced plastic, or painted steel and part of the receiver. The unit shall be weatherproof or provided with a separate weatherproof housing and equipped with a sealed door for access to the mechanism and designed to prevent the accumulation of moisture or fog inside the case. Provide a suitable mounting stand.

- 2.2.1.1 Indicator: The indicator shall be a minimum of 10 inches long.
- 2.2.2 Remote Read-Out: The read-out shall accept the signal output and be of the same range and flow units as the local read-out and remote transmission device. The signal shall actuate an electromechanical receiver in which the input duplicates the output of the remote transmission device. Any necessary a.c. or d.c. power supply shall be provided. The read-out shall be visible through a shatterproof clear window. The read-out shall not be affected by the intended end use environment. The case shall be aluminum, fiberglass reinforced plastic, or painted steel and be dust tight. Provide a suitable mounting stand.
- 2.2.2.1 Indicator: The indicator shall be a minimum of 4 inches long.
- 2.2.2.2 Recorder: The chart shall be 10 inches or 12 inches in diameter and shall rotate once weekly. The chart drive shall be driven by a synchronous motor from 115 volts, 60 hertz, a.c.
- 2.2.2.3 Integrator: The integrator shall read the total flow in the units specified using only a whole power of 10 multiplier.
- 2.3 ELECTRICAL REQUIREMENTS: Unless indicated or specified otherwise, the electrical components of the meters, such as chart drives and electrical disconnecting (isolating) means, are included under this section. Provide wiring for signal circuit as recommended by the equipment manufacturer. The interconnecting conduit and wire (except when otherwise specified herein or when included in factory—assembled equipment) and the electrical connection of the meters to the electrical power circuit are specified in Division 16.
- 2.4 SPARE PARTS: Provide all standard recommended spare parts as indicated in the manufacturer's instruction manuals for each component in the system. Furnish one year's supply of charts and ink for each recording device.

PART 3 - EXECUTION

- 3.1 INSTALLATION: Furnish the services of an engineer representative of the manufacturer of the flow measuring equipment for checking the installation, making the necessary adjustments and calibrations, placing the equipment in operation, and performing the acceptance tests. The representative also shall be available for not less than two 8-hour days to instruct operating personnel in the use, operation, and maintenance of the equipment during the initial operating period. Install all flow measuring equipment in accordance with the recommendations of the manufacturer. Install weir(s) with the top exactly level at the elevation indicated.
- 3.2 FIELD TESTS AND INSPECTIONS: Test (calibrate) in place the flow measuring equipment to demonstrate that it meets the accuracy requirements for the full range of flows set forth in this section. Provide all labor, equipment, and incidentals required for the tests, including electric power and water required for tests. The Contracting Officer will witness all field tests and conduct all field inspections. The Contractor shall give the Contracting Officer ample notice of the dates and times scheduled for tests. Any deficiencies found shall be rectified and work affected by such deficiencies shall be completely retested at the Contractor's expense.

SECTION 13625.2

FLOW MEASURING EQUIPMENT (SEWAGE TREATMENT PLANT) KENNISON NOZZLE

PART 1 - GENERAL

- 1.1 APPLICABLE PUBLICATIONS: 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.
 - 1.1.1 Military Specification (Mil. Spec.):

MIL-P-24441A(SH) Paint, Epoxy-Polyamide Suppl 1 & Am 1

- 1.2 DESCRIPTION: The flow measuring equipment shall be the variable head meter type for open channel. The design shall permit ease of installation and shall not have any features hazardous to personnel or detrimental to the equipment. Align and adequately lubricate moving parts. Interior parts shall be easily accessible for adjustment, repair, and replacement. The flow meter shall be provided for the trickling filter recirculation flow as indicated. The Contractor shall provide all systems complete and ready for operation. All incidental piping, controls, and accessories required for complete operating systems shall be at the expense of the Contractor. Provide all control wiring and accessories in accordance with NFPA 70.
- 1.3 GENERAL REQUIREMENTS: For proper protection, one copy of all instruction sheets giving the proper field handling and installation requirements of the manufacturer shall be attached to, or accompany, each device.

1.4 SUBMITTALS:

- 1.4.1 Manufacturer's Literature and Data: Submit and obtain approval for manufacturer's literature and data on all components of flow measuring equipment.
- 1.4.2 Certified Test Reports: Submit certified copies of the following:
 - a. Perform calibration and submit certified test report for flow nozzle.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT: Unless otherwise specified, all materials and equipment shall be standard commercial products in regular production by the manufacturer and suitable for the required service.

- 2.1.1 Kennison Nozzle: The Kennison Nozzle shall be a 6 inch nozzle and measure the flow of 0 to 200 gallons per minute. The nozzle shall be constructed of high tensile cast iron with brass bushed piezometer vent with bronze mounted vent cleaner. The nozzle shall be equipped with leveling lugs, hydraulically operated vent cleaner, all piping and fittings, sediment—trap and stilling well for use with a bubbler level indicator (trickling filter recirculation flow).
- 2.1.2 Bubbler System for Kennison Nozzle: The system shall be suitable for installation in a small wet well attached to a Kennison Nozzle with a 0 to 6 inch head range. The system shall show the flow in GPM flowing in the nozzle. There shall be provided one reed type air pump, air storage tank, air flow meter, instantaneous readout (digital or mechanical arm), dust and moisture tight metal enclosure, air tubing, system fuse, on-off switch and wall mounting bracket. The system shall operate on 120 V, single phase, 60 Hz current.
- 2.1.3 Alternate Sonar System: A single manufacturer sonar system suitable for use with a Kennison Nozzle will be considered by the Contracting Officer. System shall provide the same information as in 2.1.2 above.
 - 2.2 READ-OUT DEVICE: Provide the meter with the following:
- 2.2.1 Local Read-Out: The read-out shall be visible through a shatterproof clear window. The read-out shall be made without creating any problem with taking the flow measurement. The read-out mechanism shall not be affected by the intended end use environment. The read-out case shall be aluminum, fiberglass reinforced plastic, or painted steel and part of the receiver. The unit shall be weatherproof or provided with a separate weatherproof housing with a sealed door for access to the mechanism and designed to prevent the accumulation of moisture or fog inside the case. Provide a suitable mounting.
- 2.2.1.1 Indicator: The indicator shall be a minimum of 10 inches long.
- 2.3 ELECTRICAL REQUIREMENTS: Unless indicated or specified otherwise, the electrical components of the meters, such as chart drives and electrical disconnecting (isolating) means, are included under this section. The interconnecting conduit and wire (except when otherwise specified herein or when included in factory—assembled equipment) and the electrical connection of the meters to the electrical power circuit are specified in Division 16.
- 2.4 SPARE PARTS: Provide five spare fuses, one spare air pump, and all standard recommended spare parts as indicated in the manufacturer's instruction manuals for each component in the system.

- 3.1 MATERIALS PROTECTION: The entire tube, except the throat section of the Kennison nozzle, shall receive a four-coat system conforming to Mil. Spec. MIL-P-24441. Apply the system in the following order: one coat of Formula 150, one coat of Formula 151, one coat of Formula 156, and one coat of Formula 152. The final total dry film thickness shall be not less than 10 mils. Furnish all other items in accordance with the manufacturer's standard practice suitable for end use environment.
- 3.2 INSTALLATION: Furnish the services of an engineer representative of the manufacturer of the flow measuring equipment for checking the installation, making the necessary adjustments and calibrations, placing the equipment in operation, and performing the acceptance tests. The representative also shall be available for not less than two 8-hour days to instruct operating personnel in the use, operation, and maintenance of the equipment during the initial operating period. Install all flow measuring equipment in accordance with the recommendations of the manufacturer. Install variable head meter(s) for closed channel(s) in accordance with the ASME publication "Fluid Meters." Install weir(s) with the top exactly level at the elevation indicated.
- 3.3 FIELD TESTS AND INSPECTIONS: Test (calibrate) in place the flow measuring equipment to demonstrate that it meets the accuracy requirements for the full range of flows set forth in this section. Provide all labor, equipment, and incidentals required for the tests, including electric power and water required for tests. The Contracting Officer will witness all field tests and conduct all field inspections. The Contractor shall give the Contracting Officer ample notice of the dates and times scheduled for tests. Any deficiencies found shall be rectified and work affected by such deficiencies shall be completely retested at the Contractor's expense.

SECTION 13626

SLUDGE DRYING BEDS

- 1. APPLICABLE PUBLICATIONS: The following publications of the issues listed below, but referred to elsewhere by basic designation only, form a part of this specification to the extent indicated by references thereto (where a number is suffixed to the specification number, it denotes the effective amendment to the specification):
 - 1.1 American Society for Testing and Materials (ASTM):

C200-78 Vitrified Clay Pipe

- 2. GENERAL REQUIREMENTS: The sludge drying beds shall be provided complete as specified and/or as shown on the drawings including all piping, valving, underdrain, concrete work, crushed stone, and sand.
 - 3. SUBMITTALS:
- 3.1 Submittals: Partial submittals will not be acceptable. Annotate descriptive data to show the specific model, type, and size of each item the Contractor proposes to furnish. Prepare shop drawings on sheets not smaller than 30 inches by 42 inches, and include data essential to the proper installation of each system. Do not commence work until the design of each system and the various components have been approved. The submittal requirements of Section 15011, "General Requirements, Mechanical" applies to the following items. All submittals shall be approved by the Contracting Officer.
- 3.2 Certificates: Submit certificates from the manufacturer attesting that the following products conform to all requirements of this specification and of reference documents:
 - a. Stone
 - b. Sand
- 3.2.1 Sample Certificate: The certificate shall not contain statements that could be interpreted to imply that the product does not meet all requirements specified, such as "as good as"; "achieve the same end use and results as materials formulated in accordance with the referenced specifications"; "equal or exceed the service and performance of the specified material". The certificate should simply state that the product conforms to all requirements specified.

SAMPLE CERTIFICATE

The manufacturer hereby certifies that the following products being furnished for this project conform to all requirements of the project specifications and of the reference specifications listed:

MANUFACTURER AND PRODUCT

REFERENCE SPECIFICATION

John Doe Company Portland Cement, Type I

ASTM C150-74, Type I

SIGNATURE AND TITLE

- 3.2.1.1 Lab Certification of Stone: The Contractor shall submit to an independent testing laboratory samples of each size of media he proposes to use for the sludge drying beds prior to delivery. The sample shall be tested in accordance with the specified requirements. Certified copies of the laboratory analysis showing that the samples conform to the specifications shall be furnished the Contracting Officer. The samples shall be kept as a standard for visual inspection of the material received. Should the Contracting Officer require that check samples from delivered materials be tested, the Contractor shall so comply. If these samples do not conform, the material shall be removed from the site at the Contractor's expense. All expense involved in testing shall be borne by the Contractor.
- 3.2.1.2 Lab Certification of Sand: The Contractor shall submit samples of the sand that he proposes to use to the North Carolina Department of Natural and Economic Resources, Raleigh, North Carolina, for analysis. No sand shall be used until copies of the analysis have been submitted and approved by the Contracting Officer.
 - 4. EXCAVATION, TRENCHING, AND BACKFILLING:
- 4.1 General Requirements: This work shall be done according to Section 02200, "Earthwork", and Section 02722, "Exterior Sanitary Sewers".
 - 5. PRODUCTS:
- 5.1 Underdrain Pipe: All underdrain piping shall be perforated vitrified clay conforming to ASTM Specification C700.
 - 5.2 Crushed Stone:
- 5.2.1 General: The crushed stone shall be of a quality which will satisfactorily withstand the disintegrating effect of weather and the sewage applied. It may be granite, limestone, or trap rock having chemical and physical properties to satisfy the following requirements:
 - a. Los Angeles abrasion test-loss of not more than 40%.
 - b. The percentage of absorption shall not exceed 0.7%.
 - c. The minimum specific gravity shall be 2.60.
 - d. The crushing strength shall be not less than 15,000 pounds per square inch.
 - e. The sulphate shall not exceed 1.2%.

- f. The loss in sodium sulphate test of 20 cycles shall not exceed 10%.
- 5.2.2 Gradation: Gradation for the several layers of stone for the drying beds shall be as indicated on the drawings.
- 5.3 Sand: The sand shall be natural sand, screened to obtain the gradation specified below and shall be free from clay, coal, or other deleterious substances. The sand shall have an effective size between 0.35 mm and 0.50 mm with a uniformly coefficient not over 3.00. The use of river sand which has been screened and washed will be permitted provided that the above requirements on gradation are satisfied. Dust content of the sand shall be less than 0.5%.

6. INSTALLATION:

- 6.1 Underdrains: All underdrains shall be laid uniformly to the grade shown and with the bells upgrade. The pipe shall be completely surrounded with crushed stone. The joints shall be covered with two layers of tar paper on the upper side to prevent entrance of dirt into the pipe.
- 6.2 Stone: The grading within the limits set for each layer shall be as uniform as practicable. The stone shall be delivered to the site and placed in the structure in such a manner as to eliminate segregation. No fines or organic matter shall be included. The first layer shall be placed to the underside of the underdrain piping. The piping shall be bedded and placed and then surrounded with stone carefully placed to completely cover the pipe. Each layer shall be completed and correctly leveled off before the next layer is placed. Trucks shall not be allowed to travel over the bed except when supported by substantial solid planking runways approved by the Contracting Officer. Light track-land equipment specially approved by the Contracting Officer for this use may be used for distributing the stone over the beds.
- 6.3 Sand: The material shall be deposited in the structure after completion of the stone fill. It shall be leveled off and raked to the proper elevation allowing 1/2 inch for subsequent settlement when saturated. No deleterious matter shall be permitted to enter the bed during the operation. Trucks will not be permitted to run on the bed but they may dump directly into the structure and the sand may be distributed with light track-land equipment specifically approved by the Contracting Officer for this purpose. The surface of the sand shall be leveled and dressed off.

SECTION 14337

UNDERRUNNING BRIDGE CRANE, 3-TON CAPACITY

PART 1 - GENERAL

- 1.1 APPLICABLE PUBLICATIONS: 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.
 - 1.1.1 American Gear Manufacturers Association (AGMA) Publications:
 Gear Standards
 - 1.1.2 American Institute of Steel Construction (AISC) Publications:
 Design, Fabrication & Erection of Structural Steel of Buildings
- 1.1.3 American National Standards Institute, Inc. (ANSI) Publications:

B30.11-80 Monorail Systems and Underrunning Cranes
B30.16-73 Overhead Hoists

1.1.4 American Society for Testing and Materials (ASTM) Publications:

Specification for Mild- to Medium-Strength A27-81 Carbon-Steel Castings for General Application and Rev. A Specification for Structural Steel A36-77 and Rev. A A53-81 Welded and Seamless Steel Pipe and Rev. A A108-81 Cold-Finished Carbon Steel Bars and Shafting A148-81 Specification for High-Strength Steel Castings for Structural Purposes Magnetic Particle Examination of Steel Forgings A275-80 High-Strength Bolts for Structural Steel A325-81 Joints, Including Suitable Nuts and Plain Hardened Washers A434-81 Quenched and Tempered Alloy Steel Bars, Hot-

Rolled or Cold-Finished

A439-80	Specification for Austenitic Ductile Iron Castings
A576-81	Special Quality Hot-Rolled Carbon Steel Bars
B148-78	Specification for Aluminum Bronze Sand Castings
B584-79	Specification for Copper Alloy Sand Castings

1.1.5 Crane Manufacturers Association of American, Inc. (CMAA) Publications:

No. 74-74 Specifications for Toprunning & Underrunning Single Girder Electric Overhead Traveling Cranes

1.1.6 Hoist Manufacturers Institute (HMI) Publications:

HMI 100-71 Electric Wire Rope Hoists

1002 1070

1.1.7 National Electrical Manufacturers Association (NEMA) Publications:

Rev. 1-79, Rev. 2-80	Industrial Controls and Systems
MG1-1978 Rev. 1-78	Motors and Generators
through	
Rev. 6-81	
WC3-80	Rubber-Insulated Wire and Cable for the
	Transmission and Distribution of Electrical Energy

ICS6-1978 Enclosures for Industrial Controls and Systems Rev. 1-80

1.1.8 National Fire Protection Association (NFPA) Publications:

No. 70-1982 National Electrical Code

1.1.9 Monorail Manufacturers Association (MMA):

Underhung Cranes and Monorail System (UCMS)

1.2 SUBMITTALS: Section 15011, "Mechanical General Requirements" with the following additions and modifications applies: Submit manufacturer's descriptive data, shop drawings and operations, and maintenance manuals for the crane. Shop drawings shall show the general arrangement

of components, clearances, principal dimensions, details of structural connections, electrification details, electrical wiring diagrams, and details of all components. Accompany shop drawings with design calculations verifying size of structural members, lifting beams, and trolley and bridge traveling drives. The calculations shall include stress and loading diagrams. Submit factory test reports for magnetic-particle testing of each hook and hook nut and certification of minimum wire rope breaking strength for each hoist.

PART 2 - PRODUCTS

- 2.1 DESCRIPTION: The OET cranes furnished under this specification shall be the crane manufacturer's standard product as furnished to the commercial market and shall conform to CMAA No. 74, except as specified herein. Each crane service class in this specification corresponds to the service class of the same designation in CMAA No. 74. Underhung electric powered overhead traveling cranes shall consist of a complete traveling hoist and bridge assembly with end trucks, current collectors, and controls ready for immediate operation. The cranes shall be of the single girder type, outdoor type, cab or pendant controlled, and shall have the spans, capacities, speeds and lifts as specified.
- 2.2 SAFETY: Crane shall conform to the applicable mandatory and advisory safety requirements of ANSI B30.11, B30.16, and HMI 100, except as modified herein.
- 2.3 PERFORMANCE: When operated in accordance with the safety rules of ANSI B30.11, B30.16, and HMI 100, through a representative repetitive cycle of motions and loads commensurate with the specified crane service class, no electrical part shall sustain a temperature rise in excess of the applicable allowable limits of NEMA MG1 and ICS for the corresponding part or item. Steady running rated travel, lifting, and lowering speeds developed under test shall not vary from specified speeds by more than plus or minus 10 percent while carrying the rated capacity load.
- 2.3.1 Capacity: The OET crane shall have a minimum rated capacity of three tons (one ton equals 2000 pounds).
- 2.3.2 Speeds: OET crane shall have the following rated speeds (plus or minus 10 percent) while handling the rated capacity load:
 - a. Hoist high speed of 15 feet per minute (ft/min), low speed of five feet per minute (ft/min).
 - b. Trolley speed of 75 ft/min.
 - c. Bridge speed of 100 ft/min.
- 2.4 STRUCTURAL DESIGN: Structural design shall conform to applicable portions of CMAA No. 74 and AISC except as specified herein.

2.5 MATERIAL:

- 2.5.1 Limitations on Cast Iron Use: Cast iron will not be allowed in the construction of load carrying parts except for brake drums. Ductile cast iron brake drums recommended by the brake manufacturer are permitted on brakes. Load carrying part is defined as any weight handling equipment part that supports the load and upon failure could cause dropping, uncontrolled shifting or uncontrolled movement of the load.
- 2.5.2 Structural Steel: Structural steel shall conform to ASTM A36. The minimum thickness of material shall be 0.3125 inch except that the webs of channels and beams, and resistor frames may be 0.25 inch, and sheet steel for cabs and other enclosures may be 0.10 inch.
- 2.5.3 Cast Steel: Cast steel shall conform to ASTM A27, grade 60-30, or A148, as required for design limitations.
- 2.5.4 Steel Pipe: Seamless steel pipe shall conform to ASTM A53, type S, grade B, and shall be of the open hearth or basic oxygen steel.
- 2.5.5 Hot-rolled Steel Bars: Hot-rolled steel bars, up to and including five inch diameter stock, shall conform to ASTM A576, grade designation as applicable, or to ASTM A434, class as applicable. Forged steel may be used in lieu of hot-rolled steel bars.
- 2.5.6 Cold-rolled or Cold-drawn Steel Bars: Cold-rolled or cold-drawn steel bars shall conform to ASTM A108, grade designation as applicable.
- 2.5.7 Cast Iron: Cast iron shall conform to ASTM A27, grade not less than 60-30, or ASTM A148, grade as applicable.
- 2.5.8 Nodular Graphitic Cast Iron: Nodular graphitic cast iron shall conform to ASTM A439, type as applicable to the design tensile and yield strength, and the Brinell hardness required.
- 2.5.9 High Strength Bolts: High strength bolts for structural steel joints shall conform to ASTM A325.
- 2.5.10 Bronze: Bronze shall conform to ASTM B584, alloy number as applicable. Aluminum bronze shall conform to ASTM B148, alloy number 90.
- 2.5.11 Nuts, Bolts and Screws: All nuts, bolts, and screws shall have standard screw threads in accordance with NBS H28.
- 2.6 GEARING: All gears and pinions shall be of steel, except worm gears may be of high strength bronze. Gearing shall be straight spur or bevel, parallel shaft helical, herringbone, or spiral bevel type for all cranes, and shall be in accordance with AGMA criteria.
- 2.7 BEARINGS: All bearings shall be of the antifriction type, except that bearings subject to a slight rocker motion, such as the idler sheave bearing, may be of the bronze bushing type. The B-10 life rating

of antifriction bearings shall be 5,000 hours for class A1, A2, and B cranes.

- 2.8 BRIDGE DRIVES: Bridge drives shall be electric powered. Unless otherwise specified, bridge drive arrangement shall be selected by the manufacturer and shall conform to CMAA No. 74. Bridge travel speed shall be as specified.
- 2.9 COUPLINGS: All couplings shall be located immediately adjacent to a bearing. Couplings between closely spaced bearings shall be of the full flexible type. Couplings for use with floating shafts shall be of the half flexible type with pilots. Rigid couplings shall be steel or malleable iron and shall be of the compression or safety flange type.
- 2.10 WHEELS: Wheels and wheel loading shall be in accordance with CMAA No. 74. When rotating axles are used, drive wheels shall be press fitted and keyed to the axles, and idler wheels shall be press fitted.
- 2.11 STOPS: All cranes shall be provided with stops in accordance with the provisions of CMAA No. 74 and the listed ANSI standards.
- 2.12 GIRDERS: The crane girders shall be welded structural steel box sections, wide flange beams, standard "I" beams, reinforced beams, or box sections, fabricated from structural shapes. The manufacturer shall specify the type and construction of the girders to be furnished.
- 2.13 BRIDGE END TRUCKS: Bridge end trucks shall be fabricated of welded structural sections and shall be of the manufacturer's standard design, geared electric motor driven and equal to CMAA No. 74 and other listed ANSI standards.
- 2.14 ELECTRIC POWERED HOIST AND TROLLEY: Provide hoist and trolley meeting the following requirements and complying to HMI 100 except as specified otherwise.
 - 2.14.1 Capacity: 6,000 pounds.
- 2.14.2 Hook Lift Range: From finish floor level to height of at least 12 feet above finish floor.
- 2.14.3 Hoisting Speeds: Provide hoist capable of hoisting and lowering capacity load at two speeds, high speed of 15 feet per minute, low speed of five feet per minute. Hoist motor shall be rated at five horsepower or six horsepower for high speed hoisting. Hoist motor horsepower rating for low speed shall be 1/3 of the high speed horsepower rating.
- 2.14.4 Controls: Pendant push button controls for hoist and trolley, suspended from hoist at a level four feet above finish floor. Provide controls with a minimum of eight push buttons: Power On, Hoist Start-Stop (momentary contact), Hoisting Slow, Hoisting Fast, Lowering Slow, Lowering Fast, Trolley Right, Trolley Left.

- 2.14.5 Hoist Gear Train: Alloy steel spur gears or helical gears.
- 2.14.6 Hoist Brakes: Provide hoist motor brake in addition to an automatic mechanical load brake, Weston-type.
- 2.14.7 Wire Rope: High strength, flexible plow steel with hemp or steel center; minimum safety factor of five to one based on ratio of actual minimum wire rope breaking load to the calculated load on rope when crane is assumed hoisting the rated capacity.
 - 2.14.8 Hoist Hook and Hook Components:
- 2.14.8.1 Forged Steel Hook: Complete with spring-loaded steel throat opening safety device.
- 2.14.8.2 Disassembly: Hook and hook nut shall be capable of complete disassembly that enables access to all surfaces of hook, including shank and hook nut for inspection purposes. Provision shall be made for the hook nut, or other hook-to-block fastener, to be keyed to hook shank by means of a set screw of similar, easily removable, securing device.
- 2.14.8.3 Hook Non-Destructive Test: Each hook, including shank and hook nut, shall be inspected over the entire surface areas by magnetic particle inspection. If hook nut is not used, any device that functions the same as the hook nut shall be inspected by magnetic particle inspection.
- 2.14.8.4 Procedure: Magnetic particle inspection shall be conducted in accordance with ASTM A275. This inspection shall be conducted at the factory of the hook manufacturer or hoist manufacturer. Alternately, a recognized independent testing organization may conduct the inspections if equipped and competent to perform such a service, and if approved by the Contracting Officer.
- 2.14.8.5 Acceptance Criteria: Defects found on the hook or hook nut shall result in rejection of defective items for use on furnished hoist. For this inspection, a defect is defined as a linear or non-linear indication for which the largest dimension is greater than 1/8 inch. Weld repairs on defects on hook or hook nut will not be permitted.
- 2.14.8.6 Test Report: A test report of the magnetic particle inspection of each hook and hook nut provided shall be submitted to and approved by the Contracting Officer prior to final acceptance of hoist installation. Test reports shall be certified by the testing organization.
- 2.15 ELECTRICAL EQUIPMENT: The electrical equipment shall conform to NFPA No. 70 and CMAA No. 74, except as specified herein, and shall be designed to operate from the voltage, frequency, and phase indicated. The design for wiring, insulation, allowable voltage drop, current collectors, control, overcurrent protection, and grounding shall be in accordance with NFPA No. 70, as applicable, and as specified herein.

- 2.15.1 Motors: Each crane motion shall be driven by a separate motor independent of other motions. Bridge motors shall conform to NEMA MG1 and the following:
 - a. Motor mounting, shaft, and key dimensions shall conform to the manufacturer's standard.
 - b. Temperature rise shall be used in accordance with NEMA MG1, for the motor type and insulation used.
 - c. Enclosure: Totally enclosed.
 - d. Maximum Rated Speed: 1,800 revolutions per minute (rpm) (nominal).
 - e. Bearings: Ball or roller.
 - f. Insulation: NEMA MG1, part 1, class A, B, F, or H.
 - g. Bridge motor starting torque shall be a minimum of 160 percent of full load torque.
 - h. Time Ratings: The crane manufacturers shall ensure that the motors are certified to be at not less than 30 minutes by the motor manufacturer in accordance with NEMA MG1.
- 2.15.2 Bridge Electrification System: Each bridge electrification system shall be of the cable reel type.
- 2.15.2.1 Cable Reel Type: Cable reel type conductors shall be rope stranded, flexible, insulated, portable cable and conforming to NEMA WC3. The reel mechanism shall be manufactured specifically for the purpose intended and shall operate to keep all excess cable from entanglement, abrasion or excessive stress.
- 2.15.3 Controllers: Controllers shall be provided with NEMA rated or definite purpose contactor specifically rated for crane service. The magnetic contactors used shall not exceed the manufacturer's published ratings. Controllers shall be mounted in enclosures conforming to NEMA ICS, part 1-110, type as applicable to the hoist characteristics and use. When resistors are mounted in the same enclosure as controllers, air circulation by natural convection or forced ventilation shall be provided.
- 2.16 RUNWAY TRACK SYSTEM: Provide each track system designed and constructed in accordance with the applicable requirements of Monorail Manufacturers Association Specification for Underhung Cranes and Monorail Systems (MMA-UCMS), with the modifications and additions specified herein. Monorail track systems shall be suspended from structural members provided in and specified in Section 05120, Structural Steel.
- 2.16.1 Patented Track: Provide specially designed track, i.e., patented track, constructed from welded structural steel components. The lower flange of the track section shall have flat treads; minimum lower

flange width of 3.25 inches; chemical composition of 0.50 to 0.06 percent carbon content, 0.60 to 0.90 percent manganese content; and treads shall be hardened to a minimum Brinell Hardness Number of 225. Upper flange and web of the track section shall be structural steel, continuously welded together or provided as one monolithic piece. American Standard I-beams or Wide Flange Beams are not acceptable. Provide complete shop drawings and calculations for the strength design and the deflection of the track beams shall be submitted to and approved by the Contracting Officer.

- 2.16.2 Connections to Structural Supports: Provide means of connecting the monorail beams to the structural supports. The connection system shall be the sole responsibility of the monorail supplier. Complete shop drawings and calculations for the alternate connections shall be submitted to and approved by the Contracting Officer prior to provision of track beam connections by the contractor. Design of connections shall conform to design requirements specified in MMA-UCMS. The connections shall be designed and constructed to ensure no impairment of the strength of track or track supports. Each track splice joint shall be located on centerline of a hanger or a support. Provide bracing to hold track sections in rigid alignment at all joints.
- 2.17 TECHNICAL MANUALS: The contractor is responsible for providing three copies of technical manuals to cover all cranes. Manuals shall be as specified hereinafter for all of the components, assemblies, subassemblies, attachments, and accessories, whether the item was manufactured and assembled in-house or obtained by the contractor from other sources. The manuals shall be submitted to the Contracting Officer for review at least 60 days prior to the acceptance testing of the first crane. The manuals shall be approved by the Contracting Officer prior to the final acceptance of the first crane.

2.17.1 Manual Format:

- 2.17.1.1 Volumes: Manuals may be in separate books or volumes consistent with the contractor's standard commercial practice. Manufacturer's manuals or data for components or assemblies, which are provided as part of this contract, shall be assembled and bound securely into a manageable volume or volumes and will be indexed by major assembly and component in sequential order. Where practicable, all manual drawings and instruction sheets should not exceed a single foldout sheet.
- 2.17.1.2 Table of Contents: A table of contents shall be made part of the assembled publication set, and pen and ink changes or rough penciled diagrams or illustrations normally furnished with the preliminary draft will not be acceptable in the finished product.
- 2.17.1.3 Binder: Each volume of the technical manual set shall be securely bound in a durable, hard covered, water resistant binder.
- 2.17.1.4 Identification: The cover sheet or binder on each volume of the technical manuals shall be identified and marked as follows:
 - a. Equipment manufacturer and/or contractor's address

- b. Contract number
- c. Equipment identification, make, model, serial number
- d. Volume number and title of the manual
- 2.17.2 Manuals: Technical manuals are required to cover each specific make, model, year, and serial numbered piece of equipment scheduled for delivery under terms of the contract. It is the intent of these requirements to use standard commercial manuals modified, as necessary, to meet the minimum specifications set forth herein.
- 2.17.2.1 Operating Instructions: The contents of the operator's manual shall include specific instructions and illustrations of the equipment operation as follows:
 - Operator prestart checks, lubrication, and service requirements, including crane capacity.
 - b. Starting procedures and controls.
 - Operations of the basic machine, attachments, and accessories.
 - d. Safety precautions to be observed while operating under all operating conditions for which the equipment was designed.
 - e. Operator service requirements during operations.
- 2.17.2.2 Maintenance, Service, and Repair Instructions: The contents of the maintenance and repair manual shall include all necessary instructions that will enable an average skilled mechanic, without prior knowledge of the specific type, make, or model of equipment, to maintain the equipment in a safe and serviceable condition. It should be emphasized that the equipment will be serviced and repaired in Government shop facilities. Therefore, the maintenance and repair manual shall contain all necessary instructions, illustrations, charts, and diagrams covering the following as a minimum:
 - a. Lubrication instructions shall include:
 - Table showing recommended lubricants for specific temperature applications. Table shall include listing of the Military Specifications, Federal Specifications, Federal Stock System Numbers or General Services Administration Supply System Numbers applicable to recommended lubricants.
 - Chart with schematic diagram of the equipment showing lubrication points, types of lubricants, service intervals, and capacities.

- b. Preventative: A table of preventative maintenance instructions including frequency in time, or hours covering routing servicing, lubrication, and adjustments.
- c. Troubleshooting: Troubleshooting guides and diagnostic techniques that will enable prompt isolation of the cause of malfunction with corrective maintenance instructions.
- d. Repair: Instructions for removal, replacement, disassembly and assembly, and repair of all components, assemblies, subassemblies, accessories, and attachments normally subjected to wear, damage, and/or malfunctioning.
- e. Adjustments: Maintenance and repair data, i.e., tolerances, dimensions, settings, and adjustments, normally required for performing routine maintenance servicing, including removal, replacement, and reassembly of components, assemblies, subassemblies, accessories, and attachments normally subject to wear, damage, or malfunctioning.
 - Brakes and Brade Drums: Contractor shall provide detailed criteria covering all brakes and brake drums including the following: disassembly instructions, spare parts, complete adjustment criteria, maximum wear allowed on brake shoes and drums.
- 2.17.2.3 Parts Manuals: The contents of the parts manuals shall provide positive identification and coverage for all of the parts of components, assemblies, subassemblies, and accessories of the end item normally subjected to wear, malfunctioning, damage, or loss. Common hardware items such as mild steel bolts, nuts, washers, cotter pins, and the like may be omitted.
 - a. Illustrations: Clear and legible illustrations, drawings, and/or exploded views shall be provided to identify all individual parts, components, assemblies, and subassemblies of the end item. Part numbers and description shall be shown on illustrations or listed separately. When the illustrations omit the part numbers and description, both the illustrations and separate listings shall show the index, reference, or key number which will cross reference the illustrated part to listed part. Parts shown in the listings shall be grouped by components, assemblies, and subassemblies with individual parts identified to the assembly.
 - b. Identification: Components, assemblies, and/or parts purchased by the contractor for which the contractor does not have design control shall be identified by the actual manufacturer's name and part numbers. Repair parts data shall provide positive identification for a component of the complete equipment without the need for contact with manufacturer or dealer facilities to identify ordering part numbers.

- c. On-Hand Spare Parts: Each parts manual shall include a parts list of spares to be kept on hand by the crane owner as recommended by the equipment manufacturer.
 - Wire Rope: Provide full description of replacement wire rope including rope size, nominal breaking strength material composition and type of construction.

PART 3 - EXECUTION

3.1 FIELD INSTRUCTION AND TESTS:

3.1.1 Field Test: The field test shall be witnessed by the Contracting Officer and a representative of the Transportation Division (Code (12)) Atlantic Division Naval Facilities Engineering Command.

3.1.1.1 No-Load Test:

a. Hoist:

 Raise each load hook into the hoist limit switch at slow operating speed. Verify that hoist motion stops when hoist block engages limit switch. Lower and raise each hook through all controller points.

b. Trolley:

- Operate trolley through all controller points in both directions. Operate the full distance of the bridge rails and verify satisfactory trolley brake operations.
- 3.1.1.2 125 Percent Load Test: Test load shall be a minimum of 125 percent of rated capacity of crane.

a. Hoist:

- Static Test: Raise test load approximately one foot and hold for ten minutes. Verify that no lowering of test load will occur. Lowering indicates malfunction of hoisting components or brakes.
- 2. Dynamic Test: Hoist and lower test load through all controller points. Lower the test load to the ground until hoist lines are slack. Wait five minutes, hoist lower test load again through controller points.
- 3. Hoist Load Brake: Raise test load approximately five feet. With the hoist controller in the neutral position, release (by hand) the electric holding brake. Verify mechanical load brake holds the test load. Again with the electric holding brake in the released position, start the test load down (first point) and return the

controller to off position as the test load lowers. The load mechanical brake shall prevent the test load from accelerating. NOTE: It is not necessary for the mechanical load brake to halt the downward motion of the test load.

- 4. Loss of Power (Panic Test): This test is designed to test the reaction of a hoisting unit in the event of power failure during a lift. Hoist the test load to convenient distance above the surface. Lower test load at slow speed and with the controller in the slow lowering position, disconnect the main power source and return the controller to the neutral position. Verify that the test load motion stops when the controller is placed in the neutral position.
- b. Trolley Motion: Operate trolley with test load (if space is available) the full distance of the bridge rails using extreme caution and verify satisfactory trolley drive brake operation.
- 3.1.1.3 Capacity Load Speed Tests: With the hoist loaded to rated capacity, hoist and lower the capacity load verifying that the hoisting and lowering speeds are provided as specified. With the hoist loaded to rated capacity, operate trolley along bridge, verifying that the trolley speed and bridge speed are provided as specified.
- 3.1.2 Instructing Operating and Maintenance Personnel: Upon completion of the work on the first crane and at a time designated by the Contracting Officer, the services of a competent technician regularly employed by the contractor shall be provided for the instructions of the Government personnel in the proper operation and maintenance of overhauled cranes. The period of instruction shall be for not less than one-half eight hour working day for instruction and training of operating personnel and not less than one-half eight hour working day for instruction and training of maintenance personnel. The training course plans shall be approved by the Contracting Officer.

SECTION 15011

MECHANICAL GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 APPLICABLE PUBLICATIONS: 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.

1.1.1 Federal Specifications (Fed. Spec.):

TT-E-489F Enamel, Alkyd, Gloss (for Exterior and Interior & Am 1 Surfaces)

TT-E-496B Enamel, Heat-Resisting (400 Degrees Fahrenheit), & Am 2 Black

TT-P-28F Paint, Aluminum, Heat Resisting (1200 Degrees Fahrenheit)

TT-P-645A Primer, Paint, Zinc-Chromate, Alkyd Type

1.1.2 Military Specifications (Mil. Spec.):

DOD-P-15328D Primer (Wash), Pretreatment (Formula No. 117 for Metals) (Metric)

1.1.3 American Society for Testing and Materials (ASTM) Publication:

B117-73 Salt Spray (Fog) Testing, Method of (R79)

- 1.2 APPLICATION: This section applies to the piping sections of Division 2, "Site Work" and all sections of Division 15, "Mechanical" of this project except as specified otherwise in each individual section.
- 1.3 SUBMITTALS: Submit shop drawings, manufacturers data and certificates for equipment, materials and finish, and pertinent details for each system where specified in each individual section, and have them approved before procurement, fabrication or delivery of the items to the job site. Partial submittals will not be acceptable and will be returned without review. Submittals shall include the manufacturer's name, trade name, catalog model or number, nameplate data, size, layout dimensions, capacity, project specification and paragraph reference, applicable Federal, Military, industry and technical society publication references, and other information necessary to establish contract compliance of each item the Contractor proposes to furnish.

- 1.3.1 Shop Drawings: Drawings shall be a minimum of 8.5-inches by 11-inches in size, except as specified otherwise. Drawings shall include floor plans, sectional views, wiring diagrams, and installation details of equipment; and equipment spaces identifying and indicating proposed location, layout and arrangement of items of equipment, control panels, accessories, piping, ductwork, and other items that must be shown to assure a coordinated installation. Wiring diagrams shall identify circuit terminals, and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance and replacement of operating equipment devices. If equipment is disapproved, drawings shall be revised to show acceptable equipment and be resubmitted.
- 1.3.2 Manufacturer's Data: Submittals for each manufactured item shall be manufacturer's descriptive literature of cataloged products, equipment drawings, diagrams, performance and characteristic curves, and catalog cuts.
- 1.3.3 Publication Compliance: Where equipment or materials are specified to conform to industry and technical society publications of organizations such as American National Standard Institute (ANSI), American Society for Testing and Materials (ASTM), and Underwriters Laboratories, Inc. (UL), proof of such compliance shall be submitted. The label or listing by the specified organization will be acceptable evidence of compliance. Submit a certificate from an independent testing organization adequately equipped and competent to perform such services, and approved by the Contracting Officer, stating that the item has been tested in accordance with the specified organization's publication.
- 1.3.4 Certified Test Reports: The testing requirements in referenced publications for materials will be waived provided the manufacturer's original certificates are submitted stating that previously manufactured materials have been tested by approved laboratories, that such materials meet testing requirements specified, and that the materials furnished for this project are of the same type, quality, manufacture, and make as that tested; copies of the test reports need not be submitted except as specifically requested by the Contracting Officer.
- 1.3.5 Certificates of Compliance: Submit certification attesting that materials and equipment to be furnished for this project comply with the requirements of this specification and of the reference publications. Pre-printed certifications will not be acceptable; certifications shall be the manufacturer's original. The certification shall not contain statements that could be interpreted to imply that the product does not meet all requirements specified, such as "as good as"; "achieve the same end use and results as materials formulated in accordance with the referenced publications"; "equal or exceed the service and performance of the specified material". The certification shall simply state that the product conforms to the requirements specified.

- 1.4 OPERATION AND MAINTENANCE MANUAL: Furnish an integrated operation and maintenance manual including each item of equipment. Furnish three copies of the manual bound in hardback binders or an approved equivalent. Furnish one complete manual prior to the time that equipment tests are performed, and furnish the remaining manuals before the contract is completed. Inscribe the following identification on the cover: the words OPERATION AND MAINTENANCE MANUAL, the name and location of the equipment or the building, the name of the Contractor, and the contract number. The manual shall include the names, addresses, and telephone numbers of each subcontractor installing equipment, and of the local representatives for each item of equipment. The manual shall have a table of contents and be assembled to conform to the table of contents with the tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in. The manual shall include: wiring and control diagrams with data to explain detailed operation and control of each item of equipment; a control sequence describing start-up, operation and shut-down; description of the function of each principal item of equipment; the procedure for starting; the procedure for operating; shut-down instructions: installation instructions: maintenance instructions: lubrication schedule including type, grade, temperature range, and frequency; safety precautions, diagrams, and illustrations; test procedures; performance data; and parts list. The parts lists for equipment shall indicate the sources of supply, recommended spare parts, and the service organization which is reasonably convenient to the project site. The manual shall be complete in all respects for equipment, controls, accessories, and associated appurtenances provided.
- 1.5 POSTED OPERATING INSTRUCTIONS: Furnish approved operating instructions for each principal item of equipment for the use of the operation and maintenance personnel. The operating instructions shall include wiring diagrams, control diagrams, and control sequence for each principal item of equipment. Operating instructions shall be printed or engraved, and shall be framed under glass or in approved laminated plastic and posted where directed by the Contracting Officer. Operating instructions shall be attached to or posted adjacent to each principal item of equipment including start up, proper adjustment, operating, lubrication, shut-down, safety-precautions, procedure in the event of equipment failure, and other items of instruction as recommended by the manufacturer of each item of equipment. Operating instructions exposed to the weather shall be made of weather-resisting materials or shall be suitably enclosed to be weather protected. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.
- 1.6 INSTRUCTION TO GOVERNMENT PERSONNEL: Furnish the services of competent instructors to give full instruction to the Government personnel in the adjustment, operation and maintenance, including pertinent safety requirements of each item of equipment and each system. Each instructor shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and

maintenance work. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of mandays (8-hours) of instruction furnished shall be as specified in each individual section.

- 1.7 DELIVERY AND STORAGE: Properly store, adequately protect and carefully handle equipment and materials to prevent damage before and during installation. Handle, store, and protect equipment and materials in accordance with the manufacturer's recommendations. Replace damaged or defective items.
- 1.8 CATALOGED PRODUCTS: Materials and equipment shall be cataloged products of manufacturers regularly engaged in production of such materials or equipment and shall be manufacturer's latest design that complies with the specification requirements. Materials and equipment shall duplicate items that have been in satisfactory commercial or industrial use. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the items need not be the products of the same manufacturer. Each item of equipment shall have the manufacturer's name, address, model number and serial number on the nameplate securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.
- 1.9 VERIFICATION OF DIMENSIONS: Coordinate the proper relation of the work to the building structure and to the work of all trades. Visit the premises and become familiar with the dimensions in the field, and advise the Contracting Officer of the discrepancy before performing any work.
- 1.10 MANUFACTURER'S RECOMMENDATIONS: 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 furnished to the Contracting Officer prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.
- 1.11 ELECTRICAL REQUIREMENTS: Furnish motors, controllers, contactors, and disconnects with their respective pieces of equipment. Motors, controllers, contactors, and disconnects shall conform to and shall have electrical connections provided under Section 16402, "Interior Wiring Systems". Furnish internal wiring for components of packaged equipment as an integral part of the equipment. Extended voltage range motors will not be permitted. Controllers and contactors shall have a maximum of 120 volt control circuits, and auxiliary contacts for use with the controls furnished. When motors and equipment furnished are larger than sizes indicated, the cost of additional electrical service and related work shall be included under the section that specified that motor or equipment. Power wiring and conduit for field installed equipment

shall be provided under and conform to the requirements of Section 16402, "Interior Wiring Systems".

PART 2 - PRODUCTS

- 2.1 PAINTING OF EQUIPMENT: Equipment painting, factory applied or shop applied, shall be as specified herein, and provided under each individual section of this specification.
- 2.1.1 Factory Painting Systems: Manufacturer's standard factory painting systems may be provided subject to certification that the factory painting system applied will withstand 125 hours in a salt-spray fog test. except that equipment located outdoors shall withstand 500 hours in a salt spray fog test. Salt spray fog test shall be in accordance with ASTM B117. Immediately after completion of the test, the paint shall show no signs of blistering, wrinkling or cracking; and no loss of adhesion; and the specimen shall show no signs of rust creepage beyond 0.125 inch on either side of the scratch mark. The film thickness of the factory painting system applied on the equipment shall not be less than the film thickness used on the test specimen. If manufacturer's standard factory painting system is being proposed for use in lieu of the shop painting systems using Fed. Spec. TT-E-496 or TT-P-28, certifications that the manufacturer's standard factory painting system will conform to the heat resistance requirement of Fed. Spec. TT-E-496 or TT-P-28 as applicable, shall be submitted in addition to other certifications.
- 2.1.2 Shop Painting Systems: Clean, pretreat, prime and paint metal surfaces; except aluminum surfaces shall not be painted. Apply coatings to clean dry surfaces. Clean the surfaces to remove dust, dirt, rust, oil and grease by wire brushing and solvent degreasing prior to application of paint, except metal surfaces subject to temperatures in excess of 120 degrees Fahrenheit (F) shall be cleaned to bare metal. Where more than one coat of paint is specified, apply the second coat after the preceding coat is thoroughly dry. Lightly sand damaged painting and retouch before applying the succeeding coat.
- 2.1.2.1 Metal Surfaces Subject to Temperatures Less Than 120 Degrees F.: Immediately after cleaning, the metal surfaces shall receive one coat of Mil. Spec. DOD-P-15328 pretreatment primer applied to a minimum dry film thickness of 0.3 mil, one coat of Fed. Spec. TT-P-645 primer applied to a minimum dry film thickness of one mil; and two coats of Fed. Spec. TT-E-489 enamel applied to a minimum dry film thickness of one mil per coat.
- 2.1.2.2 Metal Surfaces Subject to Temperatures Between 120 and 400 Degrees F.: Surfaces shall receive two coats of Fed. Spec. TT-E-496, Type II, heat-resisting enamel applied to a total minimum thickness of 2 mils.
- 2.1.2.3 Metal Surfaces Subject to Temperatures Greater Than 40 Degrees F.: Surfaces shall receive two coats of Fed. Spec. TT-P-28

heat-resisting aluminum paint applied to a total minimum dry film thick-ness of 2 mils.

*** END OF SECTION ***

SECTION 15250

INSULATION FOR MECHANICAL SYSTEMS

- 1. APPLICABLE PUBLICATIONS: The publications listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent indicated by references thereto:
 - 1.1 Federal Specification (Fed. Spec.):

HH-I-558B Insulation; Blocks, Boards, Blankets, Felts, Sleeving (Pipe and Tube Covering), and Pipe Fitting Covering; Thermal (Mineral Fiber, Industrial Type)

1.2 Military Specification (Mil. Spec.):

MIL-A-3316B Adhesive, Fire Resistant, Thermal Insulation & Am 2

1.3 American Society for Testing and Materials (ASTM) Publications:

E84-81 Surface Burning Characteristics of Building

C591-69 Rigid Preformed Cellular Urethane Thermal Insulation

- 2. GENERAL REQUIREMENTS: Section 15011, "General Requirements, Mechanical", applies to this section, with the additions and modifications specified herein.
- 2.1 Description of Work: The work includes providing new insulation for mechanical systems including piping, as specified herein where indicated on the drawings or specifically called for elsewhere in the specifications. Materials and completed installation shall have a fire hazard rating not to exceed 25 for flame spread and 50 for smoke developed as determined by ASTM E84, except as specified herein. In the publications referred to herein, the advisory provisions shall be considered to be mandatory, as though the word "shall" had been substituted for "should" wherever it appears; reference to the "authority having jurisdiction" shall be interpreted to mean the Contracting Officer. Vapor barrier will not be required on piping, ductwork and equipment used for heating only. Insulation material shall be installed in a first class manner with smooth and even surfaces, with jackets drawn tight and smoothly cemented down on longitudinal and end laps. Scrap pieces of insulation shall not be used where a full length section will fit. Insulation materials shall not be applied until surfaces to be covered are tested for leaks, cleaned and dried, and foreign material such as rust, scale and dirt has been removed.

Insulation shall be clean and dry when installed and during the application of any finish. Insulation shall be neatly finished at hangers. Insulation shall be continuous through hangers, sleeves, wall and ceiling openings, except at fire dampers in duct systems. Provide a complete moisture and vapor seal wherever insulation terminates against metal hangers, anchors and other projections through insulation on cold surfaces for which a vapor seal is specified. Joints, breaks, punctures and voids shall be filled with vapor barrier compound and covered with vapor sealed material identical to that surrounding. Products containing asbestos will not be permitted.

