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DEPARTMENT OF THE NAVY

ATLANTIC DIVISION, NAVAL FACILITIES ENGINEERING COMMAND

NORFOLK, VIRGINIA

LANTDIV RAC Contract No.
N62470-89-D-3032

N62470-93-B-3213
NAVFAC Specification No. 05933213
Appropriation: DERA

GROUNDWATER REMEDIATION AT Q AREA
DRUM STORAGE YARD
NAVAL BASE, NORFOLK, VIRGINIA

Design by:

BAKER ENVIRONMENTAL, INC.
CORAOPOLIS, PENNSYLVANIA

Specification Prepared by:

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Environmental Quality Division Director: W. H. Russell, P.E.

Date:_____

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SECTION 01010

GENERAL PARAGRAPHS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910	Occupational Safety and Health Standards
29 CFR 1910.120	Hazardous Waste Operations and Emergency
29 CFR 1926	Safety and Health Regulations for Construction

CORPS OF ENGINEERS (COE)

COE EP 1110-1-8	1993 Construction Equipment Ownership and Operating Expense Schedule
COE EM 385-1-1	1992 Safety and Health Requirements Manual

MILITARY STANDARDS (MIL-STD)

MIL STD 461	(Rev C) (Notice 2) Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference
MIL STD 462	(Notice 6) Measurement of Electromagnetic Interference Characteristics

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 241	1989 Safeguarding Construction, Alteration, and Demolition Operations

1.2 PRECONSTRUCTION SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic Contract.

1.2.1 SD-09, Reports

a. Work Plan G

1.2.1.1 Work Plan

Within 60 days of issuance of the delivery order, submit a work plan consisting of the following elements.

a. Narrative

Provide a brief description of the project objectives, scheduling, sampling and analysis requirements, decontamination procedures, removal and excavation procedures, and storage, transportation, and treatment requirements; and a detailed sequence of events for the construction, extraction, and treatment methods.

b. Technical Specifications

Provide, in an amendment format, any additions and modifications to the contract specifications required to accurately describe the materials and work procedures envisioned to satisfy the requirements of the delivery order. Contact Code 406, Specifications Branch, Engineering and Design Division, LANTNAVFACENGCOM, (804) 322-4406, for availability of guide specification sections for those sections required, but not included in the contract documents.

c. Shop Drawings

Shop drawings shall detail and describe all components of the project not currently indicated on the contract drawings such that the shop drawings and the contract drawings, when taken together, provide a complete representation of the project requirements. Shop drawings shall be prepared and sealed by a registered professional engineer. Shop drawings shall include: 1) Site plans and structural drawings providing details of all site work, including the layout, arrangement, and components of the groundwater remediation system; 2) Drawings showing erosion controls to be used during construction. 3) Drawings providing details of the layout and installation of all process equipment.

d. Environmental Protection Plan

Within 15 days of issuance of the delivery order, meet with the Navy's Technical Representative (NTR) to discuss environmental protection requirements for the project. After meeting with the NTR, prepare and submit an Environmental Protection Plan in Accordance with Section C, Part 4.0, of the Basic Contract.

e. Health and Safety Plan

Provide a site specific health and safety plan (HASP) in accordance with Section C, Part 3.0, of the Basic Contract. The HASP shall include but is not limited to the following:

1. Names of the Health and Safety officer and names of alternates responsible for Health and Safety.

2. Description of the levels of personal protection to be used for each task.

3. A description of the frequency and types of personal monitoring.

4. Employee training.

5. A description of environmental sampling techniques and instrumentation.

6. Site control measures.

7. Decontamination procedures.

8. Standard Health and Safety operating procedures.

9. Contingency plan.

10. NFPA 241

f. QC Plan

Provide a QC Plan in accordance with Section C, Part 6.0, of the Basic Contract.

(1) Submittal Register

As part of the QC Plan, submit a completed Submittal Register to document quality control for materials, inspection, and testing in accordance with Section C, Part 7.0 of the Basic Contract. A copy of the Submittal Register is provided at the end of this section.

(2) Testing Laboratory Qualifications

As part of the QC Plan, submit qualifications for each laboratory which shall be used in accordance with Section C, Part 6.0, of the Basic Contract.

g. Sampling and Analysis Plan

Provide a Sampling and Analysis Plan describing all sampling and analyses requirements for the delivery order. The Plan shall contain a field sampling plan and a quality assurance plan.

1.2.2 Forwarding Preconstruction Submittals

Within 60 days of issuance of the delivery order, and before procurement, fabrication, or mobilization, submit to the Architect-Engineer, Baker Environmental, Inc., Airport Office Park, Building 3, 420 Rouser Road, Coraopolis, PA 15108, and to distribution as directed by the NTR, the preconstruction submittals required in this specification. The Architect-Engineer and NTR shall review the Work Plan to determine

compliance of the Contractor's Work Plan with the requirements of the contract documents for this delivery order.

1.2.3 Review Comments

The Contractor's Work Plan shall be reviewed. The NTR shall compile and coordinate all Government review comments, and forward consolidated review comments to the Contractor. Review comments on the Work Plan shall be resolved, and submittals modified as required. After the correction of the submittals, submit corrected final copy of the Work Plan to the Commander, LANTNAVFACENGCOM, Code 183, 1510 Gilbert Street, Norfolk, Virginia 23511-2699 for final review. The Work Plan shall be approved prior to commencement of any other work associated with this delivery order.

1.2.4 Transformer Submittals

Submit to the Commander, LANTNAVFACENGCOM, Code 04A1, 1510 Gilbert Street, Norfolk, Virginia 23511-2699 submittals for the pad-mounted transformers.

1.3 SUBMITTALS

Submit the following in accordance with Section C, Part 7.0, of the Basic Contract.

1.3.1 SD-18, Records

a. Shop Drawings

b. Record Documents/Drawings

c. Environmental Conditions Report

d. Network Analysis Diagram

e. Status Reports

f. QC Meeting Minutes

g. Test Results Summary Report

h. Contractor Production Report

i. QC Report

j. Rework Items List

k. Permits

l. Contractor's Closeout Report

1.3.1.1 Record Documents/Drawings

Maintain two sets of full size contract drawings and two sets of full size approved shop drawings marked to show any deviations which have occurred, including buried or concealed construction and utility features revealed

during the course of construction. Record horizontal and vertical locations of buried utilities that differ from the contract drawings. These drawings shall be available for review by the NTR at any time. At the completion of the work, deliver marked sets of the contract drawings to the NTR. The Contractor shall incorporate all shop drawing deviations, and deliver one complete set of the shop drawings to the NTR.

1.3.1.2 Environmental Conditions Report

Prior to starting work, perform a preconstruction survey with the NTR. Take photographs showing existing environmental conditions on and adjacent to the site. Prior to starting work, submit the results of the survey in an Environmental Condition Report to the NTR.

1.3.1.3 Contract Management System (CMS)

The CMS shall be a system able to provide, as a minimum, the activities in sorts or groups as specified in the Basic Contract and any subsequent Delivery Orders.

a. Network Analysis Diagram

Within 30 days of approval of the Contractor's Work Plan, submit a Network Analysis Diagram in accordance with the Basic Contract and any subsequent Delivery Orders.

b. Status Reports

All Status Reports shall comply with the Basic Contract and any subsequent Deliver Orders. Submit a Technical Progress Report, Cost Performance Report, Modification Log, Time-Scaled Logic Diagram, Government Materials Tracking Report, Variance Analysis Report, and Waste Materials Report. Submit the first delivery order Status Report approximately 30 days after approval of the Contractor's Work Plan. Thereafter, submit Status Reports every 30 days. Status report periods shall be consistent with the invoice reporting periods.

1.3.1.4 QC Meeting Minutes

The QC Representative shall document all QC meetings by delivering copies of the minutes to the NTR within 3 calendar days after each QC meeting. The submittals shall comply with Section C, Part 6.0 of the Basic Contract.

1.3.1.5 Test Results Summary Report

A summary report of all field tests and laboratory analytical results shall be submitted to the NTR within 30 days after laboratory receipt of samples and in accordance with Section C, Part 6.0 of the Basic Contract.

1.3.1.6 Contractor Production Report (CPR)

The CPR shall be prepared and submitted daily to the NTR in accordance with Section C, Part 6.0, of the Basic Contract.

1.3.1.7 QC Report

The QC Report shall be submitted by the QC Representative to the NTR every day work is performed, material is delivered, direction is pending, or a labor force is present in accordance with Section C, Part 6.0, of the Basic Contract.

1.3.1.8 Rework Items List

The QC Representative shall deliver a copy of the rework items list to the NTR on a monthly basis in accordance with Section C, Part 6.0, of the Basic Contract.

1.3.1.9 Permits

Fifteen days prior to beginning onsite work, submit draft copies of the following permits required for onsite activities:

a. Excavation Permit; from the Public Works Officer, Utilities Division

1.3.1.10 Contractor's Closeout Report

Submit upon completion of the project. This report shall include: Introduction, Summary of Action, Final Health and Safety Report, Summary of Record Documents, Field Changes and Contract Modification, Final Documents, Complete Set of all Field Test and Laboratory Analytical Results, Complete Set of All Data Validation Results, Offsite Transportation and Treatment of Materials, and QC Summary Report.

1.3.2 Forwarding Submittals

After approval of the work plan, and before procurement or fabrication, submit, except as specified otherwise, to the Architect-Engineer, Baker Environmental, Inc., Airport Office Park, Building 3, 420 Rouser Road, Coraopolis, PA 15108, the shop drawings and technical data required in the technical sections of this specification. The Architect-Engineer for this project shall review and provide surveillance for the NTR to determine if Contractor-approved submittals comply with the contract requirements, and shall review and approve for the NTR those submittals not permitted to be Contractor approved to determine if submittals comply with the contract requirements. At each "Submittal" paragraph in the individual specification sections, a notation "G", following a submittal item, indicates the Architect-Engineer, acting as the agent for the NTR, is the approving authority for that submittal item. One copy of the transmittal form for submittals shall be forwarded to the Resident Officer in Charge of Construction (ROICC).

1.4 GENERAL INTENTION

It is the declared and acknowledged intention and meaning to provide and secure Contractor services for groundwater remediation at the Q-Area Drum Storage Yard (QADSY) Site, Naval Base, Norfolk, Virginia, complete and ready for use.

1.5 GENERAL DESCRIPTION

This work includes preparation of a work plan and submittals previously described, and providing all labor, supervision, tools, materials, equipment and transportation necessary to install and operate for 180 days an air sparging/soil vapor extraction (AS/SVE) system for remediation of contaminated groundwater at the QADSY Site. Components of this project include but are not limited to: mobilization and preparatory work; installation of an air sparging/soil vapor extraction system and related treatment system; construction of treatment system buildings and related site work; monitoring of AS/SVE system and treatment systems including testing, sampling and analytical requirements; operation of the AS/SVE systems and treatment systems for a period of 180 days; and site restoration and other related work.

After the remediation system has been installed the Contractor will operate and maintain the remediation system for a period of 180 days. The Contractor shall be responsible for correcting and repairing all problems that may occur during this 180 day period.

1.6 DESCRIPTION OF CONTAMINANTS PRESENT

Groundwater at the QADSY Site has been contaminated with volatile organic compounds (VOCs) including tetrachloroethene (PCE), trichloroethene (TCE), 1,1,1-Trichloroethane (TCA), 1,2-dichloroethene (DCE), and 1,1-DCE. Site characterization activities conducted at the site have defined the approximate extent of contamination present.

The results of the chemical analyses for the soil borings and monitoring wells installed at QADSY Site are indicated in the reference documents. The above list of contaminants may not be all inclusive.

1.7 LOCATION

The work shall be located at the QADSY Site, Naval Base, Norfolk, Virginia, approximately as shown.

1.8 PROJECT INFORMATION

1.8.1 Drawings, Maps and Specifications

Four sets of contract drawings, maps and specifications shall be furnished to the Contractor, except applicable publications incorporated into the technical provisions by reference. Additional sets shall be furnished on request at no additional charge. The work shall conform to the following contract drawings and maps, all of which form a part of these specifications and are available in the office of the NTR.

EFD Dwg. No.	NAVFAC Dwg. No.	Title	Sheet No.
431066	4331066	Cover Sheet and general Notes	T-1
431067	4331067	Existing Conditions - AOC1	C-1
431068	4331068	Existing Conditions - AOC2	C-2
431069	4331069	Site Layout - AOC1 and AOC2	C-3
431070	4331070	Well Construction Details	C-4

431071	4331071	Equipment General Arrangement and Miscellaneous Details	C-5
431072	4331072	Boring Logs	C-6
431073	4331073	Boring Logs	C-7
431074	4331074	Boring Logs	C-8
431075	4331075	Architectural Plans, Elevations and Sections	A-1
431076	4331076	General Notes, Symbols and Abbreviations	S-1
431077	4331077	Building Plans, Sections and Details	S-2
431078	4331078	Building Plans, Sections and Details	S-3
431079	4331079	Plans, Schedules and Details	M-1
431080	4331080	Process Flow Schematic	P-1
431081	4331081	Legend, Abbreviations and Fixture Schedule	E-1
431082	4331082	AOC1 and AOC2 Site Plans	E-2
431083	4331083	AOC1 Lighting and Power Plans	E-3
431084	4331084	AOC2 Lighting and Power Plans	E-4

1.8.2 Reference Report

The following reference reports are available for examination in the office of the NTR and are intended only to show the existing conditions. The reports and drawings are the property of the Government and shall not be used for any purpose other than that intended by the specification.

Reports

A. "Revised Draft Final Remedial Investigation/Feasibility Study, Q Area Drum Storage Yard, Norfolk Naval Base, Norfolk, Virginia". Environmental Science and Engineering, Inc., October 1995.

1.9 PROJECT SCHEDULE AND TIME CONSTRAINTS

The Contractor shall be required to (a) commence work under this contract within 10 calendar days after the date the Contractor receives the notice to proceed, (b) prosecute the work diligently, and (c) complete the entire work ready for use not later than one calendar year after receiving approval of the work plan. The time stated for completion shall include project construction, start-up operations, and restoration of the site. The 180-day operational period is excluded from this schedule. Contractor shall notify the COMNAVBASE, Environmental Programs Office (Ms. Dianne Bailey, Code N42B, (804) 444-3009) a minimum of 14 days prior to mobilization.

PART 2 PRODUCTS

2.1 SAFETY FENCING

Safety fencing shall be orange, high density, ultra violet stabilized polyethylene, at least four feet in height.

PART 3 EXECUTION

3.1 FACILITIES AND SERVICES

The Contractor shall provide all temporary facilities necessary for the proper completion of the work, as necessary and as specified.

3.1.1 Availability of Utilities Services

a. Government utilities, if available at the work sites shall be made available to the Contractor without charge.

b. The Government shall supply non-potable water required to perform work to the Contractor. The water source location will be as directed by the NTR. Work shall be coordinated with the Base Environmental Management Office (Dianne Bailey, (804) 444-3009). The Contractor shall provide all piping, hoses, pumps, and connections to transport water to the desired locations on site. The Contractor shall also provide a backflow-prevention device at the water source.

c. The Government shall supply reasonable amounts of electricity to the Contractor. The Contractor shall provide all equipment and labor necessary to connect, convert, and transfer the utilities to the work. The Contractor shall make connections and disconnections.

d. The Contractor shall not operate nor disturb the setting of control devices in the station utilities system, including water, sewer, electrical, and steam services. The Government shall operate the control devices as required for normal conduct of the work. The Contractor shall notify the NTR, giving 15 days advance notice when such operation is required.

e. The Contractor shall contact Base Telephone Services in writing to obtain telephone connection. The Contractor shall provide all equipment and labor necessary to connect the telephone service to the site. The Contractor shall make arrangements for connections and disconnections and payments.

3.1.2 Storage in Existing Buildings

Storage in existing buildings shall not be allowed.

3.1.3 Open Site Storage Size and Location

The open site available for storage/laydown/decontamination shall be confined to the areas indicated by the NTR.

3.1.4 Trailers, Storage, and Temporary Buildings

Locate trailers, storage, and temporary buildings where directed and within the indicated operations area. Trailers or storage buildings shall be permitted where space is available subject to the approval of the NTR. The trailers or storage buildings shall be suitably painted and kept in a

good state of repair. Failure of the Contractor to maintain the trailers or storage buildings in good condition shall be considered sufficient reason to require their removal. Trailers shall be anchored to resist high winds and must meet applicable State or local standards for anchoring mobile trailers.

3.1.4.1 Storage and Office Trailers

Trailers must meet State law and station requirements and must be in good condition. Trailers shall be lockable and shall be locked when not in use. Trailers shall have a sign not smaller than 24 inches by 24 inches in the lower left hand corner of left door of trailer with the following information: company name, address, registration number of trailer or vehicle identification number, location on base, duration of contract or stay on-base, contract number, local on-base phone number, off base phone number of main office, and emergency recall person and phone number.

3.1.5 Cleaning Up

During the progress of the remediation, the work area and adjacent areas shall be kept clean and free of all rubbish, surplus materials, and unneeded construction equipment.

No material or debris shall be allowed to flow or wash into watercourses, ditches, gutters, drains, or pipes.

The Contractor shall remove all temporary buildings and structures built under this contract on or before the completion of the work.

All materials and equipment installed by the Contractor or any subcontractors shall be thoroughly clean, and on completion of the work shall deliver it undamaged and in fresh and new-appearing condition.

The Contractor shall restore or replace, when and as directed by the NTR, any property damaged by the contract work and equipment or by employees. The property shall be restored in a condition at least equal to that existing prior to the beginning of construction operations. Suitable materials, equipment, and methods shall be used for such restoration. The restoration of property shall be done promptly and shall not be left until the end of the contract period.

3.2 RESTRICTIONS ON OPERATIONS

3.2.1 Scheduling

The Naval Base Norfolk shall remain in operation during the entire construction period. The Contractor shall schedule the work as to cause the least amount of interference with Base operations. Work schedules shall be subject to the approval of the NTR. Permission to interrupt Base roads shall be requested in writing a minimum of 15 calendar days prior to the desired date of interruption. Notify the NTR 48 hours prior to starting excavation.

3.2.2 Regular Work Hours

The regular work hours for the Naval Base Norfolk are 0645 to 1615, Monday through Friday.

3.2.3 Work Outside Regular Hours

If the Contractor desires to carry on work outside regular hours or on Saturdays, Sundays, or holidays, the Contractor shall submit an application to the NTR, two regular working days prior to the scheduled working date. The Contractor shall allow ample time to enable satisfactory arrangements to be made by the Government for inspecting the work in progress. At night, the Contractor shall light the different parts of the work in an approved manner.

3.2.4 Security Requirements

The Contractor shall comply with the general security requirements as stipulated in Section C, Part 2.0, of the Basic Contract. No employee or representative of the Contractor will be admitted to the work site without satisfactory proof of United States citizenship unless specifically authorized to the work site by the NTR.

3.2.5 Restrictions On Equipment

3.2.5.1 Radio Transmitter Restrictions

The Contractor shall conform to the restrictions and procedures for the use of radio transmitting equipment, as directed by the NTR. Do not use transmitters without prior approval.

3.3 EQUIPMENT OWNERSHIP AND OPERATING EXPENSE SCHEDULE

Whenever a contract or modification of contract price is negotiated, the Contractor's cost proposal for equipment ownership and operating expenses shall be determined in accordance with the following requirements. A copy of COE EP 1110-1-8 is available for review at:

OICC/ROICC
NAVFACENGCOM Contracts
Building Z140, Naval Station
Norfolk, Virginia 23511-2699

a. Allowable cost for construction, marine plant, and equipment in workable condition, owned or controlled, and furnished by a Contractor or subcontractor at any tier shall be based on actual cost data when the Government can determine both ownership and operating costs for equipment or equipment groups of similar serial numbers and series from the Contractor's accounting records. When both ownership and operating costs cannot be determined from the Contractor's accounting records, equipment costs shall be based on the applicable provisions of COE EP 1110-1-8, Region II (the schedule). Working conditions shall be considered to be average for determining equipment rates using the schedule unless otherwise specified by the Contracting Officer. For equipment not included

in the schedule, rates for comparable pieces of equipment may be used or a rate may be developed using the formula provided in the schedule. For forward pricing, the schedule in effect at the time of negotiations shall apply. For retrospective pricing, the schedule in effect at the time the work was performed shall apply.

b. Equipment rental costs are allowable, subject to FAR 31.105(d)(2)(ii) and FAR 31.205-36, when substantiated by certified copies of paid invoices. Rates for equipment rented from an organization under common control, lease purchase, or sale-lease back arrangements will be determined using the schedule. However rental costs leased from an organization under common control that has an established practice of leasing the same or similar equipment to unaffiliated lessees shall not be allowed. Costs for major repairs and overhaul are not allowed.

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

3.4 ACTIONS REQUIRED OF THE CONTRACTOR

The Contractor shall comply with all requirements stated in Section C, Part 2.0, of the Basic Contract.

3.4.1 Station Permits

The Contractor shall obtain all necessary station permits. Permits are required for, but not necessarily limited to, welding and digging. Burning shall not be permitted. Applications are to be submitted to the NTR. The Contractor shall allow 7 calendar days for processing of the applications.

3.5 PUBLIC RELEASE OF INFORMATION

The Contractor shall comply with all requirements stated in Section C, Part 2.0, of the Basic Contract.

3.6 ENVIRONMENTAL PROTECTION REQUIREMENTS

Provide and maintain, during the life of the delivery order, environmental protection as defined in Section C, Part 4.0, of the Basic Contract, with additional requirements as follows:

a. Provide 24 hour advance written notice to the NTR of Contractor's intention to dispose of contaminated soil and material off-Base.

b. Disposal of contaminated soil at facilities not holding a valid Commonwealth of Virginia permit is specifically prohibited. The

prohibition also applies to sites where a permit may have been applied for but not yet obtained.

c. Off-base disposal of construction debris outside the parameters of this paragraph at sites without state permits and/or not in accordance with all regulatory requirements shall require the Contractor at his own expense to remove, transport, and relocate the debris to a state approved site. The Contractor shall also be required to pay any fines, penalties, or fee related to the illegal disposal of construction debris.

3.7 PUBLIC SAFETY MEASURES

3.7.1 Safety Fencing

Safety fencing shall be installed around the Contractor's work area as required to protect equipment and to provide for public safety during construction.

3.7.2 Safety Drums

Safety drums shall be installed as necessary at areas of excavation where vehicle traffic may be expected.

3.8 REQUIRED INSURANCE

Insurance requirements from Section H of the Basic Contract are enforced in their entirety.

3.9 FIRE PROTECTION

3.9.1 Compliance

COE EM-385-1-1, NFPA 242, and activity fire regulations. Obtain approval from the activity Fire Chief prior to commencement of hit work operations.

3.9.2 Notification of Fire

Post the activity fire poster in conspicuous locations and at telephones in construction shacks.

-- End of Section --

Contract Number: | Project Title: Groundwater Remediation at Q-Area Drum Sto

SPEC SECTION NO.	SD NO, AND TYPE OF SUBMITTAL MATERIAL OR PRODUCT	SPEC PARA NO.	CLASSIF/ APPR BY CO *	GOVT OR A/E REVIEWER	TRANS CONTROL NO.	PLANNED SUBMITTAL DATE
(a)	(b)	(c)	(d)	(e)	(f)	(g)
1) 01010	SD-09, Reports	1.2.1				
2)	Work Plan	1.2.1.1	G			
3) 01010	SD-18, Records	1.3.1				
4)	Shop Drawings	1.2.1.1				
5)	Record Documents/Drawings	1.3.1.1				
6)	Environmental Conditions Report	1.3.1.2				
7)	Network Analysis Diagram	1.3.1.3				
8)	Status Reports	1.3.1.3				
9)	QC Meeting Minutes	1.3.1.4				
10)	Test Results Summary Report	1.3.1.5				
11)	Contractor Production Report	1.3.1.6				
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16) 01430	SD-12, Field Test Reports	1.2.2				
17)	Waste Characterization Sample	1.2.2.1				
18)	Analyses					
19) 02050	SD-08, Statements	1.3.1				
20)	Demolition Plan	1.3.1.1				

* Navy Notes:
Approved by:
G: NTR
Blank: CQC Manager

* NASA Notes:
Approved by:
Blank: Contracting Officer

* Army Notes:
Classification:
GA: Gov't Approval
FIO: For Information Only

Contract Number: | Project Title: Groundwater Remediation at Q-Area Drum Sto

SPEC SECTION NO.	SD NO, AND TYPE OF SUBMITTAL MATERIAL OR PRODUCT	SPEC PARA NO.	CLASSIF/ APPR BY CO *	GOVT OR A/E REVIEWER	TRANS CONTROL NO.	PLANNED SUBMITTAL DATE
(a)	(b)	(c)	(d)	(e)	(f)	(g)
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12)	Waste Shipping Documentation	1.2.2.1				
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16)	Work Site Decontamination	1.2.2.4				
17)	Verification					
18) 02571	SD-05, Design Data	1.2.1				
19)	Bituminous job mix formula	1.2.1.1				
20) 02661	SD-02, Manufacturer's Catalog Data	1.3.1				

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(a)	(b)	(c)	(d)	(e)	(f)	(g)
1)	Water service line	2.1				
2)	Corporation stops	2.1.2.1				
3)	Valve boxes	2.1.2.5				
4)	Water meters	2.2				
5)	Backflow preventer	2.3				
6)	Anti-freeze device	2.3.1				
7) 02661	SD-06, Instructions	1.3.2				
8)	Installation	3.1.1				
9) 02902	SD-02, Manufacturer's Catalog Data	1.2.1				
10)	Piping and Fittings	2.1				
11)	Valves	2.1				
12)	System Control Panel	2.4.1	G			
13)	Air/Water Separators	2.4.2	G			
14)	Liquid Transfer Pumps	2.4.3	G			
15)	Carbon Adsorbers	2.4.4	G			
16)	Cartridge Filters	2.4.6	G			
17) 02902	SD-04, Drawings	1.2.2				
18)	Soil Vapor Extraction System	1.2.2.1	G			
19)	Wells and Piping					
20)	Soil Vapor Extraction Equipment	2.4	G			

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(a)	(b)	(c)	(d)	(e)	(f)	(g)
1) 02902	SD-05, Design Data	1.2.3				
2)	Engineering Design Calculations	1.2.3.1	G			
3) 02902	SD-12, Field Test Reports	1.2.4				
4)	Soil Vapor Extraction	1.2.4.1				
5) 02902	SD-19, Operations and Maintenance	1.2.5				
6)	Soil Vapor Extraction Equipment	2.4	G			
7) 02903	SD-02, Manufacturer's Catalog Data	1.2.1				
8)	Piping and Fittings	2.1				
9)	Valves	2.1				
10)	Air Compressor	2.5.1	G			
11) 02903	SD-04, Drawings	1.2.2				
12)	Air Sparging System Wells and	1.2.2.1	G			
13)	Piping					
14)	Air Sparging Equipment	2.5	G			
15) 02903	SD-05, Design Data	1.2.3				
16)	Engineering Design Calculations	1.2.3.1	G			
17) 02903	SD-12, Field Test Reports	1.2.4				
18)	Air Sparging System Performance	1.2.4.1				
19)	Data					
20) 02903	SD-19, Operations and Maintenance	1.2.5				

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(a)	(b)	(c)	(d)	(e)	(f)	(g)
1)	Air Sparging Equipment	2.5	G			
2) 04200	SD-02, Manufacturer's Catalog Data	1.2.1				
3)	Masonry accessories	2.3				
4)	Reinforcement	2.3.1				
5)	Flashing	2.3.5				
6) 04200	SD-04, Drawings	1.2.2				
7)	Reinforcing steel	1.2.2.1				
8) 04200	SD-06, Instructions	1.2.3				
9)	Masonry cement	2.2.3				
10) 04200	SD-11, Factory Test Reports	1.2.4				
11)	Efflorescence test	2.4.1				
12) 04200	SD-14, Samples	1.2.5				
13)	Masonry and stone units	1.4	G			
14) 05210	SD-04, Drawings	1.2.1				
15)	Steel joist structure	1.2.1.1				
16) 05210	SD-08, Statements	1.2.2				
17)	Welder qualification	1.2.2.1				
18) 05210	SD-12, Field Test Reports	1.2.3				
19)	Erection inspection	3.3.1				
20)	Welding inspections	3.3.1				

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(a)	(b)	(c)	(d)	(e)	(f)	(g)
1) 05310	SD-02, Manufacturer's Catalog Data	1.2.1				
2)	Accessories	2.2				
3) 05310	SD-04, Drawings	1.2.2				
4)	Layout	1.2.2.1				
5) 05310	SD-05, Design Data	1.2.3				
6)	Deck units	2.3.1				
7) 05310	SD-08, Statements	1.2.4				
8)	Qualification of welders	1.3.2				
9) 05310	SD-13, Certificates	1.2.5				
10)	Fire safety	1.3.3.1				
11)	Wind storm resistance	1.3.3.2				
12) 05500	SD-13, Certificates	1.2.2				
13)	certificate	1.2.2.1				
14) 07160	SD-02, Manufacturer's Catalog Data	1.2.1				
15)	Asphalt	2.1				
16)	Asphalt primer	2.2				
17)	Fibrous asphalt	2.3				
18)	Saturated felt	2.4.1				
19) 07214	SD-02, Manufacturer's Catalog Data	1.2.1				
20)	Block or board insulation	2.1				

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(a)	(b)	(c)	(d)	(e)	(f)	(g)
1)	Vapor retarder	2.1.6				
2)	Pressure sensitive tape	2.2				
3)	Protection board or coating	2.3				
4)	Accessories	2.4				
5) 07214	SD-06, Instructions	1.2.2				
6)	Block or Board Insulation	2.1				
7)	Adhesive	2.4.1				
8) 07220	SD-02, Manufacturer's Catalog Data	1.2.1				
9)	Fasteners	2.4				
10)	Insulation	2.1				
11) 07220	SD-04, Drawings	1.2.2				
12) 07220	SD-06, Instructions	1.2.3				
13)	Fasteners	2.4				
14)	insulation	2.1				
15) 07220	SD-10, Test Reports	1.2.4				
16)	Flame spread and smoke	1.3.1				
17)	developed ratings					
18) 07513	SD-02, Manufacturer's Catalog Data	1.2.1				
19)	Asphalt	2.2.1				
20)	Felts	2.2.2				

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(a)	(b)	(c)	(d)	(e)	(f)	(g)
1)	Fasteners	2.2.6				
2)	Primer	2.2.3				
3)	Asphalt roof cement	2.2.4				
4)	Moisture release vents	2.2.8				
5)	Warranty	1.2.1.1				
6) 07513	SD-06, Instructions	1.2.2				
7)	Asphalt	2.2.1				
8)	Felts	2.2.2				
9)	Primer	2.2.3				
10)	Asphalt roof cement	2.2.4				
11) 07513	SD-08, Statements	1.2.3				
12)	Bill of lading	1.4.1				
13)	Qualifications of Applicator	1.3.1				
14) 07513	SD-12, Field Test Reports	1.2.4				
15)	Samples of built-up roofing	3.4.2				
16) 07513	SD-18, Records	1.2.5				
17)	Information card	3.5				
18) 07600	SD-04, Drawings	1.2.1				
19)	Base flashing	3.1.8				
20)	Counterflashing	3.1.9				

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(a)	(b)	(c)	(d)	(e)	(f)	(g)
1)	Flashing at roof penetrations	3.1.15				
2)	Scuppers	3.1.12				
3) 07600	SD-18, Records	1.2.2				
4) 07920	SD-02, Manufacturer's Catalog Data	1.2.1				
5)	Sealants	2.1	G			
6)	Primers	2.2				
7)	Bond breakers	2.3				
8)	Backstops	2.4				
9) 08110	SD-02, Manufacturer's Catalog Data	1.2.1				
10)	Doors	2.1				
11)	Frames	2.4				
12)	Weatherstripping	2.5				
13) 08110	SD-03, Manufacturer's Standard Col	1.2.2				
14) 08110	SD-04, Drawings	1.2.3				
15)	Doors	2.1	G			
16)	Frames	2.4				
17)	Accessories	2.2				
18) 08110	SD-07, Schedules	1.2.4				
19)	Doors	2.1	G			
20)	Frames	2.4				

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(a)	(b)	(c)	(d)	(e)	(f)	(g)
1) 08710	SD-02, Manufacturer's Catalog Data	1.2.1				
2)	Hardware items	2.3	G			
3) 08710	SD-06, Instructions	1.2.2				
4)	Installation	3.1				
5) 08710	SD-07, Schedules	1.2.3				
6)	Hardware schedule	1.2.3.1	G			
7)	Keying system	2.3.4				
8) 08710	SD-18, Records	1.2.4				
9) 08710	SD-19, Operation and Maintenance M	1.2.5				
10)	Hardware Schedule	1.2.3.1				
11) 09900	SD-02, Manufacturers Catalog Data	1.2.1				
12)	Coating	1.2.1.1	G			
13)	Sealant	1.2.1.1				
14) 09900	SD-06, Instructions	1.2.2				
15)	Application instructions	3.2				
16)	Manufacturer's material safety	1.6.2				
17)	data sheets					
18) 09900	SD-07, Schedules	1.2.3				
19)	Piping identification	3.6				
20) 09900	SD-08, Statements	1.2.4				

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(a)	(b)	(c)	(d)	(e)	(f)	(g)
1)	Applicator's qualifications	1.2.4.1				
2)	Evidence of acceptable variation	1.2.4.2	G			
3) 09900	SD-14, Samples	1.2.5				
4)	Color	1.8	G			
5) 10201	SD-03, Manufacturer's Standard Col	1.2.1				
6)	Wall louvers	2.2	G			
7) 10201	SD-04, Drawings	1.2.2				
8)	Wall louvers	2.2	G			
9) 15054	SD-02, Manufacturer's Catalog Data	1.3.1				
10)	Air compressor	2.2	G			
11)	Inlet air filters	2.2.10				
12)	Line silencer	2.2.11				
13)	Air flow rate and pressure	2.3				
14)	recorder					
15)	Filter housing	2.2.9.2				
16) 15054	SD-04, Drawings	1.3.2				
17)	Air compressor system	1.3.2.1	G			
18) 15054	SD-08, Statements	1.3.3				
19)	Work plan	1.3.3.1				
20)	Factory test procedures	2.4.1	G			

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(a)	(b)	(c)	(d)	(e)	(f)	(g)
1)	Factory testing certification	1.3.3.2				
2)	Qualifications of field	1.3.3.3				
3)	supervisors					
4)	Field test procedures	3.3.1				
5)	Training material	1.3.3.4				
6) 15054	SD-11, Factory Test Reports	1.3.4				
7)	performance tests	2.4.1				
8)	Sound level and run-in tests	2.4.1				
9) 15054	SD-12, Field Test Reports	1.3.5				
10)	Air compressor performance tests	3.3.1.1				
11)	Instrumentation test	3.3.1.2				
12)	Sound level tests	3.3.1.3				
13)	Air compressor system test	3.3.1				
14) 15054	SD-13, Certificates	1.3.6				
15)	Air compressor system	1.3.2.1				
16)	system installation	1.3.6.1				
17) 15054	SD-18, Records	1.3.7				
18)	Posted operating instructions	1.10				
19) 15054	SD-19, Operation and Maintenance M	1.3.8				
20)	Air compressor system	1.3.2.1	G			

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(a)	(b)	(c)	(d)	(e)	(f)	(g)
1) 15055	SD-02, Manufacturer's Catalog Data	1.3.1				
2)	Vacuum Pump	2.2	G			
3)	Inlet air filter	2.2.5.4				
4)	Line silencer	2.2.10				
5)	Air flow rate and pressure	2.3				
6)	recorder					
7)	Filter housing	2.2.9.2				
8) 15055	SD-04, Drawings	1.3.2				
9)	Vacuum pump system	1.3.2.1	G			
10) 15055	SD-08, Statements	1.3.3				
11)	Work plan	1.3.3.1				
12)	Factory test procedures	2.4.1	G			
13)	Factory testing certification	1.3.3.2				
14)	Qualifications of field	1.3.3.3				
15)	supervisors					
16)	Field test procedures	3.3.1				
17)	Training material	1.3.3.4				
18) 15055	SD-11, Factory Test Reports	1.3.4				
19)	performance tests	2.4.1				
20)	Sound level and run-in tests	2.4.1				

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(a)	(b)	(c)	(d)	(e)	(f)	(g)
1) 15055	SD-12, Field Test Reports	1.3.5				
2)	Vacuum pump performance tests	3.3.1.1				
3)	Instrumentation test	3.3.1.2				
4)	Sound level tests	3.3.1.3				
5)	Vacuum pump system test	3.3.1				
6) 15055	SD-13, Certificates	1.3.6				
7)	Vacuum pump system	1.3.2.1				
8)	system installation	1.3.6.1				
9) 15055	SD-18, Records	1.3.7				
10)	Posted operating instructions	1.10				
11) 15055	SD-19, Operation and Maintenance M	1.3.8				
12)	Vacuum pump system	1.3.2.1	G			
13) 15400	SD-02, Manufacturer's Catalog Data	1.4.1				
14)	Pipe and fittings	2.1				
15)	Valves	2.2.2				
16)	Floor Drain/Separators	2.1.4.1				
17) 15501	SD-02, Manufacturer's Catalog Data	1.3.1				
18)	Unit heaters	2.1.1	G			
19)	Exhaust fans	2.1.2	G			
20) 15501	SD-06, Instructions	1.3.2				

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(a)	(b)	(c)	(d)	(e)	(f)	(g)
1)	Installation manual	1.3.2.1				
2) 15501	SD-19, Operation and Maintenance M	1.3.3				
3)	Unit heaters	2.1.1				
4)	Exhaust fans	2.1.2				
5) 15971	SD-02, Manufacturers Catalog Data	1.4.1				
6)	Actuators	2.2	G			
7)	Thermostats	2.3	G			
8)	End switches	2.4	G			
9) 15971	SD-04, Drawings	1.4.2				
10)	Control system diagram	1.4.2.1	G			
11)	Ladder diagram	1.4.2.2	G			
12)	Sequence of operation	1.4.2.4	G			
13)	Arrangement drawing	1.4.2.5	G			
14)	Wiring diagram	1.4.2.3	G			
15) 15971	SD-18, Records	1.4.3				
16)	Training course documentation	3.4.1	G			
17)	Qualified service organization	3.5	G			
18)	list					
19) 15971	SD-19, Operation and Maintenance M	1.4.4				
20)	Space temperature control system	1.4.4.1	G			

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(a)	(b)	(c)	(d)	(e)	(f)	(g)
1) 16301	SD-02, Manufacturer's Catalog Data	1.4.1				
2)	Medium voltage cable	2.1.3	G			
3)	Medium voltage cable	2.1.4	G			
4)	terminations					
5)	Medium voltage cable joints	2.1.5	G			
6) 16301	SD-08, Statements	1.4.1				
7)	Cable splicer qualifications	1.4.1.1	G			
8) 16301	SD-09, Reports	1.4.2				
9)	Arc-proofing test	1.4.2.1	G			
10)	Medium voltage cable	1.4.2.2	G			
11)	qualification and production tests					
12) 16301	SD-12, Field Test Reports	1.4.3				
13)	Acceptance Checks and Tests	3.2.1	G			
14) 16402	SD-02, Manufacturer's Catalog Data	1.3.1				
15)	Switches	2.7	G			
16)	Receptacles	2.8	G			
17)	Circuit breakers	2.9.2	G			
18)	Transformers	2.12	G			
19)	Motor controllers	2.14	G			
20)	Telecommunications cabling	2.15.6	G			

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(a)	(b)	(c)	(d)	(e)	(f)	(g)
1)	Building protector assemblies	2.15.7	G			
2)	Telephone dialer	2.15.8	G			
3) 16402	SD-04, Drawings	1.3.2				
4)	Panelboards	2.9	G			
5)	Transformers	2.12	G			
6) 16402	SD-08, Statements	1.3.3				
7)	Fuses	2.11	G			
8) 16402	SD-09, Reports	1.3.3.1				
9)	Transformer design and	1.3.3.2	G			
10)	prototype tests					
11) 16402	SD-12, Field Test Reports	1.3.4				
12)	600-volt wiring test	3.2.2	G			
13)	Grounding system test	3.2.6	G			
14)	Transformer tests	3.2.3	G			
15)	GFI receptacle test	3.2.4	G			
16) 16402	SD-19, Operation and Maintenance M	1.3.5				
17)	Electrical Systems	1.3.5.1				
18) 16462	SD-01, Data	1.3.1				
19)	Tested transformer losses	2.2.2.2	G			
20)	Transformer loss	2.2.2.1	G			

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GA: Gov't Approval
FIO: For Information Only

Contract Number: | Project Title: Groundwater Remediation at Q-Area Drum Sto

SPEC SECTION NO.	SD NO, AND TYPE OF SUBMITTAL MATERIAL OR PRODUCT	SPEC PARA NO.	CLASSIF/ APPR BY CO *	GOVT OR A/E REVIEWER	TRANS CONTROL NO.	PLANNED SUBMITTAL DATE
(a)	(b)	(c)	(d)	(e)	(f)	(g)
1) 16462	SD-02, Manufacturer's Catalog Data	1.3.2				
2)	Pad-mounted transformers,	2.2	G			
3)	dead-front					
4) 16462	SD-04, Drawings	1.3.3				
5)	Pad-mounted transformer drawings	1.3.3.1	G			
6) 16462	SD-11, Factory Tests	1.3.4				
7)	design tests	1.3.4.1	G			
8)	routine and other tests	1.3.4.2	G			
9) 16462	SD-12, Field Test Reports	1.3.5				
10)	acceptance checks and tests	3.5.1	G			
11)	Ground resistance test reports	1.3.5.1	G			
12) 16462	SD-18, Records	1.3.6				
13)	Transformer test schedule	1.3.6.1	G			
14) 16462	SD-19, Operation and Maintenance M	1.3.7				
15)	Pad-mounted transformers,	2.2	G			
16)	dead-front					
17) 16510	SD-02, Manufacturer's Catalog Data	1.4.1				
18)	Fluorescent lighting fixtures	2.1	G			
19)	Fluorescent electronic ballasts	2.1.1	G			
20)	Fluorescent lamps	2.1.2	G			

* Navy Notes:
Approved by:
G: NTR
Blank: CQC Manager

* NASA Notes:
Approved by:
Blank: Contracting Officer

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SPEC SECTION NO.	SD NO, AND TYPE OF SUBMITTAL MATERIAL OR PRODUCT	SPEC PARA NO.	CLASSIF/ APPR BY CO *	GOVT OR A/E REVIEWER	TRANS CONTROL NO.	PLANNED SUBMITTAL DATE
(a)	(b)	(c)	(d)	(e)	(f)	(g)
1)	High-intensity-discharge (HID)	2.2	G			
2)	lighting fixtures					
3)	HID ballasts	2.2.1	G			
4)	High-pressure sodium (HPS) lamps	2.2.2	G			
5)	Photocell switch	2.4	G			
6) 16510	SD-08, Statements	1.4.2				
7)	Qualification of manufacturer	1.5.1	G			
8) 16510	SD-12, Field Test Reports	1.4.3				
9)	Operating test	3.2				
10) 16510	SD-18, Records	1.4.4				
11)	Information card	1.4.4.1	G			

* Navy Notes:
Approved by:
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Blank: CQC Manager

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SECTION 01430

WASTE SAMPLING REQUIREMENTS

PART 1 GENERAL

Waste sampling requirements of this section apply to excavated soils and fluids (i.e., decontamination water and drilling fluids) generated during construction.

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (USEPA)

EPA/540/P-91/008	Compendium of ERT Waste Sampling Procedures, 1991
EPA SW-846	Test Methods for Evaluating Solid Wastes (Nov. 1986)

NAVAL ENERGY AND ENVIRONMENTAL SUPPORT ACTIVITY (NEESA)

NEESA 20.2-047B	Sampling and Chemical Analysis Quality Assurance Requirements for the Navy Installation Restoration Program (June 1988)

1.2 SUBMITTALS

Submit the following in accordance with Section C, Part 7.0, of the Basic Contract.

1.2.1 SD-08, Statements

1.2.1.1 Sample Log

Provide a detailed summary of all waste characterization samples collected. The Sample Log should include the type of sample collected, the location of the sample, the analyses performed, and the location of the analyses results.