- 2.2 Submittals Required: The submittal requirements of Section 15011, "General Requirements, Mechanical", applies to the following lists.
 - 2.2.1 Manufacturer's Data:
 - a. Insulation
 - b. Jackets
 - c. Adhesives, Mastic and Coatings
 - 2.2.2 Certificates of Compliance:
 - a. Insulation
 - b. Jackets
 - c. Adhesives, Mastics and Coatings
- 3. PIPING INSULATION: New above ground piping and existing above ground insulated piping affected by the Contractor's operations, after being tested, shall be cleaned and insulated. Insulate fittings with the same material and thickness as adjacent runs of pipe. Pipe insulation shall be continuous through wall and floor openings, and pipe sleeves shall be sized accordingly. For hot piping inside building that is more than 6 feet above the floor, terminate the insulation immediately adjacent to each end of unions, flanges, pressure regulating valve assemblies, trap assemblies, strainers, and valves. Insulate pipe at hangers. For insulation protection shields Type 40; provide rigid pipe insulation of the same thickness as adjacent pipe insulation and having a minimum compressive strength of 35 psi or provide hardwood plugs having a minimum of one square inch bearing surface with the wood grain perpendicular to the pipe, between the insulation protection shield and the pipe; except insulation having a minimum density of 7 pounds per cubic foot may be provided between the insulation protector and the pipe for piping 2 inches and smaller. Install pipe insulation with all joints tightly butted. Overlap longitudinal jacket laps not less than 1.5 inches. Wrap butt joints with butt strips not less than 3 inches wide of identical material to jacket. Cement jacket laps and butt strips on both surfaces with adhesive conforming to Mil. Spec. MIL-A-3316, Class 2, or with factory applied self sealing system. Staples shall be stainless steel, outside clinched without complete penetration of insulation. Where vapor barrier jacketing is pierced or punctured it shall be brush coated with vapor barrier coating to provide a vapor tight covering. For concealed hot piping, adhesive is

not required when jacket is secured with flared staples on 4 inch centers. Where molded or mitered fitting covers are used they shall be joined with adhesive conforming to Mil. Spec. MIL-A-3316, Class 2 or wired in place and provide with a smoothing coat of finishing cement.

- 3.1 Domestic Cold Water, Domestic Hot Water, and Roof Drain: Insulate with fibrous glass insulation conforming to Fed. Spec. HH-I-558, Form D, Type III, Class 12, minimum density of 3 pounds per cubic foot, provided with a factory-applied vapor barrier jacket; or insulate with urethane insulation conforming to ASTM C 591 with a factory-applied vapor barrier jacket.
- 3.1.1 Domestic Cold Water, Domestic Hot Water, and Cold Drain Piping: Insulation shall be minimum of one inch thick fibrous glass insulation or 0.75 inch thick urethane insulation, except insulation on recirculating domestic hot water piping loop shall be minimum of 1.5 inches thick fibrous glass insulation or one inch thick urethane insulation.
- 3.1.2 Roof Drain Piping: Horizontal piping above grade, underside of roof drain body, and vertical piping between horizontal roof drain piping and roof drain body shall be insulated as specified for domestic cold water piping.
- 3.1.3 Concealed Domestic Water Supply Piping to Shower Heads: Insulate as specified for domestic cold water piping; only where piping is subject to freezing, in an outside wall, or in a ventilated pipe chase.
- 3.1.4 Water Piping With Electric-Resistance Heater Cable: Insulation shall be minimum of 2 inches thick.
- 3.2 Aluminum Jacket: New piping insulation and existing piping insulation affected by the Contractor's operations, exposed to the weather shall be provided with protective aluminum jacket with factory-applied polyethylene and kraft paper moisture barrier. Aluminum jackets shall be corrugated and shall be not less than 0.016 inch thick. Jackets shall be secured with aluminum or stainless steel bands not less than 0.375 inch wide, or secured with aluminum or stainless steel screws; not more than 8 inches apart. Each jacket shall be applied by turning a one inch hem on one longitudinal edge and the hemmed edge turned in and lapped over the unhemmed edge. The jacket may be machine cut to produce a straight smooth edge and the hem omitted. The longitudinal and circumferential seams shall be lapped not less than 2 inches. Jackets on horizontal piping shall be installed with the longitudinal seam approximately midway between the horizontal centerline and bottom side of the pipe with top edge of the jacket overlapping the bottom edge of the jacket, with the seam of each jacket slightly offset from the seam of the adjacent jackets. The jackets on vertical lines and lines pitched from the horizontal shall be installed from low point to high point so that the lower circumferential edge of each jacket overlap the jacket below it. Special fitting jackets conforming to the above with the exception of longitudinal lapping dimensions and

location of seams shall be used for fittings, valves and flanges. Jackets for fittings, valves and flanges shall be properly overlapped and secured. Jackets shall be finished neatly at pipe hangers and shall be terminated neatly on the ends of unions, valves, traps and strainers. Equivalent aluminum jacketing system, when approved by the Contracting Officer, will be acceptable.

- 3.3 Heat Tape: All of the above piping shall be wrapped with FPE heat tape, rated at six watts per foot 120 V service. The tape to be used is automatic having a preset thermostat set at the factory and is to be run parallel to the pipe with the thermostat being in actual contact with the pipe.
 - a. Protection to be 2-inch pipe to -5°F
 - b. Protection to be 3-inch pipe to -5°F
 - c. Protection to be 4-inch pipe to -5°F
 - d. Protection to be 6-inch pipe to -5°F

*** END OF SECTION ***

SECTION 15271

IN-PLANT PIPING AND ACCESSORIES

PART 1 - GENERAL

1.1 APPLICABLE PUBLICATIONS: The following publications of the issues listed below, but referred to elsewhere by basic designation only, form a part of this specification to the extent indicated by references thereto (where a number is suffixed to the specification number, it denotes the effective amendment to the specification):

1.1.1 Federal Specifications:

TT-P-645A	Primer, Paint, Zinc Chromate, Alkyd Type
WW-V-51F	Valve, Angle, Check, and Globe, Bronze (125, 150 and 200 Pound, Threaded Ends, Flange Ends Solder Ends, and Brazed Ends, For Land Use)
WW-V-54D(3)	Valve, Gate, Bronze (125, 150, and 200 Pound, Threaded Ends, Flange Ends, Solder End, and Brazed Ends, For Land Use)
WW-V-58B	Valves, Gate, Cast-Iron; Threaded and Flanged

1.1.2 Military Specification:

MIL-V-12003F

	Operate	d				
MIL-V-18436E	Valves,	Check;	Bronze,	Cast-Iron,	and	Steel

Valves, Plug: Cast Iron or Steel, Manually

1.1.3 American Society for Testing and Materials (ASTM):

A 48-76	Gray Iron Castings
A 53-82	Pipe, Steel, Black and Hot-Dipped, Zinc- Coated Welded and Seamless
A 120-82	Pipe, Steel, Black and Hot-Dipped Zinc- Coated (Galvanized) Welded and Seamless for Ordinary Uses
A 126-73	Gray Iron Castings for Valves, Flanges and Pipe Fittings
B 32-76	Solder Metal
B 61-74	Steam or Valve Bronze Castings

	B 62-74	Composition Bronze or Ounce Metal Castings
	B 88-82	Seamless Copper Water Tube
1.1.4	American W	ater Works Association (AWWA):
	C 104-80	Cement Mortar Lining for Cast-Iron and Ductile Iron Pipe and Fittings for Water
	C 110-82	Gray-Iron and Ductile-Iron Fittings, 2 inch through 48 inch, for Water and Other Liquids
	C 111-80	Rubber Gasket Joints for Cast-Iron and Ductile-Iron Pressure Pipe and Fittings
	C 115-75	Flanged Cast-Iron and Ductile-Iron Pipe with Threaded Flanges
	C 151-81	Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids
	C 500-80	Gate Valves - 3 inch through 48 inch - For Water and Other Liquids
	C 504-80	Rubber Seated Butterfly Valves
	C 600-82	Installation of Cast-Iron Water Mains
	C 601-81	Disinfecting Water Mains
	c 800-66	Threads for Underground Service Line Fittings
1.1.5	Underwriter	s' Laboratories (UL):
	UL 262-80	Gate Valves for Fire-Protection Service, May 1973
	UL 312-80 (R 82)	Swing-Check Valves for Fire-Protection Service, June 1973
1.1.6	American Na	tional Standards Institute (ANSI):
	816.3-77	Malleable Iron Threaded Fittings Class 150 and 300
	B16.18-78	Cast Bronze Solder-Joint Pressure Fittings
	316.22-82	Wrought Copper and Bronze Solder-Joint Pressure Fittings
	316.26-75	Cast Copper Alloy Fittings for Flared Copper Tubes

B16.39-77 Malleable Iron Threaded Unions Class 150, 250, and 300

1.1.7 National Fire Protection Association (NFPA):

24-73

Outside Protection

1.1.8 Manufacturers Standardization Society of the Valve and Fittings Industry (MSS) Publications:

SP-58-75 Pipe Hangers and Supports - Materials, Design

and Manufacture

SP-69-76 Pipe Hangers and Supports - Selection and

Application

1.1.9 LANTDIV Plate:

WD-1 Standard Thrust Blocks for Water Mains

- 1.2 DESCRIPTION: Work included is all in-plant process piping and accessories for deep well house, water plant, and sewage pumping stations to 5 feet outside the building line and the in-building piping and accessories at the wastewater treatment plant. Pipe lines 4 inch and larger shall be flanged ductile iron pipe. Pipe line smaller than 4 inch shall be threaded galvanized steel. Copper tubing shall be used for pipe one inch and smaller.
- 1.2.1 The work under this section includes but is not limited to the following:
 - a. Pipe and Fittings
 - b. Gate Valves
 - c. Plug Valves
 - d. Butterfly Valves
 - e. Check Valves
 - f. Air Release Valves
 - g. Bench Stands
 - h. Pipe Hangers and Supports
 - i. Wall Casting
 - i. Wall Sleeves
- 1.3 GENERAL REQUIREMENTS: Section 15011, "General Requirements, Mechanical" also applies to this section except as specified otherwise. Reference Section 15301, "Exterior Sanitary Gravity Sewer" and Section 15272, "Water Distribution for Requirements for Non-Plant Piping".
- 1.4 SUBMITTALS REQUIRED: Shop drawings, manufacturer's data and certificates for equipment, materials, finish, and pertinent details for each system shall be submitted and approved before procurement, fabrication, or delivery of such items to the job site. Partial submission will not be acceptable. Descriptive data shall be annotated to show the specific model, type, and size of each item the Contractor proposes to

furnish. The submittals requirements of Section 15011, "General Requirements, Mechanical" applies to the following lists. Items in the following lists shall be approved by the Contracting Officer.

1.4.1 Manufacturer's Data:

- a. Pipe Fittings, Joints, Couplings, and Gaskets
- b. Valves
- c. Bench Stands
- d. Pipe Hangers and Supports
- e. Wall Casting
- f. Wall Sleeves
- g. Backflow Preventers
- 1.4.2 Certificates of Compliance: Submit certificates from the manufacturer attesting that each of the following items conform to all requirements of this specification and of reference publications.
 - a. Pipe and Fittings, Joints, and Couplings
 - b. Valves
 - c. Pipe Hangers and Supports

PART 2 - PRODUCTS

2.1 PIPE AND PIPE FITTINGS:

- 2.1.1 Ductile-Iron Pipe and Fittings: AWWA C151, minimum thickness Class 52; AWWA C115 Class 53 for flanged pipe. Fittings shall be AWWA C110 with a pressure rating not less than that of the pipe. Provide AWWA C104 standard thickness cement-mortar lining for pipe and fittings. Provide AWWA C111 mechanical joints or push-on joints for buried piping. Provide AWWA C111 rubber gaskets for each flange in piping.
- 2.1.2 Copper tubing shall be hard copper tubing conforming to ASTM B88, Type K for underground and Type L for aboveground. Provide ANSI B16.18 or ANSI B16.22 solder joint fittings using ASTM B32, 50-50 tin-lead solder; or with ANSI B16.26 flared joint fittings.
- 2.1.3 Galvanized Steel Pipe: ASTM A53 or ASTM A120, Schedule 40, zinc coated threaded end connections. Provide ANSI B16.3 zinc coated threaded fitting and ANSI B16.39 zinc coated unions.
- 2.1.4 Insulating Joints: Joints between pipe of dissimilar metals shall have a rubber gasket or other approved type of insulating joint or dielectric coupling which will effectively prevent metal-to-metal contact between adjacent sections of piping.
- 2.1.5 Accessories: Provide flanges, connecting pieces, transition glands, transition sleeves, and other adapters as required.
- 2.2 VALVES: Valves conforming to the same specification shall be of one make throughout the project.

2.2.1 Gate Valves:

- 2.2.1.1 Gate Valves on Buried Piping: Valves shall have non-rising stems and shall be double-disc parallel seat type. Valves shall open by counterclockwise rotation of the valve stem. Valves shall have O-ring stem seals, except when gearing is specified, in which case conventional packing shall be used in lieu of O-ring seal. Stuffing boxes shall be bolted and constructed so as to permit the easy removal of parts for repairs.
- 2.2.1.1.1 Valves 3-inch Size and Larger: Except as otherwise specified hereinafter, valves shall conform to AWWA C500 or to UL 262. Valves shall have mechanical-joint or push-on joint ends and gaskets conforming to ANSI A21.11 (AWWA C111), except as follows: Valves conforming to UL 262 shall be designed for a hydraulic working pressure of 175 psi for valve sizes 12-inch and smaller and 150 psi for sizes larger than 12-inch.
- 2.2.1.1.2 Valves Smaller Than 3-inch Size: Valves shall conform to the requirements of AWWA C500, except for size, or to UL 262. Valves shall be designed for a working pressure of 175 psi.
- 2.2.1.2 Gate Valves in Valve Chambers, Valve Pits, and in Above Ground Locations:
- 2.2.1.2.1 Valves 3-inch Size and Larger: Valves shall conform to WW-V-58 or to UL 262. Valves shall be of the outside-screw-and-yoke configuration. Valves shall have flanged ends unless otherwise indicated or otherwise specified hereinafter. Valves conforming to WW-V-58 shall be Type II, Class 1. Valves conforming to UL 262 shall be designed for a hydraulic working pressure of 175 psi for valve sizes 12-inch and smaller and 150 psi for valve sizes larger than 12-inch.
- 2.2.1.2.2 Valves Smaller Than 3-inch Size: Valves shall conform to either WW-V-54, WW-V-58, or to UL 262. Valves conforming to WW-V-54 shall be Type III, Class A. Valves conforming to WW-V-58 shall be Type II, Class 1. Valves conforming to UL 262 shall be of outside-screw-and-yoke configuration and shall be designed for a hydraulic working pressure of 175 psi. Valves shall have threaded ends.
- 2.2.2 Plug Valves: Plug valves for sewage and sludge service shall be MIL-V-12003, Class 150, Type II, Style A or B as specified herein. Body shall be of semi-steel with Buna-N solid plug. Plug valves 10-inch and larger shall be geared (Style A). Provide operating wheels on all geared valves and levers for others (Style B).
- 2.2.3 Butterfly Valves: This section covers butterfly valves for use on filter piping. Butterfly valves shall be of the rubber-seated tight-closing type and shall meet or exceed the requirements of AWWA Specification C504 for both the valve and valve operator. Valve ends shall be flanged and drilled 125-pound ANSI for the inside service.
- 2.2.3.1 Body: Valve body shall be high-strength cast iron ASTM A126, Class B with 18-8 Type 304 stainless steel body seat. Valve vane shall be

high-strength cast iron ASTM A48, Class 40, having rubber seat mechanically secured with an integral 18-8 stainless steel clamp ring and 18-8 stainless steel nylon locked screws. Rubber seat shall be a full-circle 360 degree seat not penetrated by the valve shaft. Valve shaft shall be one-piece, extending full size through the entire valve and operator with no neckdown, keyways, or holes to weaken it. Valve shaft shall have 304 stainless steel journals rotating in reinforced teflon bearings. Valve shall have permanently set two-way thrust bearing. Packing shall be "triple-seal" rubber designed for permanent duty in underground service.

- 2.2.3.2 Operator: Valve operator shall be the pneumatic type manufactured in accordance with AWWA C504. Design shall operate the valve against 75 psi line pressure with 70 psig regulated air pressure. Solenoid valves shall be integrally mounted on the operator.
- 2.2.4 Solenoid valves shall be quick opening suitable for operation on 120 volt, single phase, 60 Hz power. Coil shall be designed for continuous duty. Body shall be of forged brass. Design shall be for non-lubricated air.

2.2.5 Check Valves:

- 2.2.5.1 Check Valves 3-inch Size and Larger: Valves shall conform to MIL-V-18436 or to UL 312. Valves shall have hub ends suitable for mechanical joint on buried lines; and shall have flanged ends in valve chambers, valve pits, or in above-ground locations. Swing-check valves shall have clear-port opening. Valves conforming to MIL-V-18436 shall be Type III, shall have cast-iron or steel bodies with bronze trim, and shall be designed for a hydraulic working pressure of 175 psi for valve sizes 12-inch and smaller and 150 psi for valve sizes larger than 12-inch.
- 2.2.5.2 Check Valves Smaller than 3-inch Size: Valves shall conform to either WW-V-51, MIL-V-18436, or UL 312. Valves shall have threaded ends. Valves conforming to WW-V-51 shall be Type IV, Class A. Valves conforming to MIL-V-18436 shall be Type III, shall have cast-iron or steel bodies with bronze trim, and shall be designed for a hydraulic working pressure of 175 psi.
- 2.3 VALVE BOXES: Valve boxes shall be provided for underground valves. The boxes shall be of cast iron and shall consist of a base section, center extension sections as required, and a top section with cover marked "DRAIN", "SEWER", or "WATER", as applicable. The box shall be set vertical with the top at finished grade. Provide 24-inch square by 4-inch thick concrete pad at top of valve boxes located in grassed areas.
- 2.4 AIR RELEASE VALVES: The Contractor shall provide automatic air release valves on the discharge piping of the well water pumps, filters, and softeners. The valve shall be the one-inch deep well type, capable of discharging 1000 cfm at a pressure differential of approximately 58 psi. The valve body shall be constructed of cast iron, float of stainless steel, seat of hy-car rubber, and cup of bronze.

- 2.5 BENCH STANDS: Provide wall mounted bench stands where required for the operation of valves and sluice gates. Bench stands shall be either rising stem or non-rising stem type of cast iron construction. The stand shall be fully adjustable in both the horizontal and vertical direction. Provide handwheel operator.
- 2.6 PIPE HANGERS AND SUPPORTS: MSS-SP-58 and MSS-SP-69. Provide adjustable type. Finish of rods, nuts, bolts, washers, hangers, and supports shall be zinc plated after fabrication. Provide additional supports at the concentrated loads in piping between supports, such as inline pumps and flanged valves.
 - 2.6.1 Maximum Spacing Between Hangers:
- 2.6.1.1 Vertical Piping: Support metal piping at each floor, but at not more than 10 foot intervals.
- 2.6.1.2 Horizontal spacing of the hangers, unless otherwise noted, shall not exceed the following:

Pipe Size	Hanger Spa	cing (DC)
	Metal	PVC
Up to 1"	61	31
1-1/2" to 2"	81	51
2-1/2" to 4"	101	61
6" and over	121	61
Cast Iron Soil Pipe	5'	

- 2.7 WALL CASTINGS: Cast iron wall castings shall be provided where indicated on the drawings. Size and end configuration shall be as indicated. All wall castings shall contain an intermediate wall collar. Provide tapping or drilling as required.
- 2.8 WALL SLEEVES: Provide hot dipped galvanized split ring wall sleeves where pipes pass through walls and floor slabs not using wall castings. Sleeves shall be 1/2-inch larger I.D. than the 0.D. of the pipe passing through. Caulk between the pipes with oakum and lead to make watertight.

PART 3 - EXECUTION

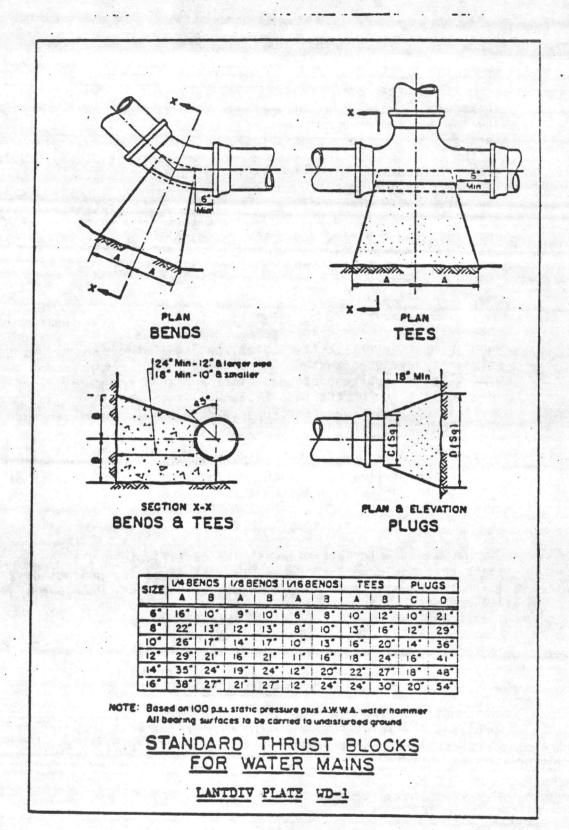
3.1 HANDLING: Pipe, fittings, valves, hydrants, and other accessories shall be handled in such manner as to insure delivery to the trench in sound, undamaged condition. Special care shall be taken not to injure pipe coatings or linings. If coatings or linings of pipe and fittings are damaged, satisfactory repairs shall be made at no extra cost to the Government. Pipe shall be carried to the trench and not dragged. Rubber gaskets that are not to be installed immediately shall not be left in the sunlight, but shall be stored under cover out of direct sunlight.

3.2 PIPE INSTALLATION AND JOINTING:

- 3.2.1 Pipe, fittings, valves, and accessories will be carefully inspected before and after installation, and those found defective will be rejected. Pipe and fittings shall be free from fins and burrs. Before being placed in position, pipe, fittings, valves, and accessories shall be cleaned and shall be maintained in a clean condition. Under no circumstances shall pipe, fittings, valves, or any other water line material be dropped or dumped. Pipe shall be cut accurately to measurements established at the site and shall be worked into place without springing or forcing. Piping that does not allow sufficient space for proper installation of jointing material shall be replaced by one of proper dimensions. The pipe shall be graded in straight lines, taking care to avoid the formation of any dips or low points. Pipe shall be supported at its proper elevation and grade, care being taken to secure firm and uniform support. Wood support blocking will not be permitted. Anchors and supports shall be provided where necessary and where indicated on the project drawings for fastening work into place. Proper provision shall be made for the expansion and contraction of pipe lines. Open ends of pipe at the end of each day's work shall be closed temporarily with wood blocks or bulkheads. Piping shall be inspected, tested, and approved before being completely buried, covered, or concealed.
- 3.2.2 Ductile-Iron Pipe and Fittings: AWWA C600 for pipe installation, joint assembly, valve and fitting installation, and thrust restraint, except as otherwise specified hereunder. Provide AWWA C600 joint assembly for mechanical joints and with the recommendations of Appendix A to AWWA C111. Make flanged joints up tight; avoid undue strain on flanges, fittings, valves, and other accessories. Use full-sized bolts for the bolt holes; use of undersized bolts to make up for misalignment of bolt holes or for any other purpose will not be permitted. Do not allow adjoining flange faces to be out of parallel to such degree that the flanged joint cannot be made watertight without overstraining the flange. When any flanged pipe or fitting has dimensions that do not allow the making of a proper flanged joint as specified in this paragraph, replace it with one of proper dimensions. Assemble insulating joints as specified for flanged joints, except that bolts with insulating sleeves shall be full size for the bolt holes. Assure that there is no metal-to-metal contact between dissimilar metals after joint has been assembled.
- 3.2.3 Joints for Copper Tubing: Copper tubing shall be cut with square ends, and all burrs and fins removed. Tubing shall be handled carefully and all tubing dented, gouged, or otherwise damaged shall be replaced with undamaged tubing. Solder joints shall be made using 50-50 lead-tin solder. End of tubing and inside of fitting or coupling shall first be cleaned with wire brush or abrasive. A rosin flux shall then be applied to the tubing end and on the recess inside of fitting or coupling. Tubing end shall then be inserted to the full depth of the recess and soldered. For compression joints on flared tubing, the tubing shall be inserted through the coupling nut and flared with an approved flaring tool.

- 3.2.4 Threaded Connections: Jointing compound for pipe threads shall be polytetrafluoroethylene (PTFE) pipe thread tape, pipe cement and oil, or PTFE powder and oil; apply only on male threads. Provide exposed ferrous pipe threads with one coat of Fed. Spec. TT-P-645 primer applied to a minimum dry film thickness of 1.0 mil.
- 3.3 PIPE ANCHORAGE: Anchorage of buried pipe lines shall be by means of concrete thrust blocks (reaction backing), using concrete with a minimum compressive strength of 2000 psi. All 1/16 and sharper bends, tees, and dead ends of pipe shall be securely blocked in the direction of flow with poured-in-place concrete bearing solidly against the pipe and affording a minimum of 3 square feet of bearing area against a vertical trench face for 3- and 4-inch pipe and in accordance with LANTDIV Plate WD-1 for piping 6-inch diameter and larger. Plate WD-1 appears at the end of this section.
- 3.4 SETTING VALVES AND VALVE BOXES: Valves and valve boxes shall be set plumb, and centered, with valve boxes placed directly over the valves. Valve boxes shall, if possible, be located outside the area of the roads and streets. Earth fill shall be carefully tamped around the valve box to distance of 4 feet on all sides of the box or to the undisturbed trench face if less than 4 feet. Valves shall have the interiors cleaned of all foreign matter before installation. Stuffing boxes shall be tightened and the valve shall be inspected in opened and closed positions to see that all parts are in working condition.
- 3.5 DISINFECTION: New water piping and existing water piping affected by Contractor's operations shall be disinfected in accordance with AWWA C601. Piping system shall be filled with solution containing minimum of 50 parts per million of available chlorine and allowed to stand for minimum period of 24 hours. Solution shall be flushed from system with clean water until maximum residual chlorine content is not greater than 0.2 parts per million.
- 3.6 IDENTIFICATION TAGS AND PLATES: Valves shall be provided with tags or plates numbered and stamped for their usage. Plates and tags shall be of brass or suitable nonferrous material and shall be securely mounted or attached.
- 3.7 FIELD TESTS AND INSPECTIONS: Perform all field tests, and provide all labor, equipment, and incidentals required for testing, except that water and electric power needed for field tests will be furnished as set forth in Division 1. The Contractor shall produce evidence, when required, that any item of work has been constructed in accordance with contract requirements. Allow concrete to cure a minimum of 5 days before testing any section of piping where concrete thrust blocks have been provided.
- 3.7.1 Testing Procedure: Test piping in accordance with the following applicable standards, as modified herein:
 - a. Ductile-Iron: AWWA C600 for pressure and leakage tests, except no leakage will be allowed for flanged joints.

- b. Copper Tubing and Steel Pipe: AWWA C600 for hydrostatic testing. No leakage shall be allowed.
- 3.7.1.1 Special Testing Requirements: For pressure test, use a hydrostatic pressure 50 psi greater than the maximum working pressure of the system, but not less than 200 psi. Hold this pressure for not less than 2 hours. Prior to the pressure test, fill that portion of the piping being tested with water for a soaking period of not less than 24 hours. For leakage test, use a hydrostatic pressure not less than the maximum working pressure of the system. Leakage test may be performed at the same time and at the same test pressure as the pressure test.
- 3.7.1.2 All equipment shall be tested in operation to demonstrate compliance with the contract requirements.



*** END OF SECTION ***

05-81-1478 15271-11

SECTION 15309

CLEANING, INSPECTION, AND REPAIR OF SEWERS

1. GENERAL REQUIREMENTS: The work includes the cleaning, television inspection, and testing of approximately 11,080 LF of sanitary gravity sewers, and the chemical sealing and testing of leaking joints. The work further includes the rehabilitation of 42 existing manholes. Quantities of the work for chemical sealing and testing of sanitary gravity sewers are specified in the section entitled "Bids". Quantities for other work items are as indicated on the contract drawings. Section 02722, "Exterior Sanitary Sewer" also applies to this section except as specified otherwise. Excavation and backfilling are specified in the section of the specification entitled "Earthwork" and paving is specified in the section entitled "Pavement Removal and Replacement".

2. SUBMITTALS:

- 2.1 Materials Tests and Test Reports: The testing requirements for materials incorporated in referenced documents will be waived provided the manufacturer submits certificates stating that previously manufactured materials have been tested by recognized laboratories, that such materials meet testing requirements specified, and that the materials furnished for this project are of the same type, quality, manufacture and make as that tested. Copies of the test reports need not be submitted except as specifically requested by the Contracting Officer.
- 2.2 Certificates: Submit certificates from the manufacturer attesting that the following products conform to all requirements of this specification and of reference documents:

a. Chemical Grout Material

2.2.1 Sample Certificate: The certificate shall not contain statements that could be interpreted to imply that the product does not meet all requirements specified, such as "as good as"; "achieve the same end use and results as materials formulated in accordance with the referenced specification"; "equal or exceed the service and performance of the specified material". The certificate should simply state that the product conforms to all requirements specified.

SAMPLE CERTIFICATE

The manufacturer hereby certifies that the following products being furnished for this project conform to all requirements of the project specifications and of the reference specifications listed:

MANUFACTURER AND PRODUCT

REFERENCE SPECIFICATION

John Doe Company Portland Cement, Type I

ASTM C150-74, Type I

SIGNATURE AND TITLE

- 2.3 Manufacturer's Data: Submit complete descriptive literature for the following. Data shall be sufficient to show conformance to specified requirements.
 - a. Chemical Grout Material
 - b. Acid Proof Cement
 - c. Sewer Line Cleaning Equipment
 - d. Description of Cleaning Operation
 - 2.4 Shop Drawings:
 - a. Work Sequence and Schedule
 - b. Solids and Water Removal System
 - 2.5 Certificates of Conformance:
 - a. Backflow Preventers
 - 2.6 Reports:
 - a. Daily Report
 - b. Final Report
 - c. T.V. Video Tapes
- 3. EQUIPMENT: All machines, tools, and equipment used in the performance of the work shall be appropriate for accomplishing the specified work, and shall be maintained in a satisfactory operating condition at all times.
- 3.1 High Velocity Hydraulic Cleaning Equipment: All high velocity sewer cleaning equipment shall be truck mounted for ease of operation. The equipment shall have a minimum of 500 feet of one inch high-pressure hose with a selection of two or more high velocity nozzles. The nozzles shall deliver a minimum capacity of 60 gallons per minute at the nozzle's head and have a working pressure of 950 to 1,000 pounds per square inch. The nozzles shall be capable of producing a scouring action from 15 degrees to 45 degrees in all size lines designated to be cleaned. Equipment shall also include a high velocity gun for washing and scouring manhole walls and floors. The gun capacity shall be 5 to 27 gallons per minute at 200 to 800 pounds per square inch. The gun shall be capable of producing flows from a fine spray to a long distance solid stream. The equipment shall carry its own water tank, 1,000 gallons minimum, and capable of holding corrosive or caustic cleaning chemicals, auxiliary engines and pumps, and hydraulic driven hose reel. All controls shall be located so that the equipment can be operated above ground.

- 3.2 Mechanical Cleaning Equipment: Bucket machines shall be in parts with each machine powered with a minimum of a 16 horsepower engine to insure sufficient pulling power. Each machine shall be equipped with a two speed transmission and shall be able to pull at rates of 175 feet per minute in high speed and 115 feet in low speed. The power rodding machine shall be of a "continuous rod" type capable of holding a minimum of 1,000 feet of rod. The rod shall be especially treated steel. The machine shall have a positive rod drive and produce a 2,000 pound rod pull. To insure safe operation, the machine shall have a fully enclosed body and an automatic safety throw-out clutch.
- 3.3 Closed Circuit Television Equipment: Television equipment shall consist of a self-contained camera and a monitoring unit connected by a three or more wire coaxial cable. The equipment shall be mounted in a truck van for ease of operation. The camera shall be small enough to insure passage through a six inch diameter sewer, shall be waterproof and shall have a self-continuous 600-line resolution picture showing the entire inside periphery of the pipe. Equipment shall include winches and associated equipment for operating the camera and grout packer. The Contractor shall also provide a camera for taking pictures of problem areas from the monitor's viewing screen.
- 3.4 Grout Packer: Equipment shall include a grout packer connected in tandem with the television camera. The packer shall be a device that shall contain expandable sleeves so that joints and faults can be completely isolated from the remainder of the sewer to form a void area at the point of sewer leakage. The system shall include all pumps, hoses, cables, rejointer, meters and equipment necessary for the performance of the work.
- 4. FLOW CONTROL: A sewer line plug shall be inserted into the line at a manhole upstream from the section to be inspected. The plug shall be so designed that all or any portion of the sewage flows can be released. During the inspection portion of the operation, flows shall be shut off or substantially reduced in order to properly inspect the pipe at the invert. After the inspection is complete, flows shall be restored to normal. When adequate control cannot be obtained or flooding of buildings occur, the Contractor shall provide by—pass pumping at his own expense.

5. SEWER LINE JOINT TESTING:

- 5.1 Each sewer line joint shall be tested to determine if leakage exists in the pipe joints. Joint testing shall be done utilizing a void pressure monitoring system. Generally this shall be accomplished by applying a positive pressure to each joint, or series of joints, allowing time for the system to stabilize and measuring the amount of pressure decay over a given length of time.
- 5.2 Testing Procedures: Each joint of the sewer line shall be located with closed circuit television and either water tested or air tested with the grout packer prior to grouting. The air test shall consist of applying a precise pressure of 4 pounds per square inch gage into each void area created by the testing device. Once the 4 pounds per

square inch gage of the void area has been recorded on the meter above ground for sufficient time to stabilize the system, the application of pressure shall be stopped. At a point when the meter records precisely 4 pounds per square inch gage, the meter shall be observed for a minimum of 15 seconds. Should the pressure in the void area drop to less than 2 pounds per square inch gage within 15 seconds, the joint or fault in the void area will have failed the test. The water test shall consist of pumping water through the testing device into the void area to a minimum pressure of 10 pounds per square inch gage. Once the 10 pounds per square inch gage of the void area has been recorded on the meter above ground for sufficient time to stabilize the system, the pressure shall then be increased a minimum of 1 pound per square inch gage within a 1 minute time period. If the pressure cannot be increased 1 pound per square inch gage within 1 minute, the joint fails the test. Any joint failing the test shall be sealed as specified in the paragraph entitled "Sewer Line Joint Sealing" and retested by the same method and procedures until the joint passes the test.

6. CLEANING:

- 6.1 Cleaning operations shall be accomplished by approved mechanically powered, or high velocity sewer cleaning equipment or combinations thereof as required. Selection of the equipment and methods used shall be based on the conditions of the lines at the time the work commences. A manhole section found to be completely or partially stopped up, plugged or heavily intruded with roots shall be cleared with an approved root cutter or other device in a satisfactory manner. Cleaning operations shall leave the pipes and manholes clean and free of all obstructions including sand, sludge, rock, grease, roots and all other deleterious matter and obstructions. All sections of pipe that are not clean to within 95% clear inside pipe diameter opening as revealed by the television inspection shall be recleaned and reinspected until the pipe is proven clean as specified herein at no additional cost to the Government. All manholes in the sanitary system indicated to be sealed shall be cleaned as specified herein.
- 6.2 Cleaning equipment selected shall be capable of removing all sludge, sand, rock, grease, roots and other deleterious matter and obstructions from the sewer lines and manholes without damage. Whenever lines to be cleaned show evidence of being more than one—half filled with solids or resist effective cleaning by hydraulic methods, then bucket machines, scrapers, augers or other equipment shall be utilized to remove the major portion of the material before hydraulic equipment is brought into use for finishing. Only cleaning equipment properly sized for the pipe being cleaned will be permitted.
- 6.3 Satisfactory precautions shall be taken to protect the sewer lines and manholes from damage that might be inflicted by the improper or careless use of cleaning equipment. Whenever hydraulically propelled cleaning tools which depend upon water pressure to provide their cleaning force or any tools which retard the flow of water in the sewer line are used, precautions shall be taken to insure that the water pressure created

does not cause any damages or flooding to Government property being served by the manhole section involved.

- 6.4 Removal of all debris resulting from the cleaning operations shall be accomplished in an approved manner at the downstream manhole of the section being cleaned. Passing material from manhole section to manhole section which could cause line stoppages shall not be permitted. All dirt, debris, roots and other material removed from the sewers shall be removed from the limits of the station. Under no circumstances shall sewage or solids removed from the sewers be dumped onto streets or into ditches, catch basins or storm sewers. The Contractor shall be responsible for clean-up of any waste materials as a result of this work, in all areas.
- 7. CLOSED CIRCUIT TELEVISION INSPECTION shall be performed on one manhole section at a time unless otherwise permitted. Each manhole section being inspected shall be isolated from the remainder of the line by the use of line plugs or other approved measures to insure total viewing of the inside periphery of the pipe. When adequate sewage flow control cannot be obtained by plugging or other approved methods, pumps or siphons shall be used to divert all or a portion of the flow as may be necessary to perform the inspection and sealing operations and maintain continuous use of the sewer system. The inspection shall be performed by pulling the television camera through the line along the axis of the pipe. The inspection may be performed in a forward and/or backward direction depending upon the line conditions at the time of inspection. The view seen by the television camera shall be transmitted to a monitor of suitable size located inside a mobile TV studio. The mobile studio shall be of such size to accommodate the Contracting Officer and the Contractor's operating personnel for the purpose of viewing the monitor while the inspection is in progress. The Contracting Officer shall have access to view the television screen at all times. Video recorded tapes shall be performed on all sewer lines that are T.V. inspected and a copy of all tapes shall be submitted to the Contracting Officer. The television viewers and the Contracting Officer shall constantly watch the receiving camera to observe the interior conditions of the pipe and as each joint is reached the viewer shall stop the packer and notify the packer pump operator to perform a pressure test. These requirements apply for the test before sealing joints, as well as the test on completed sealed joints. If the TV inspection encounters sewer lines that are completely obstructed through collapse of the sewer, the Contractor shall identify the extent of damage, log it on the daily report, and notify the Contracting Officer.
- 8. GROUT MATERIALS: One of the following grouting compounds shall be used for pipeline grouting. The chemical grout used shall have a documented service of satisfactory performance in similar usage.
- 8.1 Chemical grout for pipeline sealing shall be a chemical grout which is a non-corrosive, hydrophilic polymer with a viscosity in the 250 to 300 CPS range which contains solid materials constituting 82 to 88 percent of its total weight. When mixed with an equal quantity of water containing an accelerator the material shall expand to 10 to 12 times its original volume and cure to a tough flexible elastomeric condition. Induction and gel times are directly related to the temperature of the sewer pipe and accelerator concentration. Accelerator concentration and sewer temperature

shall be carefully checked to insure the proper induction and gel times of the grouting compound.

- 8.2 Chemical grout for pipeline sealing shall be a acrylate polymer grout consisting of a mixture of water soluable acrylate monomers and cross-linker, which when catalyzed and initiated forms a flexible gel. The chemical grout shall have a density of 9.8 lb/gal, 39-41 percent solids, with a triethanolamine catalyst, and a ammonium Persulfate initiator. The chemical grout, when mixed with the grouting solution, shall have a solids content of 10 percent, a viscosity of not more than 2 CPS, and a minimum permeability of 5 x 10^{-9} cm/sec. When the gel is in contact with water, it shall expand to 10 percent of its original volume.
- 8.3 Mixing and Handling: Mixing and handling of the chemical grout and constituents forming it shall be in accordance with the printed recommendations of the manufacturer and in such a manner as to minimize hazard to personnel. It is the responsibility of the Contractor to provide appropriate protective measures to insure that chemicals or gels produced by said chemicals are under the control of the Contractor at all times.
- SEWER LINE JOINT SEALING: For all lines each leaking joint shall be sealed as specified herein, using grout materials specified hereinbefore. Generally, this shall be accomplished by forcing chemical sealing materials into the infiltration point through a system of pumps, hoses and rejointer. Jetting or driving pipes from the surface that could damage or cause undermining of the pipe lines, shall not be allowed. The packer sleeves shall then be expanded using precisely controlled pressures. The pneumatically expanded sleeve shall seal against the inside periphery of the pipe to form a void area at the point of infiltration, now completely isolated from the remainder of the pipe lines. Into this isolated area sealant materials shall be pumped through the hose system at controlled pressures which are in excess of ground water pressures. The pumping. metering, and packer rejointer device shall be integrated so that proportions and quantities of materials, and pressures for materials and sealing can be instantly regulated in accordance with the type and size of the leak, percentage of voids being filled, type of soil surrounding the pipe, and the rate of flow of the sealing solution in relation to the back pressures. Upon completion of the injection, the television camera shall be moved to a position to observe and inspect the result of the injection. If inspection shows the seal was not completely effective, the process shall be repeated until all infiltration has been cut off. Before final acceptance, each joint and fault sealed shall be retested as specified hereinbefore. Should a joint fail to pass the test, it shall be resealed and retested until the test requirements are met. After the leak has been satisfactorily sealed, excessive gels shall be removed from the inside of the pipe by partially inflating the packer and pulling it past the area as a wiper to restore the pipe to its original inside diameter. The excess grout material shall be flushed or pushed forward to the next manhole, removed from the sewer system and disposed of by the Contractor as specified for disposal of debris resulting from cleaning operations. In no case shall excess grout material from succeeding sections be allowed to accumulate and be flushed down the sewer.

10. MANHOLE REPAIRS:

10.1 Frames and covers for manholes shall conform to RR-F-621, Figure 1, Size 22A for frame and Figure 8, Size 22A for cover in paved areas, and Figure 4, Size 22 for frame and Figure 12, Size 22 for cover in

nonpaved areas. Frames and covers shall be factory coated with asphalt based paint.

- 10.2 Sealing and Coating Manholes with Acid Proof Cement (Indicated as "Seal Manhole Interior" on the Contract Drawings): Acid proof cement shall be capable of resisting corrosive or deteriorating gases and fluids. It shall consist of two parts; a powdered filler and a sodium silicate compound liquid binder. Fill shall be powdered inert silicate systems and aluminum silicate. The filler shall be delivered in sealed bags and the binder in steel drums. The interior surfaces of walls of existing manholes indicated to be sealed and coated with acid-proof cement shall be scraped and cleaned to free large scale, debris, soft mortar, loose mortar and other foreign matter. The interior surfaces shall be thoroughly cleaned prior to the application of a dilute minimum 10 percent solution of muriatic acid which shall remain on the walls 30 minutes. The muriatic acid shall then be washed out of the manhole following the 30 minute period. Upon completion of the cleaning operation, the manhole shall be inspected to insure its readiness to receive the acid-proof cement coating. It is imperative the walls of the manhole be dry. All leaks in the manhole shall be stopped with pressure chemical grout, as specified in the paragraph entitled "Manhole Sealing" of this section, before any work is done associated with the application of the acid-proof cement. acid-proof cement mixture shall consist of 4 parts filler to 1 part The binder shall be placed in a mortar box or mixture and the filler slowly added while mixing. Once all of the filler is added, the cement shall be thoroughly mixed for at least 5 minutes. The acid-proof cement shall be applied to the interior surfaces by the use of a cement stucco gun. The nozzle of the cement stucco gun shall be held at such a distance and position that the stream of flowing material shall impinge at right angles to the surface being covered and that any rebound will not fall on surfaces yet to be coated with the mixture. All acid-proof cement shall be deposited in such manner that there will be no pockets or void spaces between the manhole walls and the cement mixture. No admixtures, cements, limes, antifreezing compounds, accelerating mixtures, sand, gravel, water, or soluble compounds shall be added with the acid-proof cement. The freshly applied mixture shall not be disturbed until it is thoroughly set and cured. Filler and binder described herein shall be equal to "Acid-proof concrete No. 54", manufactured by the Sauereisen Cement Company, 160 Gamma Drive, Pittsburgh, Pennsylvania 15238.
- 10.3 Manhole Sealing: Manhole indicated to be sealed shall be sealed by pressure chemical grouting. A hole shall be drilled at the point of infiltration through the wall of the manhole to the surrounding ground area. An approved grouting packer device shall be inserted into the hole and chemical grout pumped into the ground surrounding the manhole until infiltration has stopped. This procedure may have to be exercised in a number of locations in a single leaking manhole. Dye tracer may be used in chemical solutions so as to trace the flow the grout.
- 10.4 Pointing Up Mortar Joints and Patching Cracks and Holes: In the manholes indicated to be sealed, all soft, mushy or loose mortar between bricks shall be removed to a depth where the mortar is in good condition. The mortar joints, cracks and holes shall be cleaned of all

foreign matter and washed with potable water. The mortar joints, cracks and holes shall then be filled with fresh mortar consisting of one part portland cement to one part approved mortar sand. The quantity of water in the mix shall be sufficient to produce a stiff workable mix. Water shall be potable and free from harmful acids, alkalies and organic impurities. The mortar shall be used within 30 minutes after the ingredients are mixed with water. No materials or any other foreign matter shall be allowed to enter the sewer system.

- 10.5 Reset or Replace Loose Broken Bricks: Broken and loose bricks in the manholes indicated to be sealed shall be reset into the manhole walls. All parts of any broken bricks shall be removed and new bricks shall be set into the hole. New bricks shall conform to ASTM C32, Grade MS, Standard Size. No materials or any other foreign matter shall be allowed to enter the sewer system. Fresh mortar as specified in the paragraph entitled "Point Up Mortar Joints and Patching Cracks and Holes" of this section shall be used. Loose bricks shall be reset with fresh mortar.
- 10.6 Structural upgrading of manholes shall include those manholes so designated on the plans. Structural upgrading shall include but not be limited to the rebuilding of a major portion of the manhole invert using brick and mortar or cement and construction of a manhole's foundation base or a portion thereof with cement. Structural upgrading may also include reconstruction of the inlet and outlet sewer line joints. Structural upgrading is distinguishable from and is not to be confused with the patch or plugging process of manhole walls and inverts necessary prior to internal sealing as specified herein.
- 10.6.1 When structural upgrading of a manhole is required, there shall be careful coordination of the structural work required between the Contracting Officer and Contractor. Under no circumstances shall structural upgrading of manholes be accomplished prior to approval of the Contracting Officer. While performing the structural upgrading, the manhole shall be kept absolutely free and dry of all incoming wastewater and shall be kept free and dry of all wastewater after completion of the work until such time as the Contracting Officer and Contractor agree that returning wastewater to the manhole will not be detrimental to the previously performed structural upgrading work.
- 10.7 Repair around manhole rings includes the repair of manholes where designated on the plans.
- 10.7.1 The existing manhole cover and ring shall be removed; then the old joint between the ring and masonry manhole shall be cleaned of all loose mortar and brick and the surface of the manhole prepared suitable to accept portland cement as specified in paragraph 10.8.4. The existing ring shall be resealed firm and protected from traffic until such time as the integrity of the work will not be damaged by such traffic.
- 10.8 Manhole top raising shall be accomplished on those manholes so designated on the plans. The tops of designated manholes shall be raised by the Contractor as follows:

- 10.8.1 Remove the existing manhole ring and cover from the masonry manhole.
- 10.8.2 Remove and clean all old mortar that was used to bind the existing manhole ring to the manhole.
- 10.8.3 Build up manhole with concrete brick and mortar coarsing to proper height. Plaster inside and out of the new surface with a 1/2-inch coat of mortar.
- 10.8.4 Reset ring in continuous mortar base to finished grade. Provide 45# grout fill around entire ring and protect until all material has reached its desired strength.
- 10.9 Manhole cover replacement shall be accomplished where designated on the plans. New replacement covers shall meet the requirements of paragraph 10.1. Covers shall be solid and suitable for traffic loading. Replaced covers shall be returned to the Government.
- 10.10 Replacing ring and cover shall be accomplished in accordance with paragraph 10.8 where designated on the plans.
- 10.11 Sealing manhole covers to the manhole rings shall be accomplished where designated on the plans. Manhole covers shall be sealed where existing covers are not sealed tightly to the manhole rings in critical areas where ponding water causes seepage between the cover and ring. Sealing shall be accomplished by using a permanently self-adhering and flexible sealant that is water impervious and resists cracking and remains adhesive due to loadings upon the manhole cover. The sealant shall be Ram-Nek or equal as manufactured by the K. T. Snyder Company of Houston, Texas. Sealant shall be placed around the entire circumference of the manhole cover and ring and shall be placed in such quantity to visably cover and overlap the entire joint between the cover and ring.
- 10.12 Repairing inverts shall be accomplished on manholes so designated on the plans. Repairing inverts will include the restoration of the invert and invert shelves to a smooth finish free of sharp edges and providing a full half round section from invert in to invert out. Work may be accomplished with normal invert materials as described in Section 02722, "Sanitary Sewers".
- 10.13 Sloping inverts shall be accomplished on manholes so designated on the plans. Sloping invert shelves shall consist of cleaning the shelves and then building up the invert shelves with sand grout material to provide a smooth even slope from the manhole wall to the invert.

 Materials used shall be as described in Section 02722, "Sanitary Sewers".
- 10.14 Smoothing shelf mortar shall be accomplished on manholes so indicated on the plans. Smoothing shelf mortar shall consist of cleaning the shelves and then applying a mortar to the shelf surface to provide a smooth even surface. Materials used shall be as described in Section 02722, "Sanitary Sewers".