1.2.2 SD-12, Field Test Reports

a. Waste Characterization Sample Analyses

1.2.2.1 Waste Characterization Sample Analyses Results

Provide the results of all waste charaterization sample analyses results in a consise and organized manner.

1.3 DEFINITIONS

1.3.1 Contractor Generated Wastes

Contractor generated wastes shall include all materials which become contaminated with wastes as defined in the Basic Contract as a result of Contractor activity at the site after the commencement of contract work.

1.3.2 Government Generated Wastes

Government generated wastes shall include all debris, incidental soils, drum, and container contents existing at the site prior to the commencement of contract work.

1.3.3 Waste Characterization Sampling

Waste characterization sampling shall include all sampling of the excavated soils to characterize the soils for disposal. The sampling of liquid waste shall also be included under this definition.

1.4 DESCRIPTION OF WORK

Collect and analyze environmental samples from each waste stream to determine applicable transportation and disposal requirements.

1.5 QUALITY ASSURANCE

1.5.1 Waste Sampling

Adhere to all sample acquisition, handling, custody documentation, decontamination, and quality assurance/quality control (QA/QC) requirements and procedures as required by federal, state and local regulations.

1.5.2 Analytical Laboratory

The Contractor shall be solely responsible for the execution and accuracy of the waste stream analyses. The Contractor shall use a NEESA-certified laboratory for all soil and waste analyses. All analytical standard methods shall meet, at a minimum, NEESA 20.2-047B QA/QC Level C requirements for confirmation sampling and Level C requirements for waste characterization sampling and shall also be in accordance with federal, local and state regulations.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 GENERAL

Supply all personnel, equipment, and facilities to collect and analyze the environmental samples required to characterize the wastes.

3.1.1 Waste Characterization Samples

Waste characterization samples shall be collected for the purpose of determining handling, transportation, and disposal requirements and for determining personal and environmental protection and monitoring requirements.

Characterization samples shall be collected from the soils from each AOC. One thoroughly mixed composite sample shall be collected for every 25 cubic yards or fraction thereof of material. The composite sample shall consist of six (6) grab samples representative of the material being sampled. The grab samples shall thoroughly mixed to obtain a relatively homogenous mixture.

At a minimum, the characterization samples shall be analyzed for the following parameters (additional analyses may be reuqired by the disposal facility):

1. TCLP Metals - EPA Methods 7060, 7080, 7130, 7190, 7420, 7470, 7760, 7741

2. TCLP Volatiles - EPA Method 8240

3. TCLP Semi-Volatiles - EPA Method 8270

4. TPH - EPA Method 3550/8015

5. RCRA Characteristics - SW-846 9010, 1010, 9012, 9030

The soil shall contain no free liquid as demonstrated by EPA SW-846 Method 9095, paint filter liquids test.

In addition to the above analyses, the Contractor shall be responsible for performing any additional analyses required by the off-site soil disposal facility. These additional analyses shall be identified in the Contractor's Sampling and Analysis Plan.

3.1.2 Incidental Waste Samples

Collect samples from incidental wastes generated by the Contractor during normal construction activities (except general refuse) to determine applicable transportation and disposal requirements. Also included under this category is all water generated during the remedial action including, but not limited to, water from decontamination of personnel and equipment, groundwater encountered dueing excavation, and rainfall and surface water runoff accumulated in the open excavations. Analyze incidental waste samples for the following parameters and any additional analyses required by the off-site disposal facility:

* TCLP Metals - EPA Methods 7060, 7080, 7130, 7190, 7420, 7470, 7741, 7760
* TCLP VOAs - EPA Method 8240
* TCLP SVOAs - EPA Method 8270

3.1.3 Sample Handling

Sampling, sample handling, and sampling containers must be consistent with the chemicals expected, the matrix of the sample, and planned analytical procedures. Precleaned glass sample containers with teflon lids are required for soil samples.

The Contractor shall describe in the Sampling and Analysis Plan strict chain-of-custody procedures to be used during collection, transport, and analysis of all samples.

3.1.4 Sampling Documentation

Maintain a sample log containing, at a minimum, the following information:

a. Date and Time of Sampling

b. Sample Locations

c. Sample Matrix

d. Sample Identification Number

e. QA/QC Sample Identification

f. Analyses to be Performed

g. Type and Number of Sample Containers

h. Signatures of Individuals Performing Sampling

-- End of Section --

SECTION 02050

DEMOLITION AND REMOVAL

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A10.6	(1990) Demolition Operations

CODE OF FEDERAL REGULATIONS (CFR)

40 CFR 61-SUBPART M	National Emission Standard for Asbestos

1.2 GENERAL REQUIREMENTS

Do not begin demolition until authorization is received from the NTR. Remove rubbish and debris from the station daily. Store materials that cannot be removed daily in areas specified by the NTR.

1.3 SUBMITTALS

Submit the following in accordance with Section C, Part 4 of the Basic Contract.

1.3.1 SD-08, Statements

a. Demolition Plan

Submit proposed demolition and removal procedures to the NTR for approval before work is started. The Demolition Plan shall include procedures for removal and disposition of materials, coordination with other work in progress, detailed description of methods and equipment to be used, and the sequence of operations.

1.4 REGULATORY AND SAFETY REQUIREMENTS

Comply with federal, state, and local hauling and disposal regulations. In addition to the requirements of the "Contract Clauses," safety requirements shall conform with ANSI A10.6, "Demolition Operations - Safety Requirements".

1.4.1 Notifications

Furnish timely notification of demolition projects to Federal, State, regional, and local authorities in accordance with 40 CFR 61-SUBPART M. Notify the Regional Office of the United States Environmental Protection Agency (USEPA) State's environmental protection agency and the NTR in

writing 10 days prior to the commencement of work in accordance with 40 CFR 61-SUBPART M.

1.5 DUST AND DEBRIS CONTROL

Prevent the spread of dust and debris and avoid the creation of a nuisance or hazard in the surrounding area. Do not use water if it results in hazardous or objectionable conditions such as, but not limited to, ice, flooding, or pollution.

1.6 PROTECTION

1.6.1 Traffic Control Signs

Where pedestrian and driver safety is endangered in the area of removal work, use traffic barricades with flashing lights. Notify the NTR prior to beginning such work.

1.6.2 Existing Work

Protect existing work which is to remain in place, be reused, or remain the property of the Government. Repair items which are to remain and which are damaged during performance of the work to their original condition, or replace with new. Provide new supports and reinforcement for existing construction weakened by demolition or removal work. Repairs, reinforcement, or structural replacement must have NTR approval.

1.6.3 Facilities

Protect existing electrical and mechanical services and utilities. Where removal of existing utilities and pavement is specified or indicated, provide approved barricades, temporary covering of exposed areas, and temporary services or connections for electrical and mechanical utilities.

1.7 BURNING

Burning shall not be permitted.

1.8 RELOCATIONS

Perform the removal and reinstallation of relocated items as indicated with workmen skilled in the trades involved. Repair items to be relocated which are damaged or replace damaged items with new undamaged items as approved by the NTR.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 EXISTING FACILITIES TO BE REMOVED

3.1.1 Utilities and Related Equipment

Remove existing utilities as required to perform the work. Relocate and/or terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by the NTR. Remove meters and related equipment, as required, and deliver to a location on the station in accordance with instructions of the NTR. If utility lines are encountered that are not shown on drawings, contact the NTR for further instructions.

3.1.2 Paving and Slabs

Remove (sawcut) concrete and asphaltic concrete paving and slabs including aggregate base as required to construct buildings and install trenches for AS/SVE System. Provide neat sawcuts at limits of pavement removal.

3.1.3 Patching

Where removals leave holes and damaged surfaces exposed in the finished work, patch and repair these holes and damaged surfaces to match adjacent finished surfaces. Where new work is to be applied to existing surfaces, perform removals and patching in a manner to produce surfaces suitable for receiving new work. Finished surfaces of patched area shall be flush with the adjacent existing surface and shall match the existing adjacent surface as closely as possible as to texture and finish.

3.2 FILLING

Fill holes and other hazardous openings in accordance with Section 02220, "General Excavation, Filling and Backfilling".

3.3 DISPOSITION OF MATERIAL

Except where specified in other sections, all materials and equipment removed, and not reused, shall become the property of the Contractor and shall be removed from Government property. All materials shall be disposed of in accordance with Section 01010, "General Paragraphs". Title to materials resulting from demolition, and materials and equipment to be removed, is vested in the Contractor upon approval by the NTR of the Contractor's demolition and removal procedures, and authorization by the NTR to begin demolition. 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.

3.4 CLEANUP

3.4.1 Debris and Rubbish

Remove and transport debris and rubbish in a manner that will prevent spillage on pavements, streets or adjacent areas. Clean up spillage from pavements, streets and adjacent areas. Dispose of debris and rubbish in

accordance with Section 01010, "General Paragraphs".

-- End of Section --

SECTION 02220

GENERAL EXCAVATION, FILLING, AND BACKFILLING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 698	(1991) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft (600 kN-m/m))
ASTM D 1140	(1992) Amount of Material in Soils Finer Than the No. 200 (75-Micrometer) Sieve
ASTM D 1556	(1990) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(1991) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft (2,700 kN-m/m))
ASTM D 2487	(1993) Classification of Soils for Engineering Purposes
ASTM D 2922	(1991) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(1988; R 1993) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 4318	(1993) Liquid Limit, Plastic Limit, and Plasticity Index of Soils

COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-1909	Fertilizer

CORPS OF ENGINEERS (COE)

COE EM-385-1-1	(1992) Safety and Health Requirements Manual

1.2 DEFINITIONS

1.2.1 Hard Materials

Weathered rock, dense consolidated deposits, or conglomerate materials which are not included in the definition of "rock" but which usually

require the use of heavy excavation equipment, ripper teeth, or jack hammers for removal.

1.2.2 Cohesive Materials

Materials ASTM D 2487 classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesive only when the fines have a plasticity index greater than zero.

1.2.3 Cohesionless Materials

Materials ASTM D 2487 classified as GW, GP, SW, and SP. Materials classified as GM and SM will be identified as cohesionless only when the fines have a plasticity index of zero.

1.3 SUBMITTALS

Submit the following in accordance with Section C, Part 7.0 of the Basic Contract.

1.3.1 SD-12, Field Test Reports

a. Fill and backfill test

b. Select material test

c. Density tests

1.4 DELIVERY, STORAGE, AND HANDLING

Perform in a manner to prevent contamination or segregation of materials.

1.5 CRITERIA FOR BIDDING

Base bids on the following criteria:

a. Surface elevations are as indicated.

b. Pipes or other artificial obstructions, except those indicated, will not be encountered.

c. Groundwater elevations indicated by the boring log were those existing at the time subsurface investigations were made and do not necessarily represent groundwater elevation at the time of construction.

d. Material character is indicated by the boring logs.

e. Blasting will not be permitted. Remove material in an approved manner.

PART 2 PRODUCTS

2.1 SOIL MATERIALS

Free of debris, roots, wood, scrap material, vegetation, refuse, soft unsound particles, and frozen, deleterious, or objectionable materials. Unless specified otherwise, the maximum particle diameter shall be one-half the lift thickness at the intended location.

2.1.1 Common Fill

Approved, unclassified soil material with the characteristics required to compact to the soil density specified for the intended location.

2.1.2 Backfill and Fill Material

ASTM D 2487, classification GW, GP, GM, SW, SP, SM, with a maximum ASTM D 4318 liquid limit of 35 maximum ASTM D 4318 plasticity index of 12, and a maximum of 25 percent by weight passing ASTM D 1140, No. 200 sieve.

2.1.3 Topsoil

Natural, friable soil representative of productive, well-drained soils in the area, free of subsoil, stumps, rocks larger than one inch diameter, brush, weeds, toxic substances, and other material detrimental to plant growth. Amend topsoil pH range to obtain a pH of 5.5 to 7.

2.1.4 Select Material

ASTM D 2487, classification GW, GP, SW, SP.

2.2 BORROW AND BACKFILL MATERIAL

Obtain borrow materials required in excess of those furnished from excavations from sources outside of Government property. The Contractor shall be responsible for excavating and loading the borrow material at the source and for transportation to the site. All borrow and backfill material required to accomplish the work under these Contract Documents are subject to the following requirements:

a. Only natural earth materials may be used as borrow material.

b. Only suitable materials shall be used in the construction of backfills, i.e., no frozen material, roots, sod, or other objectionable material.

2.3 BURIED WARNING AND IDENTIFICATION TAPE

Polyethylene plastic and metallic core or metallic-faced, acid- and alkali-resistant, polyethylene plastic warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 3 inch minimum width, color coded as specified below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and

identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording. Color and printing shall be permanent, unaffected by moisture or soil.

Warning Tape Color Codes

Yellow:	Electric
Yellow:	Gas, Oil; Dangerous Materials
Orange:	Telephone and Other Communications
Blue:	Water Systems
Green:	Sewer Systems
White:	Steam Systems
Gray:	Compressed Air

2.3.1 Warning Tape for Metallic Piping

Acid and alkali-resistant polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of tape shall be 0.003 inch. Tape shall have a minimum strength of 1500 psi otherwise, and 1250 psi crosswise, with a maximum 350 percent elongation.

2.3.2 Detectable Warning Tape for Non-Metallic Piping

Polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of the tape shall be 0.004 inch. Tape shall have a minimum strength of 1500 psi lengthwise and 1250 psi crosswise. Tape shall be manufactured with integral wires, foil backing, or other means of enabling detection by a metal detector when tape is buried up to 3 feet deep. Encase metallic element of the tape in a protective jacket or provide with other means of corrosion protection.

PART 3 EXECUTION

3.1 PROTECTION

3.1.1 Protection Systems

Provide shoring, bracing, cribbing, and sheeting in accordance with COE EM-385-1-1, as required.

3.1.2 Drainage and Dewatering

Provide for the collection and disposal of surface and subsurface water encountered during construction. Dewatering will not be allowed except as approved by the NTR.

3.1.2.1 Drainage

So that construction operations progress successfully, completely drain construction site during periods of construction to keep soil materials sufficiently dry. provide temporary ditches, swales, and other drainage features and equipment as required to maintain dry soils. When unsuitable

working platforms for equipment operations and unsuitable soil support for subsequent construction features develop, remove unsuitable material and provide new soil material as specified herein.

3.1.3 Underground Utilities

Location of the existing utilities indicated on the drawings is approximate. The Contractor shall physically verify the location and elevation of the existing utilities indicated prior to starting construction. The Contractor shall scan the construction site with electromagnetic and sonic equipment and mark the surface of the ground where existing underground utilities are discovered.

3.1.4 Machinery and Equipment

Movement of construction machinery and equipment over pipes during 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.

3.2 EXCAVATION

Excavate to contours, elevation, and dimensions indicated. Keep excavations free from water. Excavate soil disturbed or weakened by Contractor's operations, soils softened or made unsuitable for subsequent construction due to exposure to weather. Refill with backfill and fill material and compact to 95 percent of ASTM D 1557 maximum density.

3.2.1 Structures With Spread Footings

Ensure that footing subgrades have been inspected and approved by the NTR or their representative prior to concrete placement. Fill over excavations with concrete during foundation placement.

3.2.2 Pipe Trenches

Excavate to the dimension indicated. Grade bottom of trenches to provide uniform support for each section of pipe after pipe bedding placement.

3.2.3 Hard Material Excavation

Remove hard material to elevations indicated in a manner that will leave foundation material in an unshattered and solid condition. Roughen level surfaces and cut sloped surfaces into benches for bond with concrete. Protect shale from conditions causing decomposition along joints or cleavage planes and other types of erosion. Removal of hard material and rock beyond lines and grades indicated unless previously authorized by the NTR will not be grounds for a claim for additional payment.

3.3 FILLING AND BACKFILLING

Fill and backfill to contours, elevations, and dimensions indicated. Compact each lift before placing overlaying lift.

3.3.1 Common Fill Placement

Provide for general site and place in 6 inch lifts. Compact areas not accessible to rollers or compactors with mechanical hand tampers. Aerate material excessively moistened by rain to a satisfactory moisture content. Finish to a smooth surface by blading, rolling with a smooth roller, or both.

3.3.2 Backfill and Fill Material Placement

Provide for paved areas and under concrete slabs, except where select material is specified. Place in 6 inch lifts. Place backfill material adjacent to structures as the structural elements are completed and accepted. Backfill against concrete only when approved. Place and compact material to avoid loading upon or against the structure.

3.3.3 Select Material Placement

Provide under porous fill of structures not pile supported. Place in 6 inch lifts. Backfill adjacent to structures shall be placed as structural elements are completed and accepted. Backfill against concrete only when approved. Place and compact material to avoid loading upon or against structure.

3.3.4 Trench Backfilling

Backfill as rapidly as construction, testing, and acceptance of work permits. Place and compact backfill under structures and paved areas in 6 inch lifts to top of trench and in 6 inch lifts to one foot over pipe outside structures and paved areas.

3.3.4.1 Bedding Requirements

Except as specified otherwise in the individual piping section, provide bedding for buried piping in accordance with AWWA C600, Type 4, except as specified herein. Backfill to top of pipe shall be compacted to 95 percent of ASTM D 698 maximum density. Plastic piping shall have bedding to spring line of pipe. Provide ASTM D 2321 materials as follows:

a. Class I: Angular, 0.25 to 1.5 inches, graded stone.

b. Class II: Coarse sands and gravels with maximum particle size of 1.5 inches, including various 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.

3.4 BURIED WARNING AND IDENTIFICATION TAPE

Provide buried utility lines with utility identification tape. Bury tape 12 inches below finished grade; under pavements and slabs, bury tape 6 inches below top of subgrade.

3.5 BURIED DETECTION WIRE

Bury detection wire directly above non-metallic piping at a distance not to exceed 12 inches above the top of pipe. The wire shall extend continuously and unbroken, from manhole to manhole. The ends of the wire shall terminate inside the manholes at each end of the pipe, with a minimum of 3 feet of wire, coiled, remaining accessible in each manhole. The wire shall remain insulated over it's entire length. The wire shall enter manholes between the top of the corbel and the frame, and extend up through the chimney seal between the frame and the chimney seal. For force mains, the wire shall terminate in the valve pit at the pump station end of the pipe.

3.6 COMPACTION

Expressed as a percentage of maximum density. Determine in-place density of existing subgrade; if required density exists, no compaction of existing subgrade will be required. Density requirements specified herein are for cohesionless materials. When cohesive materials are encountered or used, density requirements may be reduced by 5 percent.

3.6.1 General Site

Compact underneath areas designated for vegetation and areas outside the 5 foot line of the structure to 85 percent of ASTM D 698.

3.6.2 Structures, Spread Footings, and Concrete Slabs

Compact top 12 inches of subgrades to 95 percent of ASTM D 1557. Compact fill and backfill material to 95 percent of ASTM D 1557.

3.6.3 Adjacent Area

Compact areas within 5 feet of structures to 90 percent of ASTM D 1557.

3.6.4 Paved Areas

Compact top 12 inches of subgrades to 95 percent of ASTM D 698. Compact fill and backfill materials to 95 percent of ASTM D 698.

3.7 FINISH OPERATIONS

3.7.1 Grading

Finish grades as indicated within one-tenth of one foot. Grade areas to drain water away from structures. For existing grades that will remain but which were disturbed by Contractor's operations, grade as directed.

3.7.2 Seed

Scarify existing subgrade. Provide 4 inches of topsoil for newly graded finish earth surfaces in areas disturbed by the Contractor. Additional topsoil will not be required if work is performed in compliance with stripping and stockpiling requirements. If there is insufficient on-site topsoil meeting specified requirements for topsoil, provide topsoil

required in excess of that available. Provide grass seed mix at 5 pounds per 1000 square feet. Provide CID A-A-1909, Type I, Class 2, 10-10-10 analysis fertilizer at 25 pounds per 1000 square feet. Provide commercial agricultural limestone of 94-80-14 analysis at 70 pounds per 1000 square feet. Provide mulch and water to establish an acceptable stand of grass.

3.7.3 Protection of Surfaces

Protect newly graded areas from traffic, erosion, and settlements that may occur. Repair or reestablish damaged grades, elevations, or slopes.

3.8 DISPOSITION OF SURPLUS MATERIAL

Remove from Government property surplus or other soil material not required or suitable for filling or backfilling, and brush, refuse, stumps, roots, and timber.

3.9 FIELD QUALITY CONTROL

3.9.1 Sampling

Take the number and size of samples required to perform the following tests.

3.9.2 Testing

Perform one of each of the following tests for each material used. Provide additional tests for each source change.

3.9.2.1 Fill and Backfill Material Testing

Test fill and backfill material in accordance with ASTM C 136 for conformance to ASTM D 2487 gradation limits; ASTM D 1140 for material finer than the No. 200 sieve; ASTM D 4318 for liquid limit and for plastic limit; ASTM D 698 or ASTM D 1557 for moisture density relations, as applicable.

3.9.2.2 Select Material Testing

Test select material in accordance with ASTM C 136 for conformance to ASTM D 2487 gradation limits; ASTM D 1140 for material finer than the No. 200 sieve; ASTM D 698 or ASTM D 1557 for moisture density relations, as applicable.

3.9.2.3 Density Tests

Test density in accordance with ASTM D 1556, or ASTM D 2922 and ASTM D 3017. When ASTM D 2922 and ASTM D 3017 density tests are used, verify density test results by performing an ASTM D 1556 density test at a location already ASTM D 2922 and ASTM D 3017 tested as specified herein. Perform an ASTM D 1556 density test at the start of the job, and for every 10 ASTM D 2922 and ASTM D 3017 density tests thereafter. Test each lift at randomly selected locations every 2000 square feet of existing grade in fills for structures and concrete slabs, and every 2500 square feet for other fill areas and every

2000 square feet of subgrade in cut.

-- End of Section --

SECTION 02222

EXCAVATION, REMOVAL, AND TREATMENT OF CONTAMINATED SOIL

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY OF TESTING AND MATERIALS (ASTM)

ASTM D 4397	1991 Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (USEPA)

EPA SW-846	1986 Test Methods for Evaluating Solid Waste (Physical/Chemical Methods)
EPA 600/R-92/096	1992 Potential Reuse of Petroleum Contaminated Soil: A Directory of Permitted Recycling Facilities
EPA 600/4-79-020	1983 Methods for the Chemical Analysis of Water and Wastes
EPA 540/P-87/001a	1987 A Compendium of Superfund Field Operations Methods

1.2 DEFINITIONS

1.2.1 Excavated Soil Reused as Clean Fill

Soils containing less than 100 parts per million (ppm) of total organic halogens (TOX), less than 50 ppm of total petroleum hydrocarbons (TPH) and less than 10 ppm of the sum of benzene, toluene, ethyl benzene, and xylene (BTEX), shall be used on-site as fill material in these excavations.

1.2.2 Contaminated Soil

Soils containing concentrations greater than 100 ppm TOX and/or 100 ppm TPH, shall be considered contaminated with hazardous materials and/or petroleum products.

1.3 DESCRIPTION OF WORK

Excavation is required for the construction of equipment buildings, at AOC1 and at AOC2, along with the installation of trenching for underground piping. The material excavated may be contaminated soil, as defined in this section. If contaminated soil is encountered, excavation and removal shall be in accordance with this section.

Excavate to the horizontal limits of the identified contaminated soil as necessary. After removing contaminated soil as necessary, sample, test and excavate as specified until clean soil is encountered. Concrete pavement shall be swept clean.

1.4 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic Contract.

1.4.1 SD-08, Statements

a. Excavation and Material Handling Plan G

b. Site Health and Safety Plan G

c. Field Sampling and Laboratory Testing Plan G

1.4.1.1 Excavation and Material Handling Plan

A material handling plan shall be furnished by the Contractor 15 days prior to initiation of the work that describes phases of dealing with the contaminated soil, including the following: a schedule to be employed in the excavation, a sequence of operations, the method of excavation, hauling, proposed equipment, and handling of the contaminated materials, soil testing requirements, and safety precautions and requirements. The plan shall define the Contractor's source for fill and method for importing the fill material.

1.4.1.2 Site Health and Safety Plan

Describe safety precautions for each phase of the project as specifically related to soil removal and treatment operations. Identify safety equipment and procedures to be available and used during the project. Furnish the name and qualifications based on education, training, and work experience of the proposed Site Health and Safety Officer.

1.4.1.3 Field Sampling and Laboratory Testing Plan

Describe field sampling methods and quality control procedures. Identify laboratory and laboratory methods to be used for contamination testing. Sample reports shall show sample identification for location, date, time, sample method, contamination level, name of individual sampler, identification of laboratory, and quality control procedures.

PART 2 PRODUCTS

2.1 PLASTIC SHEETING

ASTM D 4397

PART 3 EXECUTION

3.1 GENERAL

a. The methods and procedures for excavation and backfill shall be in accordance with Section 02220, "General Excavation, Filling, and Backfilling".

b. The Contractor shall notify the NTR at least 48 hours prior to the start of excavation. The Contractor shall stage his/her operations to minimize the time the excavated soil is exposed to the weather. Provide protection measures around the area of excavation to divert runoff of water from within the excavation boundaries.

3.2 PREPARATION

For excavation activities within the indicated areas of contaminated soil, all asphalt pavement, concrete slabs, and structures encountered above or below the ground surface, shall be removed, brushed to remove soil materials, and placed in a designated rubble pile. Any and all washdown water shall be collected and disposed of as contaminated water.

3.3 EXCAVATION REQUIREMENTS

Remove contaminated soil from the locations for the equipment buildings indicated. Excavate contaminated soil vertically as necessary to accomodate building foundations, and horizontally, as indicated. Excavate soil for pipe trenches as indicated.

3.3.1 Temporary Containment of Contaminated Soil

Soil removed from the excavation shall be placed in a temporary containment area. Provide a temporary containment area near the excavation area. Cover containment area with 6 mil reinforced polyethylene sheeting. Place excavated soil on the impervious barrier and cover with 6 mil reinforced polyethylene sheeting. Provide a straw bale berm around the outer limits of the containment area and cover with polyethylene sheets. Secure edges of sheets with weights to keep the polyethylene sheeting in place. All water runoff shall be diverted from the stockpiled material.

3.3.2 Excavation Procedure

Methods and equipment used to remove contaminated soil shall result in minimal disturbance to remaining soil beyond the excavation limits. Any materials that becomes contaminated as a result of the Contractor's operation shall be removed and disposed of at no additional cost to the Government.

Excavated slopes which are unstable or subject to slides shall be flattened or cut back as required to ensure slope stability, or supported in accordance with Section 02220, "General Excavation, Filling and Backfilling". Dewatering will not be permitted unless approval is obtained from the Contracting Officer. Excavations shall not extend beneath existing groundwater levels. Any water (ground, rain, or surface) collected in the open excavation pit or temporary containment area shall

be properly tested and disposed of. Collected water shall be tested in accordance with EPA SW-846 and EPA 600/4-79-20 and state and local required analyses. Water that contains contaminants above locally acceptable levels shall be disposed of in accordance with Federal, State and local regulations. Contaminated water shall not be disposed of in the onsite sanitary or storm sewer systems. Non-contaminated water shall be disposed of onsite.

Contractor shall commence backfilling of the excavation a maximum of ten days after the contaminated materials have been removed to the limits indicated. Contractor shall have all confirmatory sampling and testing accomplished as necessary to comply with this requirement.

3.4 EXCAVATION MONITORING

Continuous monitoring of excavation work shall be accomplished with organic vapor analyzer/flame ionization device (OVA/FID) capable of detecting volatile organic vapors to a minimum of 1 ppm. Continuous monitoring shall be accomplished during all excavation operations regardless of location on the site.

Notify the Contracting Officer prior to any overexcavation which may be necessary for equipment clearance or utilities conflicts. When soils with OVA/FID readings indicating a possible flammable vapor emission, the Contractor shall take the necessary precautions as dictated in the Site Health and Safety Plan.

3.4.1 Testing Laboratory

The Contractor shall submit to the Contracting Officer the names of all testing laboratories to be used to accomplish analysis of contaminated soil. A maximum turnaround time of 48 hours for sample analyses shall be required in accordance with the standard work week of the contract. Reports shall be provided to the Contracting Officer within 48 hours of sampling.

3.5 TESTING REQUIREMENTS FOR DISPOSAL OF CONTAMINATED SOILS

1. One composite sample shall taken from each equipment building and shall be analyzed for each required test. To develop a composite sample of the size necessary to run the required tests, the Contractor shall take several samples from different areas along the surface and in the center of the area to be excavated. Theses samples shall be combined and thoroughly mixed to develop the composite sample.

2. The soil shall contain no free liquid as demonstrated by EPA SW-846 Method 9095, paint filter liquids test.

3. The sum of benzene, toluene, ethyl benzene, and xylene (BTEX) concentrations shall be determined by using EPA SW-846 Method 5030/8020.

4. TPH (total petroleum hydrocarbons) concentrations shall be determined by using EPA 600/4-79-020 Method 418.1, which has

been modified for use with soil.

5. Material shall be tested for TOX (total organic halogens) in accordance with EPA SW-846 Method 9020.

6. Material shall be analyzed for Full TCLP in accordance with EPA SW-846 Method 1311 and for ignitability, corrosivity, and reactivity.

7. Material shall be tested for PCB's (polychlorinated bipehenyls) in accordance with EPA SW-846 Method 8080.

8. Moisture content of the sample shall be determined in accordance with EPA Method 160.3.

3.6 CRITERIA FOR DISPOSAL APPROVAL

As identified by the Contracting Officer:

1. Soils failing the TCLP Test shall be managed in accordance with the Virginia Hazardous Waste Management Regulations. Payment for disposal of materials failing the TCLP metals test shall be made in accordance with the "CHANGES" clause of the General Conditions.

2. Soils exhibiting a TOX > 100 ppm shall not be disposed of until separate approval from the Virginia Department of Environmental Quality is granted. Payment for disposal of such materials shall be made in accordance with the "CHANGES" clause of the General Conditions.

3. If the concentration of total BTEX > 10 ppm or TPH > 50 ppm, the soil shall be disposed of using soil recycling.

4. If the concentration of TPH < 50 ppm and total BTEX < 10 ppm, the contaminated soil shall be used as on-site fill material.

3.7 SPILLS OF CONTAMINATED SOILS

The Contractor shall use appropriate vehicles and operating practices to prevent spillage or leakage of contaminated materials from occurring during operations. All vehicles leaving the contaminated soil removal site shall be inspected by the Contractor to ensure that no contaminated soil adheres to the wheels or undercarriage. An impervious barrier shall be placed under all areas that contaminated soil will rest on to prevent contamination from leaching into clean soil. Contaminated soil piles shall be covered at all times when not being worked on to minimize erosion.

3.8 TREATMENT FACILITIES

The proposed treatment method for soils meeting the constraints described in this section is soil recycling. The Contractor shall select a permitted facility for the treatment and disposal of the contaminated soil.

--End of Section--

SECTION 02223

TRANSPORTATION AND DISPOSAL OF CONTAMINATED MATERIAL

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent required. The publicaitons are referred to within the text by the basic designation only.

CODE OF FEDERAL REGULATIONS

40 CFR Part 261	Identification and Listing of Hazardous Waste
40 CFR Part 262	Standards Applicable to Generators of Hazardous Waste
40 CFR Parts 100 to 180	Transportation

UNITED STATED ENVIRONMENTAL PROTECTION AGENCY (USEPA)

SW-846	(1986) Test Methods for Evaluating Solid Waste (Physical/Chemical Methods).

1.2 SUBMITTALS

Submit the following in accordance with Section C, Part 7.0 of the Basic Contract.

1.2.1 SD-08, Statements

1.2.1.1 Treatment or Disposal Facility Verification

Verification that the proposed treatment or disposal facility is permitted to accept the contaminated materials specified, prior to the start of excavation.

1.2.2 SD-18, Records

a. Waste Shipping Documentation

b. Waste Delivery Documentation

c. Disposal Site Decontamination Verification

d. Work Site Decontamination Verification

1.2.2.1 Waste Shipping Documentation

Copies of manifests and other documentation required for shipment of hazardous waste materials within 24 hours after removal of waste from the

site. Manifest documentation shall be in accordance with 40 CFR 261 and 40 CFR 262. All shipment manifests shall be signed by the NTR. Manifest documents are not required for soil which does not meet the characteristics of a hazardous waste as defined in 40 CFR 261.

1.2.2.2 Waste Delivery Documentation

Verification that the wastes were actually delivered to the approved treatment facility, within 7 days of shipment.

1.2.2.3 Disposal Site Decontamination Verification

Verification that all vehicles and containers were decontaminated prior to leaving the disposal site, within 7 days of disposal.

1.2.2.4 Work Site Decontamination Verification

Verification that all vehicles, equipment, and containers were decontaminated prior to leaving the work site shall be submitted within 24 hours of vehicles, equipment, or containers leaving the work site. Verification that all trucks transporting contaminated materials were properly operating, and were covered, shall be submitted within 24 hours after removal of waste from the site.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 Materials and Equipment

The Contractor shall furnish all labor, materials, and equipment necessary to transport and dispose of Government and Contractor generated wastes in accordance with applicable federal, state, and local requirements.

3.2 Records

The Contractor shall originate, use, and maintain the waste shipment records/manifests as required by the Virginia Department of Environmental Quality and the U.S. Department of Transportation, as necessary.

3.3 Temporary Storage of Contaminated Materials

The Contractor shall schedule and control the work such as to minimize the quantity and duration of on-site contaminated material storage. All contaminated materials stored on-site shall be stored in a temporary containment area, or in covered containers or vehicles designed to contain such materials without spillage. Any damage or contamination caused by contaminated materials storage shall be repaired or removed to the satisfaction of the NTR.

3.4 Transportation

The Contractor shall be solely responsible for complying with all federal, state, and local requirements for transporting hazardous materials through the applicable jurisdictions and shall bear all responsibility and cost for

any noncompliance. In addition to those requirements, the Contractor shall do the following:

a. Inspect and document all vehicles and containers for proper operation and covering.

b. Inspect all vehicles and containers for proper markings, manifest documents, and other requirements for waste shipment.

c. Perform and document decontamination procedures prior to leaving the worksite and again before leaving the disposal site.

3.5 Incidental Waste

All incidental waste materials removed from the site shall be disposed of in a treatment/disposal facility permitted to accept such materials.

3.6 Sampling and Analysis Requirements for Disposal

The Contractor shall conduct sampling and analysis in accordance with Section 01430, "Waste Sampling Requirements".

3.7 Method of Measurement

The quantity of work done under this Section shall be measured in tons of soil removed from the site.

-- End of Section --

SECTION 02571

PAVEMENT REMOVAL AND REPLACEMENT

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M140	1987 (R 1988) Emulsified Asphalt
AASHTO M208	1987 Cationic Emulsified Asphalt
AASHTO M226	1980 (R 1986) Viscosity Graded Asphalt Cement

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 698	1978 (R 1990) Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5.5-lb (2.49-kg) Rammer and 12-in. (305-mm) Drop
ASTM D 1557	1978 (R 1990) Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb (4.54-kg) Rammer and 18-in. (457-mm) Drop

DEPARTMENT OF TRANSPORTATION (DOT)

DOT D-6.1	1988 Uniform Traffic Control Devices for Streets and Highway

FEDERAL SPECIFICATIONS (FS)

FS SS-S-200	(Rev. E) (Am. 1) Sealant, Joint, Two-Component, Jet-Blast Resistant, Cold-Applied, For Portland Cement Concrete Pavement

VIRGINIA DEPARTMENT OF TRANSPORTATION (VDOT)

VDOT RBS	1991 Road and Bridge Specifications

1.2 SUBMITTALS

Submit the following in accordance with Section C, Part 7.0 of the Basic Contract.

1.2.1 SD-05, Design Data

a. Bituminous job mix formula

1.2.1.1 Bituminous Job Mix Formula

Submit the bituminous mix design, including mixing temperature, for approval. The bituminous mix design shall include a certified laboratory analysis of mix composition with marshall stability value, void content, and flow. After mix design approval, job mixes shall conform to the range of tolerances specified in VDOT RBS.

1.3 QUALITY ASSURANCE

1.3.1 Modification to References

Except as specified herein, work and materials shall be in accordance with the VDOT RBS. The provisions therein for method of measurement and payment do not apply, and references to "Engineer" shall mean the NTR.

1.4 BARRICADES AND SIGNALS

Provide and maintain temporary signs and barricades to protect personnel and new construction from damage by equipment and vehicles until the surface is approved by the NTR. Work shall be conducted to permit a minimum of one traffic lane on two lane streets, and two traffic lanes on four lane streets, to be open for traffic at all times.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Bituminous Concrete

VDOT RBS, Section 211, Type SM-2A for material and mix. Provide crushed stone aggregate for the bituminous mix.

2.1.2 Stone Base Course

VDOT RBS, Sections 203 and 208, Type 1, size no. 20, 21, 21A or 21B.

2.1.3 Bituminous Tack Coat

2.1.3.1 Emulsified Asphalts

AASHTO M140, Grades RS-1, MS-1, HFMS-1, SS-1, and SS-1h . Dilute the SS-1 and SS-1h asphalts at the rate of one part water to one part asphalt.

2.1.3.2 Cationic Emulsified Asphalts

AASHTO M208, Grades CRS-1, CSS-1, and CSS-1h. Dilute the CSS-1 and CSS-1h asphalts at the rate of one part water to one part asphalt.

2.1.3.3 Asphalt Cements

AASHTO M226, Grade AC-20.

PART 3 EXECUTION

3.1 PAVEMENT INSTALLATION

The work includes the removal of existing pavement and the provision of new pavement where excavations are made in the existing pavement. Except as otherwise indicated, the restored pavement area shall be the same kind and thickness as previously existed, and shall match and tie into the surrounding pavement in a neat and acceptable manner.

3.2 ROADS AND PARKING AREAS

3.2.1 Pavement Removal

Make a straight line sawcut 12 inches beyond the edge of the excavation to a minimum depth of 2 inches for bituminous concrete pavement and 6 inches for portland cement concrete pavement. Portland cement concrete pavement overlaid with bituminous concrete shall be sawcut to a minimum depth of 8 inches. The pavement shall be broken up and removed, along with its base and subgrade, to the depth indicated or specified.

3.2.2 Subgrade Placement

Provide as specified in Section 02220, "General Excavation, Filling, and Backfilling."

3.2.3 Stone Base Placement

Provide a stone base course a minimum of 8 inches thick, unless indicated otherwise. Place the stone base in two equal lifts, with each lift compacted to 100 percent ASTM D 698 maximum density. At the Contractor's option, bituminous concrete may be provided in lieu of stone base material.

3.2.4 Bituminous Concrete Placement

Provide a tack coat on the exposed edges of the cold joints and on the bituminous concrete base when provided, and provide a minimum 2.5-inch thick bituminous concrete surface course, unless indicated otherwise, in accordance with VDOT RBS. Place each lift compacted to 96 percent of maximum laboratory density. The finished surface shall be uniform in texture and appearance and free of cracks and creases.

3.2.5 Portland Cement Concrete Pavement

Provide as specified in Section 03302. "Cast-in-Place Concrete, Minor Construction." Provide reinforcing as indicated to match existing reinforcing. The concrete surface shall be struck off, screeded, tamped, and finished to the same surface elevation and texture as the adjacent existing concrete. Cure concrete for 7 days. Maintain existing joint patterns.

3.2.6 Bituminous Concrete Overlay

For portland cement concrete pavement overlaid with bituminous concrete pavement, provide the portland cement concrete pavement and bituminous concrete pavement as specified above, except provide a tack coat at the rate of 0.10 gallon of residual asphalt per square yard on the restored portland cement concrete base. Allow tack coat to become tacky prior to portland concrete placement. Apply the tack coat and bituminous concrete pavement only when the portland cement concrete base surface is clean and dry, and has cured for a minimum of 7 days.

3.3 MATERIAL DISPOSAL

Provide as specified in Section 02050, "Demolition and Removal."

-- End of Section --

SECTION 02661

EXTERIOR WATER DISTRIBUTION SYSTEM (MINOR CONSTRUCTION)

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 1785	(1993) Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2241	(1993) Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D 2466	(1994) Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2564	(1993) Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D 2855	(1993) Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D 3139	(1989) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM F 402	(1993) Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings
ASTM F 477	(1993) Elastomeric Seals (Gaskets) for Joining Plastic Pipe

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C500	(1993) Gate Valves for Water and Sewerage Systems
AWWA C508	(1993) Swing-Check Valves for Waterworks Service, 2 in. Through 24 in. NPS
AWWA C509	(1987) Resilient-Seated Gate Valves for Water and Sewerage Systems
AWWA C511	(1992) Reduced-Pressure Principle Backflow-Prevention Assembly

AWWA C651	(1992) Disinfecting Water Mains
AWWA C700	(1990; Addendum 1991) Cold-Water Meters - Displacement Type, Bronze Main Case
AWWA C701	(1988) Cold-Water Meters - Turbine Type, for Customer Service
AWWA C800	(1989) Underground Service Line Valves and Fittings
AWWA C900	(1989; Addendum 1992) Polyvinyl Chloride (PVC) Pressure Pipe, 4 in. through 12 in., for Water Distribution
AWWA M23	(1980) PVC Pipe - Design and Installation

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY, INC. (MSS)

MSS SP-80	(1987) Bronze Gate, Globe, Angle and Check Valves

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 24	(1992) Installation of Private Fire Service Mains and Their Appurtenances

UNI-BELL PVC PIPE ASSOCIATION (UBPPA)

UBPPA UNI-B-3	(1988) Installation of Polyvinyl Chloride (PVC) Pressure Pipe
UBPPA UNI-B-8	(1986) Direct Tapping of Polyvinyl Chloride (PVC) Pressure Water Pipe

UNDERWRITERS LABORATORIES INC. (UL)

UL 262	(1994) Gate Valves for Fire-Protection Service
UL 312	(1993; R 1994) Check Valves for Fire-Protection Service
UL 789	(1993; R 1994) Indicator Posts for Fire-Protection Service

1.2 DESIGN REQUIREMENTS

1.2.1 Water Service Lines

Provide water service lines indicated as 1-inch lines from water distribution main to a point approximately 5 feet from building. Water service lines shall be polyvinyl chloride (PVC) plastic pipe. Provide water service line appurtenances where specified. Submit design

calculations for water piping.

1.3 SUBMITTALS

Submit the following in accordance with Section C, Part 7.0 of the Basic Contract.

1.3.1 SD-02, Manufacturer's Catalog Data

a. Water service line piping, fittings, joints, valves and couplings

b. Corporation stops

c. Valve boxes

d. Water meters

e. Backflow preventer

f. Anti-freeze device

Submit manufacturer's standard drawings or catalog cuts for the listed items, except submit both drawings and cuts for push-on joints. Include information concerning gaskets with submittal for joints and couplings.

1.3.2 SD-06, Instructions

a. Installation procedures for water piping

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 Delivery and Storage

Inspect materials delivered to site for damage. Unload and store with minimum handling. Store materials on site in enclosures or under protective covering. Store plastic piping and jointing materials, and rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes and fittings free of dirt and debris.

1.4.2 Handling

Handle pipe, fittings, valves, hydrants, and other accessories in a manner to ensure delivery to the trench in sound undamaged condition. Take special care to avoid injury to coatings and linings on pipe and fittings; make satisfactory repairs if coatings or linings are damaged. Carry, do not drag pipe to the trench. Store rubber gaskets and plastic piping and jointing materials that are not to be installed immediately, under cover out of direct sunlight.

PART 2 PRODUCTS

2.1 WATER SERVICE LINE MATERIALS

2.1.1 Piping Materials

2.1.1.1 Plastic Piping

Plastic pipe and fittings shall bear the seal of approval of the National Sanitation Foundation for potable water service. Plastic pipe and fittings shall be supplied from the same source.

a. Polyvinyl chloride (PVC) plastic piping: ASTM D 1785, Schedule 40; or ASTM D 2241, with SDR as required to provide 150 psi minimum pressure rating. Fittings shall conform to ASTM D 2466. Pipe and fittings shall be of the same PVC plastic material and shall be one of the following pipe/fitting combinations, as marked on pipe and fitting, respectively: PVC 2120/PVC II; PVC 2116/PVC II. Solvent cement for jointing shall conform to ASTM D 2564.

2.1.2 Water Service Line Appurtenances

2.1.2.1 Corporation Stops

Ground key type; made of bronze conforming to ASTM B 61 or ASTM B 62; and suitable for the working pressure of the system. Ends shall be suitable for solder-joint, or flared tube compression type joint. Threaded ends for inlet and outlet of corporation stops shall conform to AWWA C800; coupling nut for connection to flared copper tubing shall conform to ASME/ANSI B16.26.