- 11. WATER FOR CLEANING OPERATIONS shall be furnished free by the Government at nearest available hydrants. The Contractor shall furnish all necessary hose equipment, holding tanks, and attachments required to complete the work. The water shall be conserved and not used unnecessarily. No fire hydrant shall be obstructed in case of fire in the area served by the hydrant. Use of hydrant water shall be discontinued if an emergency requiring the water arises elsewhere on the station. Water will be furnished for filling Contractor's holding tanks only, unless otherwise permitted. An 8-inch air gap shall be provided between any fill line from the stations water system to the Contractor's holding tanks during filling operations. In the event direct connections to sewer cleaning equipment are permitted, an AWWA C506 back flow preventer of the reduced pressure principle type, approved by the Foundation for Cross-Connection Control and Hydraulic Research, University of Southern California, shall be utilized. Government water utilized for purposes beyond the requirements of this contract will not be furnished unless purchased at current local rates. All necessary metering equipment for purchased water shall be provided by the Contractor.
- 12. RECORDS, VIDEO TAPES, AND PHOTOGRAPHS OF THE WORK shall be obtained as the work progresses as specified hereinafter. Records shall be kept on approved forms. All records and photographs shall be properly identified and dated.
- 12.1 Daily records, in log form, shall be kept of all cleaning, television and repair work. The log shall show clearly the exact location and size of each defect discovered by the television. The reference location shall include the distance from the reference manhole and also the position of the defect in relation to the axis of the pipe. The log shall record the location of all in-use and abandoned service connections including those connected to manholes and those tapped directly to the sewer line. If the service connection is leaking, an estimate of the quantity of infiltration flow shall be recorded. Defects to be recorded including leaking joints, longitudinal and radial cracks, crushed and broken pipe, manhole leakage and defects, root infiltration, pipe misalignment, flooded inverts, improper grades, and other irregularities that may be encountered. In addition, storm sewer connections shall be recorded. The actual lengths and diameters of sewer pipes cleaned and inspected shall be recorded. Actual lengths shall be determined accurately by approved methods. Records shall be kept of all cleaning and repair work and shall show clearly where the work was done, the type of work accomplished, types of equipment used, quantity of chemical grout used, the nature of the results, and any other pertinent information relevant to the cleaning and repair work. The Contractor shall also provide recommendations for additional remedial work required to prevent infiltration and inflow. The complete records shall be bound into a report in a satisfactory manner. Three copies of each report, including duplicates of each photograph, shall be delivered to the Contracting Officer.
- 12.2 Photographs of the inspection work shall be required. The Contractor shall provide all equipment and materials necessary for taking photographs of the view which appears on the TV monitor. The photographs

or satisfactory duplicates thereof shall be mounted into the final TV report in an approved manner. Pictures shall be made of all broken pipes, irregularities of pipe alignment or grade, bad leaks, obstructions areas, storm sewer connections and other problem areas for future reference.

- 13. RESTORING LAWNS: Restoring lawns shall be done in accordance with the section of this specification entitled "Turf".
- 14. DAMAGE TO OTHER WORK: All damage incurred by the Contractor to other existing work shall be repaired by him to match the existing construction; all such repair work shall be at the Contractor's expense. All such repair work shall be done to the satisfaction of the Contracting Officer.

*** END OF SECTION ***

SECTION 15386

TRICKLING FILTER

- 1. 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:
 - 1.1 Federal Specification (Fed. Spec.):

SS-S-448	Slag and	Stone,	Crushed	; Gravel,	Crushe	ed and
& Am 2	Uncrushed	d (for	Sewage T	rickling	Filter	Media)

- 1.2 American Institute of Steel Construction (AISC) Publication:

 Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings (1969)
- 1.3 American National Standards Institute (ANSI) Publications:

A21.6-1975	Cast Iron Pipe Centrifugally Cast in Metal Molds, for Water or Other Liquids
A21.8-1975	Cast-Iron Pipe Centrifugally Cast in Sand-Lined Molds, for Water or Other Liquids
A21.51-1971	Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids
B3.15-1972	Load Ratings and Fatigue Life for Ball Bearings
B3.16-1972	Load Ratings and Fatigue Life for Roller

1.4 American Society for Testing and Materials (ASTM) Publications:

A36-75	Structural Steel
A48-74	Gray Iron Castings
A53-76	Welded and Seamless Steel Pipe
A120-76	Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Ordinary Uses
A123-73	Zinc (Hot Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip

Zinc Coated Steel Wire Strand
Aluminum-Alloy Sheet and Plate
Aluminum-Alloy Extruded Structural Pipe and Tube
Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
Aggregate for Masonry Mortar
Portland Cement
Vitrified Clay Filter Block for Trickling Filters
Vitrified Clay Pipe, Extra Strength and Standard Strength, and Perforated Clay Pipe

1.5 American Water Works Association (AWWA) Publication:

C110-82 Grey-Iron and Ductile-Iron Fittings, 2 in.
Through 48 in., for Water and Other Liquids

1.6 Steel Structures Painting Council (SSPC) Publication:

SSPC-SP8-63 No. 8 Pickling

- 2. DESCRIPTION: The trickling filter shall be made of the high rate type and shall include a rotary distributor, reinforced concrete walls and base, filter media, filter block underdrainage system, and all other components indicated or necessary for proper operation. The Contractor shall provide all systems complete and ready for operation. All incidental piping, controls, and accessories required for complete operating systems shall be at the expense of the Contractor. Provide all control wiring and accessories in accordance with NFPA 70.
- WORK INCLUDED UNDER OTHER SECTIONS: Concrete work for trickling filter tank, including rotary distributor base: Section 03302, Cast-In-Place Concrete.
- 4. GENERAL REQUIREMENTS: Section 15011, General Requirements, Mechanical, applies.
- 4.1 Submittals: Partial submittals will not be acceptable. Annotate descriptive data to show the specific model, type, and size of each item the Contractor proposes to furnish. Prepare shop drawings on sheets not smaller than 30 inches by 42 inches, and include data essential to the proper installation of each system. Do not commence work until the design of each system and the various components have been approved. The submittal requirements of Section 15011, General Requirements, Mechanical

applies to the following lists. Items in the following lists (which are followed by (CO)) shall be approved by the Contracting Officer.

- 4.1.1 Manufacturer's Data:
 - a. Rotary distributor (CO)
 - b. Plastic filter media (CO)
- 4.1.2 Shop Drawings:
 - a. Trickling filter
 - b. Rotary distributor (CO)
 - c. Plastic filter media (CO)
- 4.1.3 Certified Data:
 - a. Stone filter media (CO)
- 4.1.4 Operation and Maintenance Manuals:
 - a. Trickling filter
 - b. Rotary distributor (CO)
 - c. Spare parts catalog (CO)
- 4.1.5 Samples:
 - a. Filter media (CO)
- 5. MATERIALS AND EQUIPMENT:
- 5.1 General: Unless otherwise specified, all materials and equipment shall be standard commercial products in regular production by the manufacturer and suitable for the required service. Structural steel shall conform to ASTM A36. Steel pipe for structural members and distributor arms shall conform to ASTM A53. Steel members which will be in contact with sewage, completely or intermittently, during normal operation of the equipment shall have a minimum thickness of 1/4-inch. All cast iron shall conform to ASTM A48, Class 30. Aluminum-alloy used for structural members and pipe shall conform to ASTM B209 (3003-H14) and ASTM B429 (6063-T6), respectively.
- 5.2 Rotary Distributor: The rotary distributor shall be suitable for the distribution of sewage uniformly over the filter bed at the rates of flow and under the operating conditions specified herein. The rotary distributor shall include distributor arms, center column, and other appurtenances necessary for proper operation. The rotary distributor shall rotate solely from the reaction of sewage flowing through jets or nozzles in the distributor arms and shall operate freely and effectively over the entire range of operation.

- 5.2.1 Design and Operating Requirements: The rotary distributor shall be designed for a filter bed of 62 feet inside diameter. Design flows shall range from a minimum of 75 gallons per minute (qpm) to a maximum of 800 gpm, and the average design loading shall be 400 gpm. total head available at the inlet (above the media surface) shall be 3.0 feet at the maximum rate of flow. The maximum velocity in the arms shall not exceed 4.0 feet per second (fps). The rotary distributor and each of its component parts shall be designed to withstand all structural and mechanical stresses brought about by the following loads: weight of equipment plus liquid: wind loading and a live load of 300 pounds at any point on the arm. Safety factor for the foregoing shall be a minimum of 1.6 based on the yield point of the steel. The anchorage of concrete center pier shall be designed to resist, with a minimum safety factor of 2.0, a maximum overturning moment brought about when arms on one side of the distributor are filled with water and those on the other side are empty. Vertical deflections at the end of the distributor arms shall not exceed 4 inches and arms shall have clearance above the surface of filter bed as indicated. The rotary distributor shall be designed for continuous 24-hour service under design load without excessive wear, damage, or failure. Stresses developed under the aforementioned operating conditions and loads shall not exceed the stresses allowed under the AISC Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings.
- 5.2.2 Center Column: The center column shall be mast-type or turntable-type and shall include a stationary assembly, rotating assembly, seal, bearing assembly, lubricating fittings, and anchor bolts. Ample port areas or openings shall be provided to permit unrestricted flow of sewage from inlet in stationary assembly through rotating assembly into distributor arms.
- 5.2.2.1 Stationary Assembly: Elements of the stationary assembly shall be of cast iron, structural steel, steel pipe, or aluminum-alloy. The stationary assembly shall have a 10-inch diameter inlet and be designed for anchorage to the hollow concrete center pier by anchor bolts.
- 5.2.2.2 Rotating Assembly: Elements of the rotating assembly shall be of cast iron, structural steel, or aluminum—alloy, except as otherwise specified herein. Turntable, when provided, shall be of cast iron only. Steel for non—structural applications shall have a minimum yield point of 30,000 pounds per square inch (psi). An adjustable weir shall be provided to divide the flow between the primary and secondary arms such that only primary arms will operate at minimum flow and that all arms will discharge uniformly at maximum flow. The weir shall be accessible for adjustment without dismantling the equipment. The weir shall be in the rotating assembly. Rotating assembly shall have suitable machined surfaces for installation of distributor arms and shall be of a height that will provide suitable anchorage for distributor arm supports.
- 5.2.2.3 Seal: A mechanical seal or an air gap shall be provided that will prevent the leakage of water between the stationary and rotating

assemblies at the maximum hydraulic head. Any type of seal employing mercury as the sealing element will not be allowed.

- 5.2.2.3.1 Mechanical Seal: The mechanical seal, if selected, shall be designed to withstand the full hydraulic head in the rotating assembly. Seals shall have an annular ring of replaceable grease-resistant neoprene or polytetrafluoroethylene with a low coefficient of friction. Seals between horizontal surfaces shall be maintained against the seal plate by annular steel weight strips and steel seal clamps. Seals between vertical surfaces shall be spring loaded in steel retainer rings attached to the rotating assembly.
- 5.2.2.3.2 Air Gap: An air gap, if selected, shall be provided to prevent the liquid from entering the rotor bearing and shall require no auxiliary equipment to maintain the air gap between the fixed feeder pipe or column and the rotating sleeves and/or drum. Means shall be provided to prevent the liquid level in the rotating equipment from rising positively to the elevation of the air gap. The relief device provided to prevent this shall be so constructed that any overflow would discharge on the surface of the filter, visible to the operator and at a point above or apart from normal distribution outlets.
- 5.2.2.4 Bearings: The radial and axial loads of the rotating assembly and distributor arms shall be transmitted to the stationary assembly by an anti-friction thrust bearing of the ball or roller type. Guide or steady bearings shall be provided where necessary to maintain alignment. Design of bearings shall be such that the rotating assembly will maintain its alignment, start freely, and operate satisfactorily at the minimum head at all conditions of wind and temperature. Bearings shall be designed for the vertical thrust of the machine full of water and the horizontal thrust due to eccentric loads on the arms. Bearings shall have a minimum rated-life expectancy of 100,000 hours (L-10) when equipment is operating continuously under loading conditions specified in paragraph 5.2.1, Design and Operating Requirements. Load rating and fatigue life shall be based on ANSI B3.15 and B3.16, as applicable.
- 5.2.2.5 Lubrication Fittings: All moving parts subject to wear and all bearings shall be provided with adequate means for lubrication. Lubrication shall be by grease or oil, as suitable. Greased bearings shall be provided with fittings for grease gun service. If not easily accessible, the bearing lubrication fittings shall be provided with grease tubing extended to convenient locations. The grease fitting shall be a type that prevents overlubrication and building-up of pressure injurious to bearings. Each oil reservoir shall be liberal in size and provided with an opening for filling, an overflow opening at the proper location to prevent overfilling, an oil-level sight glass, and a drain at the lowest point. The Contractor shall provide the manufacturer's recommended lubricant sufficient for six months of normal operation.
- 5.2.2.6 Anchor Bolts: Anchor bolts with necessary hex nuts and washers shall be Type 304 stainless steel. Anchor bolts and accessories

shall be provided to secure the stationary assembly to the hollow concrete center pier.

- 5.2.3 Distributor Arms: The distributor arms shall be attached to the rotating assembly by flanged or screwed connections. The arms shall be of steel pipe, structural steel with minimum wall thickness of 1/4-inch, or aluminum-alloy. The end of each arm shall be provided with a quick-opening shear gate for flushing. Arms shall be supported from the rotating assembly by cables, steel tie rods with turnbuckles, or a steel truss. Wire strand for cables shall conform to ASTM A475. Arm supports shall be laterally braced by means of horizontal steel tie rods with turnbuckles. Each arm shall have openings so spaced as to distribute the flow uniformly over the filter bed. Nozzles and spreaders shall be provided at each opening and shall be of corrosion-resistant non-ferrous material. Nozzles shall be designed to provide maximum reactive force with minimum head loss. Spreaders shall be designed to disperse the flow evenly from each opening. Each spreader shall be easily removable for cleaning and shall be equipped with replaceable orifices permitting variation of flow capacity with different orifices. Rectangular-arm distributors shall have orifices in the spreaders. Orifices and openings shall be of non-clogging design.
- 5.2.4 Center Pier Supply Fitting: The 10-inch supply inlet line junction fitting shall be a base-plate with short riser pipe and flange suitable for the rotary distributor center column attachment. The construction shall be cast iron, ductile iron, or steel conforming to AWWA C110, ANSI A21.6, ANSI A21.8, ANSI A21.51, or ASTM A120, respectively.
- 5.3 Supply Piping and Valves: Piping and valves for the supply line are specified in Section 02722, Exterior Sanitary Sewers.
- 5.4 Filter Blocks: The underdrain system shall include rectangular and cut tile blocks, cover blocks for drainage channels, and vent blocks. All blocks shall conform to ASTM C159, Type I-H, except that cover blocks shall not have apertures and vent blocks shall have openings to accomodate vent stacks. Cut or angle blocks shall be cut on an angle to approximately conform to the wall curvature. Filter underdrain blocks shall have semi-circular inverts or equivalent section and shall cover the entire floor of the filter. Vent stack pipes shall be of extra strength vitrified clay pipe conforming to ASTM C700 and shall be provided as indicated.

5.5 Filter Media:

5.5.1 Quality: The media shall be crushed stone, crushed slag or plastic. Crushed stone or crushed slag shall conform to SS-S448, Grade A or Grade B. The top 18 inches of media shall have a loss by the 20-cycle sodium sulfate soundness test of ASTM C88 of not more than 10 percent by weight, the balance of the media shall pass a 10-cycle test using the same criteria. Plastic media shall be random-dumped ring type or stacked modular type. Random-dumped ring type shall be of the long term heat aging rigid polypropylene plastic specially manufactured as trickling

filter media, with a minimum void volume of 90 percent and a minimum of 25 square feet of surface area per cubic foot of volume. Plastic stacked modular type shall be of saran, polyvinyl chloride (PVC) fiberglass reinforced resins, or plastic equally resistant to oxidation, ozone aging, or effects of ultra violet exposure and shall have minimum void volume and surface area per cubic foot of volume as required for random-dumped ring type media. The media shall provide a minimum projected life of 25 years in the intended service. Projected life shall be based on in-use case history or simulated aging tests as performed by an independent testing laboratory acceptable to the Contracting Officer. Such tests shall be substantiated by certified test reports. Installed media shall be capable of providing support for a concentration of 200 lbs on a one square foot area on any part of the surface without damage to or displacement of the media.

- 5.5.2 Size and Grading: Stone or slag media shall conform to SS-S-448, Grading size 3-1/2 to 2-1/2 inches. Plastic media shall be the manufacturer's standard as approved by the Contracting Officer.
- 6. SPARE PARTS: All standard spare parts shall be provided as recommended in the manufacturer's instruction manuals for each component of the equipment.
- 7. MATERIALS PROTECTION: All ferrous metal surfaces shall be pickled in accordance with SSPC-SP8. All ferrous metal surfaces, including rotating assembly, distributor arms, supports, and attachments shall be zinc coated in accordance with ASTM A123, as applicable. The interior and exterior of all fabricated ferrous metal components shall be pickled and galvanized after fabrication. To prevent corrosive action, insulating components such as gaskets, couplings, or bushings, of a dielectric type which will prevent corrosion of bimetallic type contacts, shall be used at connections between dissimilar metals.
 - 8. INSTALLATION AND CONSTRUCTION:
 - 8.1 Rotary Distributor:
- 8.1.1 General: The rotary distributor shall be installed in accordance with the recommendations of the manufacturer and by workmen experienced in the installation of this type of equipment. All components with galvanized or other corrosion protective coating shall be carefully checked and any damaged or abraded areas shall be restored to the original or an equivalent coating.
- 8.1.2 Erection of Equipment: Special care shall be taken to ensure proper alignment of all equipment. The anchor bolts shall be set in place and the nuts tightened against the shims. After the foundation alignments have been approved, the stationary assembly shall be securely bolted in place. The alignment of equipment shall be further checked after securing to the foundations and, after confirmation of all alignments, the stationary assembly shall be finally grouted in place. Equipment shall be

aligned with associated piping and under no circumstance will "pipe springing" be allowed. The weir shall be set in accordance with the directions of the manufacturer, based on anticipated flows.

- 8.2 Placing Filter Block: Filter underdrain blocks shall be laid in a dry mortar bed. The mortar shall contain one part cement conforming to ASTM C150, Type II, and 4 parts sand conforming to ASTM C144, except 1:3 cement—sand mortar bed for the first course of blocks where cover blocks are used. After the blocks are laid and before the stone is placed, the dry mortar bed shall be dampened by sprinkling. Filter blocks shall be installed so that there will be an uninterrupted flow through the drainage channels in the blocks to the effluent channel. Blocks shall be laid in true alignment, with cross joints staggered in longitudinal rows at right angles to the center drains. The rows of blocks shall start at the edge of the drainage channel and end at a sufficient distance from the filter wall so as to provide an air passage around the inside periphery of the filter. Air ducts comprised of either blocks or stacks shall be provided for venting air to the atmosphere as shown on the drawings. A plan layout of filter block units shall be provided by the manufacturer.
- 8.3 Placing Filter Media: Stone or slag media delivered to the filter site shall be stored on wood planks or other approved clean hard surface areas. Stone and slag shall not be dumped directly into the filter. The media shall be rescreened or forked at the filter site to remove all fines before placement in the filter. Material shall be placed by hand to a depth of 12 inches above the filter block and all material shall be carefully placed so as not to damage or displace the underdrains. The remainder of the material may be placed by means of belt conveyors, wheelbarrows, or other approved equipment. The media shall be placed in layers not exceeding 18 inches in depth. Filter media shall be placed as nearly as practicable in final position to avoid excessive rehandling; special care shall be taken to avoid breakage or segregation of different sized particles. Dumping the filter media directly from trucks into the filter, dropping the filter media from heights exceeding 3 feet or throwing the media into the filter will not be permitted. If it is determined that an excessive amount of fractured stone or dust is passing into the underdrains, the Contractor may be required to remove and rescreen the filter media at a location outside the filter walls. There shall be no walkways or runways over the filter except for the purpose of installing materials or equipment for the filter. Storing of materials, such as cement or sand, or placement of heavy construction equipment within the filter walls will not be permitted. Concrete, sand, dirt, or other materials deleterious to the filter shall not be passed over the filter by any means. No material shall be dropped from a height of greater than 3 feet. Trucks, tractors, or other heavy equipment shall not be driven over the filter during or after construction. Installation of plastic filter media shall be made in accordance with the recommendations of the media manufacturer.

9. FIELD TESTS AND INSPECTIONS:

- 9.1 General: As an exception to requirements that may be stated elsewhere in the Contract, the Contracting Officer will witness all field tests and conduct all field inspections. The contractor shall give the Contracting Officer 10 days prior notice for dates and times for acceptance tests and inspections. Water required for field tests will be furnished by the Government in accordance with Division I.
- 9.2 Test: The distributor mechanism shall be tested to demonstrate correct alignment, smooth operation, and uniformity of flow distribution over the filter media.

*** END OF SECTION ***

SECTION 15390

AERATION EQUIPMENT

- 1. SCOPE: This Section includes aeration equipment.
- 2. APPLICABLE DOCUMENTS: The following specifications and standards of the issues listed in this paragraph (including the amendments, addenda, and errata designated), but referred to hereinafter by basic designation only, form a part of this specification to the extent required thereto.
 - 2.1 Federal Specifications:

WW-P-501	Pipe Fittings, Cast Iron, Screwed 125 and 150 Pound	
WW-P-521	Pipe Fittings, Flange Fittings and Flanges, Ferrous and Steel (Screwed and Butt-Welded), 150 Pound	

2.2 Non-Government Documents:

2.2.1 American Gear Manufacturers Association Standards:

210.02-65	Surface Durability (Pitting) of Spur Gear Teeth
211.02-69 (R 74)	Surface Durability (Pitting) of Helical and Herringbone Gear Teeth
211.02A-69 (R 74)	Rating for the Durability of Helical and Herring- bone Gears for Enclosed Drives
211.02B-69 (R 74)	Rating for the Durability of Helical and Herring- bone Gears for Gearmotors
215.01-66 (R 74)	Information Sheet for Surface Durability (Pitting) of Spur, Helical, Herringbone, and Bevel Gear Teeth
220.02-66	Rating the Strength of Spur Gear Teeth
221.02-65	Rating the Strength of Helical and Herringbone Gear Teeth
221.02A-66	Rating for the Strength of Helical and Herring- bone Gears for Enclosed Drives
221.028-66	Rating for the Strength of Helical and Herring- bone Gears for Gearmotors
225.01-67	Information Sheet for Strength of Spur, Helical, Herringbone, and Bevel Gear Teeth

	226.01-70	Information Sheet - Geometry Factors for Deter- mining the Strength of Spur, Helical, Herring- bone, and Bevel Gear Teeth
	241.02-72	Specification for General Industrial Gear Materials - Steel (Drawn, Rolled, and Forged)
	245.01-64	Specification for Cast Steel Gear Materials
	390.03-80	Gear Classification Manual
	420.04-75	Practice for Helical and Herringbone Gear Speed Reducers and Increasers
	440.04-71	Practice for Single and Double-Reduction Cylindrical-worm and Helical-worm Speed Reducers
2.2.2	American Gas	Association:
	Gas Measurem	ent Committee Report No. 1
2.2.3	American Nat	ional Standards Institute:
	A21.6-75	Cast-Iron Pipe Centrifugally Cast in Metal Molds for Water or Other Liquids
	A21.7-70	Cast-Iron Pipe Centrifugally Cast in Metal Molds for Gas
	A21.8-75	Cast-Iron Pipe Centrifugally Cast in Sand-Lined Molds for Gas
	A21.9-70	Cast-Iron Pipe Centrifugally Cast in Sand-Lined Molds for Gas
	A21.10-77	Cast-Iron Fittings 2-inches through 48-inches for Water and Other Liquids
	A21.11-79	Rubber Gasket Joints for Cast-Iron Pressure Pipe and Fittings
	A21.14-74	Grey Iron and Ductile Iron Fittings; 3-inches through 24-inches for Gas
	A21.51-76	Ductile-Iron Pipe Centrifugally Cast in Metal Molds or Sand-Lined Molds for Water and Other Liquids
	A21.52-76	Ductile-Iron Pipe Centrifugally Cast in Metal Molds or Sand Molds for Gas
	B15.1-72	Mechanical Power-Transmission Apparatus

B16.1-75 Specification B16.1 for Class 125 Flanged Fittings

B16.5-77 Steel Pipe Flange and Flanged Fittings

2.2.4 American Society for Testing and Materials:

A36-77a Structural Steel

A48-76 Gray Iron Castings

A53-80 Welded and Seamless Steel Pipe

A108-79 Cold-Finished Carbon Steel Bars and Shafting

A120-79 Black and Hot-Dipped Zinc-Coated (Galvanized)
Welded and Seamless Steel Pipe for Ordinary Uses

A126-73 Gray Iron Castings for Valves, Flanges, and Pipe Fittings

A536-72 Ductile Iron Castings

A668-81A Alloy Steel Forgings for General Use

2.2.5 American Society of Mechanical Engineers:

PTC9-70 Displacement Compressors, Vacuum Pumps, and Blowers

2.2.6 American Water Works Association:

15th Ed. Standard Methods for the Examination of Water and Waste Water

C207-78 Steel Pipe Flanges

C504-80 Rubber Seated Butterfly Valves

C600-82 Installation of Cast-Iron Water Mains

2.2.7 Anti-Friction Bearing Manufacturers Association:

Anti-Friction Bearing Manufacturers Association Standards, Latest Revision

3. GENERAL REQUIREMENTS: The aeration equipment shall be of the diffused air type having an oxygenation capacity of 35 lbs/hour of atmospheric oxygen to the liquid and maintaining complete suspension of all sludge solids throughout the entire aeration tank. The aeration equipment shall completely mix the contents of the aeration tank such that the velocity in any part of the tank shall not be less than 0.5 feet per second. Concrete work is included under Section 03302, "Cast-in-Place"

Concrete". Piping not specified herein is included under Section 15301, "Exterior Sanitary Sewers". Field painting is included under Section 09910, "Painting of Buildings". Electrical work is included under Section 16402, "Interior Wiring Systems". The Contractor shall provide all systems complete and ready for operation. All incidental piping, controls, and accessories required for complete operating systems shall be at the expense of the Contractor. Provide all control wiring and accessories in accordance with NFPA 70.

- 3.1 Electrical Motors, Controllers, Contactors, and Disconnects: Furnish motors, controllers, contactors, and disconnects with their respective pieces of equipment. Motors, controllers, contactors, and disconnects shall conform to and shall have electrical connections provided under Section 16402, "Interior Wiring Systems". Controllers and contactors shall have a maximum of 120 volt control circuits, and auxiliary contacts for use with the controls furnished. When motors and equipment furnished are larger than sizes indicated, the cost of providing additional electrical service and related work shall be included under this section.
- 3.2 Submittals: The Contractor shall submit shop drawings including construction details for the following: layout and spacing of diffusers, diffuser holders, and diffuser holder assemblies; air blower assembly; air filter assemblies; and piping layouts. The Contractor shall certify in writing that the diffuser layout has an oxygenation capacity of 1.5 lbs of oxygen per electrical input horsepower per hour when tested under standard conditions in clear tap water at 68 degrees F, zero dissolved oxygen, 18 feet liquid submergence, and 8 cfm air flow rate per diffuser. Certification shall include description of test procedure, test data, and calculations of oxygenation capacity. Data shall also be furnished to substantiate that the manufacturer's diffuser layout can achieve mixing and adequate velocities for the geometry of the basins as indicated. Data and calculations will be reviewed by the Contracting Officer and are subject to his approval. The diffuser layout shall have sufficient mixing capacity to thoroughly mix the wastewater throughout the tank depth and to maintain the biological floc in suspension in concentration of up to 10,000 mg/1.
- 4. MATERIALS AND EQUIPMENT: Unless otherwise specified, all material and equipment shall be standard commercial products in regular production by the manufacturers and suitable for the required service. Unless otherwise specified, all structural steel shall conform to ASTM Specification A36. All submerged steel shall have a minimum thickness of 1/4-inch.
- 4.1 Diffused Air Aeration Equipment: Aeration equipment shall include diffusers, diffuser holder assembly, air piping, air blower, air filter, and accessory items as indicated and as specified herein. Diffusers shall be of the coarse bubble type.
- 4.1.1 Coarse Bubble Diffusion: Coarse bubble diffusers shall be of the non-porous nozzle type. Nozzle devices shall be saddle-mounted or thread-mounted on a diffuser header as recommended by the diffuser

manufacturer. Nozzle orifice shall be sized for the particular application to assure proper range of exit velocity and back pressure. Units shall be stainless steel.

- 4.1.2 Swing-Out Type Diffuser Holder Assembly: The diffuser holder assembly shall be of the swing-out type. The assembly shall include an upper pivot joint with air control and shut-off valve, a hanger pipe with intermediate pivot joint, and a diffuser header. The upper pivot joint shall be of cast-iron or cast steel and shall have a trunnion type support for the rotary joint. The unit shall have a base flange for mounting to a wall anchorage elbow, and the joint shall rotate on two bronze sleeve bearings, either permanently lubricated or with suitable grease fittings for lubrication. Chloroprene or Buna N rubber O-ring gaskets shall be included at each pivot bearing to insure air and water tightness. Valve shall be butterfly type and be suitable for air control and complete shut-off. Butterfly valve shall conform to AWWA Standard C504, shall have cast-iron body and chloroprene rubber seat, and shall be lever or handwheel operated. The intermediate pivot joint shall be as specified for the upper joint, except that it shall not have the integral valve and base flange. Threaded or flanged connections shall be provided for the upper and lower hanger pipes. Bearings with O-ring seals shall be as specified for the upper pivot joint. The intermediate pivot joint shall have a locking device to allow positive locking in any position. Hanger pipes and diffuser header pipes shall be as specified hereinafter. Spacing of diffuser assemblies in the basin and diffusers on the header shall be as recommended by the diffuser manufacturer. The drilling and tapping of the diffuser header pipe shall be such as to give the diffuser the correct horizontal alignment without being skewed either upwards or downwards. Diffuser header shall incorporate an adjustable stop on the wall side to prevent the diffuser coming into contact with the wall. A portable hoist shall be provided to raise and lower the diffuser assembly. Hoist shall be expressly designed to be compatible with the diffuser holder assembly and shall be provided by the same manufacturer. Hoist shall be hydraulically operated, powered by an electric motor with quick clamping arrangement to securely engage upper hanger pipe. The hoist shall be adequately powered to raise the assembly from a dry tank. The hoist shall provide means of locking the diffuser header in a raised position over the tank or the walkway.
- 4.1.3 Air blower assembly shall include air blower, blower driver, speed reducer, base plate, pressure relief and unloading valve, check valve, silencer, expansion joints, butterfly valve, thermometer, pressure gauge, and guards.
- a. Air blower shall be the rotary positive displacement type. Performance requirements for blower shall be as follows:

540 SCFM

2900 RPM

14.7 psia

0 percent

10 psig

68 degrees F

Inlet Volume
Speed
Inlet Pressure
Inlet Temperature
Relative Humidity
Discharge Pressure

The allowable tolerance on the stated inlet volume shall be plus or minus 4 percent. The unit shall be equipped with heavy-duty anti-friction bearings. Impellers, except when cast integrally with the shaft, shall be made of close-grained cast-iron conforming to Class 35 of ASTM Specification A48, or ductile iron conforming to ASTM Specification A536. Impellers shall have strong internal ribbing, shall be machined on all exterior surfaces, and shall be dynamically balanced. Shafts shall be machined and, except when cast integrally with the impeller, shall be made of steel conforming to ASTM Specification A108 or alloy steel forgings conforming to ASTM Specification A668. When shaft and impeller are cast integrally, the casting shall be of ductile iron conforming to ASTM Specification A536. When shaft and impeller are separate pieces, impeller shall be press fit onto the shaft and held by means of a Woodruff key and lock nut, or the impeller shall be mounted on the shaft with a reverse threaded connection. The casing shall be cast iron conforming to ASTM Specification A48, Class 30. The rotary displacement type unit shall have two timing gears machined from heat-treated steel to accurately synchronize the impellers so as to maintain maximum rotation efficiency. The following AGMA standards for surface durability, strength, and materials for spur gearing and helical gearing, as applicable, shall govern.

Spur gearing and AGMA 210.02 helical gearing ASMA 211.02, 211.02A, 211.02B AGMA 215.01 AGMA 220.02 AGMA 221.02, 221.02A, 221.02B AGMA 225.01 AGMA 226.01 AGMA 241.02 AGMA 245.01 AGMA 390.03 AGMA 420.03

Gears shall be enclosed in an oiltight housing and shall be lubricated by a splash oiling system from oil contained in the gear housing or pressure lubricated with integrally driven oil system. Blower shall be V-belt driven by the blower driver. Blower shall be equipped with a Kingsbury type thrust bearing on the drive shaft so that no thrust from the driver will be transmitted to the blower impellers. The blower shall have an operating sound pressure level not to exceed 90 decibels over a frequency range of 37.5 to 9600 cycles per second measured at 5 feet from the unit. The manufacturer shall provide any silencing on the blower needed to meet this requirement.

- (1) Bearings for positive displacement type blowers shall have a minimum rated life expectancy (B-10) of 30,000 hours. Internal bearings shall be splash lubricated from the gear housing oil reservoir. Drive-end bearings shall be oil lubricated
- (2) Couplings shall be self-aligning forged steel gear type having two identical hubs, two identical sleeves, a flange gasket, a set of flange bolts, nuts, and lockwashers, and four lubrication plugs with

copper gaskets. Torque shall be transmitted through the mating gear teeth of the hubs and sleeves.

- b. Blower Driver: Blower shall be driven by an electric motor through a gear reducer or V-belt drive at a speed corresponding to its peak efficiency. Motor shall operate on 480 volts, 3 phase, 60 Hertz current. Motor shall be totally-enclosed, fan-cooled. If induction type, motor shall have NEMA Class B insulation, normal starting torque, low starting current. If synchronous, it shall operate on unity power factor. Excitation shall be by direct-connected exciter. All frame sizes shall be NEMA Standards. The electric motor shall have an operating sound pressure level not to exceed 90 decibels over a frequency range of 37.5 to 9600 cycles per second measured at 5 feet from the unit. The manufacturer shall provide any silencing of the motor needed to meet this requirement.
 - c. Speed reducer shall be either V-belt drive or gear reducer.
- (1) V-belt drive shall include blower sheave, motor sheave, and V-belt. Sheaves shall be cast steel and keyed to the shaft. Multiple belts shall be used when necessary to transmit the required power. V-belt shall be of a heavy-duty type, oil and heat resistant, and static dissipating. Drive shall be designed to have a minimum service factor of 1.5.
- (2) Gear reducer: The gear drive shall be designed to transmit the maximum continuous power capability of the driver with a 2.0 service factor. The thermal rating (manufacturer's catalog value) of the frame shall not be exceeded by the input horsepower, excluding the gear service factor. The pitch-line velocities shall be less than 20,000 feet per minute. In establishing the capacity of the unit to transmit power, the following AGMA standards for surface durability, strength, and materials shall govern:

Spur gearing and	AGMA	210.02		
helical gearing			211.02A,	211 020
nerical gearing			ZII.UZA,	211.UZD
	AGMA	215.01		
	AGMA	220.02		
	AGMA	221.02.	221.02A.	221.02B
		225.01		
	AGMA	226.01		
	AGMA	241.02		
	AGMA	245.01		
	AGMA	420.04		
	AGMA	440.04		
Worm gearing	AGMA	241.02		
		245.01		
		440.04		

Gear casing shall be of cast-iron conforming to ASTM Specification A48 or fabricated steel type having center line split design and shall incorporate bolting flanges to mate with both input and output coupling guards. The

gear unit shall incorporate double helical gears having hobbed and ground-finished teeth. Gear shafts shall be supported in sleeve-type bearings, and both input and output shafts shall terminate in a standard taper. Gears shall be lubricated by a splash oiling system from oil contained in the gear housing. The driver gear unit shall have an operating sound pressure level not to exceed 90 decibels over a frequency range of 37.5 to 9600 cycles per second measured at 5 feet from the unit. The manufacturer shall provide any silencing of the reducer needed to meet this requirement.

- d. Base Plate: A cast-iron or welded steel base plate sized to carry the blower, speed reducer, and blower driver shall be provided with the necessary anchor lugs for foundation bolts. It shall have sufficient rigidity to maintain alignment between the various elements.
- e. Pressure Relief and Unloading Valve: A pressure relief and unloading valve shall be provided for the dual function of pressure relief and unloading the blower for start-up. The valve shall have a cast-iron body with integral valve seat, cast-iron disc, and steel spring for pressure setting. Valve shall be furnished for a pressure setting of 10 psig, but shall also have an operating nut or wheel for field adjustment of pressure setting. Pipe connection shall be flanged or screwed.
- f. Check Valve: Check valve shall be provided where indicated. Check valve shall have a cast-iron or steel body, a single steel or aluminum swinging disc, or dual discs. Dual disc valves shall have acrylonitrile-butadiene rubber seals on the seating surface. Piping connections shall be flanged. Valve shall be suitable for use in the pressure range of 10 psig.
- g. Silencer: Silencer shall be an absorption type, chamber type, or absorption chamber combination type. Silencer shall be of heavy gauge welded steel construction. Silencer shall be provided for inlet and/or discharge of blower as indicated. Silencer shall provide a minimum sound attenuation of 25 decibels up to 10,000 cycles per second. Silencer piping connections shall be flanged.
- h. Expansion Joints: Expansion joints shall be of the rubber spool type made of duck and chloroprene with a single arch in the middle, reinforced with steel wire rings, flanged, and fitted with galvanized split retaining rings. Expansion joints shall be suitable for use on blower discharge where indicated and shall be suitable for use with pressures up to 15 psig and temperatures up to 275 degrees F.
- i. Butterfly Valve: Butterfly valves and operators shall be in accordance with AWWA Standard C504, except as modified herein, and shall have rubber-seats which are recess mounted and clamped into the valve body. Each valve shall be shop-tested for leakage with the disc in the horizontal plane, with zero pressure downstream, and with an upstream pressure of 50 psig and in accordance with testing requirements of AWWA Standard C504 for butterfly valves. The upper surface of the disc shall be visible and covered with a pool of water. Air pressure as stated shall be applied to the lower face of the closed disc for a period of 5 minutes,

during which period there shall be no indication of leakage past the valve disc (visible in the form of bubbles in the water pool on top of the disc). Valve operator shall be handwheel, lever, or chain operated, as indicated.

- (1) Valve body shall be constructed of close-grained castiron conforming to ASTM Specification A126, Class B, with integrally cast hubs for shaft bearing housings of the through boss-type. Permanently self-lubricating body bushings shall be provided and shall be sized to withstand bearing loads. A stuffing box of liberal dimensions shall be provided at the operator end of the vane shaft, arranged so that the packing can be replaced by removing the bronze follower without removing the operator.
- (2) Discs shall be positively secured to the shaft with keys and/or pins of Type 316 stainless steel. Seating edge of the disc shall contact the seat in the body for a full 360 degrees without penetration of the seating surface by the shaft. Discs for valves with rubber seat mounted in the body shall be of a symmetrical one-piece cast design of alloy cast iron (14 percent nickel, 6 percent copper, 2-1/2 percent chromium) with no external ribs. Discs for valves with rubber seat mounted on the disc shall be cast iron conforming to ASTM Specification A48, Class 40.
- (3) Valve shaft shall be of Type 304 stainless steel and designed for both torsional and shearing stresses when the valve is operated under its greatest dynamic or seating torque.
- j. Thermometer: Thermometer shall be straight form or dial type. Thermometer shall have brass or stainless steel case. Thermometer shall be moisture—proof, dust—proof, shock—proof, and vibration—proof. Thermometer shall have a stainless steel temperature sensing bulb not less than 2-inches long, with 1/2-inch or 3/4-inch male pipe thread connection. Temperature range of the thermometer shall be 0-375 degrees F.
- k. Pressure Gauge: Pressure gauge shall be dial type and include a bourdon tube gearless movement. Dial shall be 2-1/2-inches diameter with a pressure range of 20 psig. Gauge shall have steel or brass case and have a 1/4-inch male pipe thread connection.
- 1. Guards: Belts, sheaves, gears, couplings, projecting setscrews, keys, and other rotating parts, located so that any person may come in close proximity thereto, shall be fully enclosed or properly guarded in accordance with ANSI Standard B15.1.
- m. Electrical Control Equipment: Electrical control equipment shall include motor starters; pushbutton stations; disconnect switches; and all control devices, overload protection devices, and safety devices not otherwise specified but necessary for proper and safe operation of the blower assembly. Electrical control equipment shall conform to NEMA ICS 1 and NEMA ICS 2. All electrical control equipment components shall be completely wired and mounted in a duplex control panel at manufacturer's

plant and tested prior to shipment. Enclosures for electrical controls shall be NEMA Type 4. Controls shall be located as indicated on drawings. Electric srevice available is 480 volts, 3 phase, 60 Hertz, 4 wire. Connecting electrical wiring and related equipment are specified in Section 16402, "Interior Wiring Systems".

- (1) Motor Starter and Pushbutton Station: A pushbutton actuated magnetic motor starter with overload and undervoltage protection shall be provided for each motor. Starters shall have thermal overload protection in each phase and short circuit protection. Overload protective devices shall give adequate protection to motor windings, shall be of thermal inverse-time-limit type, and shall include manual-reset type pushbutton on outside of motor starter enclosure. Pushbutton station shall be two-button start-stop. Pushbuttons shall be clearly and properly marked. The control panel shall have an elapsed time meter and cycle counter for each blower assembly to monitor run times on the units.
- (2) Wiring: All control circuits shall be wired with No. 14 gauge stranded machine—tool wire with compression type lugs and number tags on both ends of all wires. Wires shall be secured in a neat workman—like manner with plastic cable ties and/or in wiring duct.
- 4.1.4 Air filter shall be of the following type. Dimensions of air filter shall not exceed 1.5 feet width and 1 foot height.
- a. Canister Type Filter: The air filter shall be the canister type, with replaceable filter element. Element shall be of the dry pleated paper type suitable for cleaning and reusing a number of times. Filter shall have a minimum efficiency of 99.5% on 2 micron and 97% on 1 micron particles. Filter body shall be of heavy duty construction, adequately sized to handle maximum capacity of the blowers. Maximum pressure drop through the filter at 100% rated capacity shall not exceed 2.8 inches of water.
- 4.1.5 Air filter gauge shall be provided for measuring resistance in inches to air flow through the air filter. The gauge shall be of the inclined tube differential type equipped with three-way angle type valve for venting to atmosphere. It shall be of solid acrylic plastic construction with built-in level dial and shall have an adjustable scale of polished chromium with black figures and graduations. It shall be provided with necessary lengths of 1/4-inch copper or aluminum tubing, two static pressure taps, two toggle bolt mounting assemblies, and additional bottle of red gage oil.
- 4.1.6 Air piping shall include all piping from the air blower to the diffusers. Header piping shall be cast iron or steel. Drop and feeder piping shall be cast iron or steel.
- a. Cast-iron piping shall conform to ANSI Standard A21.6, A21.7, A21.8, A21.9, A21.51, or A21.52. Fittings shall conform to ANSI Standard A21.10 or A21.14. Joints shall be mechanical joints or flanged joints. Mechanical joints shall conform to ANSI Standard A21.11. Pipe flanges for flanged joints shall conform to ANSI Standard B16.1. Flanged fittings

shall conform to ANSI Standard A21.10 or A21.14. Bolts, nuts, and gaskets for flanged joints shall conform to ANSI Standard B16.1.

- b. Steel Piping: Steel pipe for sizes 4-inch diameter and smaller shall be standard-weight galvanized steel pipe conforming to ASTM Specification A120, with fittings of cast iron conforming to Specification WW-P-501, Type II, or of malleable iron conforming to Specification WW-P-521, Type II. Steel pipe for sizes 5-inch diameter and larger shall be seamless or electric-resistance welded, standard-weight, black steel pipe conforming to ASTM Specification A53, Grade B. Joints for pipe sizes 4-inch diameter and smaller shall be screwed joints. Joints for pipe sizes 5-inch diameter and larger shall be flanged with flanges conforming to Specification WW-P-521, ANSI Standard B16.5, or AWWA Standard C207. Bolts and nuts for flanged connections shall conform to the requirements specified in AWWA Standard C207. Gaskets shall be plain rubber gaskets 1/8-inch thick.
- c. Hangers and Supports: Hangers and supports shall be of approved standard design where possible and shall be adequate to maintain the supported load in proper position under all operating conditions. The minimum working factor of safety for pipe supports shall be five of the ultimate tensile strength of the material, assuming 10 feet of waterfilled pipe being supported. Pipe saddle supports shall be adjustable type with pipe and floor flanges for bolting to floor. Where used under base fittings, a matching floor flange shall be substituted for the saddle section. Where support is from walls or columns, welded steel brackets shall be furnished with anchor chair. Additional wall bearing plates shall be provided where required for wall brackets.
- 4.2 Electrical Requirements: Unless indicated or specified otherwise, the electrical components of mechanical equipment, such as motors, motor starters, control (pushbutton) stations, electrical disconnecting (isolating) means, and other devices functioning to control associated mechanical equipment, are included under this section. The work shall be complete and operable, and shall be in accordance with the National Electrical Code unless specified otherwise. The interconnecting conduit and wire (except when included in factory-assembled equipment), the motor-control equipment forming a part of motor-control centers or switch-gear assemblies, and the electrical connection of the mechanical equipment to the electrical power circuit are specified in Division 16, Electrical of these specifications.
- 5. MATERIALS PROTECTION: Except as specified otherwise herein, all exposed surfaces of ferrous metals, including those to be submerged, shall be sandblasted in accordance with SSPC-SP No. 6 and shop coated with two coats of coal tar epoxy conforming to SSPC-Paint 16 applied to a minimum dry film thickness of 8 mils each coat. The maximum time between coats shall be 72 hours. The following items shall be finished in accordance with manufacturer's standard practice suitable for end use environment: motors, gearmotors, and pushbutton stations.
- 6. INSTALLATION: The Contractor shall provide for the services of an engineer representative of each manufacturer of the various items of

equipment to assist in the installation and testing and also to be available to instruct the operating and maintenance personnel during the initial operating period.

- 6.1 Diffused Air Aeration Equipment:
- 6.1.1 Diffusers: The air diffusers shall be installed in accordance with the recommendations of the manufacturer.
- 6.1.2 Air Blower: The air blower complete with driver shall be mounted on a heavy-duty fabricated structural steel cast-iron bed or base. The base shall be complete with machined undersurface mounting pads and lifting brackets. The complete unit shall be installed as indicated and in complete accordance with the recommendations of the manufacturer.
- 6.1.3 Air Filter: The complete air filter system shall be installed in accordance with the manufacturer's instructions.
- 6.1.4 Air Piping: All piping shall be installed to true alignment and rigidly supported with pipe hangers and supports. Mechanical joints shall be made in accordance with the requirements of AWWA Standard C600. Flanged joints shall be made up tight, care being taken to avoid undue strain on flanges, valves, fittings, and other equipment and accessories. Screwed joints shall be made up tight with a stiff mixture of graphite and oil, inert filler and oil, or an approved graphite compound, applied to the male threads only. Threads shall be full cut; not more than three threads on the pipe shall remain exposed.
 - 7. OPERATION, MAINTENANCE, AND SPARE PARTS:
- 7.1 Operation and Maintenance Manual: An operation and maintenance manual for the aeration equipment shall be furnished by the Contractor. Four copies of the manual shall be delivered to the Contracting Officer. The manual shall include but not be limited to the following: detailed description of the function of each principal component of the aeration system; procedure for starting; procedure for operating, shutdown instructions; installation instructions; maintenance and overhaul instructions; lubrication schedule including type, grade, and temperature range and frequency; safety precautions, diagrams, and illustrations; test procedures; performance data; and parts list. It is intended that the manual shall be complete in all respects for all equipment, controls, accessories, and associated appurtenances.
- 7.2 Operating Instructions: Operating instructions for use by operating personnel shall be provided for each principal equipment component. The instructions shall be either attached to or placed adjacent to the applicable equipment and shall be protected against weathering. The instructions shall include but not be limited to the following: start-up; proper adjustment; operation; shutdown; safety precautions; procedure in event of equipment failure; and any other necessary items of instruction as recommended by the manufacturer of the unit.

- 7.3 Spare Parts: All standard recommended spare parts shall be provided as indicated in the manufacturer's instruction manuals, for each component in the system.
- 8. QUALITY ASSURANCE PROVISIONS: Performance tests shall be conducted on the air diffusers, air blowers, and air filters.
 - 8.1 Factory Tests:
- 8.1.1 General: All factory tests shall be conducted by the manufacturer in the presence of the Contracting Officer or his representative. The Contractor shall arrange for such tests.
 - 8.1.2 Coarse Bubble Diffusers:
- a. Non-porous nozzle diffusers shall be submitted to the following tests:
- (1) Oxygen Absorption Rating Test: Prior to starting production of nozzle diffusers, the manufacturer shall furnish three samples of the type to be furnished for installation. The sample nozzles shall be tested for oxygen absorption by the manufacturer and shall be selected at random by him.

If the results of the oxygen absorption test are satisfactory, the production of nozzle diffusers may be started. If the nozzles tested fail to meet the oxygen absorption specifications, details of manufacture shall be altered and other corrective measures taken and three sample nozzles shall again be selected and tested. This procedure will be followed until the proper structure is obtained to meet the specifications. After production of nozzles has begun, three nozzles selected at random from each nozzle lot produced for this contract shall again be tested for the oxygen absorption rating. Should any one of these samples fail to meet the specifications, additional nozzles of the same nozzle lot represented by the samples, selected as directed by the Contracting Officer or his representative, shall be submitted for a check test. If any one of the check samples fails to meet the specifications, the entire lot of nozzles represented by the samples shall be rejected.

Oxygen absorption rating of the diffuser nozzies furnished shall not be less than 53.0 parts per million per hour.

The oxygen absorption rating shall be determined by measuring the rate of conversion of sodium sulfite to sodium sulfate due to the oxygen absorption taking place in the solution. This is done by taking 50 cubic centimeter samples of the solution at intervals and adding to each sample such a fixed amount of acidified iodine solution that there is always iodine in excess of the amount required to neutralize the sulfite. The change in sulfite concentration is determined by measuring the change in the excess iodine for each interval. This is done by titrating the excess iodine with N/40 sodium thiosulfate. For a 50 cubic centimeter sample of the solution, a titration difference of 1.0 cubic centimeter of sodium thiosulfate is equivalent to 4.0 parts per million of oxygen absorption.

The results obtained by the foregoing testing procedures shall be multiplied by a correction factor determined as follows. Air shall be diffused into 0.5 cubic feet or less of distilled water at 3 inches depth for a period of two hours in which the barometric pressure and water temperature remain constant. Dissolved oxygen determinations shall then be made on samples from the water by the Azide Modification of the lodometric Method, as described in AWWA Standard Methods, 15th Edition, using sodium thiosulfate solution the same as used in the plate rating test. The dissolved oxygen thus obtained in parts per million divided into the solubility of oxygen in parts per million in water, for the barometric pressure and water temperature which obtained for the two hour period, shall constitute the correction factor. The solubility of oxygen in the water shall be that as indicated for fresh water by AWWA Standard Methods, 15th Edition, for the particular condition of barometric pressure and water temperature.

The oxygen absorption rating shall be made in a tank. The tank shall be 3 feet 6 inches long by 1 foot 7 inches wide, holding approximately 125 gallons. The tank shall be filled to the depth of 3 feet 0 inches over the top of the nozzle with tap water at 72 degrees F. Sodium sulfite, to the amount of 1200 parts per million, and 66 degrees Baume sulfuric acid, to the amount of 50 parts per million, shall be dissolved in the water. The sulfite shall be put into solution by removing some of the water from the tank, dissolving the sulfite in this and then pouring it back into the tank while air is being diffused into the solution in the tank to insure a thorough mixing.

Each diffuser nozzle to be rated for oxygen absorption shall be clamped to the nozzle holder, lowered into the tank to just below the solution and inspected with the air diffusing. Any leaks along the gasket shall be eliminated by additional tightening of the nozzle. The container with nozzle attached shall then be lowered to the tank bottom for the rating test. With air diffusing from the nozzle at 8 cfm, measured as air at 14.4 psi absolute pressure and 60 degrees F, samples of the solution shall be taken every 10 minutes for 40 minutes. These samples shall be immediately tested for oxygen absorption. The oxygen absorption rate for a 40-minute period, in which the indicated rate in any 10-minute interval does not vary more than 10 percent from the average, shall be the oxygen absorption rating of the nozzle.

No oxygen absorption rating tests shall be made when the uncovered sodium sulfite in the solution in the tank is lower than 300 parts per million.

All accepted nozzles will be suitably marked or stamped by the manufacturer. Nozzles not bearing the rating mark will not be approved for installation.

8.1.3 Air Blower: The air blower shall be subjected to the following tests at the factory by the manufacturer: (1) The casing shall pass a hydrostatic pressure test at a minimum pressure of 25 psig; (2) The impeller, before being mounted on the shaft, shall pass an over-speed spin test to a rotational speed of 120 percent of design speed; (3) After the

spin test, the impeller shall pass an inspection for weld or other structural imperfections using magnetic particle techniques or x-rays; (4) The blower shall be given a running test using manufacturer's driver. During this test, mechanical operation of all equipment shall be satisfactory. Vibration shall meet the limits specified herein, and the over-all sound pressure level shall be determined, making due allowance for any background noise during the running of the tests; (5) The blower shall be tested in accordance with the ASME Performance Test Code No. 9, using manufacturer's driver and the temperature rise method of determining horsepower. Tests shall include determination of the surge point and the shape of the characteristic curves at various inlet guide vane positions, and the determination of all data required to evaluate efficiencies and horsepower requirements for the specified conditions.

At least ten days prior to the manufacturer's running tests (4) and (5) above, the Contractor shall notify the Government when these tests are to be performed so that arrangements can be made for a representative of the Government to witness the tests.

8.2 Field Tests:

- 8.2.1 General: At least ten days prior to the manufacturer running field tests of equipment, the Contractor shall notify the Contracting Officer when these tests are to be performed so that arrangements can be made for the Contracting Officer or his representative.
- 8.2.2 Blower-driver unit shall be tested as soon as practicable after installation and the aeration tank is ready for use. The blowers shall be operated under varying capacities and discharge pressures covering the range of conditions specified. During these tests, the units shall operate without overheating or excessive vibration, and shall be satisfactory in every respect.

The field tests shall include over-all sound pressure levels of the compressor unit.

Should any defects occur before or during the tests, they shall be remedied, and changes or replacement of equipment shall be made as may be required to make the apparatus comply with these specifications.

The initial operation of the unit(s) and the conduct of the field tests shall be under the supervision of the blower manufacturer. The Contractor shall supply such labor and materials as may be necessary to properly perform the tests. During the tests, operating data shall be taken at regular intervals and incorporated in a report. Data readings shall be based on plant meters, gauges, and instruments, and shall include the following:

Air volume

Air inlet and discharge pressure and temperature

Motor amperes

Motor kilowatts

Bearing temperatures

Stator temperatures

Lubricating oil pressure and temperatures

Lubricating oil cooling water temperatures

8.2.3 Air Filter: After erection, painting, and adjustment, the entire air filtering system shall be given a thorough operations check to demonstrate that all features operate as specified.

The particulate concentration in the filter air shall be determined to indicate compliance with the requirements for cleanliness of filtered air specified above. Tests shall be made using fiberglass disc filters. The air filter manufacturer shall furnish the test apparatus and discs for use in the test. The apparatus and testing procedure shall be approved by the Contracting Officer. Sample weighing will be done by the Contracting Officer or his representative. The tests shall be performed in the filtered air plenum and shall be of sufficient duration to obtain a significant weight of particulate matter.

If the amount of particulate matter found in the filtered air exceeds the specified maximum amount, the manufacturer shall take the necessary steps to make the air filters perform as specified and the tests shall be rerun. If the air filters do not perform as specified, the Contractor shall replace them with equipment that will so perform, without additional expense to the Government.

- 8.2.4 Diffusers: Performance tests shall be conducted on the diffusers in the field.
 - a. Oxygenation capacity tests shall be performed as follows:
- (1) The aeration tank shall be thoroughly cleaned and then filled with fresh tap water.
- (2) The temperature of the fresh water shall be as close to 68 degrees F as possible.
- (3) Submersible sample pumps shall be installed at three operating depths, 3 ft, 9 ft, and 18 ft depths at two selected locations in the basin, on opposite sides of the tank, one at 1/4 of the distance from center of tank, and the other at 3/4 of the distance from the center.
- (4) A catalyst, chloride or sulfate, shall be dissolved in the tank contents, with the diffusers working to insure mixing, to a minimum concentration of 2 mg/l of cobalt ion.
- (5) After the tank has reached a steady state condition for 30 minutes, a sodium sulfite solution, which removes the dissolved oxygen,

shall be released uniformly into the tank contents. (For a liquid having an initial dissolved oxygen (D.O.) concentration of 10 ppm, approximately 1 pound of dry sodium sulfite will be required per 1,000 gallons of liquid per test. This will provide an excess of compensate for oxidation during mixing.)

- (6) As the D.O. rises in the tank, six samples, one for each depth at each location, shall be drawn at one to five minute intervals. Interval should be selected to get at least six sets of samples between 10 and 90 percent saturation. The D.O. shall be run by the Azide Modification of the lodometric Method as outlined in AWWA Standard Methods, 15th Edition, or by use of a D.O. probe and an average obtained on the samples for each sampling time.
- (7) A semilog plot of the data of the dissolved oxygen deficit against time shall be constructed. Only points between 10 and 90 percent saturation shall be considered. A line of best fit shall be drawn through the plotted points.
 - (8) The slope of the line shall be calculated.
- (9) Corrections shall be made for temperature, oxygen saturation of the water, and the relative transfer coefficient of the water and then the pounds of oxygen dissolved at standard conditions of 68 degrees F, tap water, and "O" ppm dissolved concentration shall be computed.
- (10) Should diffusers fail to produce the oxygenation capacity required, the test series shall be repeated.
- (11) If the required oxygenation capacity is not produced after two test repetitions, the Contractor shall either correct the defective unit(s) or replace them with new unit(s), and the test procedure shall be repeated as set forth herein, until satisfactory units are obtained.
 - b. Mixing test shall be performed as follows:
- (1) Velocity measurements shall be made throughout the tank under actual operating conditions to test for complete mixing of tank contents.
- (2) This test shall be conducted at the same time as the oxygenation capacity test.
- (3) Measurements shall be taken at the quarter points of each tank wall, 2 feet from the wall, and at the levels of the sample pumps used in oxygenation capacity tests. Minimum velocity shall be 0.5 feet per second. Measurements shall be taken with a Price current meter.
- (4) Should any of the velocity measurements fall below the specified minimum velocity, the test shall be repeated.

(5) If the specified minimum velocity is not produced after two test repetitions, the Contractor shall either correct the defective unit(s) or replace them with new unit(s), and the test procedures shall be repeated as set forth herein, until satisfactory units are obtained.

*** END OF SECTION ***

SECTION 15392

GRIT HANDLING EQUIPMENT

- SCOPE: This section includes grit separation, collection, and removal equipment.
- 2. APPLICABLE DOCUMENTS: The following specifications and standards of the issues listed in this paragraph (including the amendments, addenda, and errata designated), but referred to hereinafter by basic designation only, form a part of these specifications to the extent required thereto.
 - 2.1 American Gear Manufacturers Association Standards:

210.02	Surface Durability (Pitting) of Spur Gear Teeth
211.02	Surface Durability (Pitting) of Helical and Herringbone Gear Teeth
211.02A	Rating for the Durability of Helical and Herring- bone Gears for Enclosed Drives
211.02B	Rating for the Durability of Helical and Herring- bone Gears for Gearmotors
215.01	Information Sheet for Surface Durability (Pitting) of Spur, Helical, Herringbone and Bevel Gear Teeth
220.02	Rating the Strength of Spur Gear Teeth
221.02	Rating the Strength of Helical and Herringbone Gear Teeth
221.02A	Rating for the Strength of Helical and Herring- bone Gears for Enclosed Drives
221.02B	Rating for the Strength of Helical and Herring- bone Gears for Gearmotors
225.01	Information Sheet for Strength of Spur, Helical, Herringbone and Bevel Gear Teeth
226.01	Information Sheet - Geometry Factors for Deter- mining the Strength of Spur, Helical, Herringbone and Bevel Gear Teeth
241.02	Specification for General Industrial Gear Materials - Steel (Drawn, Rolled and Forged)
243.51	Specification for Worm Gear Bronze

244.02 Nodular Iron Gear Materials

245.01 Specification for Cast Steel Gear Materials

420.03 Practice for Helical and Herringbone Gear Speed Reducers and Increasers

440.03 Practice for Single and Double-Reduction Cylindrical-Worm and Helical-Worm Speed Reducers

2.2 American National Standards Institute:

B15.1 Mechanical Power-Transmission Apparatus

B17.1-1967 Keys and Keyseats

B17.2-1967 Woodruff Keys and Keyseats

2.3 American Society for Testing and Materials:

A36-77a Structural Steel

A48-76 Gray Iron Castings

A108 Cold-Finished Carbon Steel Bars and Shafting

A536 Ductile Iron Castings

2.4 National Electrical Manufacturers Association:

MG1-78 Motors and Generators

2.5 Steel Structures Painting Council:

SP6-82 No. 6 Commercial Blast Cleaning

- 3. GENERAL REQUIREMENTS: The grit removal system shall be designed to separate, collect, remove, and deposit the grit at the indicated point of its discharge, all within the area and at the elevations indicated. The Contractor shall provide all systems complete and ready for operation. All incidental piping, controls, and accessories required for complete operating systems shall be at the expense of the Contractor. Provide all control wiring and accessories in accordance with NFPA 70.
- 3.1 Definitions: The following terms, as used in this specification, shall be defined as follows:
- 3.1.1 Grit: The suspended mineral matter present in wastewater such as sand, gravel and cinders.
- 3.1.2 Grit Separation: The process separating grit from wastewater by controlling the velocity of the wastewater with the tank configuration to separate the grit from the organic solids by differential sedimentation.

- 3.1.3 Grit Collection: The process of gathering the separated grit in a hopper or other point of collection by mechanical equipment designed for the purpose.
- 3.1.4 Grit Removal: The process of conveying grit out of the chamber from the point of collection in the chamber to the indicated point of discharge. Grit removal equipment may accomplish some dewatering.
- 3.2 Electrical Motors, Controllers, Contactors, and Disconnects: Furnish motors, controllers, contactors, and disconnects with their respective pieces of equipment. Motors, controllers, contactors, and disconnects shall conform to and shall have electrical connections provided under Section 16402, "Interior Wiring Systems". Controllers and contactors shall have a maximum of 120 volt control circuits, and auxiliary contacts for use with the controls furnished. When motors and equipment furnished are larger than sizes indicated, the cost of providing additional electrical service and related work shall be included under this section.
- 3.3 Longitudinal Grit Removal System: Grit shall be separated in a longitudinal grit chamber. Collection and removal of grit shall be by chain and flight equipment.
- 3.4 Work Included under other Sections: Concrete work is included under Section 03302, "Cast-in-Place Concrete". Miscellaneous metal work is included under Section 05500, "Metal Fabrications". Mechanical piping not specified herein is included under Section 02722, "Exterior Sanitary Sewers". Field painting is included under Section 09910, "Painting of Buildings". Electrical work is specified under Section 16402, "Interior Wiring Systems".
- 4. SUBMITTALS: Partial submittals will not be acceptable. Annotate descriptive data to show the specific model, type, and size of each item the Contractor proposes to furnish. Prepare shop drawings on sheets not smaller than 30 inches by 42 inches, and include data essential to the proper installation of each system. Do not commence work until the design of each system and the various components have been approved. The submittal requirements of Section 15011, "General Requirements, Mechanical" applies to the following lists. Items in the following lists (which are followed by (CO)) shall be approved by the Contracting Officer.
 - 4.1 Manufacturer's Data:
 - a. Pump, drives, chains, and controllers (CO)
 - 4.2 Shop Drawings:
 - a. Pump, drives, chains, and controllers (CO)
 - b. Equipment layout
 - 4.3 Certificates of Compliance:
 - a. Drives and chains (CO)

4.4 Certified Data:

- a. Manufacturer's pump discharge curves (CO)
- 4.5 Operation and Maintenance Manuals:
 - a. Pumps, and drives
 - b. Spare parts catalog (CO)
- 5. MATERIALS AND EQUIPMENT: Unless otherwise specified, all materials and equipment shall be standard commercial products in regular production by the manufacturers and suitable for the required service. Unless otherwise specified, all structural steel shall conform to ASTM Specification A36. All submerged steel shall have a minimum thickness of 1/4-inch. Unless otherwise specified, all cast iron shall conform to ASTM Specification A48 Grade 30. All chains, sprockets, gears, bolts, sheaves, couplings, projecting setscrews, and other rotating parts, located so that any person may come in close proximity thereto, shall be fully enclosed or properly guarded in accordance with ANSI Standard B15.1.
- 5.1 Chain and Flight Collector: Mechanism shall be chain—and—flight type designed to move settled grit to the grit discharge. The mechanism shall include a collector assembly, and an overload alarm system.
- 5.1.1 Design: The collector assembly shall operate at a linear speed of 10 fpm. The collector mechanism and its component parts shall be designed, with a minimum factor of safety of 4, to withstand all structural and mechanical stresses brought about by the drive assembly and the following loadings: dead load and a grit load equal to a horizontal load of 8 lbs per linear foot of scraper blade in a scraping position. The mechanism shall be designed for continuous 24-hour service under design load without excessive wear, damage, or failure. The mechanism shall be capable of operating in a dry chamber without overloading the equipment. Stresses developed under the aforementioned operating conditions and loads shall not exceed the allowable stresses conforming to AISC "Specification for the Design, Fabrication and Erection of Structural Steel for Building".

5.1.2 Grit Collector Assembly:

- a. General: Assembly includes collector chain, driven sprocket, idler sprockets, shafts, bearings, collector flights and collector return rail.
- b. Collector chain shall be the heavy pintle type 720S having an average ultimate strength of 30,000 lbs and shall weigh no less than 5.2 lbs per foot. Chain links shall be of corrosion resisting malleable iron having average tensile strength of 70,000 psi and an average Brinell hardness between 170 and 190. Attachments for scrapers shall be full depth of scraper and attached with four bolts. Coupling pins shall be not less than 3/4-inch diameter heat treated high carbon steel. All cotter pins shall be stainless steel.

- c. Sprockets for collector shall be high-test cast-iron, having a minimum tensile strength of 20,000 psi cast in a chill, and shall have a Brinell hardness of not less than 360 with a chill depth of at least 3/16-inch. Sprockets shall be stress relieved before machining. Sprocket teeth shall be accurately ground to fit chain. Sprockets shall be split construction assembled with cadmium plated nuts and bolts. Driven sprocket on the headshaft shall be of the offset type. All sprockets on the head shaft shall be key seated. The idler wheel and chain take-up shaft sprocket shall not be key seated but, except for number of teeth, shall be identical in other respects to the head shaft sprockets. The idler wheel and take-up shaft sprocket shall be set-screwed to the shaft.
- d. Shafting shall be solid, cold-finished steel, ASTM A108, straight and continuous for full width of tank. Shafting shall be of sufficient size to transmit the maximum force developed by the drive assembly. Keyways shall be provided where necessary to attach or locate sprockets on shafting. Keys and key seats shall conform to ANSI Standard B17.1 or B17.2. Shafting shall be polished in areas of contact with bearings.
- Bearings shall be babbitt-lined, sleeve type, self-aligning ball-and-socket type or heat treated ductile iron, self-aligning type. All bearings, except those for bracket-supported driven sprockets, shall be bolted to the tank walls. Bearings shall be designed to allow minimum field variations without shimming. No bracket supports, except on head shaft driven sprocket, will be allowed. Bearings above water shall be provided with flush ball-check grease-lubrication fittings. Underwater bearings shall be heat treated ductile iron and be water lubricated with tops designed to prevent solids accumulation. Underwater bearings shall be equipped with flush ball-check grease-lubrication fittings for use during initial operation and at times when the tank is dewatered. Take-up bearings shall be provided on take-up shaft. Take-up bearings shall be provided arranged to slide between or to be steadied by two cast-iron, mild steel or silicon bronze guides. Take-up bearings shall have a minimum range of travel of 10 inches and shall be positioned by a stainless steel, silicon bronze or cadmium plated steel threaded power bolt, which shall be arranged for locking at any position of the bearing. All bearings shall be rated for a minimum of 5 years on a continuous service basis.
- f. Flights shall be fabricated of 1/4-inch thick structural steel plate or channels mounted 5 feet apart on the chain.
- g. Rail(s) and Track: One industrial type steel rail, minimum weight 16 pounds per yard, shall be provided for each collector mechanism. All necessary splice bars, rail clips, and appurtenances shall be included. Return tracks shall be structural steel shapes having a minimum thickness of 3/8-inch and shall be supported by steel cross members supported from chamber walls.
- 5.1.3 Overload Protection and Alarm: The collector unit shall include an overload unit designed to indicate the load on the mechanism at all times, to sound an alarm in case of impending excessive load, and to

stop the mechanism when such load is reached. The unit shall be of the watt-sensitive type, totally enclosed, except alarm bell, in a NEMA IV weatherproof enclosure. Alarm bell shall be provided with a separate switch in order that the bell may be shut off during periods when the plant is not manned.

5.1.4 Drive Assembly:

- a. General: Drive assembly shall include an electric-motor-driven speed reducer; drive sprocket on output shaft of speed reducer; drive chain from drive sprocket to driven sprocket; shear pin; and chain guard. Unit shall be fully enclosed and designed for mounting outside and exposed to the weather.
- b. Speed Reduction Unit: Speed reducer shall be either a helical gear reduction unit or a worm gear reduction unit fully enclosed in a cast iron or fabricated steel case provided with dust and oil seals with all gears running in oil and with anti-friction bearings throughout. Gears used in speed reducer shall conform to applicable requirements of the following Standards. Speed reducer shall be designed with a minimum AGMA service factor of 2.0 and shall also have an AGMA Service Classification II.

Helical gearing	AGMA	210.02		
	AGMA	211.02,	211.02A,	211.02B
		215.01		
	AGMA	220.02		
	AGMA	221.02,	221.02A,	221.02B
		225.01		
	AGMA	226.01		
	AGMA	241.02		
	AGMA	244.02	1000	
	AGMA	245.01		
	AGMA	420.03		
	AGMA	440.03		
	ASTM	A48		
	ASTM	A536		
Worm gearing	AGMA	241.02		
a siki a sikiri wa sana	AGMA	243.51		
		244.02		
	AGMA	245.01		
		440.03		
		A536		

c. Bearings: All bearings incorporated within the drive assembly shall be of the antifriction type and conform to the following minimum schedule of rated-life expectancy (L-10) based on the Antifriction Bearing Manufacturers Association Standards when operating at the normal continuous torque rating of the mechanism.

Worm gearbox bearings Geared motor (direct drive)

L10-100,000 hours L10-100,000 hours

Intermediate helical gearbox bearings Geared motor (indirect drive) L10- 17,000 hours

L10- 17,000 hours

Speed reducer case shall be equipped with oil fill port, oil drain line, and an oil level indicator pipe.

- Chain and Belt Drives: Chain and belt drives incorporated in the drive assembly shall be designed with a minimum factor of safety of 4 as applied to the ultimate breaking or transmission strength of the chain or belt with respect to the loads transmitted at normal continuous operating load. Chain and sprockets or V-belt and pulleys connecting motor and speed reducer shall be enclosed in a weatherproofed fabricated steel or fiberglass guard. Chain connecting motor and speed reducer shall be steel roller type. Sprockets shall be hardened ground alloy steel or high-test cast-iron, having a minimum tensile strength of 40,000 psi cast in a chill, and shall have Brinell hardness of not less than 360 with a chill depth of not less than 3/16-inch. Sprocket teeth shall be accurately ground to fit the chain. V-belts shall be rayon corded with heat and oil resisting rubber covering. Motor position of V-belt drives shall be adjustable to increase or decrease belt tension. The drive sprocket keyed on the output shaft of the speed reducer shall be bronze bushed with a grease-lubricated bronze bushing and provided with shear pin overload protection. The drive chain shall be of the steel roller type, shall weigh not less than 3.0 pounds per foot, and shall have an average ultimate tensile strength of 16,000 pounds. The drive chain shall have a minimum pitch of 2.6 inches. A drive chain tightener shall be provided to adjust and tighten the chain.
- e. Motor: The electric motor shall be constant speed and conform to NEMA Standard MG-1 and shall operate on 480 volts, 3 phase, 60 Hertz, current. The motor shall have at least 1 HP with a frame that is totally enclosed, fan cooled. The motor shall be NEMA Design B.
- 5.2 Organics Return Pump: With each mechanism there shall be included an organics return pump to be installed as part of each grit removal unit. The pump shall comprise a complete assembly consisting of gear motor, shafting, impeller, and mounting base. The drive motor shall be totally enclosed, suitable for all-weather operation, not less than 1/2 HP, and designed to operate on 3 phase, 60 cycle, 480 volt current. The drive assembly for each pump shall consist of a vertical mounted drive motor connected to the pump shaft by a flexible coupling. The propeller of each pump shall be machine pitched, fabricated from high grade bronze and designed to operate between 400-500 rpm. The impellers shall be rigidly fastened to a solid cold-rolled steel shaft. The thrust of the impeller shall be carried by a self-aligning grease lubricated ball bearing mounted on the support base. The shaft shall be guided at its lower end by a liquid lubricated bronze bearing mounted in a steel guide pipe supported from the base. The entire pump assembly shall be mounted on and supported by a single piece base of 3/8 inch fabricated steel.
- 5.3 Electrical Requirements: Unless indicated or specified otherwise, the electrical components of mechanical equipment, such as motors,

motor starters, control (pushbutton) stations, electrical disconnecting (isolating) means, and other devices functioning to control associated mechanical equipment, are included under this section. The work shall be complete and operable, and shall be in accordance with the National Electrical Code. The installation shall be made with rigid metal conduit and fittings. Liquid tight flexible steel conduit shall be used for short connections to motors and their controllers. The interconnecting conduit and wire (except when included in factory—assembled equipment) in the motor—control equipment forming a part of motor control centers or switch—gear assemblies, and the electrical connection of the mechanical equipment to the electrical power circuit are specified in Division 16, Electrical.

6. SPARE PARTS: Spare parts for the equipment specified above shall be furnished in the quantities listed below. The spare parts shall be identical and interchangeable with the original parts. The parts shall be furnished in containers clearly marked. Spare parts shall be furnished in accordance with the schedule below. Where the number of spare part units required by the schedule results in a fractional number of units, the number furnished shall be rounded off to the next highest.

Number of spare units required as percentage
Description of spare part unit of part units installed

a. Chain and flight collectors

Drive chains 25 percent
Collector chain lengths 5 percent
Flights, complete with attachments 5 percent
Wearing shoes 25 percent
Drive sprocket with shear pin hub 25 percent

- 7. MATERIALS PROTECTION: Submerged ferrous metals shall have surface preparation in accordance with SSPC-SP6, No. 6 "Commercial Blast Cleaning" and shop primed with an epoxy primer. All other ferrous metals shall be shop painted after thorough cleaning with a primer recommended by the manufacturer of the finish paint specified in Section 09910, "Painting of Buildings".
- 8. INSTALLATION AND CONSTRUCTION: The Contractor shall procure the services of an engineer representative of the manufacturer of all equipment for supervision during installation and acceptance tests. The representative also shall be available to instruct the operating personnel during the initial operation period.
- 8.1 Concrete construction shall be in accordance with Section 03302, "Cast-In-Place Concrete" except as modified herein. The grit collector tank floor shall be laid to the slope indicated, with the base slab poured to a minimum of 2 inches below the indicated grade. Except as otherwise specified herein, placing of base slab and mortar shall be in accordance with applicable requirements of section covering floor finishes in Section 03302, "Cast-In-Place Concrete". The base slab shall be given a screed finish, after which it shall be roughened by scoring with a rake or

similar tool. Following installation of the grit collector mechanism, the tank floor shall be brought to finish grade by means of a cement-mortar grout surfacing swept into place by use of the grit scraper arms, as hereinafter specified. When the grit collector mechanism has been erected and inspected by the engineer representative of the manufacturer and the arms and blades have been adjusted to give the required clearance above final floor grade, a 2-inch by 6-inch wooden straight-edge with metal-clad edge shall be fastened to each sweeping arm approximately 1/4-inch below the sweeping blades to provide a suitable squeegee. Cement-mortar grout shall be composed of one part cement, three parts sand with sufficient water as required for conditions of placement and with one teaspoon of powdered aluminum added per bag of cement. Before the cement-mortar grout is placed, the floor shall be thoroughly cleaned of all dirt, soil, or other substances which would prevent the proper bonding of the surfacing to the concrete subfloor. The grout surfacing shall be brought to finish grade as nearly as possible by hand. The scraper arms with straightedges attached shall be rotated manually to complete the operation. Use of the drive unit for sweeping in the grout surfacing will not be permitted. Provision shall be made to prevent grout from entering the grit hopper; any grout which falls in the grit hopper or on the tank walls shall be removed immediately.

8.2 Chain and Flight Collector: The chain and flight collector shall be installed in accordance with the recommendations and instructions of the manufacturer. Installation shall include providing all lubricants for initial operation in accordance with the manufacturer's recommendations.

9. QUALITY CONTROL:

- 9.1 Factory Inspection: Factory inspection, arranged for by the Officer in Charge of Construction, will be required specifically, but not necessarily exclusively for the following materials and equipment: grit handling unit. Factory inspection of other materials and equipment for which tests at the place of manufacturer are required herein or in referenced documents, may be waived at the option of the Officer in Charge of Construction provided certified copies of factory test reports, which shall include manufacturer's statements of conformance with all requirements of these specifications, are furnished.
- 9.2 Field Tests and Inspections: The Officer in Charge of Construction will conduct field inspections and witness all field tests and trial operations specified in this section. The Contractor shall perform all trial operations and field tests, and provide all labor, equipment and incidentals required for testing, except that the Government will provide water, fuel and electric power required for field tests, when available.
- 9.3 Extent and Scope of Field Tests: After installation and before acceptance, the work of this section shall be subjected to all necessary field tests, including those listed below. Any defective work or material found shall be replaced or repaired in an approved manner at no additional cost to the Government.

- 9.3.1 Chain and Flight Collection: The Contractor shall submit sufficient data to indicate that the collector meets all requirements of the specifications. Upon installation should the collector fail to perform as specified, the necessary changes shall be made. If the collector remains unable to perform properly, in the judgment of the Contracting Officer, it shall be removed and replaced by the Contractor at no additional expense to the Government.
- 10. OPERATION AND MAINTENANCE MANUAL: An operation and maintenance manual for each item of the grit separation, collection, removal and classifying system when used shall be furnished by the Contractor. Four copies of the manual shall be delivered by the Contracting Officer. The manual shall include, but not be limited to, the following: Detailed description of the function of each principal component of the system; procedure for starting; procedure for operating; shut—down instructions; installation instructions; maintenance and overhaul instructions; lubri—cation schedule including type, grade and temperature range, and frequency; safety precautions, diagrams, and illustrations; test procedures; performance data; and parts list. It is intended that the manual shall be complete in all respects for all equipment, controls, accessories, and associated appurtenances provided under this section.
- 11. OPERATING INSTRUCTIONS: Printed operating instructions for use by operating personnel shall be provided for each component of the grit separation, collection, removal and classifying system. The instructions shall be either attached to or placed adjacent to the equipment at the operating platform and shall be protected against weathering. The instructions shall include, but not be limited to, the following: start—up; proper adjustment; operation; lubrication; shut—down; safety precautions; procedure in event of equipment failure; and any other necessary items of instruction as recommended by the manufacturer of the unit.

*** END OF SECTION ***

SECTION 15400

PLUMBING

PART 1 - GENERAL

1.1 APPLICABLE PUBLICATIONS: 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.

1.1.1 Federal Specifications (Fed. Spec.):

L-P-387A	Plastic Sheet, Laminated, Thermosetting (For
& Am 2	Designation Plates)
W-H-196J	Heaters, Water, Electric and Gas Fired,
& Am 1	Residential
TT-P-645A	Primer, Paint, Zinc Chromate, Alkyd Type
WW-N-351C & Am 1	Nipples, Pipe, Threaded
WW-U-516B	Unions, Brass or Bronze, Threaded Pipe Connections, and Solder Joint Tube Connections
W-V-35B	Valve, Ball
& Am 1	
WW-V-51F	Valve, Angle, Check, and Globe, Bronze (125, 150 and 200 Pound) Threaded Ends, Flanged Ends, Solder Ends, and Brazed Ends, For Land Use
WW-V-54D	Valve, Gate, Bronze (125, 150 and 200 Pound,
& Am 3	Threaded Ends, Flanged Ends, Solder Ends, and
	Brazed Ends, For Land Use)
WW-V-58B	Valves, Gate, Cast-Iron; Threaded and Flanged (For Land Use)
WW-V-1967	Valve, Butterfly (Threaded Ends and Solder
& Am 1	Ends) Brass or Bronze

1.1.2 Military Specifications (Mil. Spec.):

MIL-T-12295E	Tanks, Potable Hot Water Storage
MIL-V-13612D	Valves, Relief, Pressure and Temperature (For Hot Water Supply Systems)
MIL-V-18436E	Valves, Check; Bronze, Cast-Iron, and Steel

	MIL-V-18634B	Valves; Safety, Relief, and Safety-Relief
	MIL-V-18826B	Valves, Globe and Angle, Cast-Iron
1.3	American Natio	nal Standards Institute (ANSI) Publications:
	A112.18.1M-79	Finished and Rough Brass Plumbing Fixture Fittings
	A112.19.1M-79	Enameled Cast Iron Plumbing Fixtures
	A112.19.2-73	Vitreous China Plumbing Fixtures
	A112.19.4-77	Porcelain Enameled Formed Steel Plumbing Fixtures
	A112.19.5-79	Trim for Water-Closet Bowls, Tanks, and Urinals
	A112.21.1M-80	Floor Drains
	A112.21.2-71	Roof Drains
	A112.26.1-69 (R75)	Water Hammer Arresters
	A112.36.2-75	Metallic Cleanouts
	B16.1-75	Cast-Iron Pipe Flanges and Flanged Fittings
	B16.3-77	Malleable-Iron Threaded Fittings
	B16.12-80	Cast-Iron Threaded Drainage Fittings
	B16.18-78	Cast Copper Alloy Solder Joint Pressure Fittings
	B16.22-80	Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
	B16.24-79	Bronze Pipe Flanges and Flanged Fittings
	B16.39-77	Malleable-Iron Threaded Pipe Unions
	Z124.2-80	Plastic Shower Receptors and Shower Stalls

1.1.4 American Society for Testing and Materials (ASTM) Publications:

A	47-77	Malleable-Iron Castings
A	53-80	Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless

A 74-81	Cast-Iron Soil Pipe and Fittings
A 120-80	Pipe, Steel, Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless for Ordinary Uses
A 183-80	Carbon Steel Track Bolts and Nuts
B 32-76	Solder Metal
B 61-80	Steam or Valve Bronze Castings
B 62-80	Composition Bronze or Ounce Metal Castings
В 88-81	Seamless Copper Water Tube
C 564-70 (R76)	Rubber Gaskets for Cast-Iron Soil Pipe and Fittings
D 2661-78	Acrylonitrile-Butadiene-Styrene (ABS) Plastic Drain, Waste, and Vent Pipe and Fittings
American Socie	ty of Sanitary Engineers (ASSE) Publication:
1010-67	Water Hammer Arresters
Cast-Iron Soil	Pipe Institute (CISPI) Publications:
301-78	Cast-Iron Soil Pipe and Fittings for Hubless

310-78 Patented Joint for Use in Connection with Hubless Cast-Iron Sanitary System

Cast-Iron Sanitary System

1.1.7 Manufacturers Standardization Society of the Valve and Fittings Industry (MSS) Publications:

1.1.5

1.1.6

SP-58-75

Pipe Hangers and Supports - Materials, design and Manufacture

SP-69-76

Pipe Hangers and Supports - Selection and Application

1.1.8 Plumbing and Drainage Institute (PDI) Publication:

WH201-77 Water Hammer Arrestors

1.1.9 Southern Building Code Congress International (SBCC) Publication:

1982 Standard Plumbing Code

- 1.2 GENERAL REQUIREMENTS: Section 15011, "Mechanical General Requirements," applies to this section, with the additions and modifications specified herein.
- 1.3 DESCRIPTION OF WORK: The work includes providing new plumbing systems and related work. Provide each system complete and ready for operation. Plumbing systems including fixtures, equipment, materials, installation, and workmanship shall be in accordance with the SBCC Standard Plumbing Code, except as modified herein. In the Plumbing Code referred to herein, the advisory provisions shall be considered to be mandatory, as though the word "shall" had been substituted for the word "should" wherever it appears; reference to the "authority having jurisdiction", the Administrative Authority, the Plumbing Official, and the Design Engineer shall be interpreted to mean the Contracting Officer. Capacity of equipment shall be not less than that indicated. Plumbing systems shall include all domestic hot and cold potable water piping, and domestic sanitary sewer piping beginning at a point one foot above finished floor slabs within buildings. Other piping systems are specified under Section 02713, "Exterior Water Distribution System," Section 02722. "Exterior Sanitary Sewer System", and Section 15271, "In-Plant Piping and Accessories".

1.4 SUBMITTALS:

1.4.1 Manufacturer's Data:

- a. Pipe and fittings
- b. Valves
- c. Plumbing fixtures
- d. Water heaters
- e. Pipe supports (hangers)
- f. Drains
- g. Water hammer arrestors

1.4.2 Certificates of Compliance:

- a. Pipe and fittings
- b. Valves

1.4.3 Certified Data:

- a. Water heaters
- 1.4.4 Operation and Maintenance Manuals:
 - a. Water heaters
- 1.4.5 Posted Operating Instructions:
 - a. Water heaters
- 1.5 EXCAVATION, TRENCHING, AND BACKFILLING: Provide under this section as specified in Section 02200, "Earthwork".

- 1.6 INSULATION: Insulate equipment and piping under this section as specified in Section 15250, "Insulation for Mechanical Systems".
- 1.7 FIELD PAINTING: Provide under Section 09910, "Painting of Buildings (Field Painting)".
- 1.8 FLASHING: Provide under Section 07600, "Flashing and Sheet Metal".

PART 2 - PRODUCTS

- 2.1 DWV (DRAIN, WASTE, AND VENT) PIPING: Fittings shall be long radius fittings, except fittings in vent piping may be short radius fittings. Minimum size piping shall be 2 inches for buried piping and 1.5 inches for aboveground piping.
- 2.1.1 Buried Piping: Buried piping includes piping up to but not more than 6 inches above ground or floor slab on grade.
- 2.1.1.1 Cast-Iron Hubless Pipe and Fittings: CISPI 301 with CISPI 310 coupling joints.
- 2.1.1.2 Cast-Iron Hub and Spigot Pipe and Fittings: ASTM A 74 with ASTM C 564 rubber compression gasket joints, or calked and leaded joints.
 - 2.1.1.3 Plastic Pipe, Fittings, and Solvent Cement:
- 2.1.1.3.1 Acrylonitrile-Butadiene-Styrene (ABS) System: ASTM D 2661.
 - 2.1.2 Aboveground Piping:
- 2.1.2.1 Cast-Iron Hubless Pipe and Fittings: CISPI 301 with CISPI 310 coupling joints.
- 2.1.2.2 Cast-Iron Hub and Spigot Pipe and Fittings: ASTM A 74 with ASTM C 564 rubber compression gasket joints, or calked and leaded joints.
 - 2.1.2.3 Plastic Pipe, Fittings, and Solvent Cement:
 - 2.1.2.3.1 Polyvinyl Chloride (PVC) System: ASTM D 2665.
- 2.1.2.3.2 Acrylonitrile-Butadiene-Styrene (ABS) System: ASTM D 2661.
- 2.1.2.4 Copper Tubing: ASTM B 306, with ANSI B16.23, ANSI B16.29, or ANSI B16.32 solder joint fittings using ASTM B 32, 50-50 tin-lead solder.
- 2.1.2.5 Steel Pipe: ASTM A 53 or ASTM A 120, Schedule 40, zinc-coated, threaded end connections; with ANSI B16.12 zinc-coated threaded fitgtings.

- 2.1.2.6 Grooved-End Steel Piping for Roof Drainage Only: ASTM A 53 or ASTM A 120, Schedule 40, zinc-coated, cut grooved-end steel pipe; ASTM A 47 or ASTM A 536, zinc-coated, grooved-end fittings, and mechanical couplings; ASTM A 183 coupling nuts and bolts; ASTM D 2000 rubber gaskets for water service. Fittings, mechanical couplings, and rubber gaskets shall be supplied by the same manufacturer.
- 2.1.3 Cleanouts: ANSI A112.36.2; provide threaded bronze or thermoplastic cleanout plugs.
- 2.1.3.1 Floor Cleanouts: Provide cast-iron floor cleanout with flange, polished bronze or nickel bronze rim and scoriated floor plate with CO cast in the plate. Secure floor plate with countersunk screws for installation flush with finished floor.
- 2.1.3.2 Wall Cleanouts: Provide polished stainless steel or chromium plated bronze cover plate and secure to cleanout plug with countersunk screw.
- 2.1.3.3 Cleanouts Exterior to Buildings: Provide cast-iron cleanouts and countersunk plugs. Provide 24- by 24- by 4-inch thick concrete slab with top one inch above grade with cleanout located in center of slab. Provide cast-iron cleanout box with cover.
- 2.1.4 Drains: ANSI A112.21.1M; provide cast iron drains and clamping rings for use with membrane waterproofing.
- 2.1.4.1 Flush Strainer Floor Drains: Provide with double drainage flange, perforated or slotted cast bronze or nickel bronze strainer, adjustable collar, and P-trap. Drains of sizes 2, 3, and 4 inches shall have strainers with minimum free drainage area of 5, 11, and 18 square inches, respectively.
- 2.1.4.2 Roof Drains: ANSI A112.21.2; provide zinc-coated cast-iron drains, with minimum of 10-inch diameter body, non-puncturing flashing clamp device with integral gravel stop and deck clamp, and removable cast-iron or polypropylene locking dome. Free area of dome shall be not less than two times the free area of drain outlet. Provide drain flashing ring seat flush with adjacent roof deck, and secure rigidly in place with deck clamp.
 - 2.2 DOMESTIC WATER PIPING:
 - 2.2.1 Buried Piping and Aboveground Piping:
- 2.2.1.1 Copper Tubing: ASTM B 88, Type K, with ANSI B16.18 or ANSI B16.22 solder joint fittings using ASTM B 32, 50-50 tin-lead solder; or with ANSI B16.26 flared joint fittings. ASTM B 88, Type L, may be provided for aboveground piping.
- 2.2.2 Water Valves: Provide valves suitable for minimum of 125 psig and minimum of 180 degrees F hot water. Valves shall have threaded end connections with a union on all but one side of the valve or solder end

connections for connections between bronze valves and copper tubing. Copper alloy and bronze valve body shall be ASTM B 61 or ASTM B 62 copper alloy. Ball valves and butterfly valves may be provided in lieu of gate valves.

- 2.2.2.1 Gate Valves: Fed. Spec. WW-V-54, Class 125.
- 2.2.2.2 Globe and Angle Valves: Fed. Spec. WW-V-51, Class 125.
- 2.2.2.3 Check Valves: Fed. Spec. WW-V-51, Class 125, swing check.
- 2.2.2.4 Butterfly Valves: Fed. Spec. WW-V-1967, Type B. Valves shall have two-position lever handles.
- 2.2.2.5 Ball Valves: Fed. Spec. WW-V-35, full port design, copper alloy. Valves shall have two-position lever handles.
- 2.2.2.6 Hose Bibbs: Provide angle type copper alloy globe valve with lockshield and handwheel. Inlet shall have internal threads. Outlet shall have vacuum breaker with 0.75-inch external hose threads.
- 2.2.2.7 Non-Freeze Wall Hydrant: Provide copper alloy valve with lockshield and handwheel. Inlet shall have external threads. Outlet shall have automatic draining vacuum breaker with 0.75-inch external hose threads. Hydrant shall be of sufficient length to extend through walls and place the valve seat inside the building or in the crawl space. Bonnet and valve stem shall be removable from outside of the building.
- 2.2.2.8 Combination Pressure and Temperature Relief Valves: Mil. Spec. MIL-V-13612 with test lever.
- 2.2.3 Dielectric Connections: Provide at connections between copper and ferrous metal piping materials. ASTM F 441, Schedule 80, CPVC threaded pipe nipples, 4-inch minimum length, may be provided for dielectric connections in pipe sizes 2 inches and smaller.
- 2.2.4 Water Hammer Arresters: PDI WH201, ANSI A112.26.1, or ASSE 1010.
- 2.2.5 Flow Control Devices: Provide non-adjustable flow control device to limit the maximum water flow to 3.5 gpm at supply pressure of 40 psig in each supply to lavatory faucets and at each shower head.
 - 2.3 MISCELLANEOUS PIPING MATERIALS:
- 2.3.1 Pipe Nipples: Fed. Spec. WW-N-351, copper alloy for use in copper tubing and zinc-coated Schedule 80 steel pipe for use in steel piping.
- 2.3.2 Unions: Fed. Spec. WW-U-516 for use in copper tubing; ANSI B16.39 zinc-coated steel for use in steel piping.

- 2.3.3 Escutcheon Plates: Provide one piece or split hinge type metal plates for piping passing through floors, walls, and ceilings in exposed spaces. Provide chromium-plated finish on plates in finished spaces. Provide paint finish on plates in unfinished spaces. Securely anchor plates in place with set screws or other approved positive means.
- 2.3.4 Pipe Sleeves: Provide where piping passes through walls, floors, roofs, and partitions. Secure sleeves in proper position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, floors, roofs, and partitions. Provide not less than 0.25-inch space between exterior of piping or pipe insulation and interior of sleeve. Firmly pack space with insulation and calk at both ends of the sleeve with plastic waterproof cement which will dry to a firm but pliable mass, or provide a segmented elastomeric seal.
- 2.3.4.1 Sleeves in Masonry and Concrete Walls, Floors, Roofs: Provide ASTM A 53 or ASTM A 120, Schedule 40 or Standard Weight, zinc-coated steel pipe sleeves. Extend sleeves in floor slabs 3 inches above the finished floor, except sleeves are not required where DWV piping passes through concrete floor slabs located on grade.
- 2.3.4.2 Sleeves in Partitions and Other Than Masonry and Concrete Walls, Floors, and Roofs: Provide zinc-coated steel sheet having a nominal weight of not less than 0.90 pounds per square foot.
- 2.3.5 Pipe Supports (Hangers): Provide MSS SP-58 and MSS SP-69, Type 1 or 6, of the adjustable type, except as indicated or specified herein. Provide Type 40 insulation protection shields for insulated piping. Provide steel support rods. Provide non-metallic, hair felt, or plastic piping isolators between copper tubing and the hangers. Provide flat wide band hangers for uninsulated plastic piping.
- 2.3.6 Access Panels: Provide factory prefabricated and primed steel access panels including 16-gage steel frame with a hinged or snap-on 14-gage steel cover with spring-catch or turn-latch. Provide panel with factory-primed rust-inhibitive paint. The wide-leg or flange of the frame section shall be perforated or shall extend into expanded metal wings to provide a key for plaster. Size and furnish panels under this section to provide proper access to concealed valves and control devices; install panels under the appropriate section of this specification.
- 2.4 FIXTURES, FITTINGS, ACCESSORIES, AND SUPPLIES: Provide controlstop valves in each supply to each fixture. The finish of fittings, accessories, and supplies exposed to view shall be chromium-plated. Centerset faucets shall be top-mounted with inlets of not greater than 4-inch centers. Zinc-alloy or plastic handles will not be permitted for faucets and valves.
- 2.4.1 Tank Type Water Closets (P-1): ANSI A112.19.2, white vitreous china, water conservation type, floor-mounted, floor outlet, siphon jet, elongated bowl, black solid plastic elongated open-front seat, and ANSI A112.19.5 trim. Non-float swing type flush valves are not acceptable. The water flushing volume shall not exceed 4 gallons per flush.

- 2.4.2 Lavatories (P-2): ANSI A112.19.1M, white enameled cast-iron, integral back splash, straight back type, minimum dimensions of 19 inches wide by 16 inches front to rear. Provide ANSI A112.18.1M copper alloy, centerset faucets with aerator, perforated grid strainers, and 1.5-inch adjustable P-traps. Provide ANSI A112.6.1M concealed wall hangers with thru-bolts and back plates for mounting.
- 2.4.3 Shower Supply Fittings (P-3): ANSI A112.18.1M, ball joint, self-cleaning (adjustable spray pattern) shower heads with flow control devices, connected to concealed pipe connected to copper alloy single lever type mixing valves with front access integral screw driver stops. Anchor the mixing valves and the pipe to each shower head in wall to prevent movement.
- 2.4.4 Plastic Shower Stall Units (P-4): ANSI Z124.2, white plastic receptor with three walls integrally molded in one piece or made in sections for field assembly. Provide brass body shower drains with chromium plated perforated grid strainers and 1.5-inch adjustable P-trap. Provide shower supply fittings as specified herein.
- 2.5 DOMESTIC WATER HEATERS: Fed. Spec. W-H-196, cement- or glass-lined steel tanks, high efficiency type insulated with polyurethane foam insulation, electric water heaters with double heating element, with adjustable range thermostat to allow hot water settings between 110 and 180 degrees F.

PART 3 - EXECUTION

- 3.1 INSTALLATION: Installation of plumbing systems including fixtures, equipment, materials, and workmanship shall be in accordance with the SBCC Standard Plumbing Code, except as modified herein. When fixtures require both hot water and cold water supplies, provide the hot water supply to the left of the cold water supply. Plastic piping shall not penetrate fire walls.
- 3.1.1 Threaded Connections: Jointing compound for pipe threads shall be polytetrafluoroethylene (PTFE) pipe thread tape, pipe cement and oil, or PTFE powder and oil; apply only on male threads. Provide exposed ferrous pipe threads with one coat of Fed. Spec. TT-P-645 primer applied to a minimum dry film thickness of one mil.
- 3.1.2 Pipe Supports (Hangers): Provide additional supports at the concentrated loads in piping between supports, such as for inline water pumps and flanged valves.
- 3.1.2.1 Piping to Receive Insulation: Provide temporary wood spacers between the insulation protection shield and the pipe in order to properly slope the piping and to establish final elevations. Temporary wood spacers shall be of the same thickness as the insulation to be provided under Section 15250, "Insulation for Mechanical Systems".

3.1.2.2 Maximum Spacing Between Supports:

- a. Vertical Piping: Support metal piping at each floor, but at not more than 10-foot intervals. Support plastic piping at each floor and at midpoint between floors, but at not more than 5-foot intervals.
- b. Horizontal Piping: Support cast-iron piping at 5-foot intervals, except for pipe exceeding 5-foot length, provide supports at intervals equal to the pipe length but not exceeding 10 feet. Support plastic piping at 4-foot intervals. Support steel piping and copper tubing as follows:

MAXIMUM SPACING (FEET)

Nominal Pipe Size (inches)		1.25	1.5	2	2.5	3	3.5	4	5	6
Steel Pipe	7	8	9	10	11	12	13	14	16	17
Copper Tube	6	7	8	8	9	10	11	12	13	14

- 3.2 NAMEPLATES: Provide laminated plastic nameplates for equipment, gages, thermometers, and valves; stop valves in supplies to fixtures will not require nameplates. Laminated plastic shall be 0.125 inch thick Melamine plastic conforming to Fed. Spec. L-P-387, black with white center core. Surface shall be a matte finish. All corners shall be square. Accurately align lettering and engrave into the white core. Minimum size of nameplates shall be one inch by 2.5 inches. Lettering shall be minimum of 0.25 inch high normal block lettering. Key the nameplates to a chart and schedule for each system. Frame charts and schedules under glass and place where directed near each system. Furnish two copies of each chart and schedule. Each inscription shall identify its function. Equipment nameplates shall show the following information:
 - a. Manufacturer, type, and model number
 - b. Contract number and accepted date
 - c. Capacity or size
 - d. System in which installed
 - e. System which it controls
- 3.3 DISINFECTION: Disinfect the new water piping in accordance with AWWA C601. Fill the piping systems with solution containing minimum of 50 parts per million of available chlorine and allow solution to stand for minimum of 24 hours. Flush the solution from the systems with clean water until maximum residual chlorine content is not greater than 0.2 parts per million.
- 3.4 FIELD TESTING: Before final acceptance of the work, test each system as in service to demonstrate compliance with the contract requirements. Perform the following tests in addition to the tests specified in the SBCC Standard Plumbing Code, except as modified herein. Correct all defects in the work provided by the Contractor, and repeat the tests until

the work is in compliance with contract requirements. Furnish water, electricity, instruments, connecting devices, and personnel for the tests.