2.1.2.2 Goosenecks

Type K copper tubing. Joint ends for goosenecks shall be appropriate for connecting to corporation stop and service line. Where multiple gooseneck connections are required for an individual service, connect goosenecks to the service line through a brass or bronze branch connection; the total clear area of the branches shall be at least equal to the clear area of the service line. Length of goosenecks shall be in accordance with standard practice.

2.1.2.3 Gate Valves on Buried Piping

Gate Valves 3-inch size and smaller on buried piping MSS SP-80, Class 150, solid wedge, nonrising stem. Valves shall have flanged end connections, or threaded end connections with a union on one side of the valve. Provide handwheel operators.

2.1.2.4 Curb Boxes

Provide for each curb or service stop. Curb boxes shall be of cast iron of a size suitable for the stop on which it is to be used. Provide a round head. Cast the word "WATER" on the lid. Each box shall have a heavy coat of bituminous paint.

2.1.2.5 Valve Boxes

Provide for each gate valve on buried piping. Valve boxes shall be of cast iron or precast concrete as indicated of a size suitable for the valve on which it is to be used and shall be adjustable. Provide a round head. Cast the word "WATER" on the lid. The least diameter of the shaft of the box shall be 5 1/4 inches. Each cast-iron box shall have a heavy coat of bituminous paint.

2.2 WATER METERS

AWWA C700. Meter shall register in U.S. gallons. Displacement type water shall be of freeze-proof type.

2.3 BACKFLOW PREVENTER

AWWA C511 reduced pressure principle type, as modified herein. Backflow preventers shall have threaded connections and all bronze construction for sizes of 2 inches and smaller, and shall have flanged connections and galvanized cast-iron or epoxy coated cast-iron construction for sizes larger than 2 inches. The backflow preventer shall include two check valves located between two shut-off valves with an area of reduced pressure between the check valves and a relief device arranged to discharge to the atmosphere. Fluctuation in piping pressure shall not cause cycling. The backflow preventer shall automatically maintain a low pressure zone to positively prevent the backflow of water into the water supply system. The backflow preventer shall automatically indicate failure of any part vital to the prevention of backflow by the continuous discharge of the relief device. The backflow preventer shall be suitable for a cold water working pressure of 150 psig. The backflow preventer shall be designed so that any moving part may be replaced without removing the backflow preventer.

2.3.1 Anti-Freeze Device

Provide for each backflow preventer:

a. Anti-freeze shall have external self-contained, direct acting actuator activated by ambient air temperature. Anti-freeze devices shall be factory set to begin to open at 40 degrees F air temperature, to fully open at 35 degrees F air temperature, and to fully close at 45 degrees F. Each anti-freeze device shall be provided with a strainer furnished by the anti-freeze device manufacturer.

b. Anti-freeze device shall be one of the following:

(1) Automatic bleeder valve: Provide self-contained thermally-actuated valve operated by a material having the proper temperature and volume relationship to open and close the valve. Valve design to have minimum of three port sizes for flexibility of flow rate from 8.1 GPM down to 3.25 GPM for water conservation. Valve shall have overtemperature spring to protect the thermal system and poppet. If the thermal system fails, the valve shall open. Valve shall be all bronze with stainless steel springs and Buna-S poppet.

(2) Temperature control valve: Provide self-contained, complete with thermostat and flexible armored capillary tubing. Valve shall be brass body single seated with corrosion-resistant metallic tubing; valve operator shall be fully enclosed in stainless steel.

PART 3 EXECUTION

3.1 INSTALLATION OF PIPELINES

3.1.1 General Requirements for Installation of Pipelines

These requirements shall apply to pipeline installation except where specific exception is made in the "Special Requirements..." paragraphs.

3.1.1.1 Location of Water Lines

The work covered by this section shall terminate at a point approximately 5 feet from building , unless otherwise indicated on drawings. Do not lay water lines in the same trench with gas lines fuel lines, or electric wiring.

a. Water piping installation parallel with sanitary sewer piping

(1) Normal conditions. Water piping shall be laid at least 10 feet horizontally from a sewer or sewer manhole whenever possible. Distance shall be measured edge to edge.

(2) Unusual conditions. When local conditions prevent a horizontal separation of 10 feet, water piping may be laid closer to a sewer or sewer manhole provided:

(a) 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, sewer piping shall be constructed of AWWA-approved water pipe, pressure tested in place without leakage prior to backfilling.

(c) Sewer manhole shall be of watertight construction and tested in place.

b. Installation of water piping crossing sanitary sewer piping

(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.

(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 the following. A vertical separation of at least 18 inches between bottom of sewer piping and top of water piping; adequate structural support for sewer piping to prevent excessive deflection of joints and settling on and breaking of water piping; and that the length minimum 18 feet of water piping be centered at the point of crossing so that joints shall be equidistant and as far as possible from sewer piping.

c. Sanitary sewer piping or sanitary sewer manholes. No water piping shall pass through or come in contact with any part of a sewer manhole.

3.1.1.2 Earthwork

Perform earthwork operations in accordance with Section 02220, "General Excavation, Filling and Backfilling".

3.1.1.3 Pipe Laying and Jointing

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 proper facilities for lowering sections of pipe into trenches. Do not under any circumstances drop or dump pipe, fittings, valves, or other water line material into trenches. Cut pipe accurately to length established at the site and work into place without springing or forcing. Replace by one of the proper length any pipe or fitting that does not allow sufficient space for proper installation of jointing material. Grade pipeline in straight lines; avoid formation of dips and low points. Support pipe at proper elevation and grade, and secure firm, uniform support. Wood support blocking will not be permitted. Lay pipe so that 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 necessary for fastening work into place. Make proper provision for expansion and contraction of pipelines. Keep trenches free of water until joints have been properly made. At the end of each work day, close open ends of pipe temporarily with wood blocks or bulkheads. Do not lay pipe when conditions of trench or weather prevents installation. Depth of cover over top of pipe shall not be less than 3 feet.

3.1.1.4 Installation of Tracer Wire

Install a continuous length of tracer wire for full length of each run of nonmetallic pipe. Attach wire to top of pipe in such manner that it will not be displaced during construction operations.

3.1.1.5 Connections to Existing Water Lines

After approval is obtained, make connections to existing water lines with a minimum interruption of service on the existing line. Use tapping or drilling machine valve and mechanical joint type sleeves for connections to be made under pressure. Bolt sleeves around mains; bolt valve conforming to AWWA C500 to the branch. Open valve, attach drilling machine, make tap, close valve, and remove drilling machine, all without interruption of service. Notify the NTR in writing at least 15 days prior to the date the connections are required; receive approval before any service is interrupted. Furnish all materials required to make connections into the existing water supply systems and perform all excavation, backfilling, and other incidental labor as required.

3.1.2 Installation of Water Service Piping

3.1.2.1 Location

Connect water service piping to the building service where the building service has been installed. Where building service has not been installed, terminate water service lines approximately 5 feet from the building line at a point directed by the NTR; such water service lines shall be closed with plugs or caps.

3.1.2.2 Service Line Connections to Water Mains

Connect service lines 1-inch size to the main by a corporation stop and gooseneck and install a service stop below the frostline. Connect service lines to ductile-iron water mains in accordance with AWWA C600 for service taps. Connect service lines to PVC plastic water mains in accordance with UBPPA UNI-B-8 and the recommendations of AWWA M23, Chapter 9, "Service Connections."

3.1.2.3 Special Requirements for Installation of Plastic Piping

a. Plastic piping installation, general: Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" and with the applicable requirements of ASTM D 2774 and ASTM D 2855, unless otherwise specified. Handle solvent cements used to join plastic piping in accordance with ASTM F 402.

b. Jointing: Make solvent-cemented joints for PVC plastic piping using the solvent cement specified for this material; assemble joints in accordance with ASTM D 2855. Make plastic pipe joints to other pipe materials in accordance with the recommendations of the plastic pipe manufacturer.

c. Plastic pipe connections to appurtenances: Connect plastic pipe service lines to corporation stops and gate valves in accordance with the recommendations of the plastic pipe manufacturer.

3.1.3 Disinfection

Disinfect new water piping and existing water piping affected by Contractor's operations in accordance with AWWA C651. Fill 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 solution from the systems with domestic water until maximum residual chlorine content is within the range of 0.2 to 0.5 parts per million, or the residual chlorine content of domestic water supply. Obtain at least two consecutive satisfactory bacteriological samples from new water piping, analyze by a certified laboratory, and submit results prior to new water piping being placed into service. Disinfection of systems supplying nonpotable water is not required.

3.1.4 Backflow Preventer

Backflow preventer shall be installed in accordance with manufacturer's recommendations. Install anti-freeze device per manufacturer's instructions so that discharge flow will not build up ice to block discharge from anti-freeze device.

3.2 FIELD QUALITY CONTROL

3.2.1 Field Tests and Inspections

The NTR will conduct field inspections and witness field tests specified in this section. The Contractor shall perform field tests, and provide labor, equipment, and incidentals required for testing , except that water and electric power needed for field tests will be furnished as set forth in Section 01010, "General Paragraphs". The Contractor shall produce evidence, when required, that any item of work has been constructed properly in accordance with the drawings and specifications.

3.2.2 Testing Procedure

Test water mains and water service lines in accordance with the applicable specified standard, except for the special testing requirements given in paragraph entitled "Special Testing Requirements." Test water service lines in accordance with applicable requirements of AWWA C600 for hydrostatic testing. No leakage will be allowed at plastic pipe joints.

3.2.3 Special Testing Requirements

For pressure test, use a hydrostatic pressure 50 psi greater than the maximum working pressure of the system. Hold this pressure for not less than 2 hours. Prior to the pressure test, fill that portion of the pipeline 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.

-- End of Section --

SECTION 02902

SOIL VAPOR EXTRACTION SYSTEM

PART 1 - GENERAL

The work described in this section includes the design and installation of a complete soil vacuum extraction (SVE) system, designed to operate in conjunction with an air sparging system (specified in Section 02903), to remediate groundwater within the two areas of concern (AOC1 and AOC2) as shown on the drawings and as specified herein. In addition, the work includes startup, initial testing, and operation/maintenance of the system for a 180-day operations period.

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced only. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) PUBLICATIONS

ASTM C 150	1989 Type I or II Portland Cement
ASTM D 1785	1989 Poly (Vinyl Chloride) (PVC) Plastic Pipe
ASTM D 2466	1988 Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings
ASTM D 2564	1988 Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings

CODE OF FEDERAL REGULATIONS (CFR)

40 CFR 136	40 CFR 136 Guidelines Establishing Test Procedures for the Analysis of Pollutants

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	National Electric Code

1.2 SUBMITTALS

Submit the following in accordance with Section C, Part 7, of the Basic Contract.

1.2.1 SD-02, Manufacturer's Catalog Data

a. Piping and Fittings
b. PVC Solvent Cement
c. Valves
d. System Control Panel G
e. Air/Water Separators G

f. Liquid Transfer Pumps G
g. Liquid-Phase Granular Activated Carbon Adsorbers G
h. Vapor-Phase Granular Activated Carbon G
i. Cartridge Filters
j. Positive Displacement Vacuum Blower G

1.2.2 SD-04, Drawings

a. Soil Vapor Extraction System Wells and Piping G
b. Soil Vapor Extraction Equipment G

1.2.2.1 Soil Vapor Extraction System Wells and Piping

Submit drawings by a registered professional engineer or approved by the manufacturer for the design and construction of the Soil Vapor Extraction (SVE) wells, all underground SVE piping, and appurtenances. Drawings shall include material sizes and types, arrangement of wells and underground SVE piping, and the sequence and method of installation.

1.2.2.2 Soil Vapor Extraction Equipment

Submit drawings by a registered professional engineer or approved by the manufacturer for the design and construction of the Soil Vapor Extraction (SVE) equipment. Drawings shall include equipment sizes and types, materials of construction, arrangement of equipment components, and the sequence and method of installation.

1.2.3 SD-05, Design Data

a. Engineering Design Calculations G

1.2.3.1 Engineering Design Calculations

Submit calculations by a registered professional engineer for the design and installation of the soil vapor extraction system wells, equipment, and appurtenances. Calculations shall demonstrate that the selected equipment has been properly sized, and is capable of meeting the specified performance requirements. Calculations shall include data and references used, and shall be prepared in accordance with accepted engineering practices.

1.2.4 SD-12, Field Test Reports

a. Soil Vapor Extraction System Performance Data

1.2.4.1 Soil Vapor Extraction Performance Data

Submit a report that provides details of the operation and performance of the soil vapor extraction system during the 180-day operational period. The report shall include monitoring data, analytical data, operation logs, problems noted, and evaluation of system performance.

1.2.5 SD-19, Operations and Maintenance Data

a. Soil Vapor Extraction Equipment, Data Package 4 G

1.3 DESCRIPTION OF SYSTEM

Provide soil vapor extraction (SVE) systems in accordance with these specifications to meet the performance requirements specified.

The primary objective of the work is to construct SVE systems to operate in conjunction with air sparging system (specified in Section 02903) to achieve groundwater remediation in areas of concern (AOC) at the site. The work includes the design and installation of soil extraction systems for AOC1 and AOC2 as shown on the drawings. Existing contaminant conditions and system design and performance parameters are identified in the Basis of Design Report, provided to the Contractor as a separate document.

An onsite pilot test was performed to provide preliminary site-specific data for the design of the SVE system. The results of this test are included in the Basis of Design Report.

Based on the pilot test results, an assumed radius of vacuum influence of 40 feet is recommended for both areas of concern. A spacing of 65 to 75 feet is recommended for SVE wells to ensure some overlap of vacuum influence. SVE wells should be installed to a depth of at least one foot above the high water table. SVE well construction details are illustrated on the drawings.

1.4 EQUIPMENT BUILDING

Provide buildings to house the SVE and air sparging equipment in accordance with the construction drawings and these specifications.

1.5 GENERAL REQUIREMENTS

Provide in accordance with Sections 15011, "Mechanical General Requirements" and 16011, "Electrical General Requirements."

PART 2 - PRODUCTS

2.1 SOIL VAPOR EXTRACTION PIPING, VALVES, AND FITTINGS

Provide all piping, valves, and fittings that are rated to resist external and operating forces. All materials shall be resistant to corrosion by the contaminants and conditions at the site.

PVC Piping and fittings shall conform to ASTM 1785 and ASTM 2466.

2.2 SOIL VAPOR EXTRACTION (SVE) WELLS

2.2.1 Well Casings and Screens

Provide casing and screens with adequate strength to resist external and operating forces. Wells are to be constructed of 4-inch diameter, Schedule 40 PVC threaded casing and screens.

PVC casing and screens shall conform to ASTM D 1785.

2.2.2 Filter Pack

Provide clean, round, hard water-worn quartz with less than 5 percent feldspar, no fossils, carbonate or organics. The filter pack shall have gradation specifications designed by the Contractor to facilitate the flow of gas and liquid from the surrounding soil.

2.2.3 Cement Grout

Provide neat cement grout, Type I or II portland cement conforming to ASTM C 150.

2.2.4 Bentonite Seal

Provide a minimum 6" deep bentonite seal above filter pack to prevent flow of atmospheric air to well.

2.3 MANIFOLD PIPING SYSTEM

Provide manifold piping, fittings, and valves, Schedule 40 PVC in accordance with ASTM D 1785 and ASTM D 2466, as shown on the drawings and/or as required to construct a complete and operable system.

2.3.1 Soil Monitoring Probes

Provide a system of soil monitoring probes to monitor the SVE system. The number and location of soil probes shall be determined by the Contractor. Recommended soil probe construction details are shown on the drawings.

2.4 SOIL VAPOR EXTRACTION EQUIPMENT

Provide the following soil vapor extraction equipment, complete and ready for use, including all associated vacuum pumps, piping, valves, fittings, controls, and appurtenances. Provide separate systems for AOC1 and AOC2. The soil vapor extraction equipment shall be designed for continuous operation and shall be equipped with the necessary controls and instrumentation to allow for automatic operation with minimum operator input. All equipment shall be furnished by a supplier(s) that is established in the design and manufacture of such equipment. The equipment shall be installed in the equipment buildings as indicated. Platform or skid mounted equipment is acceptable, provided that the equipment skid(s) can be installed in the equipment buildings, as designed.

2.4.1 System Control Panel

Provide a single control panel for the soil vapor extraction equipment, that will allow for automatic, un-attended operation of the system.

2.4.2 Air/Water Separators (T-110 and T-111)

Provide an air/water separator for each system, as indicated and specified. The air/water separators shall be furnished by a supplier that is

established in the design and manufacture of such equipment. The equipment shall be installed in the two equipment buildings as indicated.

2.4.2.1 Functional Description

Each air/water separator shall be capable of separating condensed and entrained liquid from the soil vapor flow stream.

Each air/water separator shall be sized to meet the designed air flow rates for each system. Approximate flow capacities are as follows:

a. T-110 shall have a maximum air flow capacity of 400 cubic feet per minute (cfm).

b. T-111 shall have a maximum air flow capacity of 1,000 cfm.

2.4.3 Liquid Transfer Pumps (P-100 and P-101)

Provide a transfer pump for each system, to pump collected water from the air/water separator through the liquid phase carbon adsorbers. Each transfer pump shall be a positive displacement or metering type pump, capable of pumping at a flow rate and pressure required by the liquid phase carbon adsorbers. Each pump shall be provided with all required controls and level sensors to allow for automatic operation.

2.4.4 Liquid-Phase Carbon Adsorbers (X-110 and X-111)

Provide a liquid phase carbon adsorber for each system, including the vessel, granular activated carbon (GAC) media, and appurtenances. The carbon adsorbers shall be furnished by a supplier that is established in the design and manufacture of such equipment. The equipment shall be installed in the two equipment buildings as indicated.

2.4.4.1 Functional Description

Each adsorber shall be designed to remove volatile organic contaminants from the recovered groundwater. The liquid phase carbon adsorbers shall be vertical, cylindrical pressure vessels, with a volume of approximately 55 gallons, a capacity of approximately 165 pounds of GAC, and shall be provided with a corrosion resistant lining.

Quick connect inlets and outlets shall be provided, with caps, to allow for removal and replacement with a new unit.

Each adsorber shall be provided with inlet and outlet pressure gages and sample port.

2.4.4.2 Materials of Construction

The adsorber vessels shall be constructed of heavy gage steel or plastic, with corrosion resistant lining and components.

The adsorber vessels shall be factory filled with granular activated carbon meeting the following specifications:

a.	Iodine Number (min.)	900
b.	Abrasion Number (min.)	75
c.	Moisture (max.)	2.0%
d.	Effective Size (mm)	0.8-1.0
e.	Water Soluble Ash (max.)	0.5%
f.	U.S. Standard Series	
	Sieve Size:	
	Larger than No. 8 (max.)	15%
	Smaller than No. 30 (max.)	4%

2.4.5 Vapor Phase Carbon Adsorbers (X-120 and X-121)

Provide a vapor phase carbon adsorber for each system, including the vessel, granular activated carbon (GAC) media, and appurtenances. The carbon adsorbers shall be furnished by a supplier that is established in the design and manufacture of such equipment. The equipment shall be installed in the two equipment buildings as indicated.

2.4.5.1 Functional Description

Each adsorber shall be designed to remove volatile organic contaminants from the extracted air. The vapor phase carbon adsorbers shall be vertical, cylindrical pressure vessels, and shall be provided with a corrosion resistant lining.

Inlets and outlets shall be designed to allow for removal of the unit and the replacement with a new unit.

Each adsorber shall be provided with inlet and outlet pressure gages and a sample port.

Each vapor phase carbon adsorber shall be sized to meet the designed air flow rates for each system. Approximate flow capacities are as follows: X-120 flow capacity = 400 cubic feet per minute (cfm); X-121 flow capacity = 1000 cfm.

2.4.5.2 Materials of Construction

The adsorber vessels shall be constructed of heavy gage steel or plastic, with a corrosion resistant lining and components.

The adsorber vessels shall be factory filled with granular activated carbon meeting the following specifications:

a.	Iodine Number (min.)	900
b.	Abrasion Number (min.)	75
c.	Moisture (max.)	2.0%
d.	Effective Size (mm)	0.8-1.0
e.	Water Soluble Ash (max.)	0.5%
f.	U.S. Standard Series	
	Sieve Size:	
	Larger than No. 8 (max.)	15%
	Smaller than No. 30 (max.)	4%

2.4.6 Cartridge Filters (F-130 A/B and F-131 A/B)

Provide two (2) cartridge filters for each system, sized to handle the designed vacuum flow rates for each system.

2.4.7 Positive Displacement Vacuum Blower (P-200 and P-201)

Provide a positive displacement vacuum blower, for each system as indicated, sized to meet the flow and vacuum demands of the SVE system, and in accordance with Section 15055, "Nonlubricated Rotary Screw Vacuum Pumps."

2.4.7.1 Functional Description

Each positive displacement vacuum blower shall be sized to meet the designed air flow rates for each system. Approximate air flow capabilities are as follows:

a. P-200 shall have a maximum vacuum flow rate of 350 cfm at 6-inches vacuum Hg.

b. P-201 shall have a maximum vacuum flow rate of 900 cfm at 6-inches vacuum Hg.

PART 3 EXECUTION

3.1 GENERAL

Using information provided in the Basis of Design, design and install full-scale soil vapor extraction systems at the site for the areas of concern as indicated on the drawings and as specified. Separated liquid shall be pumped to a designated stormwater discharge point, or passed through a granular activated carbon filter is required for effluent limits to meet requirements of the Base VPDES Permit. Gases removed shall pass through a granular activated carbon filter to meet air discharge requirements.

3.2 SAMPLING AND ANALYSIS PLAN

Submit in accordance with Section 01010, "General Paragraphs."

All sampling analysis required to operate and monitor the SVE system shall be included.

3.3 AREA OF COVERAGE

The full-scale soil vapor extraction systems shall function to remove vapors generated by the companion air sparging systems within AOC 1 and AOC 2 as indicated on the drawings. Contractor's design shall indicate system layout and estimated vacuum radius of influence for each well.