- 3.4.1 Domestic Water Piping: Before insulation is applied, hydrostatically test each piping system at not less than 100 psig with no leakage or reduction in gage pressure for 2 hours.
- 3.4.2 DWV Piping: Before the installation of fixtures, cap the ends of each system, fill the piping with water to the roof, and allow to stand until a thorough inspection has been made. After the plumbing fixtures have been set and their traps filled with water, subject the entire sanitary system to a final air pressure test of not more than one inch of water column and a smoke or peppermint test. Perform the air and smoke test with an approved smoke testing machine which must show a clear passage of smoke and air throughout the entire system. The entire system must be proven absolutely tight under such test.

*** END OF SECTION ***

SECTION 15411

COMPRESSED AIR SYSTEMS (NON-BREATHING AIR TYPE)

- 1. APPLICABLE PUBLICATIONS: 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.
 - 1.1 Federal Specifications (Fed. Spec.):

GG-G-76E & Am 1	Gages, Pressure and Vacuum, Dial Indicating (For Air, Steam, Oil, Water, Ammonia, and Chlorofluoro Hydro-Carbon Gases)
QQ-B-654A	Brazing, Alloys, Silver
WW-H-171F	Hangers and Supports, Pipe
WW-T-696F	Traps, Steam and Air
WW-V-51F	Valves, Bronze; Angle, Check and Globe, 125, 150 and 200 Pound, Screwed and Flanged (For Land Use)
WW-V-54D(3)	Valve, Gate, Bronze (125, 150 and 200 Pound, Screwed, Flanged, Solder-End, For Land Use)

1.2 Military Specifications (Mil Spec.):

MIL-S-16293G	Strainers, Sediment, Pipeline, Water, Air, Gas, Oil, or Steam
MIL-C-17596E	Compressors, Reciprocating or Rotary, Power Driven (EMD), Air, Base Mounted, 10 HP to 300 HP
MIL-V-18634B	Valve, Safety, Relief, and Safety-Relief
MIL-T-27730A	Tape, Antiseize, Tetrafluoroethylene, with Dispenser

1.3 American National Standards Institute (ANSI) Publications:

B16.18-78	Cast Bronze Solder-Joint Pressure Fittings
B16.22-81	Wrought Copper and Bronze Solder-Joint Pressure Fittings
B31.1-80	Power Piping
Z49.1-73	Safety in Welding and Cutting

- 1.4 American Society for Testing and Materials (ASTM) Publication:
 B88-81 Seamless Copper Water Tube
- 1.5 Occupational Safety and Health Act (OSHA) Standard:
 29 CFR 1910.219 Mechanical Power-Transmission Apparatus
- 2. GENERAL REQUIREMENTS: Section 15011, "General Requirements, Mechanical," applies to this section except as specified otherwise. Coordinate with Section 11240, "Water Filters and Controls" and Section 15272, "Piping Systems and Accessories".
 - 2.1 Safety Precautions:
- 2.1.1 Compressed Air Piping: Compressed air piping shall meet the requirements of ANSI B31.1.
- 2.1.2 Rotating Equipment: Fully guard couplings, motor shafts, gears and other exposed rotating or rapidly moving parts in accordance with OSHA 29 CFR 1910.219. Provide rigid and suitably secured guard parts readily removable without disassembling guarded unit.
- 2.1.3 Welding: Safety in welding and cutting of pipe shall conform to ANSI Z49.1.
- 2.2 Certified Test Reports: Submit certified test reports for the following: air compressor and compressed air dryer.
 - 2.3 Shop Drawings: Submit shop drawings for compressed air system.
 - 3. MATERIALS AND EQUIPMENT:
 - 3.1 Low Presure Air Compressor, Up to 125 psig System:
- 3.1.1 Conform to Mil. Spec. MIL-C-17596, Type I, except as specified or indicated otherwise. Provide V-belt driven, one or two stage, single-acting, air-cooled compressor completely wired and piped with inlet filter, compressor, motor, starter, control, mounted on a sturdy steel base. Capacity and motor horsepower not less than that indicated. Each compressor shall be capable of operating continuously against a discharge pressure of 125 psig at full capacity. Automatic controls shall function to maintain not less than 75 psig air pressure in receiver.
- 3.1.2 Regulate compressor by dual control. Dual system shall consist of a combination of constant speed control and an automatic start—and—stop control by automatic or manual selector switch.
- 3.1.2.1 Start-and-Stop Control: When set for start-and-stop control, motor shall stop automatically when discharge pressure reaches maximum pressure setting and start automatically when discharge pressure

falls to minimum setting. Cylinders shall unload during periods of motor shutdown.

- 3.1.2.2 Constant Speed Control: Compressor shall operate continuously at constant speed. Provide means to automatically load and unload compressor at preset minimum and maximum pressure settings respectively. Provide means for automatic release of pressure within cylinders when the unit is operating without load. Also provide means for manual or automatic unloading of cylinders during starting of unit. Equip compressor with a timed control to stop compressor after a 10-minute unloaded period if air is not used.
- 3.1.3 Provide filter-silencers on the air intake to each compressor as recommended by compressor manufacturer. Provide dry type unit suitable for use with each compressor unit herein described. Unit shall include a filter section and silencer section. Construct filter section of a pleated filter paper with protective stainless steel cloth on both sides. Furnish one extra filter for each compressor.
- 3.1.4 Provide receivers to conform to Mil. Spec. MIL-C-17596. Construct receivers in accordance with ASME Boiler and Pressure Vessel Code, Section VIII, Pressure Vessels, for working pressures indicated and maximum temperature of 450 degrees F. Each air receiver shall have supporting legs, drain valve, safety valve, pressure gages, and shut-off valve. Provide certification of factory test.
- 3.2 Low Pressure Compressed Air Dryers: Supply low pressure, non-cycling, refrigerated-type compressed air dryers, consisting of a mechanical refrigeration system equipped with a hot gas bypass feature to maintain a constant level dew point, an air-to-air heat exchanger to precool the inlet air using the cooled outlet air, an air-to-refrigerant gas heat exchanger to dry the air, and a suction line heat exchanger to prevent any liquid refrigerant from entering the compressor and causing failure. A thermal mass type chamber to dry the air is not acceptable. Dryer air circuit shall have no internal traps or filters and shall have large internal air passages to minimize pressure drop. Design parameters shall be as follows:

Capacity: 127 ACFM (Minimum)
Entering Air Temperature: 110° F
Ambient Air Temperature: 110° F
Working Pressure: 125 PSIG
Pressure Dew Point: 35° F
Approach: 2 to 3° F

3.2.1 Air circuit shall include:

a. An air-to-air heat exchanger designed to reduce cooling load at design conditions by cooling the inlet air utilizing the outlet air as the cooling medium.

- b. An air-to-refrigerant gas heat exchanger, tube-in-tube type, single-pass, 2 to 3°F approach.
- c. A mechanical moisture separator fabricated in accordance with ANSI B31.1; code stamp not required; in air line downstream of air-to-refrigerant gas heat exchanger to prevent moisture carryover.
- d. An exterior-mounted automatic drain trap, ball float type, for elimination of moisture.
 - e. A dryer capable of operating at 125 PSIG working pressure.
 - 3.2.2 Refrigeration system shall include:
- a. Refrigeration compressor, hermetic or semi-hermetic reciprocating type with built-in motor; standard components include inherent motor protection, crankcase oil strainer, and suction screen.
- b. A hot gas bypass valve in conjunction with an expansion valve to provide continuous, non-cycling operation of the dryer from 0 to 100 percent capacity.
 - c. A refrigerant dryer and liquid expansion tank.
 - d. An air-cooled condenser and condenser fan with motor.
- 3.2.3 Instrumentation and Control: Control panel in dryer cabinet shall include:
- a. Indicators for the following services: Discharge air pressure gage, inlet air temperature gage, refrigeration compressor suction pressure gage, and compressor on/run light.
- b. Electrical relays located in an enclosed portion of the panel, accessible for ease of servicing.
 - c. Controls to maintain required compressed air dew point.
- 3.2.4 Provide internal tubing, wiring, and piping complete, such that only connections to air inlet and outlet, to refrigerant compressor contactor, and to moisture drain are necessary.
- 3.3 Low Pressure Compressed Air Piping and Accessories (125 psig): Conform to the following.
- 3.3.1 Low Pressure Compressed Air Piping: Piping shall be one or both of the following materials:
- a. Piping and Fittings: Type "L" copper tubing, hard drawn, Class 1, conforming to ASTM B88, with wrought copper or cast bronze

fittings and silver brazed joints conforming to ANSI B16.18 and B16.22. Silver solder shall conform to Fed. Spec. QQ-B-654, Class III.

- 3.3.2 Compressed Air Piping Valves: 150-pound class bronze gate valves conforming to Fed. Spec. WW-V-54, Type II, Class B, or globe valves conforming to Fed. Spec. WW-V-51. Check valves: lift or swing type conforming to Fed. Spec. WW-V-51.
- 3.3.3 Pressure gages low pressure shall conform to Fed. Spec. GG-G-76, Class 1, Style X, Type I, with steel or brass case, and non-shatterable safety glass, and a pressure blowout back to prevent glass from flying out in case of an explosion. Gages shall have a 3-1/2-inch minimum diameter dial and a dial range of approximately twice working pressure.
- 3.3.4 Provide pressure reducing valves, spring loaded type, with nominal pressure rating of not less than inlet system pressure indicated. Provide pressure reducing valves capable of being adjusted to specified flow and pressure, and suitable for intended service.
- 3.3.5 Provide pipe hangers and supports conforming to Fed. Spec. WW-H-171, except as specified or indicated otherwise. Furnish zinc or cadmium plated pipe hangers and supports except for copper plated piping. Provide tubing supports of U-shaped steel bolts and nuts firmly secured to adequately support structures such as walls, columns, floors, or brackets. Clips shall fit closely around piping but shall have sufficient clearance to permit longitudinal movement of piping during normal expansion and contraction. Provide supports at valves, fittings, branch lines, outlets, changes in direction, equipment, and accessories.
- 3.3.6 Relief Valves: Bronze conforming to Mil. Spec. MIL-V-18634, Class 4 (for unfired pressure vessels), Style A (threaded connections).
- 3.3.7 Quick Disconnect Couplings: All brass and suitable for a working pressure of not less than indicated system pressure. Female side of coupling (fixed end) shall have male thread connection with automatic shutoff. Provide male side of coupling with hose stem and ball check to bleed pressure from hose and prevent hose whipping.
- 3.3.8 Use single cartridge type filters designed for 125 psig operating pressure and filter housing of brass or bronze. Provide cellulose cartridge filters of graded density construction capable of removing liquids and solids of 5 microns and larger. Filter capacity shall be compatible with rated flow of equipment or pressure reducing valves provided.
- 3.3.9 Strainers for Low Pressure Compressed Air Service: Bronze body, conforming to Mil. Spec. MIL-S-16293, Class 125, Style Y, Type II, simplex type, with 20-mesh Monel or stainless steel screen.

- 3.3.10 Provide traps for low pressure systems to conform to Fed. Spec. WW-T-696 and to drain water and other liquids from system. Type of traps as indicated, and rated working pressure not less than system operating pressure.
- 3.3.11 Flexible Connections: Vibration isolation, wire braid reinforced corrugated metal hose type, line-sized, with bronze end connections, suitable for pressure indicated. Length as recommended by manufacturer but not less than 18 inches.
- 3.3.12 Tetrafluoroethylene tape for screw-jointed pipe shall conform to Mil. Spec. MIL-T-27730.

4. INSTALLATION:

- 4.1 General Requirements, Installation: Work material and equipment into a complete, convenient, and economical system or systems; and provide apparatus, parts, materials and accessories which are necessary to accomplish this result. Piping shall follow general arrangement shown, cut accurately to measurements established for work by the Contractor, and work into place without springing or forcing. Install piping and equipment within buildings entirely out of the way of lighting fixtures and doors, windows and other openings. Run overhead piping in buildings in the most inconspicuous positions. Make provision for expansion and contraction of pipelines. Install in accordance with the best method of practice. Do not conceal piping until it has been inspected, tested, and approved. Protect materials and equipment from the weather.
- 4.2 Drainage and Flexibility: Compressed air piping shall be free of unnecessary pockets and pitched approximately 3 inches per 100 feet in the direction of flow to low points. Where pipes must be sloped so that condensate flows in opposite direction to air flow, slope 6 inches per 100 feet or greater. Provide flexibility by use of fittings, loops, and offsets in piping. Install branches at top of a main to prevent carryover of condensate and foreign matter.
- 4.3 Foundations for Equipment: Provide foundations for equipment conforming to recommendation of the manufacturer of equipment unless specified otherwise in project specifications. Provide anchor bolts of ample length with plates on bottom ends, and set by using accurately constructed templates. Level equipment on foundations by means of jacks or steel wedges. Fill spaces between equipment bases and concrete foundations solid with cement mortar.
- 4.4 Cleaning: Before assembly and installation, clean piping, fittings, valves, unions and other components of the systems of dirt, oil and other contaminants.
- 4.5 Anchoring, Guiding, and Supporting Piping: Anchor and support piping in a manner such that expansion and contraction will take place in direction desired and prevent vibration by use of vibration dampeners and

prevent undue strains on equipment served. Fabricate hangers used for support of piping 2-inch nominal pipe size and larger to permit adequate adjustment after erection while still supporting load. Use wall brackets where pipes are adjacent to walls or other vertical surfaces which may be used for supports. Furnish and install supports to adequately carry weight of lines. Provide inserts and sleeves in concrete where necessary. Design and fabrication of hanger, supports, and anchors shall conform to ANSI B31.1. Space pipe supports at intervals not greater than the following:

Nominal	Pipe	Size -	Inches	Maximum	Span-FT
		3/8			4
		1/2			5
		3/4			6.
		1			7

Note: Support annealed tubing at closer intervals to prevent sagging.

- 4.6 Screw-jointed Pipe: Cut screw-jointed pipe accurately and work into place without springing or forcing. Ream pipe ends and free pipe and fittings from burrs. Make screw joints with tetrafluoroethylene tape applied to male thread only.
- 4.7 Welding and Brazing: Qualified welders and brazers shall weld and braze joints in piping. Qualifications for welding and brazing procedures, welders, brazers, and welding operators shall be in accordance with ANSI B31.1. Contractor shall furnish six copies of qualifications to the Contracting Officer for approval.
- 4.7.1 Equipment and Protection: Protect welders and brazers from the light of the arc or flame by approved goggles, shields, helmet, and gloves. Ventilate closed spaces properly when welding or brazing is being done therein. Take care to avoid risk of fire.
- 4.7.2 Surfaces to be welded shall be free from loose scale, slag, rust, paint, oil, and other foreign material. Joint surfaces shall be smooth and free from defects which might affect proper welding. Clean each layer of weld metal thoroughly by wire brushing, grinding or chipping prior to inspection or deposition of additional weld metal.
- 4.7.3 Surface of finished welds shall have a bright metallic luster after cleaning, fairly smooth with regular, even ripples, and uniform in contour. Except as necessary to correct defects, do not dress, smooth, or finish surfaces for improving their appearance. Provide sound welds throughout and fuse thoroughly. Free inside of pipe from globules of weld metal which would restrict pipe area or might become loose. Visual examination of welds and acceptance standards shall be in accordance with ANSI B31.1.

4.7.4 Prepare brazed joints in accordance with a qualified and approved brazing procedure. Defective joints may be repaired. However, no more than two attempts to repair by reheating and additional face feeding of brazing filler metal will be permitted, after which defective joint shall be unsweated, reprepared as a new joint, inspected for defects on pipe and fittings, and rebrazed.

5. TESTING:

- 5.1 General Requirements, Testing: Contractor shall furnish equipment and apparatus necessary for tests. Make tests under the direction and subject to approval of the Contracting Officer. The Government will furnish water and electric current for tests in accordance with the General Provisions. Qualified personnel shall test high pressure air systems. Pressurize each piping system individually and check to assure that there are no cross-connections between different systems prior to operational tests.
- 5.2 Factory Tests: Test air compressors and compressed air dryers at the factory to assure proper operation. Contractor shall certify satisfactory accomplishment of tests.
 - 5.3 Hydrostatic and Leak Tightness Tests:
- 5.3.1 After installation, hydrostatically test piping systems for 30 minutes with water at one and one-half times design working pressure. Remove or isolate from the system compressor, air dryers, filters, instruments, and equipment which would be damaged by water during hydrostatic tests and reinstall after successful completion of tests.
- 5.3.2 After satisfactory completion of hydrostatic pressure test, blow systems dry with clean, oil-free compressed air and test with clean, dry air at design working pressure. Brush joints with soapy water solution to check for leaks. Install a calibrated test pressure gage in piping system to observe any loss in pressure. Calibrate the test pressure gage with a dead weight tester and certify by initial and date on dial before using. Maintain required test pressure for a sufficient length of time to enable an inspection of joints and connections.
- 5.4 Operational Tests: Test equipment as in service to determine compliance with contract requirements and warranty. During the tests, test equipment under every condition of operation. Test safety controls to demonstrate performance of their required function. Completely test system for compliance with specifications.

*** END OF SECTION ***

SECTION 15649

DIESEL ENGINE

- 1. APPLICABLE PUBLICATIONS: The publications listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent indicated by the references thereto:
 - 1.1 Federal Specifications:

L-P-387A & Am 1	Plastic Sheet, Laminated, Thermosetting
GG-G-76E	Gages, Pressure and Vacuum, Dial Indicating
HH-1-523C	Insulation Blocks and Pipe Covering, Thermal (Calcium Silicate)
HH-P-46E	Packing; Asbestos, Sheet, Compressed
QQ-S-698 & Am 3	Steel, Sheet and Strip, Low Carbon

1.2 Military Specifications:

MIL-F-16884G Fuel Oil, Diesel, Marine

1.3 American National Standards Institute (ANSI):

816.3-//	Pounds
B16.5-77	Steel Pipe Flanges and Flanged Fittings
B16.9-78	Wrought Steel Butt-Welding Fittings
B16.11-73	Forged Steel Fittings, Socket-Welding and Threaded
B31.1-80	Power Piping
S1.4-71	Sound Level Meters

1.4 American Welding Society (AWS):

D1.1-80 Structural Welding Code, Steel

1.5 American Society for Testing and Materials (ASTM):

A36-77 Structural Steel

A53-82 Welded and Seamless Steel Pipe

A120-82 Black and Hot Dipped Zinc-Coated (Galvanized)

Welded and Seamless Steel Pipe

A576-79 Steel Bars, Carbon, Hot-Rolled, Special Quality

D975-75 Diesel Fuel Oils

1.6 American Society of Mechanical Engineers (ASME):

PTC 26-62 Speed-Governing Systems for Internal Combustion Engine-Generator Units

1.7 Institute of Electrical and Electronic Engineers (IEEE):

126-1959 Recommended Specification for Speed Governing of Internal Combustion Engine-Generator Units

1.8 National Fire Protection Association (NFPA):

30-77 Flammable and Combustible Liquids Code

37-75 Stationary Combustion Engines and Gas Turbines

70-81 National Electrical Code

1.9 Society of Automotive Engineers (SAE):

J 726C-79 Air Cleaner Test Code

- GENERAL REQUIREMENTS: Section 16011, "General Requirements, Electrical", with the following additions and modifications, applies.
- 2.1 Description of Work: The work includes providing a new diesel engine at the new well site to be used as standby operation of new well pump in case of power failure, and related work. The engine shall be complete and ready for operation. Equipment, materials, installation, and workmanship shall be in accordance with applicable requirements of NFPA 30, 37, and 70, except as specified or indicated otherwise. In the NFPA standards referred to herein, the advisory provisions shall be considered to be mandatory, as though the word "shall" had been substituted for "should" wherever it appears; reference to the "authority having jurisdiction" shall be interpreted to mean the Contracting Officer. Coordinate with Section 11210, "Water Pumps".
- 2.2 Submittals Require: The submittal requirements of Section 16011, "General Requirements, Electrical" apply to the following lists.
 - 2.2.1 Manufacturer's Data:
 - a. Diesel Engine
 - b. Engine Muffler

- c. Insulation
- 2.2.2 Shop Drawings and Calculations: Pertaining to the diesel engine and auxiliary equipment.
 - a. Certified outline, general arrangement (setting plan), and anchor bolt detail drawings. Drawings shall show the total weight and center of gravity of the diesel engine.
 - b. General arrangement drawings showing location of engine in respect to the well house and connection to right angle gear drive.
 - c. Battery size and cranking time calculations.
 - d. BMEP calculations.

2.2.3 Certified Test Reports:

- a. Diesel Engine Shop Test
- 2.2.4 Operation and Maintenance Manual: Within 60 days after all shop drawings have been approved, a complete set of operation and maintenance instructions shall be submitted for approval.
 - 3. DIESEL ENGINE AND ACCESSORIES:
- 3.1 Engine: Engine shall be 4-cycle, vertical in-line or vertical "v" type. The engine shall be designed and constructed so as to eliminate undue heating, vibration, and wear. The engine shall be capable of burning diesel fuel oil conforming to ASTM D975 Grade No. 2-D and marine diesel fuel oil conforming to MIL-F-16884.
- 3.1.1 Rating: The new diesel engine shall have a continuous output shaft brake horsepower (BHP) rating of 37 at 2200 RPM. The engine BHP rating shall be acceptable only if the following limiting engine operation parameters are not exceeded to obtain this rating:

Maximum brake mean effective pressure, pounds per square inch: 150 at 1750

Maximum engine speed, revolutions per minute: 2500 RPM

The output shaft brake horsepower rating of each diesel engine shall be based upon consumption of diesel fuel oil, conforming to ASTM D975, Grade No. 2-D, at conditions of elevation of mean sea level and an atmospheric dry bulb temperature of 85 degrees F. with engine cooled by a liquid mixture of 50 percent of volume of ethylene glycol and 50 percent by volume of water in the radiator system specified.

3.1.2 Duty: Each diesel engine shall have a continuous (prime) duty rating in that it shall be capable of operating continuously at the rated

output shaft brake horsepower for a run of at least 2000 hours without interruption.

- 3.1.3 Nonoperating Protection: When the diesel engine is not operating, it shall be protected so as not to be damaged by ambient temperatures of 125 to 50 degrees Fahrenheit within the engine rooms.
- 3.1.4 Air Pollution Control: Each set shall comply with all Federal Regulations governing the control of air pollution, as applicable on the date of manufacture.
- 3.1.5 Combustion Air Filters: Each engine shall have oil bath or dry type air cleaners of adequate capacity to remove dust and abrasives from the engine combustion air. The filters shall remove not less than 97 percent of all dust particles of 5 microns and larger, and shall have an overall average efficiency of not less than 99 percent when tested with AC fine dust test in accordance with SAE J726.
- 3.1.6 Engine Lubricating Oil System: The engine lubricating oil systems shall be the full forced-feed type. Each lubricating oil system shall consist of an engine-driven, positive displacement type oil pump, a lubricating oil strainer, a lubricating oil filter, a lubricating oil cooler (if required) and associated piping. The lubricating oil filter shall be the full-flow type, complete with filter element(s). All elements of the lubricating oil system shall be manufactured by, or acceptable to, the engine manufacturer for each engine provided.
- 3.1.7 Fuel System: The engine fuel systems shall include an engine-driven fuel pump, fuel strainer and filter, and fuel injection system, complete with piping and accessories as specified herein to supply fuel to the engine from the fuel tank. All elements of the fuel system shall be manufactured by, or acceptable to, the engine manufacturer for each engine provided. A 20 gallon fuel tank shall be mounted integrally with system.
- 3.1.8 Engine Cooling System: Each engine shall have a closed, liquid cooling system complete with engine—driven coolant circulating pump, engine skid—mounted radiator, fan, piping, and controls. Coolant shall be a liquid mixture of water and ethylene glycol, 50% by volume of each. The cooling system shall have sufficient capacity to dissipate not less than the total British thermal units per hour rejected by the engine at 110 percent of rated output when operating under conditions as specified herein. The cooling system shall have a thermostatic control to maintain optimum engine operating temperatures. The filler cap shall provide for pressure relief prior to removal.
- 3.1.9 Exhaust System: Each engine shall have a complete exhaust system, including exhaust manifold with fittings and accessories.
- 3.1.10 Engine Speed Governing Systems: The engine speed governing systems shall be suitable for controlling the speed of the diesel engines within the requirements specified herein without intermediate adjustment. The speed governing systems shall maintain the specified stability without hunting or cycling. Each engine shall have an engine speed governing

system conforming to IEEE No. 126, section II. The engine speed governing system shall be adjusted to meet the performance requirements of IEEE No. 126, section II, when tested in accordance with ASME PTC26.

- 3.1.11 Cranking System: Electric starting of each diesel shall be provided, complete with alternator, all appurtenances and mechanisms necessary for manual start-manual stop operation of the diesel engine. Engine cranking system shall be activated by push buttons on the engine control panel. Storage batteries shall be sized by the manufacturer to provide not less than 5 minutes of total cranking time intermittently applied during a twenty-four minute period at zero degrees F., while retaining a battery voltage of 1.0 volt or more per cell. The specific gravity of electrolytic shall not exceed 1.250. The batteries shall be complete with connectors, connector terminals, acid resistant racks and one filling of electrolyte.
- 3.1.12 Engine Protective Devices: The diesel engine battery shall provide power to operate visual annunciators audible alarms.
- 3.1.12.1 Engine Safety Shutdown: Provide devices that shut off engine's air or fuel supply or both upon the following shutdown conditions: high engine coolant temperature and low engine oil pressure and engine overspeed. The overspeed sensing device shall be mounted on the engine, easily accessible, and shall directly measure each engine's speed. Belt connections shall not be allowed. The overspeed system shall operate independently of the engine's speed governing system. When the engine's speed reaches or exceeds 110 percent of synchronous speed, the overspeed sensing device shall react to shut off the engine's air or fuel supplies or both and shall trip the generator's main circuit breaker.
- 3.1.12.2 Visual Annunciator: Provide visual indicators on engine control panel that annunciate each engine safety shutdown when each occurs: high coolant temperature, low oil pressure, and overspeed. Visual indicator shall also indicate when safety shutdown occurred first. Label each indicator as specified herein. Provide indicators with manual reset.
- 3.1.12.3 Pre-Shutdown Alarms: Provide pre-shutdown alarm devices that sense alarm conditions of high coolant temperature, and low oil pressure and upon such alarm conditions shall activate audible alarm and visual indicator at engine control panel. Provide at engine control panel labeled visual indicators one for each pre-shutdown alarm condition, that are activated also by each pre-shutdown alarm device. The indicators specified in the paragraph, "Visual Annunciators" may be also used to indicate pre-shutdown alarm conditions. Visual indicators shall also indicate when pre-shutdown alarm condition occurred first. Provide these indicators with manual reset. Audible alarms shall have the following components: Alarm capable of producing a sound output rating of at least 85 decibels at 10 feet distance, audible alarm silencing switch, and automatic reset.
- 3.1.13 Engine Control Panel: An engine control panel complete with cabinet and accessories shall be provided for each engine. The cabinet

shall be the enclosed type fabricated of not lighter than 10 gage sheet steel. The cabinets shall be constructed with angle iron framework if required for proper stiffness and support. The gage panel shall be mounted on the engine unit base. Isolation mounting material shall be used between the base and the control panel to isolate the panel from engine vibrations. All panel-mounted instruments and gages shall be provided with ID plates as specified herein. Piping and tubing as required to connect gages shall be provided. Components provided on each engine control panel shall include the following:

- 3.1.13.1 Pressure Gages: Pressure gage materials shall conform to GG-G-76, minimum of 2 inches diameter, with silver or white dials and black markings. Duplex gages shall be of the two Bourdon tube style; gages for all other services shall be of the single Bourdon tube style. Gages shall be provided with shut-off needle valves and suitable pressure snubbers. Gages shall be provided to indicate operating parameters including the following indications:
 - a. Engine fuel oil pressure
 - b. Engine jacket water temperature
 - c. Engine lubricating oil pressure
 - d. Engine lubricating oil temperature
- 3.1.13.2 Indicating Tachometer: The tachometer shall be an electronic type or mechanical type driven by the crankshaft through a flexible shaft. Electronic type tachometer, if provided, shall be complete with magnetic pick-up on engine, control signal, transformer, and indicator. The indicator shall be the direct-reading type with a dial minimum 4 inches in diameter and graduated in revolutions per minute. The instrument shall be accurate within 2 percent plus or minus over the entire range of engine speed permitted by the governor. The tachometer face shall be marked to indicate the synchronous rpm.
 - 3.1.13.3 Visual Indicator Lights
 - 3.1.13.4 Audible Alarm
- 3.1.14 Mounting Base: If the new diesel engines do not utilize existing mounting bases (engine skids) the new diesel engines shall be factory mounted on a common base fabricated of structural steel sections. The structural base shall be of the skid type and shall have adequate strength and rigidity to maintain alignment of the equipment mounted thereon without dependence on a concrete foundation. Steel used in fabrication of the mounting base shall be free from sharp bends and corners. The attachments shall be located so that, when the equipment is hoisted, adequate clearance will exist between lifting slings and all exterior parts of the equipment. A diagram showing the lifting attachments shall be inscribed in a zinc base alloy or stainless steel plate securely fastened to the outside of the unit with the lifting capacity of each attachment marked thereon. On the diagrammatic plate, a silhouette

of the equipment showing the center of gravity shall be provided. Overall limiting dimensions shall be such that the diesel engine and engine skid can be installed at the indicated location and maintain the indicated clearances with surrounding equipment.

- 3.1.15 Clutch: Provide with the diesel engine a manually operated, twin disc, enclosed clutch designed and constructed to meet the rating and duty requirements specified for the engine and to be used for this diesel engine—water pump power transmission application.
- 4. ENGINE EXHAUST PIPING NOT INTEGRAL WITH THE ENGINES: Provide new as follows:
- 4.1 Exhaust Mufflers: A residential class muffler shall be provided for the engine which will reduce the exhaust sound spectrum to, or below, the following listed levels when measured with a sound level meter conforming to ANSI A1.4 at a 75 foot radius from the outlet, with engine loaded to full load and clear weather. Inlet and outlet connections shall be flanged and conform to drilling dimensions of ANSI B16.5, Class 150 or 300.

Fre	equency	Ba	and in Hertz	Sound Level Decibels
	20	_	75	78
	75	-	150	68
	150	-	300	60
	300	-	600	53
	600		1,200	53 48
	1,200	_	2,400	44
	The state of the s		4,800	42
			10,000	41

- 4.2 Exhaust Piping: Shall be schedule 80 black steel pipe conforming to ASTM A53 or A120. Piping 2 inches and smaller shall have threaded fittings. Piping 2.5 inches and larger shall have welding fittings. Threaded fittings shall conform to ANSI B16.3, Class 300. Welding fittings shall conform to ANSI B16.9 of the same material and weight as the piping in which they are installed. Welding shall be in accordance with ANSI B31.1, including qualification of welders. Certifications of each welder's qualifications shall be submitted to the Contracting Officer. Multiple-ply corrugated stainless steel flexible piping connectors shall be provided at the exhaust piping connection to diesel engine. Flanges shall be provided for final connections to diesel engines, exhaust mufflers and flexible connections. Gaskets shall be 0.06 inch thick packing conforming to HH-P-46. Provide rain caps on exhaust piping outlets that are capable of excluding driving rain from entering exhaust piping.
- 4.3 Insulation: Exhaust piping inside the buildings shall be insulated with calcium silicate insulation conforming to HH-I-523. Type II, Class A. 1.5-inches thick. Insulation shall be protected by a 0.016 inch thick aluminum jacket with a factory applied moisture barrier and secured by aluminum straps or screws spaced 8 inches on centers.

- 5. PIPE HANGERS AND SUPPORTS: Shall be provided and shall conform to MSS SP-58 and SP-69. Exhaust piping shall have adjustable pipe hangers Type 1 or Type 6, with insulation protection Type 40. Support rods shall be steel. The finish of pipe hangers and supports shall be painted with aluminum paint.
 - 6. MUFFLER SUPPORT AND WALL THIMBLE:
- 6.1 Materials: Materials shall be in accordance with the following specifications and standards as applicable:

Material	Specification
Structural steel-plates, shapes and tubes	ASTM A36
Carbon steel-bars, hot rolled	ASTM A576
Carbon steel-sheets and strips	QQ-S-698
Steel pipe-welded and seamless	ASTM A53

- 6.2 Construction: Welding shall conform to AWS D1.1 and shall be accomplished so as to prevent permanent distortion of connected parts. Connections shall conform to the Minimum Standard Connections as indicated in AISC Steel Construction Manual:
- 7. PAINTING: Provide painting as specified for painting of equipment in Section 15011, "Mechanical General Requirements".
- 8. SPECIAL WRENCHES AND TOOLS: Wrenches and tools specifically designed and required to work on the new equipment, which are not commercially available as standard mechanic's tools, shall be furnished to the Contracting Officer.
- 9. INSTRUCTING OPERATING PERSONNEL: Upon completion of the work on the engine installation and at a time designated by the Contracting Officer, the services of a competent engineer regularly employed by the diesel engine manufacturer shall be provided for a period of not less than one 8-hour working day for the instruction of the Government operating personnel in the proper operation and maintenance of the equipment.
- 10. IDENTIFICATION (ID) PLATES AND TAGS: Provide plates and tags sized so that inscription is readily legible to operating or maintenance personnel and securely mounted to or attached in proximity of their identified controls or equipment. Lettering shall be normal block lettering, a minimum of 0.25 inches high.
- 10.1 Materials: ID plates and tags shall be constructed of 16 gauge minimum thickness bronze or stainless steel sheet metal engraved or stamped with inscription. Plates and tags not exposed to the weather or high operational temperature of the diesel engine shall be constructed of laminated plastic, 0.125 inch thick melamine plastic conforming to Fed. Spec. L-P-387, matte white finish with black center core, with lettering accurately aligned and engraved into the white core.

- 10.2 Control Devices and Operation Indicators: Provide ID plates or tags for all provided control devices and operation indicators, including valves, off—on switches, visual, alarm annunciators, gages and thermometers, that are required for operation and maintenance of provided mechanical systems. Plates or tags shall be minimum of 0.5 inch high and 2 inches long and shall indicate component system and component function.
- 10.3 Equipment: Provide ID plates of a minimum size of 3 inches high and 5 inches long on provided equipment indicating the following information:
 - a. Manufacturer, type and model number.
 - b. Contract number and accepted date.
 - c. Capacity or size.
 - d. System in which installed.
 - e. System which it controls.
- 11. TESTING SUPERVISION: The Contractor shall furnish the services of a qualified installation engineer or technician regularly employed by the diesel engine manufacturer to supervise the field testing of each diesel engine, and auxiliaries.
- 11.1 Initial Start-Up: After the installation is complete, the installation engineer shall conduct a final pre-start check. He shall inspect the diesel engine, fuel supply systems, controls, and all auxiliary equipment. The installation engineer shall conduct the initial start-up and shall check each engine for normal operation.
- 11.2 Test: The installation engineer shall be present for the final test of the diesel engine. During the test, the installation engineer shall conduct the tests specified in the paragraph entitled "Diesel Engine Tests" and shall provide the Contracting Officer with a written test report showing the tests performed and the results of each test.

12. TESTS AND INSPECTIONS:

- 12.1 Shop Tests: Shop tests shall be performed on each complete shop assembled diesel engine prior to shipment. The Contractor shall provide the Contracting Officer with certified copies of all manufacturers' shop test data and results. All equipment necessary for tests shall be provided by the manufacturer performing the tests, and all measuring and indicating devices shall be certified to be within calibration or correction data furnished for the device.
- 12.1.1 Hydrostatic Tests: Hydrostatic test shall be performed to assure that water seals and water jackets are water tight. Test report shall indicate that test was performed, pressure at which test was made and results.

- 12.1.2 Diesel Engine Load Test: Shall be placed in continuous operation without stoppage for a period of not less than four hours. During this period, the diesel generator unit shall be operated one hour at each load point of half, three-quarter, full load and 110 percent of rated load. If stoppage becomes necessary during this period, the 4-hour run shall be repeated. The following data shall be recorded at the start, at 15 minute intervals and at the end of each load level run.
 - a. Fuel consumption.
 - b. Exhaust temperatures.
 - c. Jacket water temperatures.
 - d. Lube oil temperatures and pressures.
 - e. Crankcase vacuum.
 - f. Rpm's
- 12.1.3 Certified Test Reports: Provide test reports, certified by diesel engine manufacturer, which includes the following:
 - a. Data specified hereinbefore for shop tests.
 - b. List of and description of test equipment and test data measuring instruments used in shop tests and calibration dates for test data measuring instruments.
 - c. Statements by each shop test director that the test results and data meets the manufacturer's recommended limits and is acceptable to the test directors.
- 12.1.4 Shipment of Equipment: Contractor shall not commence shipment of the equipment to the project site without having Contracting Officer's approval of the shop test reports.
- 12.2 Field Tests and Inspections: After the engine installation is complete, the installation engineer shall conduct the following field tests and inspections. All equipment, apparatus and consumables necessary for the tests shall be provided by the Contractor. All defects disclosed by the tests shall be corrected by the Contractor without additional cost to the Government.
- 12.2.1 Piping Tests: New fuel oil piping system shall be tested with fuel oil at working pressure after the lines have been cleaned. The required test pressure shall be maintained for a sufficient length of time to enable an inspection to be made of all joints and connections. All defects which develop during testing shall be corrected, and the piping systems shall be retested until they show no defect or weakness and are tight.

- 12.2.2 Preliminary Operation: All motors shall be dried out before operation as required to develop and maintain proper and constant insulation resistance. The engine shall be operated for a period of time sufficient to assure that the unit is ready to carry the load specified herein without damage to any of the engine parts. During this preliminary operation, the Contractor and installation engineer shall check the operation of all auxiliary equipment furnished under this contract to determine that it is functioning properly, and the Contractor shall make such adjustments to all equipment as are necessary to place it in first class operating condition in conformance with the contract requirements.
- 12.2.3 Diesel Engine Tests: He shall give two weeks advance notice to the Contracting Officer, in writing, that the diesel engine and auxiliary equipment are ready and engine field tests. These tests shall include the following:
 - a. The diesel engine shall be operated loaded to the full load. The load state shall be maintained on the diesel engine for a period sufficient for all operating parameters to stabilize. Observe and record diesel engine operating parameters including oil temperature and pressure, coolant temperature and rpm, to verify all values are within manufacturers recommended limits.
 - b. Test to verify generating unit speed regulation under a gradual change from zero to full load.
 - c. Test to assure proper functioning of the overspeed trip.
 - d. Individual test of each alarm and prealarm switch to verify correct operation of the visual indicator and alarm system.
- 12.2.4 Test Report: Upon completion of field testing of each engine diesel installation, the erection engineer shall prepare a test report indicating the tests performed and the test data and test results of those tests. The report shall include a list of and description of test equipment and test data measuring instruments and calibration dates for these test data measuring instruments. The installation engineer shall make the statement on the test report that the test data taken from the diesel engine falls within the manufacturer's recommended limits and the diesel engine installation is acceptable to him. The report shall be dated, signed and given to the Contracting Officer. This report will not constitute automatic acceptance of the installation by the Government, but will be used only to verify that in the opinion of the installation engineer, as a representative of the diesel generator manufacturer, the installation is in excellent operating condition.

*** END OF SECTION ***

SECTION 15801

HEATING, VENTILATING, AND AIR CONDITIONING

- 1. APPLICABLE PUBLICATIONS: The publications listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent indicated by the references thereto:
 - 1.1 Federal Specifications (Fed. Spec.):

F-F-310A & Am 1	Filters, Air Conditioning: Viscous-Impingement and Dry Types, Replaceable
TT-S-230C & Am 2	Sealing Compound; Elastomeric Type, Single Component

1.2 Military Specification (Mil. Spec.):

MIL-F-16081G	Fans, Ventilating, Propeller
MIL-F-16716C	Fans, Centrifugal, Industrial
MIL-L-18145C	Louver, Metal; Exhaust Opening and Gravity Closing Type
MIL-H-22547B	Heat Pump, Heating and Cooling (Unitary) (8,400 to 300,000 BTU)
MIL-A-52174B	Aluminum Alloy Duct Sheet

1.3 Air Conditioning and Refrigeration Institute (ARI) Publications:

520-74	Positive Displacement Refrigerant Compressors,
	Compressor Units and Condensing Units
1981	Directory of Certified Unitary Heat Pumps

1.4 Air Moving and Conditioning Association (AMCA) Publication:

210-74 Test Code For Air Moving Devices

1.5 American Society of Heating, Refrigerating & Air Conditioning Engineers (ASHRAE) Publications:

52-76	Method of Testing Air-Cleaning Devices Used in			
	General Ventilation for Removing Particulate Matter			
1979	Equipment . Handbook and Product Directory			

1.6 American Society of Mechanical Engineers (ASME) Publication:

1980 Boiler and Pressure Vessel Codes & Am 80

1.7 American Society for Testing and Materials (ASTM) Publications:

A167-77

Stainless and Heat-Resisting Chromium - Nickel Steel Plate, Sheet and Strip

A525-80

Steel Sheet, Zinc Coated (Galvanized) by the Hot Dip Process

B280-80

Seamless Copper Tube For Air Conditioning and Refrigeration Field Service

E84-81

Surface Burning Characteristics of Building

8 National Fire Protection Association (NFPA) Publications:

Materials

70-81 National Electrical Code (ANSI C.1)

90A-78 Air Conditioning and Ventilating Systems

1.9 Sheet Metal and Air Conditioning Contractors National Association (SMACNA) Publication:

1976 Low Pressure Duct Construction Standards

- 2. GENERAL REQUIREMENTS: Section 15011, "Mechanical General Requirements," applies to this section, with the additions and modifications specified herein.
- 2.1 Description of Work: The work includes providing new heating, ventilating, and air conditioning systems, and related work. Each system shall be complete and ready for operation. Equipment, materials, installation, and workmanship shall be in accordance with NFPA 70, 90A, except as specified or indicated otherwise. Capacity and efficiency of equipment shall be not less than that indicated. In the publications referred to herein, the advisory provisions shall be considered to be mandatory, as though the word "shall" had been substituted for "should" wherever it appears; reference to the "authority having jurisdiction" shall be interpreted to mean the Contracting Officer.
- 2.2 Submittals Required: The submittal requirements of Section 15011, "Mechanical General Requirements," applies to the following lists.

2.2.1 Manufacturer's Data:

- a. Heat Pump Unit
- b. Exhaust Fans
- c. Unit Heaters

2.2.2 Shop Drawings:

- a. Heat Pump Unit
- 3. EQUIPMENT:
- 3.1 Air-Source Unitary Heat Pumps: Mil. Spec. MIL-H-22547, except as modified herein. Units shall be designed, constructed, and rating tested in accordance with ARI 240 for DOE covered products. Units shall be ARI certified and listed in the ARI Directory of Certified Unitary Air-Source Heat Pumps; in lieu of listing in the ARI Director, a letter of certification from ARI that the units have been certified and will be listed in the next Directory will be acceptable. Coils shall have copper or aluminum tubes with aluminum fins.
- 3.1.1 Performance: In Mil. Spec. MIL-H-22547, the heat pump coefficient of performance (COP) shall be replaced by the following: The heat pumps shall have the following minimum cooling performance (seasonal energy efficiency ratio, SEER), minimum heating performance (heating seasonal performance factor, HSPF), and minimum combined cooling and heating performance (seasonal energy efficiency ratio added to heating seasonal performance factor, SEER and HSPF).

Certified Cooling Capacity At the ARI Cooling Rating Conditions:	Minimum* SEER	Minimum* HSPF	Minimum* (SEER + HSPF)
30,000 BTUH and less	7.0	5.0	12.5
30,001 BTUH and more	7.5	5.5	13.5

*Although a unit may exceed the minimum SEER and the minimum HSPF, it would not be acceptable unless it also exceeded the minimum (SEER + HSPF).

3.1.2 Temperature Controls: Provide controls as specified in Mil. Spec. MIL-H-22547 and as modified herein. Indoor thermostats shall be of the adjustable type and shall conform to applicable requirements of UL 873. Lower end of heating side scale range shall be standard with manufacturer with a factory set maximum of 72 degrees F. Higher end of cooling side scale range shall be standard with manufacturer with a factory set minimum of 78 degrees F. for cooling. Thermostats modified in the field to meet the above limits are not acceptable. Thermostats shall be provided and shall be the combination heating-cooling type with contacts hermetically sealed against moisture, corrosion, lint, dust and foreign material. Manual switching for system changeover from heating to cooling or cooling to heating and fan operation shall be accomplished through the

use of a thermostat subbase. The thermostat or subbase shall contain system selector switches to provide "COOL and OFF and HEAT" and fan selector switches to provide "AUTOMATIC and ON". All necessary relays, contactors, transformers or motor starters shall be provided located in a panel or panels for easy replacement and service.

- 3.1.3 Safety Controls: Provide controls as specified in Mil. Spec. MIL-H-22547 and as modified herein. Controls and protective devices shall include a liquid line low pressure switch, suction line accumulator and pressure relief device. An automatic defrost control shall be included to accomplish defrosting (only if coil saturated temperature indicates freezing temperatures). Compressor motor shall have both thermal and overload protection. Compressor shall have internal high pressure protection.
- 3.1.4 Accessories: Provide the following accessories for the heat pump units.
 - a. 5-minute anti-recycle timer.
 - b. Start capacitor kit.
 - c. Compressor crankcase heater.
- 3.1.5 Radio Control Switch: The Government will furnish and the Contractor shall install and test a two function external relay radio controlled switch to provide remote ON-OFF operation of heat pump compressor for each heat pump system.
- 3.2 ELECTRIC UNIT HEATERS (HORIZONTAL PROPELLER FAN TYPE): Electric unit heaters shall have wattage, voltage, phase, Btu/hr output and CFM air delivery as shown on drawings. Complete unit heater assembly shall comply with built—in thermostat and terminals for control circuits as necessary and for a single source of power supply. Control transformers of adequate capacity shall be factory furnished and installed. Complete unit heater assembly shall comply with requirements of Underwriters Laboratories, Inc. and requirements hereinafter specified. Each unit heater shall be provided with built—in thermostat and control circuits as necessary and for a single source of power supply. Control transformers of adequate capacity shall be factory furnished and installed.
- 3.2.1 Casing: Shall be heavy gauge sheet metal reinforced to form a strong, durable cabinet for heater element, fan, motor and auxiliaries. Cabinet shall be neat design with no sharp corners. Cabinet design shall provide ready access to interior components without unfastening from mounting brackets. Provide means in unit to render motor vibration inaudible. Unit heater shall be constructed for suspension with approved hangers.
- 3.2.2 Fan: Shall be direct motor driven propeller type. Fan wheel shall be factory trued, dynamically balanced, and designed specifically for unit heater application and low noise level. Fan motor shall be totally enclosed, continuous duty with built-in automatic reset thermal

overload protection. Motor speed shall not exceed 1800 RPM. Motor shall be wired to heater power supply source.

- 3.2.3 Heating Element: Heating element shall consist of nickel chromium heating wire embedded in a magnesium oxide insulating refractory and sealed in corrosion-resisting metallic sheath with fins. Ends of elements shall be sealed and enclosed in a terminal box, and element sheath shall be mechanically pressed after filling to insure maximum magnesium oxide compaction. Sheath and fins shall be cast aluminum or steel with fins brazed to sheath. Casings shall be free from defects of any nature. Steel sheath and fins shall have corrosion protection by copper plating, high-temperature ceramic coating, or high-temperature aluminized finish. Heat transfer between sheath and fins shall be uniform. Fins shall be spaced a maximum of six per inch and fin surface temperature at any point shall not exceed 550 degrees F during normal operation. Elements shall be free from expansion noise and 60-cycle hum.
- 3.2.4 Louvers: Horizontal air discharge units shall have individually adjustable horizontal louvers to direct discharge air horizontally as desired. A substantially constructed louvered back, heavy grille, or wire guard shall be provided for inlet air.
- 3.3 ELECTRIC BASEBOARD HEATERS: Electric baseboard heaters shall have wattage, voltage, phase, and Btu/hr output, as shown on the drawings or as specified. Complete unit shall comply with requirements of Underwriters' Laboratories, Inc., and requirements hereinafter specified. Baseboard heater shall be a self-contained, factory-assembled unit and shall consist of heating elements, built-in thermostat, and casing with inlet and outlet grilles. Each complete heater shall be provided with terminals for control circuits as necessary and for a single source of power supply.
- 3.4 Exhaust Fans: Mil. Spec. MIL-F-16081, Type I, Class 1 for direct drive, Class 2 for belt drive, Style A for wall or window mounting. Style B for roof or ceiling mounting, except that fans shall be centrifugal type with aluminum housing, wheel and bird screen. Fan for wet well shall be corrosion resistant construction including bird screen and damper. Motors shall be completely shielded from the air stream. Provide exhaust opening and gravity closing type automatic louvers. Capacity of fans shall be certified in accordance with AMCA-210, and shall be not greater than 110 percent of the capacity indicated at indicated pressure drop.

4. ELECTRICAL:

4.1 Electrical Motors, Controllers, Contactors, and Disconnects: Furnish motors, controllers, contactors, and disconnects with their respective pieces of equipment. Motors, controllers, contactors, and disconnects shall conform to and shall have electrical connections provided under Section 16402, "Interior Wiring Systems". Controllers and contactors shall have a maximum of 120 volt control circuits, and

auxiliary contacts for use with the controls furnished. When motors and equipment furnished are larger than sizes indicated, the cost of providing additional electrical service and related work shall be included under this section.

- 4.2 Electrical Work: Is specified in the Section 16402, "Interior Wiring Systems", except for control wiring. Control wiring shall be provided under this section and shall conform to NFPA 70. Rigid metal conduit or intermediate metal conduit shall be used, except EMT conduit may be used in dry locations not enclosed in concrete or where not subject to mechanical damage.
- 5. SHEET METAL DUCTWORK: Provide in a neat workmanlike manner. Ducts shall be constructed of zinc-coated sheet steel conforming to ASTM A 525 coating designation G 90, except as specified otherwise. Ducts and accessories shall be constructed, braced, reinforced, installed, sealed, and tested in accordance with NFPA 90A, SMACNA duct construction standards, and ASHRAE equipment handbook, except as modified herein. All seams in ducts shall be calked with a single component synthetic rubber type calking compound conforming to Fed. Spec. TT-S-230; sheet metal shall be solvent cleaned before applying calking compounds. Provide duct supports (hangers) and support spacing in accordance with SMACNA duct construction standards. Lap joints shall be made in the direction of flow. Curved elbows shall have a center line radius not less than 1.5 times the width of the duct. Ducts shall be true to the dimensions indicated, and shall be straight and smooth on the inside with neatly finished airtight joints. Air support and return openings in ducts shall be provided with air diffusers or registers. The ducts shall be securely anchored into the building construction in an approved manner and shall be completely free from vibration under all conditions of operation. Supply, return, and outside-air systems shall be completely balanced.
- 5.1 Flexible Duct-Connectors: Provide at all duct connections to each exhaust fan. All connectors shall be supported at each end by metal angle frame bands, securely bolted in place as to be air-tight. Duct connectors shall be not less than 20-ounce glass fabric coated both sides with neoprene.
- 5.2 Registers and Grilles: Provide factory fabricated units of sheet steel or aluminum with all edges rolled or rounded where exposed to view, and shall be factory primed, ready for finish painting.
- 5.2.1 Registers: Units shall have a minimum of 70 percent free area. Exhaust air registers shall have a single set of nondirectional face bars or vanes. Face bars or vanes shall be spaced not more than 0.75 inch on centers and shall be not less than 0.62 inch in depth.
- 6. ADJUSTMENTS: Adjust controls and equipment so as to give satisfactory operation. Air duct systems shall be adjusted and balanced so that air quantities at all outlets are as indicated.

- 7. INSTRUCTING OPERATING PERSONNEL: Upon completion of the work and at a time designated by the Contracting Officer, the services of a competent technician shall be provided for a period of not less than one 8-hour working day for the instruction of the Government operating personnel in the proper operation and maintenance of the equipment.
- 8. FIELD TESTING: Upon completion and before final acceptance of the work, each system shall be tested as in service to demonstrate conformance with the contract requirements. Adjustment of controls and balancing of systems shall be for one year after final acceptance of the completed systems. Controls shall be tested through every cycle of operation. Safety controls shall be tested to demonstrate performance of their required function. Defects in the work provided by the Contractor shall be corrected by him at his own expense and the test repeated. The Contractor shall furnish electricity, instruments, connecting devices and personnel for the tests. Equipment, ductwork, and filters shall be cleaned thoroughly in accordance with the best practice.

*** END OF SECTION ***

SECTION 16011

ELECTRICAL GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 APPLICABLE PUBLICATIONS: 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.

1.1.1 Federal Specifications (Fed. Spec.):

TT-E-489F Enamel, Alkyd, Gloss (For Exterior and Interior & Am 1 Surfaces)

TT-E-496B Enamel, Heat-Resisting (400 Degrees Fahrenheit), & Am 2 Black

TT-P-28F Paint, Aluminum, Heat Resisting (1200 Degrees Fahrenheit)

TT-P-645A Primer, Paint, Zinc-Chromate, Alkyd Type

1.1.2 Military Specifications (Mil. Spec.):

DOD-P-15328D Primer (Wash), Pretreatment (Formula No. 117 for Metals) (Metric)

1.1.3 American Society for Testing and Materials (ASTM) Publication:

B117-73 Salt Spray (Fog) Testing, Method of (R79)

- 1.2 APPLICATION: This section applies to all sections of Division 16, "Electrical" of this project except as specified otherwise in each individual section.
- 1.3 SUBMITTALS: Submit shop drawings, manufacturers data and certificates for equipment, materials and finish, and pertinent details for each system where specified in each individual section, and have them approved before procurement, fabrication or delivery of the items to the job site. Partial submittals will not be acceptable and will be returned without review. Submittals shall include the manufacturer's name, trade name, catalog model or number, nameplate data, size, layout dimensions, capacity, project specification and paragraph reference, applicable Federal, Military, industry and technical society publication references, and other information necessary to establish contract compliance of each item the Contractor proposes to furnish.

- 1.3.1 Shop Drawings: Drawings shall be a minimum of 8.5-inches by 11-inches in size, except as specified otherwise. Drawings shall include floor plans, sectional views, wiring diagrams, and installation details of equipment; and equipment spaces identifying and indicating proposed location, layout and arrangement of items of equipment, control panels, accessories, piping, ductwork, and other items that must be shown to assure a coordinated installation. Wiring diagrams shall identify circuit terminals, and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance and replacement of operating equipment devices. If equipment is disapproved, drawings shall be revised to show acceptable equipment and be resubmitted.
- 1.3.2 Manufacturer's Data: Submittals for each manufactured item shall be manufacturer's descriptive literature of cataloged products, equipment drawings, diagrams, performance and characteristic curves, and catalog cuts.
- 1.3.3 Publication Compliance: Where equipment or materials are specified to conform to industry and technical society publications of organizations such as American National Standard Institute (ANSI), American Society for Testing and Materials (ASTM), and Underwriters Laboratories, Inc. (UL), proof of such compliance shall be submitted. The label or listing by the specified organization will be acceptable evidence of compliance. Submit a certificate from an independent testing organization adequately equipped and competent to perform such services, and approved by the Contracting Officer, stating that the item has been tested in accordance with the specified organization's test methods and that the item conforms to the specified organization's publication.
- 1.3.4 Certified Test Reports: The testing requirements in referenced publications for materials will be waived provided the manufacturer's original certificates are submitted stating that previously manufactured materials have been tested by approved laboratories, that such materials meet testing requirements specified, and that the materials furnished for this project are of the same type, quality, manufacture, and make as that tested; copies of the test reports need not be submitted except as specifically requested by the Contracting Officer.
- 1.3.5 Certificates of Compliance: Submit certification attesting that materials and equipment to be furnished for this project comply with the requirements of this specification and of the reference publications. Pre-printed certifications will not be acceptable; certifications shall be the manufacturer's original. The certification shall not contain statements that could be interpreted to imply that the product does not meet all requirements specified, such as "as good as"; "achieve the same end use and results as materials formulated in accordance with the referenced publications"; "equal or exceed the service and performance of the specified material". The certification shall simply state that the product conforms to the requirements specified.

- 1.4 OPERATION AND MAINTENANCE MANUAL: Furnish an operation and maintenance manual for each item of equipment. Furnish three copies of the manual bound in hardback binders or an approved equivalent. Furnish one complete manual prior to the time that equipment tests are performed. and furnish the remaining manuals before the contract is completed. Inscribe the following identification on the cover: the words OPERATION AND MAINTENANCE MANUAL, the name and location of the equipment or the building, the name of the Contractor, and the contract number. shall include the names, addresses, and telephone numbers of each subcontractor installing equipment, and of the local representatives for each item of equipment. The manual shall have a table of contents and be assembled to conform to the table of contents with the tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in. The manual shall include: wiring and control diagrams with data to explain detailed operation and control of each item of equipment; a control sequence describing start-up, operation and shut-down; description of the function of each principal item of equipment; the procedure for starting: the procedure for operating; shut-down instructions; installation instructions: maintenance instructions: lubrication schedule including type, grade, temperature range, and frequency; safety precautions, diagrams, and illustrations; test procedures; performance data; and parts list. The parts lists for equipment shall indicate the sources of supply, recommended spare parts, and the service organization which is reasonably convenient to the project site. The manual shall be complete in all respects for equipment, controls, accessories, and associated appurtenances provided.
- 1.5 POSTED OPERATING INSTRUCTIONS: Furnish approved operating instructions for each principal item of equipment for the use of the operation and maintenance personnel. The operating instructions shall include wiring diagrams, control diagrams, and control sequence for each principal item of equipment. Operating instructions shall be printed or engraved, and shall be framed under glass or in approved laminated plastic and posted where directed by the Contracting Officer. Operating instructions shall be attached to or posted adjacent to each principal item of equipment including start up, proper adjustment, operating, lubrication, shut-down, safety-precautions, procedure in the event of equipment failure, and other items of instruction as recommended by the manufacturer of each item of equipment. Operating instructions exposed to the weather shall be made of weather-resisting materials or shall be suitably enclosed to be weather protected. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.
- 1.6 DELIVERY AND STORAGE: Properly store, adequately protect and carefully handle equipment and materials to prevent damage before and during installation. Handle, store, and protect equipment and materials in accordance with the manufacturer's recommendations. Replace damaged or defective items.

- 1.7 CATALOGED PRODUCTS: Materials and equipment shall be cataloged products of manufacturers regularly engaged in production of such materials or equipment and shall be manufacturer's latest design that complies with the specification requirements. Materials and equipment shall duplicate items that have been in satisfactory commercial or industrial use. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the items need not be the products of the same manufacturer. Each item of equipment shall have the manufacturer's name, address, model number and serial number on the nameplate securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.
- 1.8 VERIFICATION OF DIMENSIONS: Coordinate the proper relation of the work to the building structure and to the work of all trades. Visit the premises and become familiar with the dimensions in the field, and advise the Contracting Officer of the discrepancy before performing any work.
- 1.9 MANUFACTURER'S RECOMMENDATIONS: 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 furnished to the Contracting Officer prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.
- 1.10 ELECTRICAL REQUIREMENTS: Furnish motors, controllers, contactors, and disconnects with their respective pieces of equipment except controllers indicated as part of the motor control centers shall be provided under Section 16402, "Interior Wiring Systems". Motors, controllers, contactors, and disconnects shall conform to and shall have electrical connections provided under Section 16402, "Interior Wiring Systems". Furnish internal wiring for components of packaged equipment as an integral part of the equipment. Extended voltage range motors will not be permitted. Controllers and contactors shall have a maximum of 120 volt control circuits. When motors and equipment furnished are larger than sizes indicated, the cost of additional electrical service and related work shall be included under the section that specified that motor or equipment. Power wiring and conduit for field installed equipment, and motor control equipment forming part of motor control centers or switchgear assemblies, and conduit and wiring connecting such centers, assemblies or other power sources to equipment shall be provided under and conform to the requirements of Section 16402, "Interior Wiring Systems".

PART 2 - PRODUCTS

2.1 PAINTING OF EQUIPMENT: Equipment painting, factory applied or shop applied, shall be as specified herein, and provided under each individual section of this specification.

- 2.1.1 Factory Painting Systems: Manufacturer's standard factory painting systems may be provided subject to certification that the factory painting system applied will withstand 125 hours in a salt-spray fog test. except that equipment located outdoors shall withstand 500 hours in a salt spray fog test. Salt spray fog test shall be in accordance with ASTM B117. Immediately after completion of the test, the paint shall show no signs of blistering, wrinkling or cracking; and no loss of adhesion; and the specimen shall show no signs of rust creepage beyond 0.125 inch on either side of the scratch mark. The film thickness of the factory painting system applied on the equipment shall not be less than the film thickness used on the test specimen. If manufacturer's standard factory painting system is being proposed for use in lieu of the shop painting systems using Fed. Spec. TT-E-496 or TT-P-28, certifications that the manufacturer's standard factory painting system will conform to the heat resistance requirement of Fed. Spec. TT-E-496 or TT-P-28 as applicable, shall be submitted in addition to other certifications.
- 2.1.2 Shop Painting Systems: Clean, pretreat, prime and paint metal surfaces; except aluminum surfaces shall not be painted. Apply coatings to clean dry surfaces. Clean the surfaces to remove dust, dirt, rust, oil and grease by wire brushing and solvent degreasing prior to application of paint, except metal surfaces subject to temperatures in excess of 120 degrees Fahrenheit (F) shall be cleaned to bare metal. Where more than one coat of paint is specified, apply the second coat after the preceding coat is thoroughly dry. Lightly sand damaged painting and retouch before applying the succeeding coat.
- 2.1.2.1 Metal Surfaces Subject to Temperatures Less Than 120 Degrees F.: Immediately after cleaning, the metal surfaces shall receive one coat of Mil. Spec. DOD-P-15328 pretreatment primer applied to a minimum dry film thickness of 0.3 mil, one coat of Fed. Spec. TT-P-645 primer applied to a minimum dry film thickness of one mil; and two coats of Fed. Spec. TT-E-489 enamel applied to a minimum dry film thickness of one mil per coat.
- 2.1.2.2 Metal Surfaces Subject to Temperatures Between 120 and 400 Degrees F.: Surfaces shall receive two coats of Fed. Spec. TT-E-496. Type II, heat-resisting enamel applied to a total minimum thickness of 2 mils.
- 2.1.2.3 Metal Surfaces Subject to Temperatures Greater Than 400 Degrees F.: Surfaces shall receive two coats of Fed. Spec. TT-P-28 heat-resisting aluminum paint applied to a total minimum dry film thickness of 2 mils.

*** END OF SECTION ***

SECTION 16208

DIESEL ENGINE-GENERATOR SET

PART 1 - GENERAL

- 1.1 APPLICABLE PUBLICATIONS: 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.
 - 1.1.1 Federal Specifications (Fed. Spec.):

W-B-133C	Battery, Storage (Lead Acid, Industrial Portable Service)
W-C-375B	Circuit Breaker, Molded Case, Branch Circuit and Service
WW-V-54D & Am 3	Valves, Gate, Bronze (125, 150 and 200 Pound; Threaded, Flanged and Solder)

1.1.2 Military Specifications (Mil. Spec.):

MIL-T-52777A Tanks, Storage, Underground, Glass Fiber, Reinforced Plastic

1.1.3 American National Standard Institute, Inc. (ANSI) Publications:

B15.1-72	Safety Standard for Mechanical Power Transmissions Apparatus
B16.3-77	Malleable Iron Threaded Fittings, Class 150 and 300
B16.11-80	Forged Steel Fittings, Socket Welding and Threaded
B16.18-80	Cast Copper Alloy Solder Joint Pressure Fittings
B16.22-80	Wrought Copper and Bronze Solder Joint Pressure Fittings
B16.26-75	Cast Copper Alloy Fittings for Flared Copper Tubes
B16.39-77	Malleable Iron Threaded Unions
C39.1-81	Requirements for Electrical Analog Indicating

	C50.10-77	General Requirement for Synchronous Machines
1.1.4	American Soci	ety for Testing and Materials (ASTM) Publications:
	A 53-82	Welded and Seamless Steel Pipe
	A 120-82	Black and Hot Dipped Zinc Coated (Galvanized) Welded and Seamless Steel Pipe
	A 525-81	Steel Sheet, Zinc Coated by Hot-Dipped Process
	в 8-81	Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard or Soft
	В 33-81	Tinned Soft or Annealed Copper Wire for Electrical Purposes
	B 88-81	Seamless Copper Water Tube
	В 189-81	Lead-Coated and Lead-Alloy-Coated Soft Copper Wire for Electrical Purposes
	B 230-81	Aluminum 1350-H19 Wire for Electrical Purposes
	B 231-81	Concentric-Lay-Stranded Aluminum 1350 Conductors
	В 609-81	Aluminum 1350 Round Wire, Annealed and Intermediate Tempers, for Electrical Purposes
	D 975-81	Diesel Fuel Oils
1.1.5 ublication		Electrical and Electronic Engineers (IEEE)
	126–59	Recommended Specification for Speed Governing of Internal Combustion Engine-Generator Units
1.1.6	Insulated Cab	le Engineers Association (ICEA) Publications:
	S-19-81 (6th Ed.) & Rev. 9	Rubber Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (Nema WC 3-80)
	S-61-402 (3rd Ed.) & Rev. 7-82	Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (Nema WC 5-73)
	S-66-52A Interim Standard No. 1 & Rev. 9-80	Cross-Linked-Thermosetting-Polyethylene-Insulate Wire and Cable for the Transmission and Distribution of Electrical Energy (Nema WC 7-71)

S-68-516 Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distriction of Electrical Energy (WC 8-76)

1.1.7 National Electrical Manufacturer's Association (NEMA) Publications:

ICS 1-78 General Standards for Industrial Controls (R 3-80) Systems	
ICS 2-78 (R 3-82)	Industrial Control Devices, Controllers and Assemblies
ICS 3-78 (R 79)	Industrial Systems
ICS 4-77 (R 78)	Terminal Blocks for Industrial Control Equipment and Systems
ICS 6-78 (R 80)	Enclosures for Industrial Controls and Systems
MG1-78 (R 7-82)	Motors and Generators

1.1.8 National Fire Protection Association (NFPA) Publications:

30-81 Flammable and Combustible Liquids Code

37-79 Stationary Combustion Engines and Gas Turbines

70-81 National Electrical Code

1.1.9 Steel Structures Painting Council (SSPC) Publication:

PS 10.02-82 Cold Applied Coal Tar Enamel Painting System

1.1.10 Underwriters Laboratories, Inc. (UL) Publications:

142-81 Steel Aboveground Tanks for Flammable and Combustible Liquids

1008-77 Automatic Transfer Switches
(R 80)

1236-78 Battery Chargers (R 80)

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS: Section 16011, "General Requirements, Electrical" applies to this section except as specified otherwise.

- 1.3 DESCRIPTION: Provide two diesel electric generating units with accessories, auxiliary equipment, and associated work as specified. Relocate one set as indicated.
- 1.4 SUBMITTALS: The items in the following lists which are followed by (CO) shall be approved by the Contracting Officer.
 - 1.4.1 Manufacturer's Data:
 - a. Diesel engine driven electric generator set
 - b. Fuel oil tank, fuel oil day tank unit, fuel oil tank level gage
 - c. Fuel line strainers
 - d. Engine muffler
- 1.4.2 Shop Drawings and Calculations: Pertaining to the diesel generating unit and auxiliary equipment, including the following:
 - a. Certified outline, general arrangement (setting plan), and anchor bolt details. Drawings shall show the total weight and center of gravity of the assembled equipment on the mounting skid.
 - b. General arrangement drawings showing location of all auxiliary equipment in relation to the diesel generating unit.
 - c. Piping schematics for fuel oil, lubricating oil, jacket water and cooling water integral with diesel engine.
 - d. BMEP Calculations (CO)
 - e. Battery sizes and cranking time calculations
 - f. Drawings for the transfer switch, including certified outline, electrical ratings, general arrangement, and detail drawings.
 - g. Electrical elements, schematics and wiring diagrams, including details of the safety shutdown systems and main generator circuit breaker trip system.
 - h. Torsional Vibration Analysis Calculations: (CO)
 - A description of the system relating information pertinent to analysis such as operating speed range and idenfication plate data.
 - (2) A mass-elastic assembly drawing, showing the arrangement of the units in the generator set and dimensions of

- shafting, including minimum diameters (or section moduli) of all shafting in the system.
- (3) A labeled line diagram of the mass elastic system indicating values of masses, stiffness, equivalent lengths, and equivalent diameters including basic assumptions where applicable.
- (4) Sample calculations showing procedure used to obtain resulting stress.
- (5) A calculation indicating assemblied engine-generator speed of 1800 rpm with assembly loaded to net rated generating capacity and the resulting calculated torsional stress value for this load condition. (A total of one calculated torsional stress value.)
- Details of generator frame connection to diesel engine block; details of generator rotor shaft coupling connection to engine crankshaft. (CO)
- 1.4.3 Certified Test Reports:
 - a. Diesel Engine Shop Tests
 - b. Generator Shop Tests
 - c. Diesel Engine Driven Electric Generator Set Shop Tests (CO)
- 1.4.4 Certificates of Compliance:
 - Fuel Oil Piping and Fittings (not integral with diesel engine)
 - b. Duct Sheet Steel and Duct Connectors
- 1.4.5 Operation and Maintenance Manuals: Submit manuals at least 60 days prior to field testing of set.
- 1.5 SAFETY AND INSTALLATION REQUIREMENTS: Comply with ANSI B15.1, NFPA 30, NFPA 37.

PART 2 - PRODUCTS

2.1 GENERATOR SET: Each generator set shall consist of a diesel engine connected to an alternating current generator with brushless excitation system mounted on a steel mounting base and provided with all necessary accessories, auxiliaries, and control equipment resulting in a complete self-contained unit capable of the specified operation. Set shall be housed in a weatherproof enclosure for installation outdoors.

2.1.1 Rating:

- 2.1.1.1 Rating: Diesel-electric generators shall have rated net generating capacities as indicated. Rating shall be based on the following: using No. 2 fuel oil, conforming to ASTM D975, Grade No. 2-D, as diesel engine fuel at an altitude of sea level and an atmospheric temperature of 85 degrees Fahrenheit (F); using a radiator fan driven by the diesel engine; using the coolant mixture specified herein. In spite of the fact that the generator set is intended for emergency duty, the rated net generating capacity specified shall be a prime power rating or a continuous service rating.
 - a. Rated Net Generating Capacity: The rated net generating capacity of generating unit is defined as the gross kilowatt output, at 0.8 power factor, of the generator minus the total kilowatt requirements of the electric motor driven engine accessories constituting part of the diesel engine assembly.
- 2.1.1.2 Auxiliaries: All auxiliary equipment provided with generator set shall be designed for the duty and rating requirements specified hereinbefore.
- 2.1.2 Nonoperating Protection: When the generator set is not operating, the complete set shall be protected so as not to be damaged by ambient temperatures down to zero degrees Fahrenheit.
- 2.1.3 Torsional Vibration Analysis: Torsional vibration stresses in the crank shaft and generator shaft of assembled diesel engine and driven generator shall not exceed 5000 pounds per square inch (psi) when engine is driving generator at a speed of 1800 rpm while assembled unit is loaded to rated net generating capacity. Submit copies of torsional vibration stress analysis computations to the Contracting Officer for approval. Computations shall be based on a mathematical model of the assembled diesel engine-generator unit provided or based on calculations using measured values from tests on a unit identical to the one provided. Calculations based on models or measured data from the unassembled engine and generator will not be acceptable.
- 2.1.4 Diesel Engine and Accessories: Engine, 2-cycle or 4-cycle, naturally aspirated or turbocharged, vertical in-line or vertical "V" type. Limiting characteristics of engine shall be as follows:
 - Maximum brake mean effective pressure (BMEP), pounds per square inch (psi)
 - (1) Naturally Aspirated 2-cycle engines 4-cycle engines

85 100 (2) Turbocharged Without Intercooler
2-cycle engines
4-cycle engines
125

(3) Turbocharged with Aftercooler
2-cycle engines
110
4-cycle engines
170

b. Maximum engine speed, rpm

2-cycle engines 1,800 4-cycle engines 1,800

c. Maximum piston speed, ft./min.

2-cycle engines 1,725 4-cycle engines 1,950

- 2.1.4.1 General Construction: Engine shall be constructed adequately to withstand sudden changes from no load to rated load, and to preserve alignment of integral components under all conditions of operation. Engine shall be neat in appearance and shall permit easy access to various parts for maintenance purposes. The crankshaft shall incorporate drilled passages for pressure lubrication of bearings, and the journals shall be hardened or chromium plated to provide a hard shock-resistant surface with ductile core. Crankshaft and connecting rod bearings shall be the replaceable precision sleeve type. The piston rings shall be constructed of a heat-resisting alloy steel or chromium plated cast iron. Camshafts shall be gear or chain driven, and shall have higher wear resistance at cams and journals. Timing marks shall be clearly indicated on the crankshaft and gears. Valves shall operate in removable stem guides and seat inserts. The fly-wheel shall be balanced, and shall be capable of being rotated 50 percent above the maximum rated engine rotative speed without danger of breaking or exploding. Flywheel housing shall be provided with a drain hole at the lowest point.
- 2.1.4.2 Assembly: Completely factory assemble each engine. Mount turbocharger, aftercooler if provided, and all piping integral with the engine, on the engine.
- 2.1.4.3 Engine Speed Governing System: Governing system shall be suitable for controlling the speed of the generator set within the requirements specified herein without intermediate adjustment and shall maintain the specified stability without hunting or cycling.
- 2.1.4.3.1 Speed (Frequency) Governing System: Set shall have an engine speed droop governing system, mechanical or hydraulic type, capable of maintaining the engine speed within a tolerance of plus or minus 0.5 percent of the rated engine speed when generator is carrying any constant load between no load and the net rated capacity load. Governing system shall be capable of maintaining the engine speed within a tolerance of

plus or minus 5 percent of rated engine speed when generator loading changes from no load to net rated capacity load, and vice versa.

- 2.1.4.4 Overspeed Shutdown Device: The overspeed shutdown device shall be entirely independent of the engine speed governing system and shall consist of solid state overspeed device mounted on the engine positively engaged so that engine speed shall not exceed 110 percent of synchronous speed, and shall react to shutoff the engine's air or fuel supply and trip the set output circuit breaker. Belt connections will not be allowed in this system. The overspeed device shall require manual resetting after emergency tripping.
- 2.1.4.5 Engine Fuel System: The engine shall be provided with all necessary equipment including piping, fittings, valves, filters (throw-away-type), strainers, and appurtenances. A mechanical fuel injection system shall be employed. Injection pumps shall be driven in a positive manner from cam or drive shaft. Injection pumps and injection valves shall be of a type not requiring adjustment in service and shall be capable of replacement by ordinary mechanics without special diesel experience. A pump for priming the fuel system shall be provided to facilitate easy starting.
- 2.1.4.6 Engine Lubricating Oil System: Provide with a full pressure lubricating system arranged to distribute oil to all moving parts of the engine and to cool the pistons. System shall include an engine-driven positive displacement pump, pressure regulating valves, oil filter, oil pressure indicator, crankcase ventilator for four cycle engines, and the necessary piping and fittings.
- 2.1.4.6.1 Lubricating Oil Filters: Shall be the full-flow type (throw-away-type) and shall be capable of filtering the full rate of oil flow of the oil pump at maximum engine speed. Means shall be provided to insure delivery of lubricating oil to vital wearing surfaces regardless of the condition of the filter. Additionally, the filter must provide a means of automatically bypassing filter if it should become flow-restricting.
- 2.1.4.6.2 Lubricating Oil Coolers: Provide to maintain the lubricating oil within the temperature limits recommended by the manufacturer. Oil cooler shall utilize the engine jacket cooling water from the radiator as the cooling medium. Temperature rise of the jacket water across the lubricating oil cooler shall be limited so that the temperature of the water leaving the lubricating oil cooler will be not higher than the optimum temperature as recommended by the engine manufacturer for jacket water to the engine. Cooler shall be either the shell and tube single or multipass design, or shall be built in as an integral part of the engine cooling radiator. The core shall be constructed of copperbase alloys. The cooler shall be designed for jacket water to pass through the tubes. The temperature of the oil to the engine shall be maintained at a reasonably constant value. Thermostats used in the oil cooler shall be of the non-adjustable type and factory set at the temperature as recommended by

the manufacturer. Where temperature of the oil in the cooler is regulated by controlling the jacket water temperature, the system design shall assure proper oil temperature under operating conditions.

- 2.1.4.7 Engine Cooling System: The radiator fan shall direct the air flow from the engine outward through the radiator, with horizontal air discharge. The fan shall be driven directly from the engine crankshaft or through V-belt drive. The radiator shall have sufficient capacity to dissipate not less than the total British Thermal Units per hour rejected by the engine to the cooling system at 110 percent rated load in 100 degrees F ambient, and against a static restriction of 0.5 inches of water as may be imposed by louvers, ductwork, etc. Cooling section shall have a tube and fin type core which shall consist of copper or copper base alloy tubes with nonferrous fins. The radiator shall be protected by a strong grille or metal bar guard on the exterior, and the fan shielded with a metal canopy. Filler caps shall be designed for pressure relief prior to removal. A thermostatic control valve shall be installed in the jacket water system of the engine to maintain the water system temperature of the engine. The thermostatic valve shall be the standard modulating type utilizing self-contained thermostats. The valve shall be capable of passing the water flow as determined by the manufacturer without excessive pressure drop across the valve. The valve shall be provided with one or more interchangeable thermostatic elements. The elements shall be non-adjustable type and the operating temperature shall be set at the temperature recommended by the engine manufacturer. The valve shall be designed so that in event of the thermostatic element failure, water will be able to flow through the engine. Engine shall be delivered with coolant liquid mixture of water and ethylene glycol, 50 percent by volume of each.
- 2.1.4.8 Engine Exhaust System: Provide a complete exhaust system including exhaust manifold, exhaust flexible connection and residential type silencer.
- 2.1.4.9 Exhaust Mufflers: A residential class muffler shall be provided for each engine which will reduce the exhaust sound spectrum to, or below, the following listed levels when measured with a sound level meter conforming to ANSI S1.4 at a 75 foot radius from the outlet, with engine loaded to full load and clear weather. Inlet and outlet connections shall be flanged and conform to drilling dimensions of ANSI B16.5, Class 150 or 300.

Frequency Band in Hertz			Sound Level	Decibels
20	_	75	78	
75	-	150	68	
150	-	300	60	
300	-	600	53	
600	-	1,200	48	
1,200	-	2,400	44	

- 2.1.4.10 Engine Air Induction System: The air induction system shall be equipped with heavy duty dry type air cleaners of adequate capacity to effectively remove the dirt and abrasives from the combustion air to the engine. When the engine air intake noise level is above the audible mechanical noise level of the engine, a combination filter—silencer or a separate silencer shall be provided. For two-stroke engines an air intake shut-off shall be provided which shall be operated by the engine over-speed shut-down device.
- 2.1.4.10.1 Scavenging air blowers for two stroke cycle engines shall be built integrally with and driven directly from the engine.
- 2.1.4.10.2 Turbocharger shall be a combination centrifugal blower driven by an exhaust gas turbine, with the air blower directly connected to the intake air manifold. Systems that require cooling of the intake air below ambient air temperature ahead of the turbocharger or scavenger air blower will not be acceptable. They may be lubricated from the engine pressure lubrication system or as recommended by the manufacturer. All necessary supports and connections shall be provided.
- 2.1.4.11 Engine Cranking System: NEMA ICS 1 and NEMA ICS 2. An electric cranking system shall be furnished, capable of rotating the engine at a speed sufficient for rapid starting in an ambient temperature of 20 degrees F. The system shall be designed to provide starting of the engine manually as well as automatically upon signal from the automatic transfer switch.
- 2.1.4.11.1 Crank Motor: The electric cranking system shall utilize 24-volt direct current (dc) electrical circuit, with the negative polarity grounded, energized by storage batteries. The cranking motor shall be of the heavy duty type with adequate capacity to crank the engine continuously to start the engine in an ambient temperature of 20 degrees F. The drive mechanism for engaging the starting motor with the engine flywheel shall be designed to inherently engage and release without binding. When the engine starts, a "stop cranking" switch which is engine speed actuated shall cause disengagement of the starting gearing and the shut-down of the starting motor. Engine starting shall be automatic. Automatic cranking controls shall crank the engine for three consecutive cycles before locking out the starting circuitry and activating the "overcrank" alarms. A cycle is defined as 15 seconds cranking followed by 15 seconds of no cranking.
- 2.1.4.11.2 Starting Aids: A jacket water heating system shall be provided to insure starting. The heater shall be thermostatically controlled at the temperature recommended by the engine manufacturer. Power leads shall be brought to a junction box which shall provide fusing for the heater. The junction box shall be mounted on the engine base.

- 2.1.4.11.3 Storage Battery: The engine cranking battery shall be S.A.E. Type "D," diesel engine starting type and of sufficient size and capacity in a fully charged condition to start the engine-generator six consecutive times. Batteries shall comply with Fed. Spec. W-B-133.
- 2.1.4.11.4 Battery Charger: The battery charger shall be enclosed, wall-mounted, automatic, dual rate, solid-state, constant voltage type having a.c. voltage compensation, d.c. voltage regulation and current limiting. The charger shall employ transistor controlled magnetic amplifier circuits to provide continuous taper charging. Charger shall have two ranges, float and equalize, with 0-24 hour equalizer time, d.c. cranking relay, silicon diode full-wave rectifiers, automatic surge suppressors, d.c. ammeter, d.c. voltmeter and fused inputs and outputs. Charger shall have a continuous rated output of not less than 10 amps. Battery charger shall conform to UL 1236.
- 2.1.4.12 Engine Spare Parts: Provide with generator set engine six spares of the following disposable type items: air filters, lubricating oil filter elements and fuel oil filter elements.

2.2 GENERATOR AND EXCITATION SYSTEM:

- 2.2.1 Generators: The generators shall be 480 and 208 volts, as indicated three-phase, 60-hertz, 0.80 power-factor alternating-current type with revolving field. The speed of the generator shall be that of the engine. The generator shall be capable of carrying continuously a 0.80 power factor load equal to the gross kilowatt rating of the diesel generating unit, and to carry a 0.80 power factor load ten percent in excess of the gross kilowatt rating of the diesel generating unit for 2 continuous hours out of any period of 24 consecutive hours at normal voltage and with a temperature rise of not more than 105 degrees C as measured by resistance based on 40 degrees C ambient temperature. Enclosures shall be weatherproof for installation outdoors. The generator shall conform to ANSI C50.10 and to NEMA MG-1. The generator shall have epoxy impregnated windings with class F insulation. The stator winding shall be arranged for wye connection with leads of each of the three-phase windings and nautral brought out of the bottom of the generator frame. The generator and flywheel shall have sufficient flywheel effect to meet the requirements of regulation and operation as specified. The rotor shall have continuous or interconnected amortisseur windings. Impellers shall be mounted on the rotor for cooling the generator. The rotor shall be capable of safe operation at a speed 25 percent in excess of its rated synchronous speed. The generator armature, field, and ground leads shall have clamp- or crimp-type lugs or connectors for electrical connections. Terminal markings shall conform to NEMA MG-1.
- 2.2.2 Excitation and Voltage Regulation System: The excitation system shall be the integral brushless-type consisting of a rotating a.c exciter and rectifier diode assembly together with a static type voltage regulating system and including surge protection and the required accessories. The system shall serve as an individual excitation and

regulation system for the generator specified herein and there is no requirement for parallel operation with other exciters. The excitation system shall have a continuous current rating of not less than the generator excitation current required when the generator operates at 105 percent rated voltage under the condition of continuous rating requiring maximum field current. The voltage rating of the system shall be as required to match the generator field requirements. The excitation system response ratio shall be not less than 0.5 and the ceiling voltage shall be not less than 120 percent of rated voltage.

- 2.2.2.1 Exciter: The exciter shall be a rotating a.c. generator having a rotating armature on the rotor spider and a stationary field on the stator frame. The exciter insulation shall be Class B and the temperature rise shall not exceed 70 degrees C when measured by resistance based on a 40 degree C ambient temperature.
- 2.2.2.2 Rectifiers shall be full-wave silicon diode type, with each diode protected by individual fuses. The rectifiers shall be mounted on the rotating part of the exciter to convert a.c. exciter output to d.c. for the main generator excitation. Connections shall be provided between the exciter, rectifiers, and generator field without use of brushes or slip rings.
- 2.2.2.3 Voltage Regulator: The voltage regulator shall be a completely solid state type for control of generator voltage by control of the exciter field. The regulator shall be suitable for mounting on the generator switchgear. The regulator shall control the generator exciter field as required to maintain a constant and stable generator output voltage within plus or minus 1/4 of one percent of nominal for all steady state loads from no load to full load including a five percent variation in frequency and the effects of field heating. The regulator shall be designed for single-phase voltage sensing from potential transformers furnished with the generator control panels. Electromagnetic interference suppression shall be an integral part of the regulator. Thermal protection for power semi-conductors, inherent over-voltage protection and fuse protection shall be provided internally in the regulator. No electrolytic capacitors, vacuum tubes, or electromechanical relays shall be used in the voltage regulator. A voltage regulator power supply transformer of adequate capacity for the regulator furnished shall be furnished for mounting in the generator switchgear. The regulator shall have provisions for switching to manual control to allow the generator voltage to be controlled either manually or automatically.
- 2.3 ENGINE-GENERATOR INSTRUMENTS AND CONTROLS: NEMA ICS 1, 2, 3, 4, and 6 as applicable.
- 2.3.1 Engine Control Panel: An engine control panel complete with cabinet and accessories shall be provided for each engine. The cabinet shall be the enclosed type fabricated of not lighter than 10 gage sheet steel. The cabinets shall be constructed with angle iron framework if required for proper stiffness and support. The gage panel shall be

mounted on the engine unit base. Isolation mounting material shall be used between the base and the control panel to isolate the panel from engine vibrations. All panel-mounted instruments and gages shall be provided with ID plates as specified herein. Piping and tubing as required to connect gages shall be provided. Components provided on each engine control panel shall include the following:

- 2.3.1.1 Gages: Pressure gage materials shall conform to GG-G-76, indicating dial type, minimum of 2 inches diameter, with silver or white dials and black markings. Duplex pressure gages shall be of the two Bourdon type style; pressure gages for all other services shall be of the single Bourdon tube style; pressure gages shall be provided with shut-off needle valves and suitable pressure snubbers. Temperature gages shall be indicating dial type with capilliary tubing covered with a protective casing throughout its entire length. Gages shall be provided to indicate operating parameters to an accuracy of within 2 percent of full scale reading including the following indications:
 - a. Engine jacket water temperature
 - b. Engine lubricating oil pressure
 - c. Engine lubricating oil temperature
- 2.3.1.2 Indicating Tachometer: The tachometer shall be an electronic type or mechanical type driven by the crankshaft through a flexible shaft. Electronic type tachometer, if provided, shall be complete with magnetic pick-up on engine, control signal, transformer, and indicator. The indicator shall be the direct-reading type with a dial minimum 4 inches in diameter and graduated in revolutions per minute. The instrument shall be accurate within 2 percent plus or minus over the entire range of engine speed permitted by the governor. The tachometer face shall be marked to indicate the synchronous rpm.
- 2.3.1.3 Running Time Meter: Provide meter with a totalizing mechanism that indicates not less than 9,999 hours and shall register accurately the number of hours of engine operating time.
- 2.3.1.4 Engine Protective Devices: The diesel engine battery shall provide power to operate visual annunciators and audible alarms.
- 2.3.1.4.1 Engine Safety Shutdown: Provide devices that shut off engine's air or fuel supply or both upon the following shutdown conditions: high engine coolant temperature, low engine oil pressure, engine overspeed and engine overcrank. When the engine's speed reaches or exceeds 110 percent of synchronous speed, the overspeed sensing device shall react to shut off the engine's air or fuel supplies or both and shall trip the generator's main circuit breaker.
- 2.3.1.4.2 Visual Annunciator: Provide visual indicators, with audible alarms, on engine control panel that annunciate each engine safety

shutdown when each occurs: high coolant temperature, low oil pressure, overspeed and overcrank. Visual indicator shall also indicate which safety shutdown occurred first. Label each indicator as specified herein. Provide indicators with manual reset. Audible alarm shall have the following components: alarm capable of producing a sound output rating of at least 85 decibels at 10 feet distance, audible alarm silencing switch, and automatic rating.

- 2.3.1.4.3 Pre-Shutdown Alarm: Provide pre-shutdown alarm devices that sense alarm conditions of high coolant temperature, and low oil pressure and upon such alarm conditions shall activate audible alarm and visual indicator at engine control panel. Provide at engine control panel labeled visual indicators one for each pre-shutdown alarm condition, that are activated also by each pre-shutdown alarm device. The indicators specified in the paragraph, "Visual Annunciators" may also be used to indicate pre-shutdown alarm. Visual indicators shall also indicate which pre-shutdown alarm condition occurred first. Provide these indicators with manual reset.
- 2.3.2 Generator Control Panel: The generator control panel shall be a hinged or bolted, sheet metal panel, mounted on a not lighter than sheet metal enclosure. All instruments and controls required to operate and monitor performance of the generator shall be included, but shall be not less than specified herein. Auxiliaries, such as instrument transformers and voltage regulator, may be located behind the control panel in the sheet metal enclosure. Instruments, controls, and indicating lights shall be flush mounted on the generator control panels and wired for proper operation. The generator control panels shall be an integral part of the generator set. Instruments shall comply with ANSI C39.1. Generator control panels shall include instruments and controls as follows:
 - a. Voltmeter and Ammeter: Semi-flush mounted direct indicating type, not less than 3.5 inch nominal round or square, 180 degree arc, with accuracy of two percent of full scale.
 - b. Frequency Meter: Dial type.
 - c. Control Switches: Voltage and ampere ratings suitable for the intended use. Contacts shall be rated in accordance with NEMA Standards ICS 2-125 A600.
 - d. Generator Output Circuit Breaker: Shall comply with Fed. Spec. W-C-375 thermal magnetic type. Molded case type, trip-free, and shall be mounted to allow operation from outside the control panel. Frame size shall be adequate for generator amperage when operating at standby rating, and an adjustable trip shall be provided. Lugs shall be provided for electrical connections.
 - e. Voltage adjustment rheostat.

- f. Panel lights and control switch.
- g. Alarm indicating panel.
- 2.3.3 Combined Panel: Generator control panel may be combined with the engine control panel to provide a single operator set control panel.

2.4 MOUNTING BASE:

2.4.1 Mounting Base: The new diesel generator shall be factory mounted on a common base fabricated of structural steel sections. The structural base shall be of the skid type and shall have adequate strength and rigidity to maintain alignment of the equipment mounted thereon with dependence on a concrete foundation. The base shall be provided with suitable lifting attachments. The attachments shall be located so that, when the equipment is hoisted, adequate clearance will exist between lifting slings and all exterior parts of the equipment.

2.5 AUTOMATIC TRANSFER SWITCH: UL 1008.

- 2.5.1 Automatic Transfer Switch: Provide automatic transfer switch and associated isolation and by-pass switch with the number of poles. amperage, voltage, and withstand ratings as shown. Transfer switch shall be listed per UL 1008 as a recognized component for emergency systems and rated for all classes of loads when installed in an unventilated enclosure. Electrical operation shall be accomplished by non-fused momentarily energized solenoid direct operating mechanism or stored energy operator. Mechanical locking in each direction shall be provided. Operation shall be inherently double throw where normal and emergency contacts operate with no intentional delay in mid position. Main pole structures shall be designed so that fault currents result in increased main contact pressure. An overload or short circuit shall not cause the switch to go to a neutral position. Main contacts shall be designed for automatic transfer switch service. Inspection and replacement of all main and separate arcing contacts moving and stationary, shall be possible from the front of the switch without any disassembly of operating linkages or power conductors.
- 2.5.2 Accessories: A separately mounted unitized control module shall include:
 - a. Non-adjustable (one-second, nominal) time delay to override momentary dips in normal power source.
 - b. Phase voltage relay supervision of three phases of the normal source 65 to 70 percent drop-out (D.O.) and 92 to 95 percent pick-up (P.U.) to detect "brown-out" conditions.
 - c. Voltage/frequency lockout relay (90 percent P.U., nominal) to prevent premature transfer.
 - d. System test switch (momentary type).

- e. Engine starting control contacts (one-N.C. and one-N.O.).
- f. Auxiliary pilot contacts rated 10 amperes at 480 V., 23 amperes at 208 V. a.c. (one closed on "N" (normal) and one closed on "E" (emergency)).
- g. Adjustable 2-25 minutes time delay on retransfer to normal power source.
- h. The switch shall have full rated neutral transfer contacts driven by the main contact shaft.
- i. Provide adjustable time delay, 5 to 15 minutes, on shutdown of engine-generator after retransfer of the load to "normal."
- j. Pilot lights to indicate source to which the load is connected.
- 2.6 AUTOMATIC TRANSFER SWITCH BY-PASS/ISOLATION SWITCH: A manual by-pass isolation switch shall be provided for the automatic transfer switch, arranged to bypass the emergency or the normal source of power directly to the load in one operation, isolating the automatic transfer switch from the load and both normal and emergency sources for transfer switch maintenance purposes. The by-pass-isolation switch shall be lockable in the "isolated" position. The arrangement shall permit electrical testing of the transfer switch before the load is reconnected. Interlocks shall prevent operation of the transfer switch, except for testing purposes, when the switch is in the "isolated" position. The enclosure shall be designed so that the automatic transfer switch and the isolation switch shall be accessible through individual door openings and installed in separate barriered compartments to eliminate any exposure to the operator when servicing the automatic transfer switch while the isolation switch is in the by pass isolation positon. The isolation switch compartment shall include a pilot light arranged to indicate when the switch is in the by-pass isolation position. Bypassing the automatic transfer switch shall not cause any interruption of power to the load. The current, voltage, phase, pole (with switched neutral) and short circuit ratings shall be at least equal to the transfer switch ratings. The bypass switch may be a non-loadbreak device but shall have at least equal short circuit withstand rating as the transfer switch. When the switch is installed in a non-ventilated enclosure and is carrying rated current, it's contact temperature shall not exceed the limitations designed for the transfer switch.
- 2.7 WIRE AND CABLE: Provide all wire and cable required for a complete electrical system as shown.
- 2.7.1 Conductors: Specified by American Wire Gage (AWG). Unless otherwise indicated or specified, conductors No. 6 and smaller shall be copper; conductors No. 4 and larger shall be either copper or aluminum. Copper shall be soft annealed coated type per ASTM B 33 or ASTM B 189.

Aluminum shall be EC grade conforming to ASTM B 230, or ASTM B 609, as applicable. Size, type, use, and location for all circuits shall be as shown on the "Circuit Schedule" on the drawings. Wire and cable sizes indicated are for copper; if aluminum is used, it must have the equivalent copper ampacity rating. Power cables No. 12 and smaller may be solid or 7-strand. Power cables No. 10 and larger shall be Class B stranding per ASTM B 8 (copper) or ASTM B 231 (aluminum). Multiple-conductor control cables shall be either 7-strand or 19-strand. Thermocouple extension wires shall be solid.

- 2.7.2 Insulation: As designated on the drawings, conforming to the following:
 - a. Multiple-Conductor Control Cables: Insulate for 600-volt service. Provide cables with necessary fillers and binder tape. Color-code individual conductors in accordance with ICEA, Method 1.
- 2.8 SPECIAL WRENCHES AND TOOLS: Wrenches and tools specifically designed and required to work on the new equipment, which are not commercially available as standard mechanic's tools, shall be furnished to the Contracting Officer.
- 2.9 IDENTIFICATION (ID) PLATES AND TAGS: Provide plates and tags sized so that inspection is readily legible to operating or maintenance personnel and securely mounted to or attached in proximity of their identified controls or equipment. Lettering shall be normal block lettering, a minimum of 0.25 inches high.
- 2.9.1 Materials: ID plates and tags shall be constructed of 16 gauge minimum thickness bronze or stainless steel sheet metal engraved or stamped with inscription. Plates and tags not exposed to the weather or high operational temperature of the diesel engine may be constructed of laminated plastic, black finish with white center core, with lettering accurately aligned and engraved into the white core.
- 2.9.2 Control Devices and Operation Indicators: Provide ID plates or tags for all provided control devices and operation indicators, including valves, off—on switches, visual alarm annunciators, gages and thermometers, that are required for operation and maintenance of provided mechanical systems. Plates or tags shall be minimum of 0.5 inch high and 2 inches long and shall indicate component system and component function.
- 2.9.3 Equipment: Provide ID plates of a minimum size of 3 inches high and 5 inches long on provided equipment indicating the following information:
 - a. Manufacturer, type and model number
 - b. Contract number and accepted date

- c. Capacity or size
- d. System in which installed
- e. System which it controls
- 2.10 FUEL OIL SYSTEM NOT INTEGRAL WITH ENGINE: Provide threaded fittings and end connections for steel piping. Jointing compound for pipe threads shall be pipe cement and oil, or graphite and oil. Short nipples shall be extra strong. Fuel oil piping shall be steel piping, except fuel oil supply and return piping may be copper tubing.
 - a. Steel Pipe: ASTM A53 or A120, black steel, Schedule 40. Provide steel piping buried in the ground with exterior coal tar coating system in accordance with SSPC PS-10.01.
 - b. Threaded Fittings: ANSI B16.11 or B16.3, Class 150.
 - c. Unions: ANSI B16.39, Class 150.
 - d. Copper Tubing: ASTM B88, Type K, with ANSI B16.18 or B16.22 solder joint fitting, or ANSI B16.26 flared fittings.
- 2.10.1 Fuel Oil Tank: Mil. Spec. MIL-T052777 with the additions and modifications specified. Provide a 12-inch by 12-inch by 1/4 inch aluminum plate laminated on inside bottom surface of the tank at a point vertically below the fill pipe opening and oil level gaging rod opening.
- 2.10.2 Day Tank: The day tank shall meet all applicable requirements of NFPA No. 30 and UL 142, and shall include hangers, brackets, fittings, vents, and other accessories required for installation. The fuel storage capacity of the tank shall be not less than 60 gallons.
- 2.10.2.1 Fuel Transfer Pump: A fuel transfer pump shall be mounted on the day tank supporting frame for use in conjunction with the day tank. The fuel transfer pump shall be a horizontal, position displacement, rotary pump, directly connected to an electric motor. The motor shall be a dripproof, 120 volt, single phase motor conforming to NEMA MG-1. The pump shall be capable of delivering not less than 1 gallon per minute of fuel conforming to ASTM D 975, grade 2-D, at a temperature of 32 degrees Fahrenheit, against a total dynamic head of 20 pounds per square inch and a suction lift of 10 feet. The fuel transfer pump shall be automatically controlled by a float switch in the day tank. The motor controller shall conform to NEMA ICS-1 and ICS-2 and have a HAND-OFF-AUTO selector switch. The fuel transfer day tank system shall also have a positive shutoff so that when the day tank is full, no fuel can flow into the day tank even though the external fuel supply system is pressurized.
- 2.10.2.2 Hand-Operated Transfer Pump: Provide mounted on or integral with day tank; self-priming; minimum capacity of 15 gallons per minute; rotary type with cast iron body, carbon sliding vanes and

stainless steel springs, self-adjusting for wear; suitable for pumping diesel fuel oil.

PART 3 - EXECUTION

- 3.1 INSTALLATION: Installation shall conform to the requirements of the NFPA 30, NFPA 37 and NFPA 70.
- 3.2 INSTALLATION SUPERVISION: The Contractor shall furnish the services of a qualified installation engineer or technician regularly employed by the diesel generator set manufacturer for a minimum of two 8-hour working days to supervise the field testing of each diesel generator set, and auxiliaries.
- 3.2.1 Initial Start-Up: After the installation is complete, the installation engineer shall conduct a final pre-start check. He shall inspect each diesel generator, fuel supply systems, controls, transfer switch, and all auxiliary equipment. The installation engineer shall conduct the initial start-up and shall check each engine and generator for normal operation.
- 3.2.2 Test: The installation engineer shall be present for the final test of the diesel generating unit. During the unit acceptance test, the installation engineer shall conduct the tests specified in the paragraph entitled "Generating Unit Tests" and shall provide the Contracting Officer with a written test report showing the tests performed and the results of each test.
- 3.2.3 Instructing Operating Personnel: Upon completion of the work and at a time designated by the Contracting Officer, the services of a competent installation engineer or technician regularly employed by the diesel generator set manufacturer shall be provided for a period of not less than one 4-hour period for the instruction of the Government operating personnel in the proper operation and maintenance of the equipment.