3.4 EFFLUENT REQUIREMENTS

Separated water shall meet the requirements of the Base VPDES Permit before being discharged to the stormwater system. Specific discharge

limits shall be provided by COMNAVBASE Environmental Programs Office (804-444-3009), and shall include, but not be limited to, monitoring for flow, pH (6.0 to 9.0), Chemical Oxygen Demand (COD), Oil and Grease, and Total Suspended Solids.

Air discharge requirements will be determined by the Base Air Permit. It is anticipated that the vapor from the SVE system will require GAC treatment prior to discharge to the atmosphere.

If anticipated contaminant concentrations in soil vapor are greater than 50% of the lower exposure limit (LEL), explosion-proof equipment shall be used.

3.5 INSTALLATION

Install SVE system equipment, piping, power, controls, accessories and appurtenances in accordance with the manufacturer's recommendation. Provide all necessary interconnections, services, and adjustments as required for a complete and operable system. All electrical work shall be in accordance with NFPA 70 and as specified in Section 16011.

3.5.1 Piping

All soil vacuum extraction piping shall be installed a minimum of 18-inches underground from vent wells to the equipment buildings. Separated water discharge piping shall be installed 36-inches underground from the equipment building to the nearest stormwater discharge point.

3.5.2 Sampling Ports

The system shall be provided with sampling ports for acquisition of influent and effluent vapors and liquids for analysis.

3.5.3 Soil Disposal

Material excavated for the installation of piping and the equipment building shall be sampled and disposed of in accordance with state and Federal regulations and Section 02223, "Transportation and Disposal of Contaminated Material".

3.5.4 Nameplates

Provide laminated plastic nameplates identifying pertinent information for equipment, gauges, thermometers, and stop valves. Laminated plastic shall be 0.125-inch thick Melamine plastic, 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. Equipment nameplates shall show the following information:

a. Manufacturer, type, and model number
b. Contract number and accepted date
c. Capacity or size

3.6 SEQUENCE OF OPERATION

3.6.1 Soil Vapor Extraction

Soil vapor shall be extracted from vent wells in the areas indicated on the drawings. The number and arrangement of the vent wells shall be determined by the Contractor and approved by the NTR.

3.6.2 Separation

Extracted soil vapor shall be delivered to an inlet separator to separate vapor from liquid. The separated liquid shall be treated via GAC and discharged to the Base Stormwater system. Separated vapor shall be treated via GAC, if necessary to meet emission requirements, and discharged to the atmosphere.

3.6.3 Vapor Treatment

Separated vapor shall be treated by granular activated carbon, if necessary to meet the effluent requirements of this specification, and exhausted to the atmosphere. Exhaust height shall be in accordance with local and state requirements.

3.7 STARTUP AND INITIAL TESTING

3.7.1 General

The Contractor shall provide all startup and testing services, and make all required adjustments.

Groundwater generated during system startup and testing shall be discharged per the direction of the NTR.

Contractor shall maintain an accurate log of all test procedures and results and submit a report of procedures and results to the NTR for approval.

3.8 OPERATIONS

The soil vapor extraction system shall be operated and maintained by the Contractor for a period of 180 days. The 180 day operational period shall start only after all components of the system have been through the startup and initial testing and the NTR has accepted the system in its entirety. A registered professional engineer or certified geologist, provided by the Contractor, shall monitor the vapor extraction system's operation, and provide an initial and a final report containing hours of operation, volume of water recovered, and weekly air quality laboratory analysis. After 180 days of operation by the Contractor, the Government shall assume responsibility for operation of the equipment. The Contractor shall provide 40 hours of training for Government personnel in how to properly operate and maintain the system.

3.8.1 Air Quality Analyses

Air quality analysis of extraction system influent and effluent shall be for volatile organic compounds (VOCs) as required to evaluate system performance. Contractor shall submit a Sampling and Analysis Plan outlining all sampling and analytical methods, procedures and frequencies.

3.8.2 Water Quality Analysis

Water quality analysis of SVE system influent and effluent shall be for the same VOCs as for air quality. Water quality of system effluent must meet discharge limits prior to discharge.

3.9 FINAL TESTING

Upon completion and before final acceptance of the work, the soil vacuum extraction systems shall be tested to determine compliance with the contract requirements and warranty. Each new piping system and all pressure vessels shall be pneumatically tested at not less than 125 psig and shall show no leakage or reduction in gauge pressure after 4 hours. All equipment shall be tested in operation for a continuous period of not less than 180 days. During the tests, all equipment shall be tested under every condition of operation. All controls shall be tested to demonstrate performance of their required function. All piping shall be thoroughly flushed and cleaned before being placed in operation. Separated water shall be tested to demonstrate that water quality meets all discharge requirements. The Contractor shall furnish instruments, connecting devices and personnel for the test. Each system shall be completely tested for compliance with specification and all conditions thereof, and all adjusting and balancing shall be completed to the satisfaction of the NTR. Adjustment of controls and balancing of systems shall extend for one year after the completed systems are put in operation.

-- End of Section --

SECTION 02903

AIR SPARGING SYSTEM

PART 1 - GENERAL

The work described in this section includes the design and installation of a complete air sparging (AS) system, designed to operate in conjunction with a soil vacuum extraction system (specified in Section 02902), to remediate groundwater within the two areas of concern (AOC1 and AOC2) as shown on the drawings and as specified herein. In addition, the work includes startup, initial testing, and operation/maintenance of the system for a 180-day operations period.

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced only. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) PUBLICATIONS

ASTM A 530	1992 Specialized Carbon and Alloy Steel Pipe
ASTM C 150	1989 Type I or II Portland Cement
ASTM D 1785	1989 Poly (Vinyl Chloride) (PVC) Plastic Pipe
ASTM D 2466	1988 Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings
ASTM D 2564	1988 Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings

CODE OF FEDERAL REGULATIONS (CFR)

40 CFR 136	40 CFR 136 Guidelines Establishing Test Procedures for the Analysis of Pollutants

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	National Electric Code

1.2 SUBMITTALS

Submit the following in accordance with Section C, Part 7, of the Basic Contract.

1.2.1 SD-02, Manufacturer's Catalog Data

a. Piping and Fittings
b. PVC Solvent Cement

c. Valves
d. Air Compressor G

1.2.2 SD-04, Drawings

a. Air Sparging System Wells and Piping G
b. Air Sparging Equipment G

1.2.2.1 Air Sparging System Wells and Piping

Submit drawings by a registered professional engineer or approved by the manufacturer for the design and construction of an air sparging system including sparging wells, all underground piping, and appurtenances. Drawings shall include material sizes and types, arrangements of sparging wells and underground piping, and the sequence and method of installation.

1.2.2.2 Air Sparging Equipment

Submit drawings by a registered professional engineer or approved by the manufacturer for the design and construction of the air sparging equipment sizes and types, arrangement of equipment components, and the sequence and method of installation.

1.2.3 SD-05, Design Data

a. Engineering Design Calculations G

1.2.3.1 Engineering Design Calculations

Submit calculations by a registered professional engineer for the design and installation of the air sparging system including sparging wells, all underground piping, equipment, and appurtenances. Calculations shall demonstrate that the selected equipment has been properly sized, and is capable of meeting the specified performance requirements. Calculations shall include data and references used, and shall be prepared in accordance with accepted engineering practices.

1.2.4 SD-12, Field Test Reports

a. Air Sparging System Performance Data

1.2.4.1 Air Sparging System Performance Data

Submit a report that provides detailed data on the operation and performance of the Air Sparging System during the 180-day operational period. The report shall include monitoring data, analytical data, operation logs, problems noted, and an evaluation of system performance.

1.2.5 SD-19, Operations and Maintenance Data

a. Air Sparging Equipment Data Package 4 G

1.3 DESCRIPTION OF SYSTEM

Provide air sparging (AS) systems in accordance with these specifications to meet the performance requirements specified.

The primary objective of the work is to construct AS systems to operate in conjunction with soil vapor extraction systems (specified in Section 02902) to achieve groundwater remediation in areas of concern (AOC) at the site. The work includes the design and installation of AS systems for AOC1 and AOC2 as shown on the drawings. Existing contaminant conditions and system design and performance parameters are identified in the Basis of Design Report, provided to the Contractor as a separate document.

An on-site pilot test was performed to provide preliminary site-specific data for the design of the SVE system. The results of this test are included in the Basis of Design Report.

Based on the pilot test results, an assumed radius of sparging influence of 25 feet is recommended for both areas of concern. A spacing of 40 to 45 feet is recommended for AS wells to ensure some overlap of sparging influence. AS well construction details are illustrated on the drawings.

1.4 EQUIPMENT BUILDING

Provide buildings to house the AS and SVE equipment in accordance with the construction drawings and these specifications.

1.5 GENERAL REQUIREMENTS

Provide in accordance with Sections 15011, "Mechanical General Requirements" and 16011, "Electrical General Requirements."

PART 2 - PRODUCTS

2.1 AIR SPARGING PIPING, VALVES, AND FITTING

Provide all piping, valves, and fittings that are rated to resist external and operating forces. All materials shall be resistant to corrosion by the contaminants and conditions at the site.

PVC Piping and fittings shall conform to ASTM 1785 and ASTM 2466. Stainless Steel Piping and fittings shall conform to ASTM A530.

2.2 AIR SPARGING (AS) WELLS

2.2.1 Well Casings and Screens

Provide casing and screens with adequate strength to resist external and operating forces. Wells are to be constructed of 2-inch diameter, Schedule 40 PVC casing and well screen. Screen slot size of 0.10 inches is recommended. Alternate well diameters and screen slot sizes can be proposed by the contractor, as necessary.

PVC casing and screens shall conform to ASTM D 1785.

2.2.2 Filter Pack

Provide clean, round, hard water-worn quartz with less than 5 percent feldspar, no fossils, carbonate or organics. The filter pack shall have gradation specifications designed by the Contractor to facilitate the flow of air to the subsurface.

2.2.3 Cement Grout

Provide neat cement grout, Type I or II portland cement conforming to ASTM C150.

2.2.4 Bentonite Seal

Provide a minimum 3-feet deep bentonite seal above the filter pack.

2.3 MANIFOLD PIPING SYSTEM

Provide manifold piping, fittings, and valves as shown on the drawings and/or as required to construct a complete and operable system.

2.4 GROUNDWATER MONITORING WELLS

Provide a system of groundwater monitoring wells to monitor the AS systems. Existing monitoring wells may be used whenever possible. The number and location of monitoring wells shall be determined by the Contractor and approved by the NTR. Recommended monitoring well construction details are shown on the drawings.

2.5 AIR SPARGING EQUIPMENT

Provide the following air sparging equipment, complete and ready for use, including all associated piping, valves, fittings, controls, and appurtenances. Provide separate systems for AOC1 and AOC2. Each air sparging system shall be designed for continuous and pulsed operation and shall be equipped with the necessary controls and instrumentation to allow for automatic operation with minimum operator input. Each system shall include pressure and temperature indicators, and flow meters for flow rate determination. Pressure and flowrate measurement devices shall be provided at each well. In addition to the AS wells, the system shall include manifold piping, groundwater monitoring wells, and an air compressor. All equipment shall be furnished by a supplier(s) that is established in the design and manufacture of such equipment. The equipment shall be installed in the equipment buildings as indicated. Platform or skid mounted equipment is acceptable, provided that the equipment skid(s) can be installed in the equipment buildings, as designed.

2.5.1 Air Compressor (X-200 and X-201)

Provide an air compressor for each system as indicated, sized to meet the flow and pressure demands of the AS system, in accordance with Section 15054, "Nonlubricated Rotary Screw Air Compressors".

PART 3 EXECUTION

3.1 GENERAL

Using information provided in the Basis of Design, design and install a full-scale air sparging system at the site to remediate the groundwater within the areas of the site as indicated on the drawings and as specified.

3.2 SAMPLING AND ANALYSIS PLAN

Submit in accordance with Section 01010, "General Paragraphs." All sampling/analysis required to operate and monitor the AS system shall be included.

3.3 AREA OF COVERAGE

The full-scale air sparging system shall remediate the groundwater to the established cleanup goals (Section 3.4) within AOC1 and AOC2 as indicated on the drawings. Contractor's design should include system layout and estimated radius of sparge influence for each well.

3.4 CLEANUP GOALS

The groundwater cleanup goals, in parts per billion, for the contaminants of concern are as follows:

Trichloroethene (TCE)	49
Tetrachloroethene (PCE)	60
1,1-Dichloroethene (DCE)	0.378
Vinyl Chloride	<1
Carbon Tetrachloride	2.73
Chloroform	11

3.5 INSTALLATION

Install AS system equipment, piping, power, controls, accessories and appurtenances in accordance with the manufacturer's recommendation. Provide all necessary interconnections, services, and adjustments as required for a complete and operable system. All electrical work shall be in accordance with NFPA 70 and as specified in Section 16011.

3.5.1 Piping

All air sparging piping shall be installed 18 inches underground from AS wells to the equipment buildings.

3.5.2 Soil Disposal

Material excavated for the installation of piping and the equipment building shall be sampled and disposed of in accordance with state and Federal regulations and Section 02223, "Transportation and Disposal of Contaminated Material."

3.5.3 Nameplates

Provide laminated plastic nameplates identifying pertinent information for equipment, gauges, thermometers, and stop valves. Laminated plastic shall be 0.125-inch thick Melamine plastic, 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. Equipment nameplates shall show the following information:

a. Manufacturer, type, and model number
b. Contract number and accepted date
c. Capacity or size

3.6 SEQUENCE OF OPERATION

3.6.1 Air Injection

Air under pressure shall be injected into the AS wells in the areas indicated to a depth designed by the Contractor based on site conditions and depth of groundwater contamination. The number and arrangement of the AS wells shall be determined by the Contractor and approved by the NTR.

3.7 STARTUP AND INITIAL TESTING

3.7.1 General

The Contractor shall provide all startup and testing services, and make all required adjustments.

Contractor shall maintain an accurate log of all test procedures and results and submit a report of procedures and results to the NTR for approval.

3.8 OPERATIONS

The AS system shall be operated and maintained by the Contractor for a period of 180 days. The 180 day operational period shall start only after all components of the system have been through the startup and initial testing and the NTR has accepted the system in its entirety. A registered engineer, or certified professional geologist shall monitor the AS system's operation, and provide an initial and a final report containing hours of operation, water levels and dissolved oxygen measurements, and weekly water quality laboratory analysis. After 180 days of operation by the Contractor, the Government shall assume responsibility for operation of the equipment. The Contractor shall provide 40 hours of training for Government personnel in how to properly operate and maintain the system.

3.8.1 Water Quality Analyses

Water quality analysis of AS system groundwater monitoring wells shall be for volatile organic compounds as required to evaluate system performance. Contractor shall submit a Sampling and Analysis Plan outlining all sampling and analytical methods, procedures and frequencies.

3.9 FINAL TESTING

Upon completion and before final acceptance of the work, the AS systems shall be tested as in service to determine compliance with the contract requirements and warranty. Each new piping system and all pressure vessels shall be pneumatically tested at not less than 1.5 times maximum system operating pressure and shall show no leakage or reduction in gauge pressure after 4 hours. All equipment shall be tested in operation for a continuous period of not less than 180 days. During the tests, all equipment shall be tested under every condition of operation. All controls shall be tested to demonstrate performance of their required function. All piping shall be thoroughly flushed and cleaned before being placed in operation. The Contractor shall furnish instruments, connecting devices and personnel for the test. Each system shall be completely tested for compliance with specification and all conditions thereof, and all adjusting and balancing shall be completed to the satisfaction of the NTR. Adjustment of controls and balancing of systems shall extend for one year after the completed systems are put in operation.

-- End of Section --

SECTION 03302

CAST-IN-PLACE CONCRETE (MINOR CONSTRUCTION)

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 301	(1994) Structural Concrete for Buildings
ACI 304R	(1989) Measuring, Mixing, Transporting, and Placing Concrete
ACI 305R	(1991) Hot Weather Concreting
ACI 306.1	(1990) Cold Weather Concreting

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 185	(1990; Rev. A) Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM A 497	(1990; Rev. B) Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement
ASTM A 615/A 615M	(1993) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 616/A 616M	(1993) Rail-Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A 617/A 617M	(1993) Axle-Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A 706/A 706M	(1993; Rev. A) Low-Alloy Steel Deformed Bars for Concrete Reinforcement
ASTM C 33	(1993) Concrete Aggregates
ASTM C 94	(1994) Ready-Mixed Concrete
ASTM C 143	(1990; Rev. A) Slump of Hydraulic Cement Concrete
ASTM C 150	(1994) Portland Cement
ASTM C 171	(1992) Sheet Materials for Curing Concrete

ASTM C 172	(1990) Sampling Freshly Mixed Concrete
ASTM C 173	(1993) Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C 231	(1991; Rev. B) Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 260	(1986) Air-Entraining Admixtures for Concrete
ASTM C 309	(1993) Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 494	(1992) Chemical Admixtures for Concrete
ASTM C 595	(1994) Blended Hydraulic Cements
ASTM C 618	(1994) Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
ASTM C 920	(1987) Elastomeric Joint Sealants
ASTM C 989	(1993) Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
ASTM C 1107	(1991; Rev. A) Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM D 1190	(1974; R 1980) Concrete Joint Sealer, Hot-Poured Elastic Type
ASTM D 1751	(1983; R 1991) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	(1984; R 1992) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D 4397	(1991) Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications

CORPS OF ENGINEERS (COE)

COE CRD-C-572	(1974) Polyvinylchloride Waterstop

1.2 MODIFICATION OF REFERENCES

Accomplish work in accordance with ACI publications, except as modified by this section. Consider the advisory or recommended provisions to be mandatory, as though the word "shall" had been substituted for the words

"should" or "could" or "may," wherever they appear. Interpret reference to the "Building Official," the "Structural Engineer," and the "Architect/Engineer" to mean the NTR.

1.3 DELIVERY, STORAGE, AND HANDLING

Do not deliver concrete until ready for concrete placement. Store concrete aggregates to prevent contamination or segregation. Store reinforcement of different sizes and shapes in separate piles or racks raised above the ground to avoid excessive rusting. Protect from contaminants such as grease, oil, and dirt. Provide for accurate identification after bundles are broken and tags removed.

PART 2 PRODUCTS

2.1 CONCRETE

2.1.1 Contractor Mix Design

ACI 301, except as modified herein. Unless indicated otherwise, concrete shall have a 28-day compressive strength of 4000 psi. Slump shall be between 2 and 4 inches in accordance with ASTM C 143. Provide ASTM C 33 aggregate Size No. 57 and 4 to 6 percent air entrainment for concrete exposed to freeze-thaw conditions. Accomplish air-entrainment using an air-entraining admixture.

2.1.2 Ready-Mixed Concrete

ASTM C 94, except 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.

2.2 MATERIALS

2.2.1 Cement

ASTM C 150, Type I.

2.2.2 Water

Water shall be potable.

2.2.3 Aggregates

ASTM C 33. Obtain aggregates for exposed concrete surfaces from one source. Aggregates shall not contain any substance which may be deleteriously reactive with the alkalies in the cement.

2.2.4 Admixtures

ASTM C 260 for air-entrained concrete. ASTM C 494 for water reducing (Type A, D, or E), accelerating (Type C), and retarding (Type B or D), to be used only when approved. Calcium chloride shall not be used as an admixture.

2.2.5 Reinforcement

2.2.5.1 Reinforcing Bars

ASTM A 615/A 615M, Grade 60.

2.2.5.2 Welded Wire Fabric

ASTM A 497 or ASTM A 185, 6 by 6 inches, W2.9 by W2.9, unless otherwise indicated.

2.2.6 Materials for Curing Concrete

2.2.6.1 Impervious Sheeting

ASTM C 171; waterproof paper, clear or white polyethylene sheeting, or polyethylene-coated burlap.

2.2.6.2 Liquid Membrane-Forming Compound

ASTM C 309, white-pigmented, Type 2, Class B. Do not use where finished appearance is important. Only use where approved.

2.2.6.3 Liquid Chemical Sealer-Hardener Compound

Compound shall be magnesium fluosilicate which when mixed with water seals and hardens the surface of the concrete. Do not use on exterior slabs exposed to freezing conditions. Compound shall not reduce the adhesion of resilient flooring, tile, paint, roofing, waterproofing, or other material applied to concrete.

2.2.7 Expansion-Joint Filler

ASTM D 1751 or ASTM D 1752, 1/2 inch thick, unless otherwise indicated.

2.2.8 Joint Sealant

2.2.8.1 Horizontal Surfaces (3 percent slope, maximum)

a. Outside Buildings: ASTM D 1190.

b. Inside Buildings: ASTM D 1190.

2.2.8.2 Vertical Surfaces (greater than 3 percent slope)

ASTM C 920, Type M, Grade NS, Class 25, Use T.

2.2.9 Polyvinylchloride Waterstops

COE CRD-C-572.

2.2.10 Nonshrink Grout

ASTM C 1107.

PART 3 EXECUTION

3.1 FORMS

ACI 301. Set forms true to line and grade and make mortar-tight. Chamfer above grade exposed joints, edges, and external corners of concrete 3/4 inch, unless otherwise indicated. Before concrete placement, coat the contact surfaces of forms with a nonstaining form coating compound. Do not use mineral oil on formed surfaces to be painted. Prevent concrete damage during form removal. Concrete for footings may be placed in excavations without forms upon inspection and approval by the NTR. Excavation width shall be a minimum of 4 inches greater than finished dimensions indicated.

3.2 PLACING REINFORCEMENT AND MISCELLANEOUS MATERIALS

ACI 301. Provide bars, wire fabric, and other reinforcing materials, including wire ties, supports, and other devices necessary to install and secure the reinforcement.

3.2.1 Cover and Splicing

ACI 301, unless otherwise indicated.

3.2.2 Setting Miscellaneous Material

Place and secure anchors and bolts, pipe sleeves, conduits, and other such items in position before concrete placement. Plumb anchor bolts and check location and elevation. Temporarily fill voids in sleeves with readily removable material to prevent the entry of concrete.

3.2.3 Construction Joints

ACI 301. Continue reinforcement across joints, unless otherwise indicated.

3.2.4 Expansion Joints and Contraction Joints

ACI 301. For slabs on grade, provide at edges of interior floor slabs, adjacent to walls, and as indicated. Make expansion joints 0.5 inch wide and 0.25 slab thickness deep, except as indicated otherwise. Fill expansion joints not exposed to weather with preformed joint material. Seal joints exposed to weather with joint sealant. Do not extend reinforcement or other embedded metal items bonded to the concrete through any expansion joint, unless an expansion sleeve is used. Provide contraction joints, either formed or saw cut or cut with a jointing tool to the indicated depth after the surface has been finished. Sawed joints shall be completed within 4 to 12 hours after concrete placement. Protect joints from intrusion of foreign matter.

3.3 MEASURING, MIXING, TRANSPORTING, AND PLACING CONCRETE

ACI 304R, except as modified herein. ASTM C 94; machine mix concrete and provide mandatory batch ticket information for each load of ready mix concrete. Begin mixing within 30 minutes after the cement has

been added to the aggregates. Place concrete within 90 minutes of either addition of mixing water to cement and aggregates or addition of cement to aggregates if the air temperature is less than 85 degrees F. Reduce mixing time to 60 minutes if the air temperature is greater than 85 degrees F. Additional water may be added, provided that both the specified maximum slump and water-cement ratio are not exceeded. 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. Do not place concrete when weather conditions prevent proper placement and consolidation; in uncovered areas during periods of precipitation; or in standing water. Prior to placing concrete, remove dirt, construction debris, and water , snow, and ice from within the forms. Consolidate concrete slabs greater than 4 inches depth with high frequency, internal, mechanical vibrating equipment supplemented by hand spading and tamping. Consolidate concrete slabs 4 inches or less in depth by tamping, spading, and settling with a heavy leveling straight edge.

3.3.1 Cold Weather

ACI 306.1. Provide and maintain 50 degrees F minimum concrete temperature. Do not place concrete when the ambient temperature is below 40 degrees F. Cover concrete and provide with a source of heat sufficient to maintain 50 degrees F minimum while curing.

3.3.2 Hot Weather

ACI 305R. Concrete temperature from initial mixing through final cure shall not exceed 90 degrees F. Cool ingredients before mixing, or substitute chip ice for part of required mixing water or use other suitable means to control concrete temperature to prevent rapid drying of newly placed concrete. Shade the fresh concrete and start curing as soon as the surface of the fresh concrete is sufficiently hard to permit curing without damage.

3.4 SURFACE FINISHES

ACI 301 for repair and finish, unless otherwise specified. Slope floors uniformly to drains where drains are provided. After troweling is completed, apply a liquid chemical sealer-hardener to interior slabs that do not receive floor covering.

3.4.1 Defects

Repair formed surfaces by removing minor honeycombs, pits greater than 1 square inch surface area or 0.25 inch maximum depth, or otherwise defective areas. Provide edges perpendicular to the surface and patch with nonshrink grout. Patch tie holes and defects when the forms are removed. Concrete with extensive honeycomb (including exposed steel reinforcement, cold joints, entrapped debris, separated aggregate, or other defects) which affect the serviceability or structural strength will be rejected, unless correction of defects is approved. Obtain approval of corrective action prior to repair. The surface of the concrete shall not vary more than the allowable tolerances of ACI 301. Exposed surfaces shall be uniform in appearance and finished to a smooth form finish,

unless otherwise specified.

3.4.2 Floated Finish

Place, consolidate, and immediately strike off concrete to obtain proper contour, grade, and elevation before bleedwater appears. Permit concrete to attain a set sufficient for floating and supporting the weight of the finisher and equipment. If bleedwater is present prior to floating the surface, drag the excess water off or remove by absorption with porous materials. Do not use dry cement to absorb bleedwater. Surface shall be level to within 1/4 inch in 10 feet where floor drains are not provided.

3.4.3 Steel Troweled Finish

First, provide a floated finish. When slab has attained a proper set, trowel to a smooth, hard, dense finish. Finished surfaces shall be free of trowel marks, uniform in texture, flat within 0.01 foot (approximately 1/8 inch) in 10 feet. Hand-finish portions of the slab not accessible to power finishing equipment (e.g., edges, corners) to match the remainder of the slab. Power trowel once and finally hand trowel where a finished floor covering (e.g., tile, carpet) is specified. Power trowel twice and finally hand trowel for exposed concrete floors.

3.4.4 Broomed Finish

Provide for exterior walks, platforms, patios, and ramps, unless otherwise indicated. Provide a floated finish, then finish with a flexible bristle broom. Permit surface to harden sufficiently to retain the scoring or ridges. Broom transverse to traffic or at right angles to the slope of the slab.

3.4.5 Pavement Finish

Screed the concrete with a template advanced with a combined longitudinal and crosswise motion. Maintain a slight surplus of concrete ahead of the template. After screeding, float the concrete longitudinally. Use a straight edge to check slope and flatness; correct and refloat as necessary. Obtain final finish by dragging a strip of clean, wet burlap from 3 to 10 feet wide and 2 feet longer than the pavement width across the slab. Produce a fine, granular, or sandy textured surface without disfiguring marks. Round edges and joints with an edger having a radius of 1/4 inch.

3.5 MISCELLANEOUS CONSTRUCTION

3.5.1 Concrete Walks

Provide 4 inches thick minimum unless noted otherwise. Provide contraction joints spaced every 5 linear feet, unless otherwise indicated. Cut contraction joints one inch deep minimum or 0.25 of slab thickness with a jointing tool after the surface has been finished. Provide 0.5 inch thick transverse expansion joints at changes in direction, where sidewalk abuts curb, steps, rigid pavement, or other similar structures; space joints not more than 50 feet apart. Provide a transverse slope of 1/48 unless

indicated otherwise. Limit variation in cross section to 1/240.

3.5.2 Pits and Trenches

Place bottoms and walls monolithically or provide waterstops and keys.

3.5.3 Curbs and Gutters

Provide contraction joints spaced every 10 feet maximum, unless otherwise indicated. Cut contraction joints 3/4 inch deep with a jointing tool after the surface has been finished. Provide expansion joints 1/2 inch thick and spaced every 100 feet maximum, unless otherwise indicated. Provide a broom finish.

3.5.4 Splash Blocks

Provide at outlets of downspouts emptying at grade. Splash blocks shall be precast concrete, 24 inches long, 12 inches wide, and 4 inches thick, unless otherwise indicated, with smooth-finished countersunk dishes sloped to drain away from the building. Provide compacted earth base.

3.6 CURING AND PROTECTION

ACI 301. Protect concrete from injurious action by sun, rain, wind, flowing water, frost, mechanical injury, tire marks, and oil stains. Do not allow concrete to dry out from time of placement until the expiration of the curing period. Forms may be removed 48 hours after concrete placement.

3.6.1 Moist Curing

Provide for the removal of water without erosion or damage to the structure.

3.6.1.1 Ponding or Immersion

Continually immerse the concrete throughout the curing period. Water temperature shall not be more than 20 degrees F less than the temperature of the concrete. For temperature between 40 and 50 degrees F, increase the curing period by 50 percent.

3.6.1.2 Fog Spraying or Sprinkling

Provide uniform and continuous application of water throughout the curing period. For temperatures between 40 and 50 degrees F, increase the curing period by 50 percent.

3.6.1.3 Pervious Sheeting

Cover the entire surface of the concrete with two thicknesses of wet sheeting. Mats shall be at least as long as the width of the surface to be cured. During application, do not drag the mats over the finished concrete nor over mats already placed. Completely cover surface and edges of the concrete, with a 6 inch overlap over adjacent mats. Wet mats thoroughly and keep continuously wet throughout the curing period.

3.6.2 Impervious-Sheeting Curing

Wet the entire exposed surface thoroughly with a fine spray of water and cover with impervious sheeting throughout the curing period. Lay sheeting directly on the concrete surface and overlap edges 12 inches minimum. Provide sheeting not less than 18 inches wider than the concrete surface to be cured. Secure edges and transverse laps to form closed joints. Repair torn or damaged sheeting or provide new sheeting.

3.6.3 Liquid Membrane-Forming Compound Curing

Seal or cover joint openings prior to application of curing compound. Prevent curing compound from entering the joint. Provide and maintain compound on the concrete surface throughout the curing period. Provide a continuously wetted, permeable cover as specified in paragraph entitled, "Hot Weather."

3.6.3.1 Application

Unless the manufacturer recommends otherwise, apply compound immediately after the surface loses its water sheen and has a dull appearance, and before joints are sawed. Mechanically agitate curing compound thoroughly during use. Use approved power-spraying equipment to uniformly apply two coats of compound in a continuous operation. The total coverage for the two coats shall be 200 square feet maximum per gallon of undiluted compound, unless otherwise recommended by the manufacturer's written instructions. The compound shall form a uniform, continuous, coherent film that will not check, crack, or peel. Immediately apply an additional coat of compound to areas where the film is defective. Respray concrete surfaces subjected to rainfall within 3 hours after the curing compound application.

3.6.3.2 Protection of Treated Surfaces

Prohibit foot and vehicular traffic and other sources of abrasion for not less than 72 hours after compound application. Maintain continuity of the coating for the entire curing period and immediately repair any damage.

3.6.4 Liquid Chemical Sealer-Hardener Curing

Provide for interior floors that do not receive a floor covering, or in lieu of liquid membrane-forming compound curing for other surfaces. Apply sealer-hardener in accordance with manufacturer's recommendations. Seal or cover joints and openings in which joint sealant is to be applied, as required by the joint sealant manufacturer.

3.6.5 Curing Periods

Allow 7 days.

3.7 SAMPLING AND TESTING

3.7.1 Sampling

ASTM C 172. Collect samples of fresh concrete to perform tests specified.

3.7.2 Testing

3.7.2.1 Slump Tests

ASTM C 143. Take samples during concrete placement. The maximum slump may be increased as specified with the addition of an approved admixture provided that the water-cement ratio is not exceeded. Perform tests at commencement of concrete placement and for each batch (minimum) or every 10 cubic yards (maximum) of concrete.

3.7.2.2 Air Content

ASTM C 173 or ASTM C 231. Test air-entrained concrete for air content at the same frequency as specified for slump tests.

3.7.2.3 Compressive Strength

For footings, walls, interior, and exterior slabs, take four compressive cylinder tests for each 25 cubic yards of concrete or fraction thereof in accordance with ACI 301 for each of these areas. Break two cylinders at 7 days and two at 28 days.

-- End of Section --

SECTION 04200

UNIT MASONRY

03/95

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 82	(1990; Rev. A) Steel Wire, Plain, for Concrete Reinforcement
ASTM A 90/A 90M	(1993) Weight Mass of Coatings on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings
ASTM A 153	(1982; R 1987) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 167	(1994) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 615/A 615M	(1993) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 616/A 616M	(1993) Rail-Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM B 370	(1992) Copper Sheet and Strip for Building Construction
ASTM C 27	(1993) Fireclay and High-Alumina Refractory Brick
ASTM C 55	(1993; Rev. A) Concrete Building Brick
ASTM C 62	(1992; Rev. C) Building Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C 67	(1993; Rev. A) Sampling and Testing Brick and Structural Clay Tile
ASTM C 73	(1985; R 1989) Calcium Silicate Face Brick (Sand-Lime Brick)
ASTM C 90	(1993) Load-Bearing Concrete Masonry Units

ASTM C 91	(1993) Masonry Cement
ASTM C 129	(1993) Non-Load-Bearing Concrete Masonry Units
ASTM C 144	(1993) Aggregate for Masonry Mortar
ASTM C 150	(1994) Portland Cement
ASTM C 207	(1991; R 1992) Hydrated Lime for Masonry Purposes
ASTM C 216	(1992; Rev. D) Facing Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C 270	(1994) Mortar for Unit Masonry
ASTM C 315	(1991) Clay Flue Linings
ASTM C 476	(1991) Grout for Masonry
ASTM C 568	(1991) Limestone Building Stone Standard
ASTM C 1072	(1993) Masonry Flexural Bond Strength
ASTM E 514	(1990) Water Penetration and Leakage Through Masonry

INDIANA LIMESTONE INSTITUTE OF AMERICA, INC. (ILI), Latest Edition

1.2 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic Contract.

1.2.1 SD-02, Manufacturer's Catalog Data

a. Masonry accessories

b. Reinforcement

c. Flashing

Submit for each type.

1.2.2 SD-04, Drawings

a. Reinforcing steel

1. Joint reinforcing
2. Structural reinforcing

1.2.2.1 Drawing Requirements

Indicate splicing, laps, shapes, dimensions, and details of reinforcing steel and accessories. Include details of anchors, adjustable wall ties, positioning devices, bond beams, vertical wall and lintels. Do not scale drawings to determine lengths of bars.

1.2.3 SD-06, Instructions

a. Masonry cement

When masonry cement is used, submit the manufacturer's printed instructions on proportions of water and aggregates and on mixing to obtain the type of mortar required.

1.2.4 SD-11, Factory Test Reports

a. Efflorescence test

Submit efflorescence test reports on masonry units that are to be exposed to weathering.

1.2.5 SD-14, Samples

a. Masonry and stone units G

b. Mortar color G

Submit two sets of each type masonry and stone units, showing full range of color, texture, finish, and dimensions and two samples of each color of mortar.

1.3 QUALITY ASSURANCE

1.3.1 Appearance

Do not change source or supply of materials after work has started if the appearance of the finished work would be affected.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver cementitious materials to the site in unbroken 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. Store masonry and stone units off the ground and handle with care to avoid chipping and breakage. Protect materials from damage and, except for sand, keep dry until used. Cover sand to prevent intrusion of water and foreign materials and to prevent drying. Do not use materials containing frost or ice. Store Type II, concrete masonry units at the site before using for a minimum of 28 days for air cured units, 10 days for atmospheric steam or water cured units, and 3 days for units cured with steam at a pressure of 120 to 150 psi and at a temperature of 350 to 365 degrees F for at least 5 hours.

1.5 ENVIRONMENTAL CONDITIONS

1.5.1 Cold Weather Construction

When the air temperature is below 40 degrees F and falling, or when it appears that the air temperature will drop to 40 degrees F or below within 24 hours, do not lay masonry unless the work is protected from freezing as specified below. Surfaces receiving mortar shall be free of ice and frost. 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.

1.5.2 Cold Weather Protection

Protect newly laid masonry as specified below for the respective mean daily air temperature (MDAT), that is, the average of the daytime high temperature and the forecasted nighttime low temperature.

a. MDAT 40 to 32 Degrees F: Protect masonry from rain and snow by covering the top 4 feet with weather-resistive membrane for 24 hours after laying.

b. MDAT 32 to 25 Degrees F: Completely cover newly-laid masonry with weather-resistive membrane for 24 hours.

c. MDAT 25 to 20 Degrees F: Completely cover newly-laid 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.

1.6 SCHEDULING

Coordinate masonry work with the work of other trades to accommodate built-in items and to avoid cutting and patching.

PART 2 PRODUCTS

2.1 MASONRY UNITS

2.1.1 Limestone Units

ASTM C 568; Classification III, Indiana Oolitic Limestone, Size as shown on drawings. Color, gray, Grade-standard, as determined by the Indiana Limestone Institute. Cut and drill sinkages and holes in stone for anchors, fasteners, as indicated to set stone securely in place.

2.1.2 Facing Brick

ASTM C 216, Grade SW, Type FBS, 3 5/8 inches thick, 2 1/4 inches high, and 7 5/8 inches long (modular). Color, texture, and range of facing brick shall match the brick as selected. Brick color shall be as selected by COMNAVBASE and Code 401.

2.1.3 Concrete Masonry Units

Exposed surfaces of units shall be smooth (except split faced units) and of uniform texture. Exterior concrete masonry split faced units shall have water-repellant admixture added during manufacture. Color of split faced units shall be as selected by COMNAVBASE and Code 401.

a. Hollow Load-Bearing Units: ASTM C 90, Type I or II, made with normal weight aggregate. Provide load-bearing units for exterior walls, foundation walls, load-bearing walls, and shear walls.

b. Solid Load-Bearing Units: ASTM C 90, Type I or II, and made with normal weight aggregates. Provide solid units for masonry bearing under structural framing members unless indicated otherwise.

c. 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.

2.2 MORTAR

2.2.1 Portland Cement

ASTM C 150, Type I.

2.2.2 Hydrated Lime

ASTM C 207, Type S.

2.2.3 Masonry Cement

ASTM C 91, except that for masonry cement provided for mortar for exterior walls, 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. Air content shall not be less than 11 percent.

2.2.7 Pre-Mixed Mortar

ASTM C 270. Type S, compressive strength of 1800 psi in 28 days. Air content shall not be less than 11 percent. Admixtures may be provided in mortar to retard curing and provide up to 36 hours of workability, as long as the admixture does not adversely affect bonding or compressive strength.

2.2.8 Grout

ASTM C 476 having a slump between 8" and 11" and a compressive 28 day strength of not less than 2,000 psi. Fine aggregate grout shall be used except course aggregate may be used during cold weather construction.

2.3 MASONRY ACCESSORIES

2.3.1 Horizontal Joint Reinforcement

Fabricate from cold drawn steel wire, ASTM A 82. Wire shall be hot-dipped galvanized after fabrication in accordance with ASTM A 153 Class B-2, 1.5 oz. of zinc per square foot. Reinforcement shall be truss type with two or more longitudinal wires welded to a continuous diagonal cross wire, or ladder type with perpendicular cross wires not more than 16 inches o.c. Provide flat sections 10 feet long, and preformed corners and tees approximately 30 inches long. Overall width shall be approximately 2 inches less than nominal thickness of wall.

2.3.1.1 Single-Wythe

For single-wythe walls and partitions, provide two 9 gage 0.1483 inch longitudinal wires and 9 gage cross wires.

2.3.1.2 Cavity Walls

For cavity walls, provide vertically adjustable ladder type consisting of two 9 gage (0.1483 inch) 3/16 inch longitudinal wires for the inner wythe, 3/16 inch cross wires either winged loop or eye-section receivers, and 3/16 inch wire hook type box ties or rectangular pintle ties at not more than 16 inches o.c. Pintles shall have two vertical legs. Maximum play between pintles and eyes shall be 1/16 inch. Maximum vertical misalignment between bed joints of brick and the joint reinforcement shall be 1.25 inches.

Provide one tie for every 1.78 square feet of wall area, 16 inches o.c. both ways. The above requirements are minimums. Refer to the structrual drawings for brick to block tie lateral load requirements.

2.3.2 Anchors and Wall Ties

Provide approved designs of stainless steel, zinc-coated steel, or noncorrosive metal having the equivalent total strength of steel types. Zinc coat steel 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 90M.

a. Corrugated metal ties: Not less than 7/8 inch wide by approximately 7 inches long and not lighter than 22 gage.

b. Rigid steel anchors: Not less than 1 inch 1 1/2 inches wide, 3/16 1/4 inch thick, and 18 24 inches long with each end bent not less than 2 inches.

c. Steel: Cold formed, ASTM A 666, Type 304, stainless.

2.3.3 Fastenings

Build in bolts, metal wall plugs, and other metal fastenings furnished under other sections for securing furring and other items.

2.3.4 Reinforcing Bars

ASTM A 615/A 615M or ASTM A 616/A 616M, Grade 60.

2.3.5 Through-Wall Flashing

Provide one of the following types except that flashing indicated to terminate in reglets shall be metal or coated-metal flashing and except that the material shall be one which is not adversely affected by dampproofing material.

a. Coated-Copper Flashing: 7 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. Copper or Stainless Steel Flashing: Copper, ASTM B 370, minimum 16 ounce weight; stainless steel, ASTM A 167, Type 301, 302, 304, or 316, 0.015 inch thick, 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.

2.3.6 Weep Holes

Fiberglass, 1/4 inch in diameter, each piece cut in length and placed such as to permit positive flow of collected moisture. Weep hole spacing shall

be as follows:

a.	Open Head Joints	32 inches o.c.
b.	Wall Base	16 inches o.c.
c.	Door and Louvers	16 inches o.c.

2.4 SOURCE QUALITY CONTROL

2.4.1 Efflorescence Test

Conduct efflorescence tests on masonry units that are to be exposed to weathering. Schedule tests far enough in advance of starting masonry work to permit retesting if necessary. 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.

PART 3 EXECUTION

3.1 PREPARATION

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.

c. Provide temporary bracing as required.

3.1.2 Surface Preparation

Surfaces on which masonry is to be placed shall be smooth, clean, and free of foreign substances when mortar is applied.

3.2 WORKMANSHIP

Carry masonry up level and plumb. Furnish and use story poles or gage rods 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 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 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 and where necessary. Cover tops of exposed walls and partitions not being worked on with a waterproof membrane secured in place and extended down at least 2 feet on both sides. Set stone to comply with requirements indicated on Drawings and approved Shop Drawings. Inspect scaffolding regularly to ensure that it is amply strong, well braced, and securely tied in position. Do not overload scaffolding.

3.3 MORTAR MIXING

Measure mortar materials in 1 cu. ft. containers to maintain control and accuracy of proportions. Do not measure materials with shovels. Mix mortar in a mechanical batch mixer for not less than 3 nor more than 5 minutes after all ingredients are in so as to produce a uniform mixture. Add water gradually as required to produce a workable consistency. Do not load mixer beyond its rated capacity. Keep mortar boxes, pans, and mixer drums clean and free of debris and dried mortar. Retemper mortar which has stiffened because of evaporation by adding water and mixing to obtain a workable consistency. Do not use or retemper mortar which has not been placed in final position within 2 1/2 hours after the initial mixing. Do not use antifreeze compounds, salts, or other substances to lower the freezing point of mortar.

a. Mortar: Mix mortar in accordance with ASTM C 270 to obtain type mortar required. Where colored mortars are required, pigments may be added at the site or provided as part of prepackaged mortar mix. When masonry cement is provided, conform to masonry cement manufacturer's printed mixing instructions. During mixing, add water-repellant admixture in quantity recommended by the admixture manufacturer to mortar which will be used in exterior concrete masonry unit walls.

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.

3.4 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. For horizontal joints, jointers shall be at least 12 inches long for brickwork and 16 inches long for concrete masonry. Jointers shall be 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 vertical joints first. Brush joints to remove all loose and excess mortar. 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.

3.5 TOLERANCES

Masonry work shall be within the following limits:

a. Face of Brick: 1/32 inch from face of adjacent brick.

b. Face of Concrete Masonry Unit: 1/16 inch from face of adjacent unit.

c. Variation From True Plane: 1/4 inch in 10 feet and 1/2 inch maximum in 20 feet or more.

d. Variation From Plumb: 1/4 inch in each story, noncumulative and 1/2 inch maximum in two stories or more.

e. Variation From Level: 1/8 inch in 3 feet, 1/4 inch in 10 feet, and 1/2 inch maximum.

f. Variation in Wall Thickness: Plus or minus 1/4 inch.