3.3 TESTS AND INSPECTIONS:

- 3.3.1 Shop Tests: Shop tests shall be performed on the complete shop assembled diesel engine driven electric power generator unit prior to shipment. The Contractor shall provide the Contracting Officer with certified copies of all manufacturers' shop test data and results. All equipment necessary for tests shall be provided by the manufacturer performing the tests, and all measuring and indicating devices shall be certified to be within calibration or correction data furnished for the device. Tests shall indicate satisfactory operation.
- 3.3.1.1 General Shop Tests: Temperature tests on the generator shall be performed by the manufacturer of that equipment in his own plant prior to installation on the generating unit mounting base. Temperature tests shall be in accordance with IEEE No. 115.

- 3.3.1.2 Diesel Engine Shop Tests: Hydrostatic test shall be performed to assure that water seals and water jackets are watertight. Test report shall indicate that test was performed, pressure at which test was made and results.
- 3.3.1.3 Diesel Engine-Driven Generating Unit Load Test: Shall be placed in continuous operation without stoppage for a period of not less than four hours. During this period, the diesel generator unit shall be operated one hour at each load point of half, three-quarter, full load and 110 percent of net rated capacity load at 0.80 power factor. If stoppage becomes necessary during this period, the 4-hour run shall be repeated. The following data shall be recorded at the start, at 15 minute intervals and at the end of each load level run.
 - a. Fuel consumption
 - b. Jacket water temperatures
 - c. Lube oil temperatures and pressures
 - d. Rpm's
 - e. Voltage, amperage, frequency
- 3.3.1.4 Certified Test Reports: Provide test reports, certified by diesel engine driven electric power generator unit manufacturer, which includes the following:
 - a. Data specified hereinbefore for shop tests.
 - b. List of and description of test equipment and test data measuring instruments used in shop tests and calibration dates for test data measuring instruments.
 - c. Statements by the shop tests directors that the test results and data meets the manufacturer's recommended limits and is acceptable to the test directors.
 - 3.3.1.5 Shipment of Equipment: Contractor shall not commence shipment of the equipment without having Contracting Officer's approval of the shop test reports.
 - 3.3.2 Field Tests and Inspections: All equipment, apparatus and consumables necessary for the tests, including required dummy load, shall be provided by the Contractor. The use of make-shift heater rheostats for dummy loads is prohibited. Tests shall be made under the direction of the installation engineer.
 - 3.3.2.1 Generating Unit Tests: When the Contractor considers the installation complete and in first class operating condition, and after preliminary operation has been successfully demonstrated, he shall give

two weeks advance notice to the Contracting Officer, in writing, that the generating units and auxiliary equipment are ready and final field tests will be conducted. The installation engineer shall perform tests to make certain that all equipment is functioning properly. These tests shall include the following:

- a. The diesel generator unit shall be operated loaded to the following conditions: half load, three-quarter load, full load, 110-percent of net rated capacity load, at a power factor of 1.0. Each load state shall be maintained on the generator for a period sufficient for all operating parameters to stabilize. Observe and record generator unit operating parameters including oil temperature and pressure, coolant temperature, rpm, voltage, frequency, and amperage to verify all values are within manufacturers recommended limits.
- b. Test to verify satisfactory generating unit speed regulation under a gradual change from zero to full load.
- c. Test to verify satisfactory generating unit instantaneous speed change with 25 percent load on or off.
- d. Test to assure proper functioning of the overspeed trip.
- e. Individual test of each alarm and prealarm switch to verify correct operation of the visual indicator and alarm system.
- f. Simulated power outage.
- 3.3.2.2 Test Report: Upon completion of field testing, the erection engineer shall prepare a test report indicating the tests performed and the test data and test results of those tests. The report shall include a list of and description of test equipment and test data measuring instruments and calibration dates for these test data measuring instruments. The installation engineer shall make the statement on the test report that the test data taken from each diesel generator during the field test falls within the manufacturer's recommended limits and that each diesel generator installation is acceptable to the installation engineer. The report shall be dated, signed and given to the Contracting Officer. This report will not constitute automatic acceptance of the installation by the Government.
- 3.3.2.3 Fuel Oil Tank (Exterior of Building): Prior to lowering the tank into its hole, pressurize the tank with air to 5 psig at ambient temperature. Valve off this volume of test air and verify that there is no drop in test pressure for a period of at least 10 minutes. Any loss of test pressure in the test period or any indication of permanent deformation or damage to the tank shall constitute failure of this test.

*** END OF SECTION ***

SECTION 16301

UNDERGROUND ELECTRICAL WORK

PART 1 - GENERAL

B 1-70

- 1.1 APPLICABLE PUBLICATIONS: 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.
 - 1.1.1 Federal Specifications (Fed. Spec.):

RR-F-621C Frame, Covers, Gratings, Steps, Sump and Catch Basin, Manhole

RR-G-661D Grating, Metal, Bar Type (Floor, Except for Naval Vessels)

1.1.2 American Association of State Highway and Transportation Officials (AASHTO) Publication:

Standard Specifications for Highway Bridges (Jul 1978)

1.1.3 American Concrete Institute (ACI) Publications:

315-74 Manual of Standard Practice for Detailing (R1978) Concrete Structures

318-77 Building Code Requirements for Reinforced Concrete, Including Commentary

1.1.4 American National Standards Institute (ANSI) Publication:

C2-1981 National Electrical Safety Code (NESC)

Hard Drawn Copper Wire

1.1.5 American Society for Testing and Materials (ASTM) Publications:

(R 1976)

B 8-77 Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

C 309-74 Liquid Membrane Forming Compounds for Curing Concrete

D 698-78 Moisture Density Relations of Soils and Soil-Aggregate Mixtures Using 5.5-1b. (2.49-KG)
Rammer and 12-in. (305-MM) Drop

D 1556-64 Density of Soil in Place by the Sand Cone Method

D 1557-78 Moisture-Density Relations of Soils and Soil Aggregate Mixtures Using 10-1b. (4.54-KG) Rammer and 18-inch (457-MM) Drop

1.1.6 National Electrical Manufacturer's Association (NEMA) Publications:

TC2-1978 Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80) TC3-1978 PVC Fittings for Use with Rigid PVC Conduit and Tubing TC6-1978 PVC and ABS Plastic Utilities Duct for Underground Installation TC9-1978 Fittings for ABS and PVC Plastic Utilities Duct for Underground Installation	WC3-1969 (REV 9-78)	Rubber Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (IPCEA S-19-81)
Tubing TC6-1978 PVC and ABS Plastic Utilities Duct for Underground Installation TC9-1978 Fittings for ABS and PVC Plastic Utilities Duct		Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80)
Underground Installation TC9-1978 Fittings for ABS and PVC Plastic Utilities Duct	TC3-1978	
	TC6-1978	

1.1.7 National Fire Protection Association (NFPA) Publication:

70-1981 National Electrical Code (NEC)

1.1.8 Underwriter's Laboratories Inc. (UL) Publications:

467-1972 Grounding and Bonding Equipment (1978)

510-1976 Insulating Tape

514-1979 Outlet Boxes and Fittings

854-1979 Service-Entrance Cables

- 1.2 GENERAL REQUIREMENTS: Section 16011, "Electrical General Requirements" applies to this section with additions and modifications specified herein.
- 1.2.1 Services: Services to the Water Treatment Plant, Lift Station BB-1, Well BB-220, and Well BB-221 are existing. Services to the Sewage Treatment Plant and new well shall be underground. Connections of the underground service to the panelboard is included in Section 16402, "Interior Wiring Systems". Ends of the underground conduit shall be protected by threaded metal caps until connections are made.

- 1.2.2 Electrical Characteristics: Primary electrical characteristics for this project are 12.47 kV, three phase, 4 wire, 60 hertz. Secondary electrical characteristics are as follows:
 - a. Water Treatment Plant and Wells: 120/208 volts, three phase, 4 wire, wye connected.
 - b. Sewage Treatment Plant: 277/480 volts, three phase, 4 wire, wye connected for distribution and large motors and 120/208 volts, three phase, 4 wire, wye connected for lighting, receptacles and miscellaneous small loads.
 - c. Lift Station BB-1: 120/208 volts, three phase, 4 wire, wye connected.
 - 1.2.3 Laboratory Tests:
- 1.2.3.1 Determine soil-density relationships as specified for soil tests in section entitled Earthwork.
 - 1.3 SUMITTALS REQUIRED:
 - 1.3.1 Shop Drawings (S) or Manufacturer's Data (M):

Conduit (M)
Insulating Tape (M)
Handhole Frame and Cover (M)
Cable Lubricants (M)
Sealing Material for Precast Manhole and Handhole Joints (M)
Precast Handholes (S):

- a. Material Description (i.e. fc and fy)
- b. Manufacturers Printed Assembly and Installation Instructions
- c. Design Calculations
- d. Reinforcing Shop Drawings Prepared in Accordance with ACI-315
- 1.3.2 Manufacturer's Instructions:
 - a. Manufacturer's directions for use of ground megger with proposed method indicated.
- 1.3.3 Certificates:
- 1.3.3.1 Material and Equipment: Provide manufacturer's statement certifying that the product supplied meets or exceeds contract requirements.
 - a. Precast handhole and accessories.
 - b. Handhole frame and cover.

PART 2 - PRODUCTS

- 2.1 MATERIALS AND EQUIPMENT: Provide materials and equipment listed by UL or approved by Factory Mutual (FM) System, when such equipment is listed or approved.
- 2.1.1 Conduit: Conduit shall be plastic conforming to the following:
- 2.1.1.1 Plastic duct for concrete encased burial shall be PVC and shall conform to NEMA TC6, Type EB. Fittings shall conform to NEMA TC9.
- 2.1.1.2 Plastic conduit for direct burial shall be PVC conforming to NEMA TC2 (conduit) and TC3 (fittings) Type EPC-40-PVC.
- 2.1.2 Tape: Plastic insulating tape shall conform to the requirements of UL 510.

2.1.3 Wire and Cable:

- 2.1.3.1 Wire and cable conductor sizes are designated by American Wire Gauge (AWG). Conductor and conduit sizes indicated are for copper conductors, unless otherwise noted. Insulated conductors shall bear the date of manufacture imprinted on the wire insulation with other identification. Wire and cable manufactured more than 12 months before delivery to the job site shall not be used.
- 2.1.3.2 Conductors rated 600 volts and less, including service entrances, shall conform to UL 854, Type USE. Conductors shall be copper. Conductor size and number of conductors in each cable shall be as indicated. Cable shall be color coded. Conductor identification shall be provided within each enclosure where a tap, splice or termination is made. Conductor identification shall be by color coded insulated conductors, plastic coated self sticking printed markers, colored nylon cable ties and plates or heat shrink type sleeves. Control circuit terminations shall be properly identified.

Colors for coding conductors shall be:

208 VOLT SYSTEM

480 VOLT SYSTEM

Neutral - White
Phase A - Black
Phase B - Red
Phase C - Blue
Phase C - Green

Neutral - White
Phase A - Brown
Phase B - Orange
Phase C - Yellow
Grounding Conductor - Green

Red
Phase C - Yellow
Grounding Conductor - Green

2.1.3.3 Pull Wire: Pull wire shall be plastic having a minimum tensile strength of 200 pounds. Minimum 12 inches of slack shall be left at each end of pull wire.

- 2.1.3.4 Connectors and Terminals: Connectors and terminals shall be designed and approved for use with the associated conductor material, and shall provide a uniform compression over the entire contact surface. Solderless terminal lugs shall be used on all stranded conductors.
- 2.1.4 Grounding: Grounding and bonding equipment shall conform to UL 467. Ground rods shall be copperweld type copper clad steel with diameter adequate to permit driving to full length of the rod, but not less than 3/4 inch in diameter and 10 feet long unless otherwise indicated.
- 2.1.5 Materials for Manholes and Handholes: Manholes and handholes are referred to throughout this section as "structures" or "underground structure".
- 2.1.5.1 Metal Frames and Covers: Provide cast iron or steel frames and covers conforming to Fed. Spec. RR-F-621 except where rolled steel floor plate is indicated.

PART 3 - EXECUTION

- 3.1 INSTALLATION: Underground installation shall conform to ANSI C2 and NFPA 70 except as otherwise specified or indicated.
- 3.1.1 Contractor Damage: The Contractor shall promptly repair any indicated utility lines or systems damaged by his operations. Damages to lines or systems not indicated, which are caused by his operations shall be treated as "Changes" under the terms of the General Provisions of the contract. If the Contractor is advised in writing of the location of a nonindicated line or system, such notice shall provide that portion of the line or system with "indicated" status in determining liability for damages. In any event, the Contractor shall immediately notify the Contracting Officer of any such damage.
- 3.1.2 Direct Burial System: The cables shall be buried directly in earth, except that under paved areas and roadways the cables shall be installed in conduit. Ducts shall be sloped to drain. Trenches in which the cables are placed shall be excavated by hand or with mechanical trenching equipment. Provide a minimum cable cover of 24 inches below finished grade for power and signal conductors. Trenches shall be not less than 6 inches wide, and shall be in straight lines between cable markers. Bends in trenches shall have a radius of not less than 36 inches. Where two or more cables are laid parallel in the same trench. they shall be spaced laterally at least 3 inches apart. When rock is encountered, it shall be removed to a depth of at least 3 inches below the cable and the space filled with sand or clean earth free from particles larger than 1/4 inch. Cables shall not be unreeled and pulled into the trench from one end. However, the cable may be unreeled on grade and lifted into position. Provide a plastic warning tape as specified hereinafter.

- 3.1.2.1 Cables crossing other cables or metal piping shall be separated from the other cables or pipe by not less than 3 inches of well tamped earth.
- 3.1.2.2 Cables shall be in one piece without splices between connections except where the distance exceeds the lengths in which the cable is furnished.
- 3.1.2.3 Bends in cables shall be not less than those specified in NFPA 70 for the type of cable specified.
- 3.1.2.4 Horizontal slack of approximately 3 feet shall be left in the ground on each end of cable runs, on each side of connection boxes, and at all points where connections are brought above ground. Where cable is brought above ground, additional slack shall be left to make necessary connections.
- 3.1.2.5 Identification Slabs: Provide a slab at each change of direction of the cable, over the ends of ducts or conduits which are installed under paved areas and roadways, and over each splice. Identification slabs shall be of concrete, approximately 20 inches square by 6 inches thick and shall be set flat in the ground so that the top surface projects not less than 3/4 inch, nor more than 1-1/4 inches above ground. The concrete shall have a compressive strength of not less than 3000 psi and have a smooth troweled finish on exposed surface. An identifying legend such as "cable", "duct", "splice", or other applicable designations shall be inscribed on the top surface before the concrete hardens. The letters and/or figures shall be approximately 2 inches high and the grooves shall be approximately 1/4 inch in width and depth. The slabs shall be installed so that the side nearest the inscription on the top shall include an arrow indicating the side nearest the cable.
 - 3.1.3 Underground Duct Without Concrete Encasement:
- 3.1.3.1 Conduits shall be PVC, Type EPC-40; Type EPC-80 shall be utilized where specified below. Single underground conduit runs shall not be concrete encased.
- 3.1.3.2 The top of the duct shall be not less than 24 inches below grade, shall have a minimum slope of 3 inches in each 100 feet away from buildings and toward handholes and other necessary drainage points, and shall run in straight lines except where a change of direction is necessary. As each conduit run is completed, a testing mandrel not less than 12 inches long with a diameter 1/4 inch less than the inside diameter of the duct; after which a brush, having stiff bristles, shall be drawn through until the conduit is clear of all particles of earth, sand or gravel; conduit plugs shall then immediately be installed. There shall be not less than 3 inches clearance from the conduit to each side of the trench. The bottom of the trenches shall be graded smooth; where rock, soft spots, or sharp edged materials are encountered, the bottom shall be excavated for an additional 3 inches, filled and tamped level with the

original bottom with sand or earth free from particles, that would be retained on a 1/4-inch sieve.

- 3.1.3.3 Under roads and paved areas, conduits shall be PVC Schedule 80.
- 3.1.4 Underground Duct with Concrete Encasement: Underground duct lines shall be constructed of two or more individual conduits encased in concrete and shall be PVC Type EB. The kind of conduit used shall not be mixed in any one duct bank. The concrete encasement surrounding the bank shall be rectangular in cross-section and shall provide at least 3 inches of concrete cover for ducts. Conduit shall be separated by a minimum concrete thickness of 2 inches, except that light and power conduits shall be separated from control, signal, and telephone conduits by a minimum concrete thickness of 3 inches.
- 3.1.4.1 The top of the concrete envelope shall not be less than 18 inches below grade except that under roads and pavement it shall be not less than 24 inches below grade.
- 3.1.4.2 Duct lines shall have a continuous slope downward toward underground structures and away from buildings with a pitch of not less than 3 inches in 100 feet. Except at conduit risers, changes in direction of runs exceeding a total of 10 degrees, either vertical or horizontal, shall be accomplished by long sweep bends having a minimum radius of curvature of 25 feet, sweep bends may be made up of one or more curved or straight sections or combinations thereof. Manufactured bends shall have a minimum radius of 18 inches for use with conduits of less than 3 inches in diameter and a minimum radius of 36 inches for ducts of 3 inches in diameter and larger. Trenches shall be excavated along straight lines from structure to structure before ducts are laid or structure constructed so the elevation can be adjusted, if necessary, to avoid unseen obstruction.
- 3.1.4.3 Conduits shall terminate in end-bells where duct lines enter underground sructures. Provide plastic duct spacer assemblies consisting of base spacers, intermediate spacers, and top spacers that interlock vertically and horizontally to provide a completely enclosed and locked-in duct-bank. Install spacers per manufacturer's instructions but provide a minimum of two spacer assemblies per 10 feet of duct bank. The joints of the conduits shall be staggered by rows and layers so as to provide a duct line having the maximum strength. During construction, partially completed duct lines shall be protected from the entrance of debris such as mud, sand and dirt by means of suitable conduit plugs. As each section of a duct line is completed from structure to structure, a testing mandrel not less than 12 inches long with a diameter 1/4 inch less than the size of the conduit, shall be drawn through each conduit, after which a brush having the diameter of the duct, and having stiff bristles shall be drawn through until the conduit is clear of all particles of earth, sand, and gravel; conduit plugs shall then be immediately installed.

- 3.1.4.4 New conduit indicated as being unused or empty shall be provided with plugs on each end. Plugs shall contain a weephole or screen to allow water drainage.
- 3.1.4.5 Connections to New Handholes: Concrete encased duct lines connecting to underground structures shall be constructed to have a flared section adjacent to the handhole to provide shear strength. Underground structures shall be constructed to provide for keying the concrete envelope of the duct line into the wall of the structure. Vibrators shall be used when this portion of the envelope is poured to assure a seal between the envelope and the wall of the structure.
- 3.1.4.6 Partially Completed Duct Lines: During construction wherever a construction joint is necessary in a duct line, prevent debris such as mud, sand, and dirt from entering ducts by providing suitable conduit plugs. Fit concrete envelope of a partially completed duct line with reinforcing steel extending a minimum of two feet back into the envelope and a minimum of two feet beyond the end of the envelope. Provide one No. 4 bar in each corner, three inches from the edge of the envelope. Secure corner bars with two No. 3 bars, spaced approximately one foot apart, all around. Restrain reinforcing assembly from moving during concrete pouring.
- 3.1.5 Underground Conduit for Service Feeders: Underground conduit for service feeders into buildings shall be rigid steel from the service equipment to a point 5 feet beyond the building and projections thereof. The ends of the conduit shall be protected by threaded metal caps or bushings; the threads shall be coated with graphite grease or other suitable coating. Conduit shall be cleaned and plugged until conductors are installed.
- 3.1.6 Concrete: Concrete for electrical requirements shall have a compressive strength of 3000 psi at 28 days with one inch maximum aggregate conforming to the requirements of Section 03300, "Cast-In-Place Concrete".
- 3.1.7 Warning Tapes in Earth Trenches: For the purposes of early warning and identification during future trenching or other excavation, continuous identification tapes shall be provided in the trench above direct buried cables and conduits. Tape shall be non-magnetic plastic tape or aluminum foil plastic backed tape manufactured for the purpose of early warning and identification of utilities buried below the tape. Tape shall be at least three inches in width. Color of tape shall be standard with the manufacturer for the type of utility buried below the tape. Tape shall have lettering at least one inch high with not less than the following identification on the tape: "BURIED ELECTRIC LINE BELOW" or "BURIED SIGNAL LINE BELOW". Tape shall be installed according to the printed recommendations of the tape manufacturer, as modified herein. Tapes shall be buried at a depth of 6 inches below the top surface of earth; in pavements this 6 inches shall be measured from the top of the subgrade.

3.1.8 Reconditioning of Surfaces:

- 3.1.8.1 Unpaved surfaces disturbed during the installation of duct or direct burial cable shall be restored to their original elevation and condition. Sod or topsoil shall be preserved carefully and replaced after the backfilling is completed. Sod that is damaged shall be replaced by sod of quality equal to that removed. Where the surface is disturbed in a newly seeded area, the restored surface shall be reseeded with the same quantity and formula of seed as that used in the original seeding.
- 3.1.8.2 Paving Repairs: Where trenches, pits or other excavations are made in existing roadways and other areas of pavement where surface treatment of any kind exists, such surface treatment or pavement shall be restored to the same thickness and in the same kind as previously existed, except as otherwise specified, and to match and tie into the adjacent and surrounding existing surfaces in a neat and acceptable manner.
- 3.1.9 Cable Pulling: Cables shall be pulled down grade with the feed-in point at the manhole or buildings of the highest elevation. Flexible cable feeds shall be used to convey cables through the manhole opening and into the duct runs. Cable lubricants shall be soapstone, graphite or talc for rubber or plastic jacketed cables.
- 3.1.9.1 Lubricants for assisting in the pulling of PVC, neoprene, or polyethylene jacketed cables shall be those specifically recommended by the cable manufacturer.
- 3.1.9.2 Cable pulling tensions shall not exceed the maximum pulling tension recommended by the cable manufacturer.
- 3.1.9.3 Secondary cable runs, 600 volts and less, shall include an insulated copper equipment grounding conductor sized as required by the rating of the overcurrent device supplying the phase conductors.

3.1.10 Handholes:

3.1.10.1 Workmanship: Underground structures shall be poured in place or may be of precast construction as specified hereinafter. Horizontal concrete surfaces of floors shall have a smooth trowel finish. Concrete shall be cured by applying two coats of white pigmented membrane forming—curing compound in strict accordance with the manufacturer's printed instructions, except that precast concrete may be steam cured. Curing compound shall conform to ASTM C 309. Handholes shall be standard type 2 according to Sketch NFGS 16301L-3. Covers shall fit the frames without undue play. Steel and iron shall be formed to shape and size with sharp lines and angles. Castings shall be free from warp and blow holes that may impair their strength or appearance. Exposed metal shall have a smooth finish and sharp lines and arrises. Provide all necessary lugs, rabbets and brackets. Set pulling—in irons and other built—in items in place before depositing concrete. The word "signal" shall be cast in the top face of covers.

- 3.1.10.2 Optional Precast Concrete Construction: In lieu of poured-in-place concrete handholes, the Contractor may, at his option, provide precast concrete structures, subject to the requirements specified below. Precast units shall be the product of a manufacturer regularly engaged in the manufacture of precast concrete products, including precast handholes.
 - General: Precast concrete structures shall have the same accessories and facilities as required for poured-in-place structures. Likewise, they shall have plan area and clear heights not less than those of poured-in-place structures. Concrete materials and methods of construction shall be the same as for poured-in-place concrete construction, as modified herein. Slope in floor may be omitted provided precast sections are poured in reinforced steel forms. Concrete for precast work shall have an ultimate 28-day compressive strength of not less than 4000 pounds per square inch. Structures may be precast to the design and details shown for poured-in-place construction, precast monolithically and placed as a unit: or, they may be of assembled sections. designed and produced by the manufacturer in accordance with the requirements specified. All structures shall be identified with the manufacturer's name embedded in, or otherwise permanently attached to, an interior wall face.
 - b. Design for Assembled Units: Precast structures shall be designed in accordance with ACI-318 and shall be based on the following properties:

Angle of Internal Friction $(\emptyset) = 30$ Degrees Unit Weight of Soil = 110 pcf

Lateral at Rest Earth Pressure Coefficient = 0.50

Structure top and bottom shall be designed for full dead, superimposed dead and live load including impact. Structure sidewalls shall be designed for lateral earth and hydrostatic pressures plus live load (H20 Truck) adjacent to structure. Tops and walls of structures shall be designed for AASHTO standard H2O highway loading, with 30 percent loading added for impact, and with design load being that which produces maximum shear and moment. All dead and live loads, as well as impact loading, shall be considered in design. Walls shall be designed to withstand all soil pressures, taking into consideration the soil to be encountered and ground water level present at the site, and assuming that the H20 design vehicle will operate on surfaces adjacent to the structure. Ground water level shall be assumed to be three feet below ground surface unless a higher water table is indicated in the boring logs. Design shall also take into consideration stresses induced in handling units. Lifting devices shall be provided for properly handling units.

Calculations and shop drawings shall be submitted covering the design and manufacture of precast units, and shall bear the seal of a registered professional engineer.

- c. Joints: Mating edges of precast components shall be provided with tongue and grooved joints. Joints shall be designed to firmly interlock adjoining components and to provide waterproof junctions. Joints shall be sealed water tight using preformed plastic strip conforming to AASHTO M198, Type B. Sealing material shall be installed in strict accordance with the sealant manufacturer's printed instructions. Provisions shall be made for waterproofing cable entrances into structures, and at covers in the top slab.
- 3.1.10.3 Metal Frames and Covers: Frames and covers of steel shall be welded by qualified welders in accordance with standard commercial practice. Steel covers shall be rolled steel floor plate having an approved antislip surface. Hinges shall be of wrought steel, 5 inches by 5 inches by approximately 3/16 inch thick, without screw holes, and shall be for full surface application by fillet welding. Hinges shall have non-removable pins and five knuckles. The surfaces of plates under hinges shall be true after the removal, by grinding or other approved method, of raised lugs.
- 3.1.10.4 Pulling-in irons shall be steel bars bent in the form indicated, and cast in the walls and floors. In the floor they shall be centered under the cover, and in the wall they shall be not less than 6 inches above or below, and opposite the conduits entering the structure. Pulling-in irons shall be projected into the structure approximately 4 inches. Irons shall be zinc-coated after fabrication.
- 3.1.10.5 Precast Handholes Installation: Commercial precast assembly shall be set on 6 inches of level, 90 percent compacted granular fill, 3/4 inch to one inch size, extending 12 inches beyond the handhole on each side. Granular fill shall be compacted by a minimum of four passes with a plate type vibrator. Drain sumps shall be provided for precast structures as required for poured-in-place structures.
- 3.1.10.6 Field Painting: Cast-iron frames, covers and grating not buried in masonry shall be cleaned of mortar, rust, grease, dirt and other deleterious materials, and given a coat of bituminous paint. Steel frames not buried in masonry and steel covers shall be cleaned of mortar, dirt and grease by an approved blasting process. Surfaces that cannot be cleaned satisfactorily by blasting shall be cleaned to bare metal by wire brushing or other mechanical means. Surfaces contaminated with rust, dirt, oil, grease, or other contaminants shall be washed with solvents until thoroughly cleaned. Immediately after cleaning, surfaces shall be coated with a pretreatment coating or be given a crystalline phosphate coating. As soon as practicable after the pretreatment coating has dried, treated surfaces shall be primed with a coat of zinc chromate primer and one coat of synthetic exterior gloss enamel. Pretreatment primer and

paint shall be as specified for shop painting in Section 16011, "Electrical General Requirements".

- 3.1.11 Earthwork shall be in accordance with Section 02200, "Earthwork."
- 3.1.12 Cable Terminating: Terminations of insulated power and lighting cables shall be protected from accidental contact, deterioration of coverings and moisture by the use of terminating devices and materials. Terminations shall be made using materials and methods as indicated or specified herein or as designated by the written instruction of the cable manufacturer and termination kit manufacturer. Cables and cable terminations shall be adequately supported so as to avoid any excessive strain on the termination and the conductor connection.
- 3.1.13 Splices for 600 Volt Class Cables: Splices in underground systems duct shall be made only in accessible locations such as handholes, using a compression connector on the conductor and by insulating and waterproofing by one of the following methods suitable for continuous submersion in water.
- 3.1.13.1 Cast-type splice insulation shall be provided by means of a molded casting process employing a thermosetting epoxy resin insulating material which shall be applied by a gravity poured method or by a pressure injected method. The component materials of the resin insulation shall be in a packaged form ready for convenient mixing without removing from the package. Do not allow the cables to be moved until after the splicing material has completely set.
- 3.1.13.2 Gravity poured method shall employ materials and equipment contained in an approved commercial splicing kit which includes a mold suitable for the cables to be spliced. When the mold is in place around the joined conductors, the resin mix shall be prepared and poured into the mold. Do not allow cables to be moved until after the splicing materials have completely set.
- 3.1.14 Grounding: Noncurrent carrying metallic parts associated with electrical equipment shall have a maximum resistance to solid "earth" ground not exceeding the following values:

Grounding metal enclosures of primary voltage electrical and electrically operated equipment

10 ohms

Grounded secondary distribution system neutral and noncurrent carrying metal parts associated with distribution systems and grounds not otherwise covered.

25 ohms

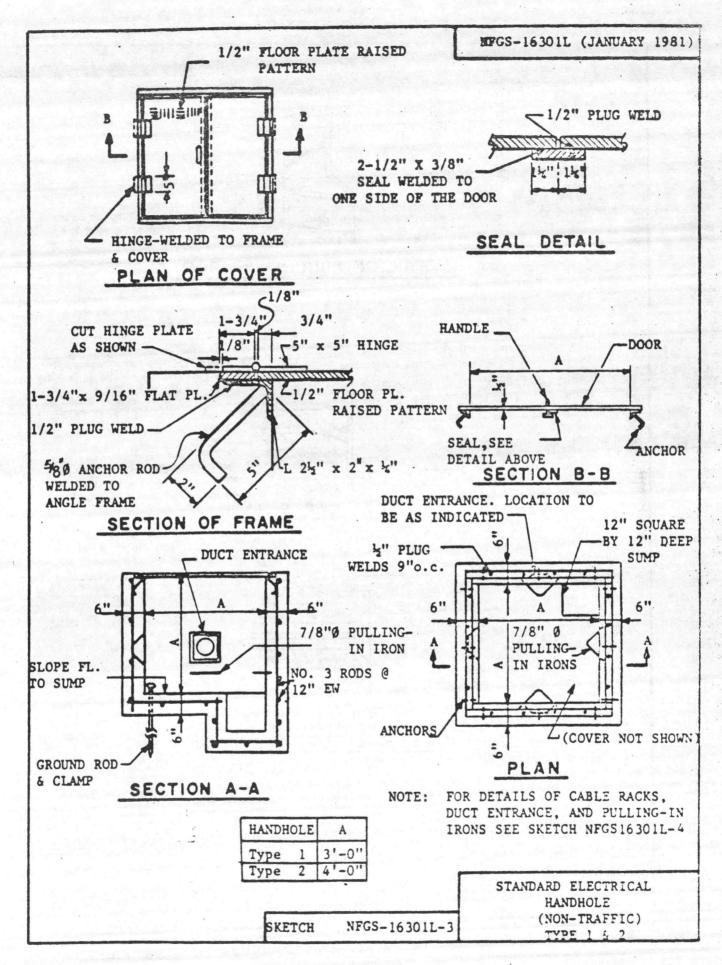
When work in addition to that indicated, or specified, is directed in order to obtain the specified ground resistance, the provisions of the contract covering "Changes" shall apply.

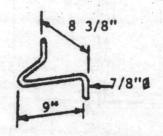
- 3.1.14.1 Grounding electrodes shall be cone pointed driven ground rods driven full depth plus 6 inches, installed when indicated to provide an earth ground of the value before stated for the particular equipment being grounded.
- 3.1.14.2 Grounding connections which are buried or otherwise normally inaccessible, and excepting specifically those connections for which access for periodic testing is required, shall be made by exothermic weld or by using a compatible mechanical connection and brazing over. Exothermic welds shall be made strictly in accordance with the weld manufacturer's written recommendations. Welds which have "puffed up" or which show convex surfaces, indicating improper cleaning, are not acceptable. No mechanical connector is required at exothermic weldments.
- 3.1.14.3 Grounding conductors shall be bare stranded copper conforming to ASTM B 8, Class B, for sizes No. 6 AWG and larger, and shall be solid bare copper conforming to ASTM B 1 for sizes No. 8 and smaller. Conduit and equipment shall be grounded with No. 6 AWG.
- 3.1.14.4 Ground Cable Crossing Expansion Joints: Ground cable crossing expansion joints or similar separations in structures and pavements shall be protected from damage by means of suitable approved devices or methods of installation which will provide the necessary slack in the cable across the joint to permit movement. Stranded or other approved flexible copper cable run or jumper shall be used across such separations.
- 3.1.15 Special Conditions: During the construction of all duct lines and underground structures located in streets, the streets shall remain open to traffic. The Contractor shall plan and execute his work to meet this condition.
- 3.2 FIELD TESTS: As an exception to requirements that may be stated elsewhere in the contract, the Contracting Officer shall be given 5 working days notice prior to each test. The Contractor shall provide all labor, equipment and incidentals required for testing, except that the Government will provide electric power required for the tests. All defective material and workmanship disclosed as the result of the tests given herein shall be corrected by the Contractor at no cost to the Government. The Contractor shall show by demonstration in service that all circuits and devices are in good operating condition. Tests shall be such that each item of control equipment will function not less than five times.
- 3.2.1 Distribution Conductors 600 Volt Class: After wiring is completed and connected ready for operation, but prior to placing systems in service and before any branch circuit breakers are closed, insulation resistance tests shall be made in all circuits. The insulation resistance

between conductors and between each conductor and ground shall be measured. Measurements shall be made with an instrument capable of making measurements at an applied potential of 500 volts. Readings shall be taken after the voltage has been applied for a minimum of one minute. The minimum insulation resistance for circuits of No. 12 AWG conductors shall be 1,000,000 ohms. For circuits of No. 10 AWG or larger conductors, a resistance based on the allowable ampacity of the conductor as fixed by NFPA 70 shall be as follows:

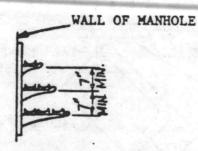
25	through	50	amperes	250.000	ohms
51	through	100	amperes	100.000	ohms
101	through	200	amperes	50.000	ohms
201	through	400	amperes	25.000	ohms
401	through	800	amperes	12,000	ohms
	0ver	800	amperes	5,000	ohms

- 3.2.2 Ground Rods: Test ground rods for ground resistance value before any wire is connected. Ground resistance measurements shall be made in normally dry weather, not less than 48 hours after rainfall. Ground resistance shall also be measured for each piece of equipment to the ground electrode. A portable ground testing megger shall be used to test each ground or group of grounds. The instrument shall be equipped with a meter reading directly in ohms or fractions thereof to indicate the ground value of the ground electrode under test. Provide one copy of the megger manufacturer's directions for use of the ground megger indicating the method to be used.
- 3.2.3 Compaction: Backfill shall be tested in accordance with ASTM D 1556 one test per lift per 2000 square feet.
 - 3.2.4 Test Report:
 - a. 600 volt cables (identify each cable & test result).
 - b. Grounding electrodes & systems (identify electrodes and systems, each test as well as the resistance and soil conditions at the time the measurements were made).

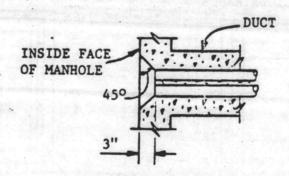




DETAIL OF PULLING-IN IRON



TYPICAL CABLE RACK



TYPICAL DUCT ENTRANCE

DETAILS

SKETCH NFGS-16301L-4

(PULLING-IN IRONS, CABLE RACK 5 DUCT ENTRANCE)

SECTION 16302

OVERHEAD ELECTRICAL WORK

PART 1 - GENERAL

1.1 APPLICABLE PUBLICATIONS: 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.

1.1.1 American National Standards Inst	itute (ANSI) Publications	:
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C2-81	National Electrical Safety Code
C37.42-69 (R1974)	Distribution Enclosed, Open and Open-Link Cutouts
C37.43-69 (R1974)	Distribution Fuse Cutout Links for Use in Distribution Enclosed, Open, and Open-Link Cutouts
C57.12.20-74	Overhead Type Distribution Transformers 67,000 Volts and Below: 500 KVA and Smaller, Including Supplement C57.12.20A-78

1.1.2 American Society for Testing and Materials (ASTM) Publication:

A 153-78 Zinc-coating (Hot-Dip) on Iron and Steel Hardware

1.1.3 American Wood-Preservers' Association (AWPA) Publication:

C.25-76 Standard for the Preservative Treatment of Crossarms by the Pressure Process

1.1.4 National Electrical Manufacturers' Association (NEMA) Publications:

TR1-74 Transformers, Regulators, and Reactors (Rev 3-77)

1.1.5 National Fire Protection Association (NFPA) Publication:

70-1981 National Electrical Code

1.1.6 Rural Electrification Administration (REA) Publications:

Wood Crossarms (Solid and Laminated), (DEC 1975) Transmission Timbers and Pole Keys (DT-5B/PE-16)

43-5 List of Materials Acceptable for Use on (JULY 1979) Electric Systems of REA Borrowers Supplements 2 & 3

1.1.7 Underwriter's Laboratories (UL) Publications:

6-76 Rigid Metallic Conduit

83-80 Thermoplastic-Insulated Wires

510-76 Insulating Tape (R Jun 80)

- 1.2 GENERAL REQUIREMENTS: Section 16011, "Electrical General Requirements" applies to this section with additions and modifications specified herein.
 - 1.2.1 Services: See Section 16301, paragraph 1.2.1.
- 1.2.2 Electrical Characteristics: See Section 16301, paragraph 1.2.2.
- 1.2.3 Connections to Existing Electrical Systems: Notify the Contracting Officer in writing at least 15 days prior to the date the connections are required; approval shall be received before any service is interrupted. Furnish all material required to make connections into the existing systems, and perform all incidental labor required.
 - 1.2.4 Submittals: Submit following information for approval:
 - 1.2.4.1 Catalog Information:
 - a. Conductor (list each size and type)
 - b. Insulator (list each size and type)
 - c. Cutouts
 - d. Transformers
 - e. Tapes
 - 1.2.4.2 Shop Drawings:
 - a. Transformers
 - 1.2.4.3 Manufacturer's Certification:
 - a. Transformer tests: Certify that routine tests per NEMA TR1 have been made on each transformer.

1.2.4.4 Manufacturer's Directions:

a. Manufacturer's directions for use of ground megger with proposed method indicated

PART 2 - PRODUCTS

- 2.1 MATERIALS AND EQUIPMENT: Materials specified herein or shown on the contract drawings which are identical to materials listed in REA 43-5 shall be considered as conforming to all requirements.
- 2.1.1 Crossarms: Provide solid type wood crossarms conforming to REA DT-5B. Crossarms shall be pressure treated with Chromated Copper Arsenate (CCA) or Ammoniacal Copper Arsenate (ACA). Treatment shall conform to AWPA C25.
 - 2.1.1.1 Provide crossarm braces as required.
- 2.1.2 Hardware: Pole line hardware shall be hot dip galvanized conforming to ASTM A 153.
- 2.1.3 Ground Rods: Provide copperweld type copper-clad steel ground rods at least 3/4 inch in diameter and 10 feet long unless otherwise indicated. Die-stamp each near the top with the name or trademark of the manufacturer and the length of the rod in feet. The rods shall have a hard, clean, smooth, continuous, surface throughout the length of the rod.
- 2.1.4 Ground Wire: Provide soft-drawn copper wire ground conductors no smaller than No. 6 AWG. Ground wire protectors shall be PVC or half round wood molding.
- 2.1.5 Fused Cutouts: Provide heavy duty drop-out fused cutouts rated 100 amperes at 14.4 kV ungrounded, conforming to ANSI C37.42. Provide type k fuses conforming to ANSI C37.43 with ampere ratings equal to 150 percent of the transformer full load rating. Open link type fuses and fuse cutouts are not acceptable.
- 2.1.6 Conduit Risers: Provide PVC conduit conforming to NEMA TC2, Type EPC-80-PVC and NFPA 70 with fittings conforming to NEMA TC3.
- 2.1.6.1 600 volt secondary riser conductors shall be copper, conforming to UL 83.
- 2.1.7 Transformers (Pole-Type): ANSI C57.12.20 self-cooled, 65 degrees C continuous temperature rise, mineral oil-immersed type. Transformers shall be rated 95 kV BIL, 15 kV class for operation on a 12.47 kV delta system. Secondary voltage shall be as indicated on drawings. Minimum impedance shall be 1.5 percent. Transformers shall have four 2-1/2 percent rated kVA high voltage taps, two above and two below rated primary voltage. Tank finish coat shall be light gray, ANSI color No. 70.

- 2.1.8 Electrical Tapes: UL 510 and shall be UL listed for electrical insulation and other purposes in wire and cable splices, terminations, repairs and miscellaneous purposes.
- 2.1.9 Calking Compound: Compound for the sealing of conduit risers shall be of a putty like consistency workable with the hands at temperatures as low as 35 degrees F, shall not slump at a temperature of 300 degrees F, and shall not harden materially when exposed to air. The compound shall readily calk or adhere to clean surfaces of the materials with which it is designed to be used. The compound shall have no injurious effects upon the hands of workmen or upon the materials.

PART 3 - EXECUTION

- 3.1 INSTALLATION: Provide overhead pole line installation conforming to the requirements of ANSI C2 (NESC) for Grade B construction of overhead lines in medium loading districts and NEC for overhead services. Regard NESC statements using the term "should" as mandatory unless an exception therefrom in writing is granted by the Contracting Officer. All streets, alleys, roads, and drives shall be considered "public." Pole configurations shall be as indicated.
- 3.1.1 Hardware: Install hardware with washer against the wood and with nuts and lock nuts applied wrench tight.
- 3.1.2 Grounding: Provide grounding for pole line conforming to ANSI C2 except that each separate ground electrode shall have a resistance to the solid earth not exceeding 10 ohms. When work in addition to that indicated or specified, is directed in order to obtain the specified ground resistance the provisions of the contract covering "changes" shall apply.
- 3.1.2.1 Make ground rod connections on pole line by thermit weld or by using a compression connector for all ground wire or wire to rod connections.
- 3.1.2.2 Make thermit welds strictly in accordance with the manufacturer's written recommendations. Welds which have puffed up or which show convex surfaces indicating improper cleaning, are not acceptable. No mechanical connectors are required at thermit weldments.
- 3.1.2.3 Ground noncurrent carrying metal parts of equipment or enclosures, grounding terminal of each arrester, and cable messengers.
- 3.1.2.4 The secondary neutral (where applicable) and the tank of each transformer shall be interconnected and connected to ground.
- 3.1.2.5 Protect grounding conductors which are run on the surface of wood poles by wood molding or plastic molding of equal mechanical strength extending from the ground line throughout transformer spaces.

- 3.1.3 Risers: Secure conduits on poles with appropriate clamps.
- 3.1.4 Transformer Installations: Provide one primary fuse cutout and one existing surge arrester for each ungrounded phase conductor. The transformer's kVA rating shall be conspicuously displayed on its tank.
- 3.2 FIELD TESTS: As an exception to requirements that may be stated elsewhere in the contract, the Contracting Officer shall be given 5 working days notice prior to each test.
- 3.2.1 Ground Rod Tests: Do not connect the ground rods until they have been tested for ground resistance value. Make ground resistance measurements in normally dry weather, not less than 48 hours after rainfall. Ground resistance shall also be measured from each piece of equipment to the ground electrode. Use a portable ground testing megger to test each ground or group of grounds. The instrument shall be equipped with a meter reading directly in ohms or fractions thereof to indicate the ground value of the electrode under test. Follow the directions provided by the equipment manufacturer for proper use of the equipment. Provide one copy of the directions for the use of the observing inspectors.
- 3.2.2 Test Transformer: Test transformer secondary voltages and adjust the voltage at the transformer to provide a secondary voltage required at each location.
- 3.2.3 Devices Subject to Manual Operation: Each device subject to manual operation shall be operated at least five times, demonstrating satisfactory operation each time.

*** END OF SECTION ***

SECTION 16402

INTERIOR WIRING SYSTEMS

PART 1 - GENERAL

- 1.1 APPLICABLE PUBLICATIONS: 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.
 - 1.1.1 Federal Specifications (Fed. Spec.):

W-C-375B Circuit Breaker, Molded Case, Branch-Circuit and Service

W-S-896E(1) Switch, Toggle (Toggle and Lock), Flush Mounted

1.1.2 American National Standards Institute (ANSI) Publications:

C80.1-1977 Specification for Rigid Steel Conduit, Zinc-coated

C80.3-1977 Specification for Electrical Metallic Tubing, Zinc-coated

C80.5-1977 Specification for Rigid Aluminum Conduit

1.1.3 American Society for Testing and Materials (ASTM) Publications:

B 1-70 Hard-Drawn Copper Wire (R 1976)

B 8-77 Concentric-Lay-Stranded Copper Conductor, Hard, Medium-Hard, or Soft

1.1.4 National Electrical Manufacturers Association (NEMA) Publications:

ICS1-1978 General Standards for Industrial Control and Systems

ICS2-1978 Industrial Control Devices, Controllers and Assemblies

ICS6-1978 Enclosures for Industrial Controls and Systems (Rev. 1-80)

KS1-1975 Enclosed Switches

	MG1-1978 (Rev. 5-80)	Motors and Generators
	ST20-1972 (R 1978)	Dry-Type Transformers for General Applications
	WD1-1979 (Rev. 1-79)	General Purpose Wiring Devices
1.1.5	National Fire	Protection Association (NFPA) Publication:
	70-1981	National Electrical Code (NEC)
1.1.6	Underwriters'	Laboratories, Inc. (UL) Publications:
	1-1979 (Mar 80)	Flexible Metal Conduit
	50-1980	Cabinets and Boxes
	67-1979 (Dec 80)	Panelboards
	83-1980	Thermoplastic-Insulated Wires and Cables
	198D-1978 (May 79)	Class K Fuses
	467-1972 (May 79)	Grounding and Bonding Equipment
	486A-1980	Wire Connectors and Soldering Lugs for Use with Copper Conductors
	489–1980	Molded-Case Circuit Breakers and Circuit Breaker Enclosures
	510-1976 (Jun 80)	Insulating Tape
	514-1979 (Apr 80)	Outlet Boxes and Fittings
	854-1979 (Nov 80)	Service-Entrance Cables
	869-1977 (Nov 80)	Service Equipment
	943-1972 (Jan 77)	Ground-Fault Circuit Interrupters

984-1979 Hermetic Refrigerant Motor-Compressors

1242-1977 Intermediate Metal Conduit (Draft)

- 1.2 GENERAL REQUIREMENTS: Section 16011, "Electrical General Requirements," applies to this section with additions and modifications specified herein. In each of the standards referred to herein, consider the advisory provisions to be mandatory, as though the word "shall" had been substituted for "should" wherever it appears. Interpret reference in these standards to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer.
 - 1.2.1 Services: See Section 16301, paragraph 1.2.1.
- 1.2.2 Electrical Characteristics: See Section 16301, paragraph
 1.2.2.
 - 1.3 SUBMITTALS:
 - 1.3.1 Manufacturer's Data:
 - a. Receptacles
 - b. Motor Controllers
 - c. Circuit Breakers
 - d. Switches
 - e. Intermediate Metal Conduit
 - f. Conduit Supports
 - g. Fuses
 - h. Pneumatic Timers
 - i. Reduced Voltage Starters
 - 1.3.2 Shop Drawings:
 - a. Panelboards
 - b. Transformers
 - 1.3.3 Certificates of Conformance or Compliance:
 - a. Conduit (except IMC)
 - b. Ground Rods
 - c. Outlet and Junction Boxes
 - d. Insulating Tapes
 - e. Conduit Fittings
 - f. Device Plates
 - g. Conductors
- 1.4 TRANSFORMER TESTS AND TEST REPORTS: Perform tests classified as "routine" per NEMA ST20 on each transformer and submit the results for approval in report form. Submittal shall also contain the results of NEMA

"design" and "prototype" tests that were made on transformers electrically and mechanically equal to those specified.

PART 2 - PRODUCTS

- 2.1 MATERIALS AND EQUIPMENT: All materials, equipment, and devices shall, as a minimum, meet the requirements of UL where UL Standards are established for those items and the requirements of NFPA-70. All items shall be new unless specified or indicated otherwise.
- 2.1.1 Coordination: Coordinate new equipment (fuses, circuit breakers, and other equipment) with existing station equipment. The Contracting Officer will provide the necessary information on existing equipment when requested.
 - 2.1.2 Conduit and Fittings:
 - 2.1.2.1 Rigid Steel Conduit (Zinc-coated): ANSI C80.1.
 - 2.1.2.2 Rigid Aluminum Conduit: ANSI C80.5.
- 2.1.2.3 Intermediate Metal Conduit (IMC): UL 1242, zinc-coated steel only.
 - 2.1.2.4 Electrical Metallic Tubing (EMT): ANSI C80.3.
 - 2.1.2.5 Flexible Metal Conduit: UL 1, zinc-coated steel only.
- 2.1.2.6 Fittings for Metal Conduit, Electrical Metallic Tubing and Flexible Metal Conduit: UL 514. All ferrous fittings shall be cadmiumor zinc-coated per UL 514.
- 2.1.2.6.1 Fittings for rigid metal conduit and IMC shall be threaded type. Split couplings are not acceptable.
- 2.1.2.6.2 Fittings for electrical metallic tubing (EMT) shall be the compression type.
- 2.1.3 Outlet Boxes and Covers: UL 514, cadmium or zinc-coated if of ferrous metal.
- 2.1.4 Cabinets, Junction Boxes, and Pull Boxes (With Volume Greater than 100 Cubic Inches): UL 50, hot-dip zinc-coated if of sheet steel.
- 2.1.5 Wires and Cables: Wires and cables shall meet the applicable requirements of NFPA 70 and UL for the type of insulation, jacket, and conductor specified or indicated. Unless indicated or specified otherwise, conductor sizes are based on copper. Conductors No. 10 AWG and smaller shall be solid copper. Conductors No. 8 AWG and larger shall be

stranded copper. Wires and cables manufactured more than twelve months prior to date of delivery to the site shall not be used.

- 2.1.5.1 Color coding is required for all service, feeder, branch, control, and signalling circuit conductors. Color shall be white for neutrals and green for grounding conductors. The color of the ungrounded conductors in different voltage systems shall be as follows:
 - a. 120/208 volt, 3-phase: red, black, and blue
 - b. 277/480 volt, 3-phase: yellow, brown, and orange

All ungrounded conductors of the same color shall be connected to the same ungrounded feeder conductor.

- 2.1.5.2 Conductor sizes are expressed in American Wire Gage (AWG) or in circular mils. Minimum size for branch circuits shall be No. 12 AWG; for Class 1 remote-control and signal-circuits No. 14 AWG; for Class 2 low-energy remote control and signal-circuits No. 16 AWG.
 - 2.1.5.3 Power and Lighting Conductors: UL 83, type THWN (or XHHW).
- 2.1.5.4 Service Entrance Conductors: UL 854, type SE, single conductor, rated 600 volts.
- 2.1.5.5 Grounding and Bonding Conductors: ASTM B 1, solid bare copper wire for sizes No. 8 AWG and smaller; ASTM B 8, class B, stranded bare copper wire for sizes No. 6 AWG and larger.
- 2.1.5.6 Flexible Connections: Connections to movable equipment shall be flexible metal conduit with the number of conductors indicated.
- 2.1.6 Splices and Termination Components: UL 486A for wire connectors, and UL 510 for insulating tapes. Connectors for wires No. 10 and smaller shall be insulated pressure—type or wirenut—type. Provide solderless terminal lugs on stranded conductors.
- 2.1.7 Device Plates: Provide one-piece device plates for outlets and fittings to suit the devices installed. Plates on unfinished walls and on fittings shall be of zinc-coated sheet steel or cast metal having round or beveled edges. Plates on finished walls shall be satin finish stainless steel or brushed-finish aluminum, minimum 0.03 inch thick. Screws shall be machine type with countersunk heads in a color to match the finish of the plate. The use of sectional type device plates will not be permitted. Plates installed in wet locations shall be gasketed. Device plates for telephone and intercommunication outlets shall have a 3/8-inch bushed opening in center.

2.1.8 Switches:

- 2.1.8.1 Toggle Switches: Fed. Spec. W-S-896, totally enclosed with bodies of thermosetting plastic and a mounting strap. Handles shall be brown. Wiring terminals shall be of the screw type, side wired. Switches shall be rated quiet-type AC only, 20 ampere, 120-277 volts, with the number of poles indicated.
- 2.1.8.2 Disconnect Switches: NEMA KS1, heavy duty fused or nonfused as indicated, single or double throw, quick-make quick-break, 240 or 600 volts, and the number of poles indicted. Provide switches in NEMA 1 or 4 enclosure per NEMA ICS6. Provide fused switches with fuse-holders to accept the specified fuse type where indicated. Switches serving as motor-disconnect means shall be horsepower rated.
- 2.1.9 Receptacles: NEMA WD 1, heavy duty, grounding type. Ratings and configurations shall be as indicated. Bodies shall be of brown thermosetting plastic supported on a metal mounting strap. Wiring terminals shall be of the screw type, side wired. Connect grounding pole to the mounting strap.
 - 2.1.9.1 Duplex Receptacles: 20 amperes, 125 volts, No. 5342.
- 2.1.9.2 Weatherproof Receptacles: Provide in a cast metal box with a gasketed, weatherproof, cast-metal cover plate and a cap over each receptacle opening. The cap(s) shall be provided with a spring-hinged flap. Receptacle shall be UL approved for use in "wet locations."
- 2.1.9.3 Ground Fault Circuit Interrupter Receptacles: UL 943, as applicable, and shall be duplex feedthrough-type for mounting in a standard outlet box. The device shall be capable of detecting a current leak of 5 milliamperes.
- 2.1.10 Panelboards: UL 67 and UL 50, as applicable. Panelboards for use as service disconnecting means shall additionally conform to UL 869. Panelboards shall be circuit breaker equipped. Design complete panelboard assembly so that any individual breaker can be removed without disturbing adjacent units or without loosening or removing supplemental insulation supplied as a means of obtaining clearances as required by UL. Where "space only" is indicated, make provisions for the future installation of a breaker sized as indicated.
- 2.1.10.1 Panelboard Buses: Provide aluminum bus bars supported on bases independent of the circuit breakers. Design main buses and back pans so that breakers may be changed without machining, drilling, or tapping. Provide an insulated neutral bus in each panel for connection of circuit neutral conductors. Provide a separate ground bus marked with a green stripe along its front and bonded to the steel cabinet for connecting grounding conductors.

- 2.1.10.2 Circuit Breakers: Fed. Spec. W-C-375
 thermal magnetic type with interrupting capacity of 10,000 amperes
 symmetrical minimum. Design breakers to accept copper, copper-clad, and
 aluminum conductors. Plug-in circuit breakers are not acceptable.
- 2.1.10.2.1 Multipole Breakers: Provide common-trip type with a single operating handle. Design breakers so that an overload in one pole automatically causes all poles to open. Maintain phase sequence throughout each panel so that any three adjacent breaker poles are connected to Phases A, B, and C respectively.
- 2.1.10.2.2 Ground Fault Circuit Interruption Breaker: UL 943 and NFPA 70. Provide with "push-to-test" button, visible indication of tripped condition, and ability to detect a current imbalance of approximately 5 milliamperes.
- 2.1.10.2.3 Fusible Switches for Panelboards: NEMA KS1, hinged door type. Switches serving as motor disconnect means shall be horsepower rated.
- 2.1.11 Fuses: Provide a complete set of fuses for each fusible switch. Time-current characteristics curves of fuses serving motors or connected in series with circuit breakers shall be coordinated for proper operation. Fuses shall have a voltage rating not less than the circuit voltage.
- 2.1.11.1 Cartridge Fuses, Current-limiting type (Class K): UL 198D, Class K-5 time-delay type. Ratings shall be 250 or 600 volts as required, and 100,000 amps rms symmetrical interrupting.
- 2.1.12 Transformers: NEMA ST20, general purpose, dry-type, self cooled, ventilated. Provide transformers in a NEMA 1 enclosure. Transformer shall have 220 degrees C insulation system with a temperature rise not exceeding 150 degrees C under full rated load in a maximum ambient of 40 degrees C. Transformer shall be capable of carrying continuously 115 percent of the nameplate KVA without exceeding the insulation rating.
- 2.1.13 Motors: NEMA MG1 except sealed (hermetic-type) motor-compressors: UL 984. The approximate size of each motor is indicated. Determine specific motor characteristics to insure provision of correctly sized starters and overload heaters. Motors for operation on 208-volt, 3-phase circuits shall have a voltage rating of 200 volts, and those for operation on 480-volts, 3-phase shall have voltage rating of 460 volts. Motors shall be designed to operate at full capacity with a voltage variation of plus or minus 10 percent of the motor voltage rating. Motors shall be of sufficient size for the duty to be performed and shall not exceed their full load nameplate current rating when driven equipment is operated at specified capacity under the most severe conditions likely to be encountered.

- 2.1.14 Motor Controllers: NEMA ICS1 and ICS2. All controllers shall have thermal overload protection in each phase and short circuit protection. Magnetic type motor controllers, unless otherwise indicated. shall have control circuits designed to restart motors after unscheduled power interruptions. When used with a pressure, float, or similar automatic-type or maintained-contact switch, the controller shall have a hand-off-automatic selector switch. Connections to the selector switch shall be such that only the normal automatic regulatory control devices will be by-passed when the switch is in the "hand" position. All safety control devices such as low and high pressure cutouts, high temperature cutouts, and motor overload protective devices shall be connected in the motor control circuit in both the "hand" and the "automatic" positions. Control circuit connections to any hand-off-automatic selector switch or to more than one automatic regulatory control device shall be made in accordance with a manufacturer's approved wiring diagram. The selector switch shall have means for locking in any position. For each motor not in sight of the controller, the controller disconnecting means shall be capable of being locked in the open position or a manually operated. non-fused switch which will disconnect the motor from the source of supply shall be placed within sight of the motor location. Overload protective devices shall give adequate protection to the motor windings, be of the thermal inverse-time-limit type, and include a manual-reset type push button on the outside of the motor controller case. The cover of a combination motor controller and manual switch or circuit breaker shall be interlocked with the operating handle of the switch or circuit breaker so that the cover cannot be opened unless the handle of the switch or circuit breaker is in the off position. A heavy duty control transformer shall be incorporated into each 480 volt controller to provide 120 volt control circuit operation. Pneumatic timers shall be incorporated into controllers where indicated. Each controller shall be equipped with a spare set of NO and NC auxiliary contacts.
- 2.1.14.1 Enclosures for Starters and Controllers: NEMA 1 per NEMA ICS6, unless indicated otherwise.
- 2.1.14.2 Manual Starters: Single pole designed for surface mounting. Provide pilot light in enclosure where indicated.
- 2.1.14.3 Pilot and Indicating Lights: Provide transformer, resistor, or diode type.
 - 2.1.14.4 Terminal Blocks: NEMA ICS4.
- 2.1.14.5 Reduced-voltage controllers shall be provided for polyphase motors 20 horsepower and larger. Reduced-voltage starters shall be of the single-step autotransformer, reactor, or resistor type, or as indicated, and shall have an adjustable time interval beween application of reduced and full voltages to the motors.

- 2.1.14.6 Multiple-Speed Motor Controllers: Across-the-line type, electrically and mechanically interlocked. Multiple-speed controllers shall have compelling relays.
- 2.1.15 Pneumatic Timing Relay: Relays shall have adjustable time delays of 0.5 second to 3 minutes after energization. Repeat accuracy deviation shall be plus or minus 10 percent under constant temperature conditions.
- 2.1.16 Motor Control Centers: NEMA Standard No. ICS2, Class II, Type B, in NEMA Type 1 enclosure. Control centers shall be rated at 480 volts, 3 phase, 60 Hertz, with bus braced for 42,000 amperes RMS symmetrical. Arrange busing so that control center can be expanded from both ends. Bus shall be tin-plated copper. Interconnecting wires shall be copper. Terminal blocks shall be plug-in type so that controllers may be removed without disconnecting individual control wiring.
 - 2.1.17 Telephone System: Provide as indicated.
- 2.1.17.1 Outlet Box for Telephone System: Standard type, as specified hereinbefore. Mount flush in finished wall at the height indicated.
- 2.1.17.2 Cover Plates: Standard telephone type of the finish specified for receptacle and switch cover plates.
 - 2.1.17.3 Conduit Sizing: Conduit shall be a minimum of 3/4 inch.
 - 2.1.18 Grounding and Bonding Equipment: UL 467.
- 2.1.18.1 Equipment Grounds: Provide a green-colored equipment grounding conductor which shall be separate from the electrical system neutral conductor. Provide equipment ground conductors in branch circuits serving convenience outlets, receptacles, portable and permanently installed electrical appliances, equipment, apparatus, and other miscellaneous metal-enclosing bodies (including light switch boxes) normally within contact of personnel.
- 2.1.18.2 Ground Rods: Copperweld type, 3/4 inch in diameter and 10 feet long unless otherwise indicated.

PART 3 - EXECUTION

- 3.1 INSTALLATION:
- 3.1.1 General Requirements: Electrical installations shall conform to the requirements of NFPA 70 and to the requirements specified herein. Measure mounting heights specified or indicated to the center of the device or outlet.

- 3.1.2 Wiring Methods: Wiring method shall be insulated conductors installed in conduit, except where specifically indicated or specified otherwise, or required by NFPA 70 to be installed otherwise. Conduit shall be rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT) except where specified or indicated otherwise.
- 3.1.2.1 Aluminum Conduit: Do not install underground or encase in concrete.
- 3.1.2.2 Electrical Metallic Tubing: Do not install underground, encase in concrete, use in areas where subject to severe physical damage, or use in outdoor work.
- 3.1.2.3 Service Entrance Conduit: Rigid steel or IMC from the service equipment to the service entrance fitting or weatherhead outside the building.
- 3.1.3 Conduit Installation: Unless indicated otherwise, conceal conduit within finished walls, ceilings, and floors. Keep conduit at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install conduit parallel with or at right angles to ceilings, walls, and structural members where located above accessible ceilings and where conduit will be visible after completion of project.
- 3.1.3.1 Support Conduit by pipe straps, wall brackets, hangers or ceiling trapeze. Fasten by wood screws to wood; by toggle bolts on hollow masonry units: by concrete inserts or expansion bolts on concrete or brick; by machine screws, welded threaded studs, or spring-tension clamps on steel work. 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 or wood screws. Threaded C-clamps may be used on rigid steel conduit only. Do not weld conduits or pipe straps to steel structures. The load applied to fasteners shall not exceed one-fourth of the proof test load. Fasteners attached to concrete ceiling shall be vibration and shock resistant. 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 joints shall not cut the main reinforcing bars. Fill holes that are not used. In partitions of light steel construction, use sheet-metal screws. In suspended-ceiling construction, run conduit above the ceiling and fasten only lighting system branch circuit conduits to the ceiling supports. Spring steel fasteners may be used for lighting branch circuit conduit supports in suspended ceiling in dry locations.
- 3.1.3.2 Make changes in direction of runs with symmetrical bends or cast-metal fittings. Make field-made bends and offsets with a hickey or conduit-bending machine. Do not install crushed or deformed conduits. Avoid trapped conduits. Prevent plaster, dirt, or trash from lodging in conduits, boxes, fittings, and equipment during construction. Free clogged conduits of all obstructions.

- 3.1.3.3 Install pull wires in empty conduits in which wire is to be installed by others. The pull wire shall be plastic having not less than 200-pounds tensile strength. Leave not less than 12 inches of slack at each end of the pull wire.
- 3.1.3.4 Telephone Conduit: Install in accordance with the previous requirements for conduit. Conduit shall be 3/4 inch and shall terminate 5 feet outside building 24 inches below grade.
- 3.1.3.5 Conduit Installed in Concrete Floor Slabs: Locate so as not to adversely affect the structural strength of the slabs. Install conduit within the middle one—third of the concrete slab. Do not stack conduits. Space conduits horizontally not closer than three diameters except at cabinet locations. Curved portions of bends shall not be visible above the finish slab. Increase slab thickness as necessary to provide a minimum one inch cover over conduit. Where embedded conduits cross expansion joints, provide suitable watertight expansion fittings and bonding jumpers. Conduit larger than one inch trade size shall be parallel with or at right angles to the main reinforcement; when at right angles to the reinforcement, the conduit shall be close to one of the supports of the slab.
- 3.1.3.6 Fasten conduits to sheet metal boxes and cabinets with two locknuts where required by NFPA 70, where insulated bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, use at least a single locknut and bushing. Locknuts shall be the type with sharp edges for digging into the wall of metal enclosures. Install bushings on the ends of conduits and provide insulating type where required by NFPA 70.
- 3.1.3.7 Stub-Ups: Provide conduits stubbed up through concrete floor for connection to free-standing equipment with an adjustable top or coupling threaded inside for plugs, set flush with the finished floor. Extend conductors to equipment in rigid steel conduit, except that flexible metal conduit may be used 6 inches above the floor. Where no equipment connections are made, install screwdriver-operated threaded flush plugs in conduit end.
- 3.1.3.8 Flexible connections of short length shall be provided for recessed and semi-recessed lighting fixtures, equipment subject to vibration, noise transmission, or movement and for all motors. Liquid-tight flexible conduit shall be used in wet locations. A separate ground conductor shall be provided across flexible connections.
- 3.1.4 Boxes, Outlets, and Supports: Provide boxes in the wiring or raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures. Boxes for metallic raceways shall be of the cast-metal hub type when located in normally wet locations, when surface mounted on outside of exterior surfaces, and when installed exposed up to 7 feet above interior floors and walkways. Boxes in other locations shall be sheet steel except that aluminum boxes may be

used with aluminum conduit. Each box shall have the volume required by the NEC for the number of conductors enclosed in the box. Boxes for mounting lighting fixtures shall be not less than 4 inches square (or octagonal), except that smaller boxes may be installed as required by fixture configurations, as approved. Provide boxes installed for concealed wiring with suitable extension rings or plaster covers, as required. Boxes for use in masonry-block or tile walls shall be square-cornered tile-type or standard boxes having square-cornered tile-type covers. Provide gaskets for cast-metal boxes installed in wet locations and boxes installed flush with the outside of exterior surfaces. Provide separate boxes for flush or recessed fixtures when required by the fixture terminal operating temperature; fixtures shall be readily removable for access to the boxes unless ceiling access panels are provided. Support boxes and pendants for surface-mounted fixtures on suspended ceilings independently of the ceiling supports or make adequate provisions for distributing the load over the ceiling support members in an approved manner. Fasten boxes and supports with wood screws on wood, with bolts and 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 wood screws expansion shields, or machine screws. In open overhead spaces, cast boxes threaded to raceways need not be separately supported except where used for fixture support; support sheet metal boxes directly from the building structure or by bar hangers. Where bar hangers are used, attac the bar to raceways on opposite sides of the box and support the raceway with an approved type fastener not more than 24 inches from the box. When penetrating reinforced-concrete members, avoid cutting any reinforcing steel.

- 3.1.4.1 Boxes for use with raceway systems shall not be less than 1-1/2 inches deep except where shallower boxes required by structural conditions are approved. Boxes for other than lighting-fixture outlets 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. Telephone outlets shall be a minimum of 4 inches square by 1-1/2 inches deep.
- 3.1.4.2 Pull Boxes: Construct of not less than the minimum size required by the NEC of code-gage aluminum or galvanized sheet steel except where cast-metal boxes are required in locations specified above. Furnish boxes with screw-fastened covers. Where several feeders pass through a common pull box, tag the feeders to indicate clearly the electrical characteristics, circuit number, and panel designation.
- 3.1.5 Mounting Heights: Mount panelboards so the height of the top operating handle will not exceed 78 inches from the floor. Mount lighting switches 3 feet, 10 inches above finished floor, receptacles, and other devices as indicated.
- 3.1.6 Conductor Identification: Provide conductor identification within each enclosure where a tap, splice, or termination is made. For

conductors No. 6 and smaller, color coding shall be by factory-applied color-impregnated insulation. For conductors No. 4 and larger, color coding shall be by plastic-coated self-sticking markers, colored nylon cable ties and plates, or heat-shrink type sleeves.

- 3.1.7 Splices: Make splices in accessible locations. Make splices in conductors No. 10 AWG and smaller with an insulated pressure type connector. Make splices in conductors No. 8 AWG and larger with a solder-less connector and cover with an insulation material equivalent to the conductor insulation.
- 3.1.8 Covers and Device Plates: Install 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.
- 3.1.9 Grounding and Bonding: In accordance with NFPA 70. Ground all exposed non-current-carrying metallic parts of electrical equipment, metallic raceway systems, and neutral conductor of wiring systems. Make ground connection at the main service equipment and extend grounding conductor to the point of entrance of the metallic water service. Make connection to the water pipe by a suitable ground clamp or lug connection to a plugged tee. If flanged pipes are encountered, make connection with the lug bolted to the street side of the flanged connection. If metallic water service is use as the grounding electrode system, supplement it by an additional electrode in compliance with NFPA 70.
- 3.1.9.1 Equipment Grounds: Equipment grounds shall be solid and continuous from a connection at earth to panelboards. Make ground connections at panelboards, outlets, equipment, and apparatus in an approved and permanent manner.
- 3.1.9.2 Resistance: The maximum resistance to ground of a driven ground rod shall not exceed 25 ohms under normally dry conditions. Where the resistance obtained with one ground rod exceeds 25 ohms, provide additional ground rods not less than 6 feet on centers.
- 3.1.10 Equipment Connections: Provide power wiring for the connection of motors and control equipment under this section of the specification. Except as otherwise specifically noted or specified, automatic control wiring, control devices, and protective devices within the control circuitry are not included in this section of the specifications, but shall be provided under Section 15011, GENERAL REQUIREMENTS, MECHANICAL.
- 3.1.11 Pneumatic Timing Relays: Provide pneumatic timing relays in control circuits of motor controllers indicated. Timers shall be set to start motors at 5 second intervals with the exception that a 30 second interval shall be provided between starting of the 40 HP blower and the motor which follows in the starting sequence. The 40 HP motor shall be

started first, followed by the next larger size motor progressing to the smaller motors which shall be started last. The timing relay for the 40 HP motor shall be set at 30 seconds.

- 3.1.12 Reworking Existing System: All work shall conform to applicable requirements of this Division of the Specifications. Remove or de-energize existing electrical equipment, conduit, conductors, etc., not in use after reworking the existing system, as indicated. Keep equipment not scheduled for replacement in operation at all times. Schedule work to be renovated, changed, or modified so as not to interfere with normal operation.
- 3.1.13 Repair of Existing Work: Layout the work carefully in advance. Where cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, or other surfaces is necessary for the proper installation, support, or anchorage of the conduit, raceways, or other electrical work, do this work carefully. Repair any damage to buildings, piping, or equipment by skilled mechanics of the trades involved.
- 3.2 FIELD TESTS: As an exception to requirements that may be stated elsewhere in the contract, the Contracting Officer shall be given 5 working days notice prior to each test.
- 3.2.1 Devices Subject to Manual Operation: Each device subject to manual operation shall be operated at least five times, demonstrating satisfactory operation each time.
- 3.2.2 Test on 600-Volt Wiring: Test all 600-volt wiring to verify that no short circuits or accidental grounds exist. Tests shall be made using an instrument which applies a voltage of approximately 500 volts to provide a direct reading of resistance.
- 3.2.3 Grounding System Test: Test the grounding system to assure continuity and that the resistance to ground is not excessive. Test each ground rod for resistance to ground. Make resistance measurements in normally dry weather, not less than 48 hours after rainfall, and with the ground rod under test isolated from other grounds. Submit written results of each test to the Contracting Officer and indicate the location of the rod as well as the resistance and soil conditions at the time the measurements were made.

*** END OF SECTION ***

SECTION 16510

LIGHTING, INTERIOR

PART 1 - GENERAL

1.1 APPLICABLE PUBLICATIONS: 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.

1.1.1 American National Standards Institute (ANSI) Publications:

C82.1-1977	Specifications for Fluorescent Lamp Ballasts
C82.2-1977	Methods of Measurement of Fluorescent Lamp Ballast
C82.4-1978	Specifications for High-Intensity-Discharge Lamp Ballasts (Multiple Supply Type)

1.1.2 Illuminating Engineering Society (IES) Publication:

(1981 Edition) Lighting Handbook

1.1.3 National Fire Protection Association (NFPA) Publication:

70-1981 National Electrical Code (NEC)

1.1.4 Underwriters' Laboratories, Inc., (UL) Standards:

57-1972 (R AUG 80)	Electric Lighting Fixtures
773-1974 (R APR 81)	Plug-In, Locking Type Photocontrols for Use With Area Lighting
773A-1978	Nonindustrial Photoelectric Switches for Lighting Control
935-1978 (R SEP 80)	Fluorescent Lamp Ballasts
1029-1980	High-Intensity-Discharge-Lamp Ballasts
1570-1979 (R FEB 80)	Fluorescent Lighting Fixtures

1.2 GENERAL REQUIREMENTS: Section 16011, "Electrical General Requirements," applies with the following additions and modifications. The work includes the provision of new lighting fixtures, photocell

switches, dimmer switches, time switches, contactors, and battery-powered units and systems for interior use, including lighting fixtures and accessories mounted on the exterior surfaces of buildings. Materials not normally furnished by manufacturers of these devices are specified in Section 16402, "Interior Wiring Systems."

- 1.3 SUBMITTALS: Data, shop drawings, and reports shall employ the terminology, classifications, and methods prescribed by the IES Lighting Handbook, as applicable, for the lighting system specified.
 - 1.3.1 Manufacturer's Data:
 - a. Lighting fixtures, including lamps and ballasts
 - b. Photocell switch
 - 1.3.2 Shop Drawings:
 - a. Lighting fixture assemblies

PART 2 - PRODUCTS

- 2.1 FLUORESCENT LIGHTING FIXTURES: UL 1570, except lighting fixtures for damp and wet locations shall conform to UL 57.
- 2.1.1 Fluorescent Lamps: Provide 34 watt, T-12 Lite White rapid start lamps, unless noted otherwise.
- 2.1.2 Fluorescent Ballasts: UL 935, ANSI C82.1, and shall be labeled Certified Ballast Manufacturers (CBM) certified by Electrical Testing Laboratories (ETL). Ballasts shall be high power factor type and shall be designed to operate on the voltage system to which they are connected. Ballasts shall be Class P and shall have sound rating "A". Fixtures and ballasts shall be designed and constructed to limit the ballast case temperature to 90 degrees Celcius (C) when installed in an ambient temperature of 40 degrees C.
- 2.1.2.1 Low Temperature Ballasts: Provide fluorescent ballast having a minimum starting temperature of zero degrees F in fixtures mounted outdoors, in unheated buildings, and as indicated.
- 2.1.2.2 Energy Saving Ballasts: Provide energy saving fluorescent ballasts of the CBM certified full light output type unless low temperature ballasts are indicated on drawings. The ballasts shall have an average input wattage of 86 or less when operating two F40T12 lamps tested in accordance with ANSI C82.2 methods. Ballast shall be compatible for use with energy—saving lamps.
- 2.1.3 Open-Tube Fluorescent Fixtures: Provide with spring-loaded telescoping sockets or lamp retainers (two per lamp).

- 2.2 HIGH-INTENSITY-DISCHARGE (HID) LIGHTING FIXTURES: UL 57.
- 2.2.1 HID Lamps: Provide the number, type, and wattage indicated.
- 2.2.2 HID Ballasts: UL 1029 and ANSI C82.4 and shall be constant wattage autotransformer (CWA) or regulator, high power factor type. Ballasts shall be designed to operate on the voltage system to which they are connected. Single-lamp ballasts shall have a minimum starting temperature of zero degrees F. Ballasts shall be designed for installation in a normal ambient temperature of 25 degrees C. Ballasts shall be constructed so that open circuit operation will not reduce their average life. High Pressure Sodium (HPS) ballasts shall have a solid-state igniter/starter with an average life in the pulsing mode of 10,000 hours at an igniter/starter case temperature of 90 degrees C. Average life is defined as the time after which 50 percent will have failed and 50 percent will have survived under normal conditions.
- 2.3 RECESS- AND FLUSH-MOUNTED FIXTURES: Provide type that can be relamped from the bottom. Trim for the exposed surface of flush-mounted fixtures shall be as shown on sketches or as indicated.
- 2.4 SUSPENDED FIXTURES: Provide hangers capable of supporting twice the combined weight of the fixtures to which they are attached. Single-unit suspended fluorescent fixtures shall have twin stem hangers. Rods shall be a minimum 3/16-inch diameter.
- 2.5 PHOTOCELL SWITCH: UL 773 or UL 773A, as applicable, hermetically sealed cadmium-sulphide cell rated 240 volts ac, 60 hertz with single—throw contacts rated 1000 watts and 120 volts. The unit shall be mounted integral to the fixture in a high-impact resistant noncorroding and nonconductive molded plastic housing with an EEI-NEMA locking-type receptacle. The unit shall turn on below 3 footcandles and off at 3 to 10 footcandles. A time delay shall prevent accidental switching from transient light sources. A directional lens shall be mounted in front of the cell to prevent fixed light sources from creating a turnoff condition.

PART 3 - EXECUTION

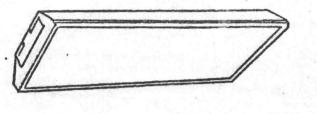
3.1 INSTALLATION: Set lighting fixtures plumb, square, and level with ceiling and walls, in alignment with adjacent lighting fixtures, and secure in accordance with manufacturers' directions and approved shop drawings. The installation shall meet with the requirements of NFPA 70. Mounting heights specified or indicated shall be to bottom of fixture. Obtain approval of the exact mounting of lighting fixtures on the job before installation is commenced and, where applicable, after coordinating with the type, style, and pattern of the ceiling being installed. Recessed and semirecessed fixtures may be supported from suspended ceiling support system ceiling tees if the ceiling system support rods or wires are provided at a minimum of four rods or wires per fixture and located not more than 6 inches from each corner of each fixture. Provide support rods

or wires for round fixtures or fixtures smaller in size than the ceiling grid at a minimum of four rods or wires per fixture and locate at each corner of the ceiling grid in which the fixture is located. Do not support fixtures by ceiling acoustical panels. Where fixtures of sizes less than the ceiling grid are indicated to be centered in the acoustical panel, support such fixtures independently or with at least two 3/4-inch metal channels spanning, and secured to, the ceiling tees.

- 3.2 GROUNDING: Ground noncurrent-carrying parts of equipment as specified in Section 16402, "Interior Wiring Systems." Where the copper grounding conductor is connected to a metal other than copper, provide specially treated or lined connectors suitable for this purpose.
- 3.3 FIELD TESTS: Perform the following field tests. The Government will provide electric power required for field tests.
- 3.3.1 Operating Test: After the installation has been completed, conduct an operating test to show that the equipment operates in accordance with the requirements of this section.
- 3.3.2 Insulation Resistance Test: Perform as specified in Section 16402, "Interior Wiring Systems," both before connection of fixtures and equipment and after fixtures and equipment are connected and ready for use.
- 3.3.3 Ground Resistance Tests: Perform as specified in Section 16402. "Interior Wiring Systems."

LIST OF SKETCHES

SKETCH NUMBER	TITLE
NFGS-16510-3	Fluorescent Troffer Luminaire
NFGS-16510-6	Industrial Fluorescent
NFGS-16510-8	Wet/Damp Location Luminaire
NFGS-16510-25	HID Wall-Mounted Luminaire
NFGS-16510-46	Ceiling-Mounted Vandal-Resistant Luminaire





1. HOUSING SHALL BE 22 GAGE (U.S STD) MIN. 5" MAX. HEIGHT AND SHALL NOT PERMANENTLY DEFORM WHEN LIFTED BY ONE CORNER WITH LENS DOOR IN PLACE NOR WITH LENS DOOR REMOVED. LENS DOOR SHALL NOT OPEN WHEN LUMINAIRE IS LIFTED BY ONE CORNER.

LUMINAIRE SHALL HAVE LESS THAN THE FOLLOWING DEFLECTION WHEN LIFTED BY ONE CORNER WITH LENS DOOR REMOVED:

 $\frac{\text{TYPE:}}{3"} \quad \frac{A}{2 \cdot 1/2"} \quad \frac{C, D \& E}{4"}$

2. HOUSING SHALL BE CHEMICALLY TREATED FOR RUST PREVENTION AND HAVE BAKED WHITE ENAMEL FINISH 85% MIN. REFLECTANCE (INTERIOR). ENDS SHALL BE SECURED BY RIVETS OR SCREWS.

3. LATCHES SHALL BE A MINIMUM OF 20 GAGE (U.S. STANDARD) STEEL OR 26 GAGE (U.S. STANDARD) SPRING STEEL. DIRECTION OF TRAVEL TO OPEN SHALL BE STAMPED ON LENS FRAME WHEN NOT OBVIOUS.

4. LENS DOOR SHALL BE 20 GAGE (U.S. STANDARD) STEEL, SHALL BE CAPABLE OF DISASSEMBLY FOR LENS REPLACEMENT. PROVIDE LIGHT TIGHT FIT WITHOUT MOVABLE BAFFLES.

5. LENS SHALL BE 0.156" (FOR TYPE'S A, C, D, E) AND 0.125" (FOR TYPE B) PLUS OR MINUS 10% OVERALL (0.09 MAX. PRISM PENETRATION) CLEAR PRISMATIC 100% ACRYLIC.

6. DOOR SHALL BE CAPABLE OF HINGING AND LATCHING FROM BOTH SIDES OF LUMINAIRE. PROVIDE SAFETY TYPE HINGES.

7. BALLAST SHALL BE HIGH POWER FACTOR (≥.9) ETL, CBM APPROVED RAPID START CLASS P ENERGY SAVING BALLAST WITH SOUND RATING OF "A" SECURE BALLAST TO HOUSING WITH AT LEAST ONE SCREW AND SLIP-ON BRACKET OR 2 SCREWS ONE AT EACH END.

8. PHOTOMETRICS: MINIMUM COEFFICIENT OF UTILIZATION (CU) FOR THE FOLLOWING CAVITY REFLECTANCES: CEILING = 80% WALL = 50% FLOOR = 20% LUMINANCE USING 3100L LAMP WITH AVG:MAX RATIO NOT TO EXCEED 1:5

ROOM CAVITY RATIO	TYPE .	A	В	C	D	E	AVG.	LUMINANCE (fL)
ROOM CAVIII RAITO	CII	0.67	0.60	0.73	0.70	0.67		45° - 2250
The state of the last of the state of the st	- 00	0.60	0.54	0.66	0.63	0.60		55° - 1605
. 2		0.54	0.48	0.59	0.56	0.54	To the state of	65° - 1125
3			0.44					75° - 750
MIN. S/MH			1.1					85° - 495

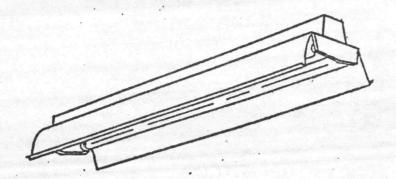
PROVIDE MIN. VISUAL COMFORT PROBABILITY (VCP) OF 65 (ASSUME 30'x30'x10'H ROOM). WHEN "OFFICE TYPE" INDICATED, PROVIDE MIN. VCP OF 70

9. PROVIDE MOUNTING HARDWARE COMPATABLE WITH CEILING MATERIAL.

TYPE A - 2'X 2' 2 LAMP TYPE B - 1'X 4' 2 LAMP TYPE C - 2'X 4' 2 LAMP TYPE D - 2'X 4' 3 LAMP TYPE E - 2'X 4' 4 LAMP

TROFFER

SKETCH NFGS-16510-3



- 1. HOUSING SHALL BE MIN. 20 GAGE (U.S. STANDARD) DIE FORMED COLD ROLLED STEEL, CHEMICALLY TREATED FOR RUST PREVENTION & FINISHED WITH WHITE BAKED ENAMEL OR POLYESTER FINISH. PROVIDE TOP AND END KNOCKOUTS.
- 2. HOUSING WELDED OR SECURED BY SCREWS OR RIVETS INTO A SINGLE ASSEMBLY.
- 3. RELECTOR SHALL BE MIN. 22 GAGE (U.S. STANDARD) (SOLID WHEN LUMINAIRE IS MOUNTED BELOW CATWALKS, ETC. 10-25% APERTURED WHEN PROTECTED FROM FALLING OBJECTS). PROVIDE 30° SHIELDING CENTER VEE. CHEMICALLY TREAT FOR RUST PREVENTION AND FINISH WITH WHITE BAKED ENAMEL, PORCELAIN ENAMEL, OR POLYESTER FINISH. MINIMUM REFLECTANCE SHALL BE 85%.
- 4. THE LUMINAIRE SHALL NOT PERMANENTLY DISTORT WHEN LIFTED BY ONE CORNER.
- 5. SPACING TO MOUNTING HEIGHT RATIO = 1.3
- 6. LUMINAIRE SHALL BE CAPABLE OF CONTINUOUS ROW AND SINGLE UNIT PLACEMENT WITH PENDANT OR SURFACE MOUNTING.
- 7. SPRING LOADED PLUNGER TYPE SOCKETS. .
- 8. BALLAST SHALL BE HIGH POWER FACTOR (≥.9) ETL, CBM APPROVED CLASS P ENERGY SAVING BALLAST WITH A SOUND RATING OF B (RAPID START OR SLIMLINE).
- 9. MINIMUM COEFFICIENT OF UTILIZATION (CU) WITH THE FOLLOWING CAVITY REFLECTANCE OF: CEILING = 80% WALL = 50% FLOOR = 20% LUMINANCE USING 3100L LAMP WITH AVG:MAX. RATIO NOT TO EXCEED 1:5

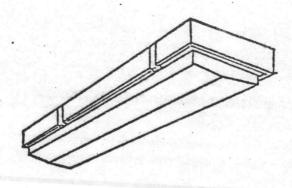
ROOM CAVITY RATIO		o CU	AVG. LUMINANE (f				
20011	1	0.85		85° -	1350		
	2	0.73		55° -	1250		
	3	0.68		65° -	1250		
	4	0.60		75° -	850		
				85° -	600		

INDUSTRIAL FLUORESCENT

TYPE A - 48" 2 LAMP 430 MA.

TYPE B - 96" 2 LAMP 430 MA.

SKETCH NFGS-16510 -6





- 1. MOLDED 100% ACRYLIC DIFFUSE LENS (NOT CLEAR) FULLY GASKETED.
- 2. PLATED BRASS OR STAINLESS STEEL LATCHES. (PLASTIC LATCHES MAY BE SUPPLIED WITH TYPE A LUMINAIRE.)
- 3. BALLAST SHALL BE HIGH POWER FACTOR (≥ .9) ETL CBM APPROVED RAPID START CLASS P ENERGY SAVING BALLAST WITH A SOUND RATING OF A. SECURE BALLAST TO HOUSING WITH AT LEAST ONE SCREW AND SLIP-ON BRACKET OR 2 SCREWS ONE AT EACH END.
- 4. UL LISTED FOR DAMP LOCATION. PROVIDE UL "WET" LABEL WHEN INDICATED.
- 5. OVERALL LUMINAIRE LENGTH SHALL BE 48" NOMINAL.
- 6. MINIMUM COEFFICIENT OF UTILIZATION (CU) WITH CAVITY REFLECTANCES OF 80% CEILING, 50% WALLS AND 20% FLOOR SHALL BE:

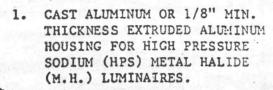
RCR			CU
1			0.67
2			0.55
3			0.50
4			0.45

7. MINIMUM SPACING TO MOUNTING HEIGHT RATIO SHALL BE 1.3.

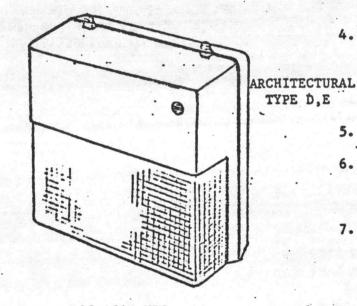
WET/DAMP LOCATION LUMINAIRE

TYPE A FIBERGLASS OR PLASTIC HOUSING TYPE B ALUMINUM HOUSING

SKETCH NFGS-16510-8



- CAST ALUMINUM, 1/8" MIN.
 THICKNESS EXTRUDED ALUMINUM,
 ABS PLASTIC OR POLYCARBONATE
 HOUSING FOR LOW PRESSURE
 SODIUM (LPS) & 35/50/70W HPS
 LUMINAIRES.
- 3. HINGED, U.V. STABILIZED POLYCARBONATE LENS OR HINGED TEMPERED GLASS WITH POLYCARBONATE SHIELD.
- 4. LAMP SIZE AS INDICATED IN FIXTURE SCHEDULE.



5. PROVIDE ALUMINUM REFLECTOR.

- 6. BALLAST SHALL BE HIGH POWER FACTOR TYPE (≥ .85) WITH CHARACTERISTICS AS INDICATED.
- PROVIDE PHOTO ELECTRIC CONTROL WHEN INDICATED.

TYPE B, E 175W M.H. TYPE C 35, 55W LPS

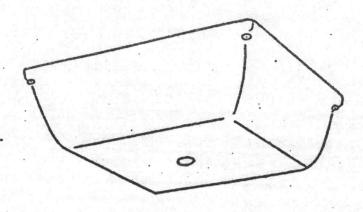
NOTE: TYPES D & E MAY BE SUBSTITUTED FOR TYPES A & B RESPECTIVELY BUT NOT VICE VERSA.

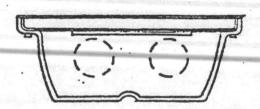
H.I.D. WALL MOUNTED LUMINAIRE

UTILITY

TYPE A, B, C

SKETCH NFGS-16510-25





- TYPE A UP TO 2-100W A-19 INCANDESCENT LAMPS MAX. DIMENSIONS 12"x12"x6"D
- TYPE B 35W, 50W OR 70W HIGH
 PRESSURE SODIUM LAMP
 AS INDICATED MAX
 DIMENSIONS 12-1/2"x
 12-1/2"x8-1/2"D

CEILING MOUNTED VANDAL-RESISTANT LUMINAIRE

LUMINAIRE REQUIREMENT

 16 GAGE (U.S. STD) STEEL OR ALUMINUM BACK PLATE.

- POLYCARBONATE PRISMATIC OR OPAL LENS HELD IN PLACE WITH 4 STAINLESS STEEL SCREWS.
- 3. FULLY GASKETED AROUND LENS AND BETWEEN LUMINAIRE AND CEILING WITH DOUBLE BAKED NEOPRENE GASKETS.
- 4. U.L. LISTED FOR DAMP LOCATIONS.
- 5. MOUNT LUMINAIRE TO CEILING WITH 4-1/4" SCREWS.
- 6. PROVIDE WIRING COMPARTMENT SUITABLE FOR USE WITH 60°C WIRE INSULATION.

SKETCH NFGS-16510-46

SECTION 16530

EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 APPLICABLE PUBLICATIONS: 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.

1.1.1 American National Standards Institute (ANSI) Publications:

C2-1981 National Electrical Safety Code

C82.4-1978 Specifications for High-Intensity-Discharge

Lamp Ballasts (Multiple Supply Type)

1.1.2 Illuminating Engineering Society (IES) Publication:

Lighting Handbook, 1981 Edition

1.1.3 National Electrical Manufacturer's Association (NEMA)
Publications:

FA 1-1973 Outdoor Floodlighting Equipment (R 1979)

OD 3-1977 Physical and Electrical Interchangeability of Photo-Control Devices and Mating Receptacle Used in the Control of Roadway Lighting, NEMA Standard for

SH 5-1969 Tubular Steel, Aluminum and Prestressed Concrete (R 1974, Roadway Lighting Poles, Standard for 1979)

1.1.4 National Fire Protection Association (NFPA) Publication:

NFPA 70-1981 National Electrical Code

1.1.5 Underwriters' Laboratories, Inc. (UL) Publication:

1029-1980 High-Intensity-Discharge Lamp Ballasts

1.2 GENERAL REQUIREMENTS: Section 16011, "General Requirements, Electrical," with the following additions and modifications, applies. Materials not considered to be lighting equipment or lighting fixture accessories are specified in Section 16301, "Underground Electrical Work", Section 16302, "Overhead Electrical Work", and Section 16402, "Interior Wiring Systems". Lighting fixtures and accessories mounted on the

exterior surfaces of buildings are specified in Section 16510, "Lighting, Interior."

- 1.3 SUBMITTALS: Data, shop drawings, and reports shall employ the terminology, classifications, and methods prescribed by the IES Lighting Handbook as applicable for the lighting system specified.
 - 1.3.1 Manufacturer's Data: Submit the following for approval:
 - a. Luminaires
 - b. Poles and Brackets
 - c. Photocell Switch

When data that describe more than one type, size, model, or item is submitted, clearly mark the data to indicate which type, size, model, or item is being provided. Data shall be sufficient to show conformance to specified requirements.

1.3.2 Shop Drawings: Submit for luminaires, show dimensions, accessories, installation details, and construction details. Aiming diagram and computerized candlepower distribution data shall accompany shop drawings.

PART 2 - PRODUCTS

- 2.1 LUMINAIRES: NEMA FA 1. Luminaries shall be as indicated and as described on Sketch NFGS-16530 Luminaire Requirements. Provide luminaires complete with lamps of the number, type and wattage indicated. The details, shapes and dimensions are indicative of the general type desired, but are not intended to restrict selection to luminaries of any particular manufacturer. Luminaires of similar designs and equipment, light-distribution and brightness characteristics, and of equal finish and quality will be acceptable as approved.
 - 2.1.1 Lamps: Provide the type and wattage indicated.
- 2.1.2 Ballasts for H-I-D Luminaires: UL 1029 and ANSI C82.4, and shall be regulator, high power factor type. Ballasts shall be designed to operate on the voltage system to which they are connected. Single lamp ballasts shall have a minimum starting temperature of zero degrees F.

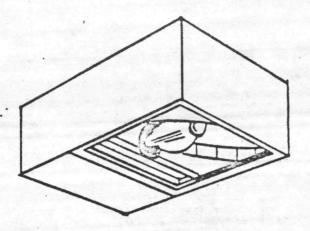
Ballasts shall be designed for installation in normal ambient temperature of 25 degrees F. Ballasts shall be constructed so that open circuit operation will not reduce their average life. High Pressure Sodium (HPS) ballasts shall have a solid state ignitor/starter with an average life in the pulsing mode of 10,000 hours at an ignitor/starter case temperature of 75 degrees C. Average life is defined as the time after which 50 percent will have failed and 50 percent will have survived under normal conditions.

- 2.1.3 Refractors: Borosilicate glass. Glass refractors shall be resistant to thermal shock.
- 2.2 PHOTOCELL SWITCH: NEMA OD 3, hermetically sealed cadmium sulphide cell rated 120 volts AC, 60 hertz with single throw contacts rated 1000 watts, and 120 volts. Mount unit integral to the luminaire. The unit shall turn on below 3 foot candles and off at 3 to 10 footcandles. A time delay shall prevent accidental switching from transient light sources. A directional lens shall be mounted in front of the cell to prevent fixed light sources from creating a turn-off condition.
- 2.3 POLES: NEMA SH 5 for concrete, embedded-base type designed for use with underground supply conductors.
- 2.3.1 Concrete Poles: Provide with 28-day compressive strength of 7000 pounds per square inch (psi). Do not subject poles to severe temperature changes during the curing period.
- 2.4 BRACKETS AND SUPPORTS: NEMA SH 5. Pole brackets shall be not less than 1-1/4-inch galvanized steel pipe or anodized aluminum secured to pole. Slip-fitter or pipe-threaded brackets may be used, but brackets shall be coordinated to the luminaires provided, and all brackets for use with one type of luminaire shall be identical. Special mountings or brackets shall be as indicated and shall be of metal which will not promote galvanic reaction with the luminaire head.

PART 3 - EXECUTION

- 3.1 INSTALLATION: ANSI C2, NFPA 70, and to the requirements specified in this section.
- 3.1.1 Concrete Poles: Install according to pole manufacturer's instructions.
- 3.1.2 Pole Setting: The pole setting depth shall be as indicated. Dig holes large enough to permit the proper use of tampers to the full depth of the hole. Place backfill in the hole in 6-inch maximum layers and thoroughly tamp it. Place surplus earth around the pole in a conical shape and pack it tightly to drain water away.
- 3.2 GROUNDING: Ground non-current-carrying parts of equipment as specified in Section 16301, "Underground Electrical Work." Where the copper grounding conductor is connected to a metal other than copper, provide specially treated or lined connectors suitable for this purpose.
- 3.3 FIELD TESTS: Perform the following field tests. The Government will provide electric power required for field tests.

- 3.3.1 Operating Test: After the installation has been completed, conduct an operating test to show that the equipment operates in accordance with the requirements of this section.
- 3.3.2 Insulation Resistance Test: Perform as specified in Section 16301, "Underground Electrical Work."
- 3.3.3 Ground Resistance Tests: Perform as specified in Section 16301, "Underground Electrical Work."



- 1. HOUSING DIE CAST ALUMINUM W/BAKED ENAMEL FINISH.
- 2. REFLECTOR ANODIZED ALUMINUM
- 3. LENS TEMPERED GLASS W/POLYESTER FIBER GASKETING AT DOOR AND AT LENS.
- 4. SPRING LATCH ON DOOR ASSEMBLY
- 5. ADJUSTABLE SLIPFITTER FOR 1 1/4" THRU 2" MAST ARM.
- 6. TWIST LOCK PHOTO ELECTRIC CELL, EXCEPT AS INDICATED.
- 7. ALL EXTERNAL HARDWARE SHALL BE STAINLESS STEEL.
- 8. ADJUSTABLE PORCELAIN SOCKET.

NOTE:

LAMP, BALLAST AND I.E.S. DISTRIBUTION AND HOUSING COLOR, SHALL BE AS SPECIFIED AND AS SHOWN IN LIGHTING FIXTURE SCHEDULE.

SKETCH NFGS-16530-1

C

*** END OF SECTION ***

SUPERSTREAS DECISION

STATE: NORTH CARCIDA DECISION NUMBER: \$031-1148 COMTES: Statevide ECTION NUMBER: \$131-1148

DATE: Date of publication
Supersedes Decision No.: NC79-1125, September 7, 1979, 14 FR 52577

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nters	5.16					
EADORS	5.01				-	
ctors :	4.04				-	
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petities	5.25			1	1	
t Operators: .		Telephone and the	CF STREET			
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22)	14.25	1		1	1	
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z machine	5.00	1			1	
773	3.67	-	1		1	
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Unlisted classifications needed for work not implied within the scape of this classification may be added only after exard as provided in the labor standards contract clauses (29 GPR, 5.5 (a) (1) (iii)).

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		Fringe Benefits Poyments						
	Bosic Hourly Rates	H&W	Pensions	Yacation	Education and/or Appr. Tr.			
								
ECISION #NC81-1148 - MOD. #	1				7. 32.5			
(45 FR 86200 - December 30,								
1980)								
tatewide, North Carolina			-	parties .				
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