3.6 BRICKWORK

Provide brickwork that conforms to requirements of paragraph entitled "Tolerances" of this section. Select and place brick so that better face of stretchers and headers is exposed.

3.6.1 Testing

Except during cold weather, as defined under paragraph entitled "Environmental Conditions," 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. Ensure that each brick is nearly saturated, but surface dry when laid. During cold weather, keep masonry units dry until laid.

3.6.2 Application

Unless indicated or specified otherwise, lay brick in running bond. Completely fill joints between bricks with mortar. Form bed joints of a thick layer of mortar slightly furrowed. Form head joints by applying a full coat of mortar on the brick to be laid. Slushing of head joints will not be permitted. Lay closure bricks with mortar on each bedding surface of unit to be laid and units in place. Place brick carefully without disturbing brick previously laid. Dry or butt joints will not be permitted. Provide grouting as specified.

3.6.3 Cavity Walls

Provide a continuous cavity as indicated. Securely tie the two wythes together with horizontal joint reinforcement. Bevel mortar beds away from cavity to prevent projection into cavity when blocks are shoved in place. Keep cavities clear and clean of mortar droppings. At the bottom of cavity

walls, in the course immediately above the through-wall flashing, temporarily omit one block every 4 feet. With a hose and clean water, wash all mortar droppings and debris out of the cavity through the temporary openings at least twice each day masonry is laid, and more often when required to keep the cavities clean. Fill in the openings with blocks and mortar after the wall is complete and the cavity has been inspected and found clean. Provide weep holes of open head joints as indicated. Cavity face of interior wythe shall be dampproofed in accordance with Section 07160, "Bituminous Dampproofing."

3.7 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 mortar to entire top surfaces of inner and outer face shells. Form head joints by applying mortar for a width of about one inch to ends of adjoining units. Mortar shall be of such thickness that it will be forced out of the joints as the units are 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 cells with mortar or grout as work progresses. Provide 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.

3.7.1 Reinforced Concrete Masonry Unit Walls

Where vertical reinforcement occurs, fill cores solid with grout. Lay units in such a manner as to preserve the unobstructed vertical continuity of cores to be filled. Embed the adjacent webs in mortar to prevent leakage of grout. Remove mortar fins protruding from joints before placing grout. Minimum clear dimensions of vertical cores shall be 2 by 3 inches. Position reinforcing accurately as indicated before placing grout. As masonry work progresses, secure vertical reinforcing in place at vertical intervals not to exceed 160 bar diameters. Use puddling rod or vibrator to consolidate the grout. Minimum clear distance between masonry and vertical reinforcement shall be not less than 1/2 inch. Unless indicated or specified otherwise, form splices by lapping bars not less than 48 bar diameters and wire tying them together.

3.8 STONE WORK

Set stone to comply with requirements indicated on Drawings and Shop Drawings. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure dimension stone coping in place. Shim and adjust anchors, supports, and accessories to set stone accurately in locations indicated with uniform joints of widths indicated and with edges and faces aligned according to established relationships and indicated tolerances.

3.9 THROUGH-WALL FLASHING

Provide as indicated. Unless indicated otherwise, extend flashing from a point 1/4 inch outside of exterior face of walls, upward across wall cavity

not less than 6 inches and into mortar of bed joint for backing wythe. Bend down exterior edge to form a drip. 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 as indicated. 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 ensure watertight construction. Provide dams at ends of flashing where masonry abuts concrete and where flashing ends within the masonry.

3.10 WEEP HOLES

Wherever through-wall flashing occurs, provide weep holes to drain flashing to exterior. Weep holes shall be open head joints at 32 inches o.c. at wall base and 16 inches o.c. at door and louver lintel locations.

3.11 HORIZONTAL JOINT REINFORCEMENT

Provide reinforcement in every other course and in the first two courses above and below openings in walls 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 6 inches. Provide welded L-shaped assemblies and welded T-shaped assemblies to match the straight reinforcement, at corners and intersections of walls and partitions. Provide mortar cover for the wire of at least 5/8 inch for exterior face of wall and 1/2 inch for interior face of wall.

3.12 GROUT PLACEMENT

Place grout from the interior side of walls, unless 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. Place grout by pumping or pouring from buckets equipped with spouts in lifts not exceeding 4 feet. Keep pours at 1 1/2 inches below top of masonry units in top course, except at finish course. Puddle or agitate grout thoroughly to eliminate voids. Remove masonry displaced by grouting operation and re-lay in alignment with fresh mortar.

3.13 FORMS AND SHORING

Construct to the shape, lines, and dimensions of members indicated. Prevent deflections which may result in cracking or other damage to supported masonry. Do not remove until members have cured.

3.14 CLEANING

3.14.1 Protection

During cleaning operations, protect work which may be damaged, stained, or discolored.

3.14.2 Pointing

Upon completion of masonry work and before cleaning, cut out defective mortar joints and tuck point joints and all holes solidly with prehydrated mortar.

3.14.3 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 scrubbing with warm water and detergent. Where soil still remains on brickwork, continue cleaning as follows: Thoroughly wet exposed surfaces of dark-colored brickwork with clear water and scrub with stiff fiber brushes and a solution of not more than 1 part of muriatic acid to 9 parts of water applied to an area of 15 to 20 square feet at a time. Clean light-colored brickwork surfaces with non-acid or buffered-acid cleaners as recommended by the brick manufacturer. Use cleaners in accordance with the instructions and recommendations of the brick and cleaner manufacturers. Immediately after cleaning each area, rinse thoroughly with clear water. Restore damaged, stained, and discolored work to original condition or provide new work.

3.14.4 Coping

Clean dimension stone coping not less than 6 days after completion of pointing and sealing, using clean water and stiff-bristle fiber brushes. Do not use wire brushes, acid-type cleaning agents, cleaning compounds with caustic or harsh fillers, or other materials or methods that could damage stone.

-- End of Section --

SECTION 05210

STEEL JOISTS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN WELDING SOCIETY, INC. (AWS)

AWS D1.1	(1994) Structural Welding Code Steel

STEEL JOIST INSTITUTE (SJI)

SJI SSLT	(1994) Standard Specifications and and Load Tables

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC PS 14.01	(1991) Steel Joist Shop Painting System

1.2 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic Contract.

1.2.1 SD-04, Drawings

a. Steel joist structure

1.2.1.1 Drawing Requirements

Submit steel joist structure drawings. Show joist type and size, layout in plan, and erection details including methods of anchoring, framing at openings, type and spacing of bridging, requirements for field welding, and details of accessories as applicable. Indicate joist loads including net wind up-lift loads on each joist.

1.2.2 SD-08, Statements

a. Welder qualification

1.2.2.1 Requirements

Prior to welding, submit certification for welder qualification, welding operation, and tacker, stating the type of welding and positions qualified for, the code and procedure qualified under, date qualified, and the firm and individual certifying the qualification tests.

1.2.3 SD-12, Field Test Reports

a. Erection inspection

b. Welding inspections

1.3 DELIVERY AND STORAGE

Handle, transport, and store joists and joist girders in a manner to prevent damage affecting their structural integrity. Store all items off the ground in a well drained location protected from the weather and easily accessible for inspection and handling.

PART 2 PRODUCTS

2.1 JOISTS AND ACCESSORIES

SJI SSLT for the joist series indicated.

2.2 PAINTING

2.2.1 Shop Painting

Clean and prime joists in accordance with SSPC PS 14.01, Steel Joist Shop Painting System, using only Type I, "Red Oxide Paint." Apply two coats with a 3 mil dry film thickness per coat (min).

2.2.2 Paint

Paints used for touch up 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.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Handling and Erection

SJI SSLT for the joist series indicated.

3.1.2 Welding

AWS D1.1.

3.2 PAINTING

3.2.1 Touch-Up Painting

After erection of joists touch-up connections and areas of abraded shop coat with paint of the same type used for the shop coat.

3.3 VISUAL INSPECTIONS

3.3.1 Erection Inspection

AWS D1.1, Section 6. Perform erection inspection and field welding inspections with AWS certified welding inspectors. Welding inspectors shall visually inspect and mark welds.

-- End of Section --

SECTION 05310

STEEL DECKS

03/95

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI SG-673	(1989; Errata 1990) Cold-Formed Steel Design Manual

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 446/A 446M	(1993) Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality
ASTM A 525	(1991; Rev. B) Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
ASTM A 611	(1992) Steel, Sheet, Carbon, Cold-Rolled, Structural Quality
ASTM A 780	(1993) Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A 792	(1993; Rev. A) Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
ASTM C 423	(1990; Rev. A) Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method

AMERICAN WELDING SOCIETY, INC. (AWS)

AWS D1.1	(1994) Structural Welding Code Steel
AWS D1.3	(1989) Structural Welding Code - Sheet Steel

FACTORY MUTUAL ENGINEERING AND RESEARCH CORPORATION (FM)

FM P7825	(1994) Approval Guide
FM D/S1-28	(1991) Insulated Steel Deck

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1993) National Electrical Code

STEEL DECK INSTITUTE (SDEI)

SDEI DMCDFDRD	(1992; Number 28) Design Manual for Composite Decks, Form Decks and Roof Decks
SDEI MCSD	(1992) Manual of Construction with Steel Deck
SDI P1	1987 Deck Damage and Penetration

UNDERWRITERS LABORATORIES INC. (UL)

UL BMD	(1993) Building Materials Directory
UL 209	(1987; R 1992) Cellular Metal Floor Raceways and Fittings
UL 580	(1988; R 1989) Uplift Resistance of Roof Assemblies

1.2 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic Contract.

1.2.1 SD-02, Manufacturer's Catalog Data

a. Accessories

1.2.2 SD-04, Drawings

a. Layout

1.2.2.1 Layout Drawings

Show location of units, location and sequence of connections, bearing on supports, methods of anchoring, attachment of accessories, adjusting plate details, size and location of holes to be cut and reinforcement to be provided, and other pertinent details.

1.2.3 SD-05, Design Data

a. Deck units

Submit manufacturer's design calculations, or applicable published literature for the structural properties of the proposed deck units.

1.2.4 SD-08, Statements

a. Qualification of welders

1.2.5 SD-13, Certificates

a. Fire safety

b. Wind storm resistance

1.3 QUALITY ASSURANCE

1.3.1 Steel Deck

Deck and accessories shall be products of a manufacturer regularly engaged in manufacture of steel decking.

1.3.2 Qualification of Welders

Provide welder qualification procedures, welder qualifications, and duration of qualification period in accordance with AWS D1.1 and AWS D1.3.

1.3.3 Regulatory Requirements

1.3.3.1 Fire Safety

Roof deck shall have been tested as a part of a roof deck construction assembly of the type used for this project, shall be listed as fire classified in the UL BMD, or listed as Class I construction in the FM P7825, and so labeled.

1.3.3.2 Wind Storm Resistance

The roof construction assembly shall be capable of withstanding an uplift pressure of 110 pounds per square foot when tested in accordance with the uplift pressure test described in the FM D/S1-28 or as described in UL 580.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver, store and handle steel deck in a manner to protect it from corrosion, deformation, and other types of damage. Do not use decking for storage or as working platform until units have been fastened into position. Exercise care not to damage material or overload decking during construction. The maximum uniform distributed storage load shall not exceed the design live load. Stack decking on platforms or pallets and cover with weathertight ventilated covering. Elevate one end during storage to provide drainage. Maintain deck finish at all times to prevent formation of rust. Replace damaged material.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Steel Sheet

Flat rolled carbon steel sheets of structural quality, thickness not less than 0.034 inch before coating, meeting the requirements of AISI

SG-673, except as modified herein.

2.1.2 Steel Coating

ASTM A 525 designation G60 galvanized, or \ ASTM A 792 designation AZ55, aluminum-zinc alloy. Apply coating to both sides of sheet.

2.2 ACCESSORIES

Provide accessories of same material as deck, unless specified otherwise. Provide manufacturer's standard type accessories, as specified.

2.2.1 Adjusting Plates

Provide adjusting plates of same thickness and configuration as decking. Provide factory cut plates of predetermined size where possible.

2.2.2 End Closures

Fabricated of sheet metal by the deck manufacturer. Provide end closures minimum 0.034 inch thick to close open ends at parapets, end walls, eaves, and openings through deck.

2.2.3 Miscellaneous Accessories

Provide cant strips, fasteners, and other types of plates and closures as indicated or as necessary to complete the work. Provide accessories required for a finished installation.

2.3 FABRICATION

2.3.1 Deck Units

SDEI DMCDFDRD. Form non-cellular decking and accessories from ASTM A 446/A 446M coated steel sheets, Grade A (33,000 psi minimum yield strength). Provide deck units having the depth and the minimum structural properties indicated.

PART 3 EXECUTION

3.1 EXAMINATION

Prior to installation of decking units and accessories, examine worksite to verify that as-built structure will permit installation of decking system without modification.

3.2 INSTALLATION

Install steel deck units in accordance with approved shop drawings. Place units on structural supports, properly adjusted, leveled, and aligned at right angles to supports. Extend deck units over three or more supports unless absolutely impractical. Report inaccuracies in alignment or leveling to the NTR and make necessary corrections before permanently anchoring deck units. Locate deck ends over supports only. Lap roof deck a minimum of 2 inches. Do not use unanchored deck units as a work or

storage platform. Permanently anchor units placed by the end of each working day. Do not support suspended ceilings, light fixtures, ducts, utilities, or other loads by steel deck.

3.2.1 Attachment

Immediately after placement and alignment, and after correcting inaccuracies, permanently fasten steel deck units to structural supports and to adjacent deck units by welding. Clamp or weight deck units to provide firm contact between deck units and structural supports while performing welding. Attachment of adjacent deck units by button-punching is prohibited.

3.2.1.1 Welding

Perform welding in accordance with AWS D1.3 using methods and electrodes recommended by the manufacturers of the base metal alloys being used. Ensure only operators previously qualified by tests prescribed in AWS D1.1 and AWS D1.3 make welds. Location, size, and spacing of fastening shall conform to the recommendations of the Steel Deck Institute and the steel deck manufacturer. Immediately clean welds by chipping and wire brushing. Heavily coat welds, cut edges and damaged portions of coated finish with zinc-dust paint conforming to ASTM A 780. Immediately recertify, or replace with qualified welders, welders that have passed qualification tests but are producing unsatisfactory welding.

3.2.2 Openings

Reinforce and frame openings through the roof in conformance with SDI P1. Cut or drill holes or other openings required for work of other trades. Deck manufacturer shall approve holes or openings larger than 6 inches in diameter prior to drilling or cutting.

3.2.3 Deck Damage

SDEI MCSD, for repair of deck damage.

3.2.4 Accessory Installation

3.2.4.1 Adjusting Plates

Install as shown on shop drawings.

3.2.4.2 End Closures

Provide end closure to close open ends of cells at columns, walls, and openings in deck.

3.3 FIELD QUALITY CONTROL

3.3.1 Decks Not Receiving Concrete

Inspect the decking top surface for distortion after installation. For roof decks not receiving concrete, verify distortion by placing a straight edge across three adjacent top flanges. The maximum allowable gap between

the straight edge and the top flanges is 1/16 inch; when gap is more than 1/16 inch, provide corrective measures or replacement. Reinspect decking after performing corrective measures or replacement.

-- End of Section --

SECTION 05500

METAL FABRICATIONS

09/95

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

THE ALUMINUM ASSOCIATION, INCORPORATED (AA)

AA 45	(1980) Aluminum Finishes
AA 46	(1978) Anodized Architectural Aluminum

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC S303	(1992) Steel Buildings and Bridges
AISC S342L	(1993) Load and Resistance Factor Design Specification for Structural Steel Buildings
AISC S335	(1989) Structural Steel Buildings Allowable Stress Design and Plastic Design

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M	(1994) Carbon Structural Steel
ASTM A 47	(1990) Ferritic Malleable Iron Castings
ASTM A 48	(1994; Rev. A) Gray Iron Castings
ASTM A 53	(1994) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 123	(1989; Rev. A) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153	(1982; R 1987) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 307	(1994) Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
ASTM A 500	(1993) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

ASTM A 569/A 569M	(1991; Rev. A, R 1993) Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip Commercial Quality
ASTM A 653/A 653M	(1994) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 687	(1993) High-Strength Nonheaded Steel Bolts and Studs
ASTM A 780	(1993; Rev. A) Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A 786/A 786M	(1993; Rev. A) Rolled Steel Floor Plates
ASTM B 26/B 26M	(1992; Rev. A) Aluminum-Alloy Sand Castings
ASTM B 108	(1994) Aluminum-Alloy Permanent Mold Castings
ASTM B 209	(1993) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 221	(1993) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes
ASTM B 429	(1992; Rev. A) Aluminum-Alloy Extruded Structural Pipe and Tube
ASTM D 1187	(1995) Asphalt-Base Emulsions for Use as Protective Coatings for Metal

AMERICAN WELDING SOCIETY, INC. (AWS)

AWS D1.1	(1994) Structural Welding Code Steel

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910.27	Fixed Ladders

FEDERAL SPECIFICATIONS (FS)

FS TT-P-664	(Rev. D) Primer Coating, Alkyd, Corrosion-Inhibiting, Lead and Chromate Free, VOC-Compliant
FS RR-G-1602	(Rev. C) Grating, Metal, Other Than Bar Type (Floor, Except for Naval Vessels)

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM BG	(1988) Metal Bar Grating Manual

NAAMM PR (1995) Pipe Railing Manual

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101 (1994) Code for Safety to Life from Fire in Buildings and Structures

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC SP 3 (1989) Power Tool Cleaning

SSPC SP 6 (1991) Commercial Blast Cleaning

1.2 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic Contract.

1.2.1 SD-04, Drawings

a. Steel lintels, installation drawings

Submit fabrication drawings showing layout(s), connections to structural system, and anchoring details.

1.2.2 SD-13, Certificates

a. Primer certificate

1.2.2.1 Certificate

Submit a certificate from the manufacturer stating that the primer conforms to requirements of FS TT-P-664. Certify that the product has been tested and approved for inclusion in the Qualified Products List (QPL).

1.3 QUALIFICATION OF WELDERS

Qualify welders in accordance with AWS D1.1 using procedures, materials, and equipment of the type required for the work.

1.4 DELIVERY, STORAGE, AND PROTECTION

Protect from corrosion, deformation, and other types of damage. Store items in an enclosed area free from contact with soil and weather. Remove and replace damaged items with new items.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Structural Carbon Steel

ASTM A 36/A 36M.

2.1.2 Anchor Bolts

ASTM A 307. Where exposed, shall be of the same material, color, and finish as the metal to which applied.

2.1.2.1 Lag Screws and Bolts

ANSI B18.2.1, type and grade best suited for the purpose.

2.1.2.2 Toggle Bolts

ANSI B18.2.1.

2.1.2.3 Bolts, Nuts, Studs and Rivets

ASME/ANSI B18.2.2 and ASTM A 687 or ASTM A 307.

2.1.2.4 Powder Driven Fasteners

Follow safety provisions of ANSI A10.3.

2.1.2.5 Screws

ANSI B18.2.1, ANSI B18.6.2, and ANSI B18.6.3.

2.1.2.6 Washers

Provide plain washers to conform to ANSI B18.22.1. Provide beveled washers for American Standard beams and channels, square or rectangular, tapered in thickness, and smooth. Provide lock washers to conform to ANSI B18.21.1.

2.2 FABRICATION FINISHES

2.2.1 Galvanizing

Hot-dip galvanize items specified to be zinc-coated, after fabrication where practicable. Galvanizing: ASTM A 123, ASTM A 153 or ASTM A 653/A 653M, G90, as applicable.

2.2.2 Galvanize

Anchor bolts, grating fasteners, washers, and parts or devices necessary for proper installation, unless indicated otherwise.

2.2.3 Repair of Zinc-Coated Surfaces

Repair damaged surfaces with galvanizing repair method and paint conforming to ASTM A 780 or by the application of stick or thick paste material specifically designed for repair of galvanizing, as approved by the NTR. Clean areas to be repaired and remove the slag from the welds. Heat surfaces to which stick or paste material is applied, 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.

2.2.4 Shop Cleaning and Painting

2.2.4.1 Surface Preparation

Blast clean surfaces in accordance with SSPC SP 6. Surfaces that will be exposed in spaces above ceiling or in attic spaces, crawl spaces, furred spaces, and chases may be cleaned in accordance with SSPC SP 3 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. Steel to be embedded in concrete shall be free of dirt and grease. Do not paint or galvanize bearing surfaces, including contact surfaces within friction-type joints, but coat with rust preventative applied in the shop.

2.2.4.2 Pretreatment, Priming and Painting

Apply pretreatment, primer, and paint in accordance with manufacturer's printed instructions. On surfaces concealed in the finished construction or not accessible for finish painting, apply an additional prime coat to a minimum dry film thickness of 1.0 mil. Tint additional prime coat with a small amount of tinting pigment.

2.2.5 Nonferrous Metal Surfaces

Protect by plating, anodic, or organic coatings.

2.2.6 Aluminum Surfaces

2.2.6.1 Surface Condition

Before finishes are applied, remove roll marks, scratches, rolled-in scratches, kinks, stains, pits, orange peel, die marks, structural streaks, and other defects which will affect uniform appearance of finished surfaces.

2.2.6.2 Unexposed Sheet, Plate, and Extrusions

Unexposed sheet, plate and extrusions may have mill finish as fabricated. Sandblast castings' finish, medium, AA 45, or AA 46.

2.3 MISCELLANEOUS PLATES AND SHAPES

Provide for items that do not form a part of the structural steel framework, such as lintels, sill angles, miscellaneous mountings and frames. Provide lintels fabricated from structural steel shapes over openings in masonry walls and partitions as indicated and as required to support wall loads over openings. Provide with connections and fasteners welds. Construct to have at least 8 inches bearing on masonry at each end.

Provide angles and plates, ASTM A 36/A 36M, for embedment as indicated. Galvanize embedded items exposed to the elements according to ASTM A 123.

PART 3 EXECUTION

3.1 INSTALLATION

Install items at locations indicated, according to manufacturer's instructions. Items listed below require additional procedures.

3.2 ANCHORAGE, FASTENINGS, AND CONNECTIONS

Provide anchorage where necessary for fastening miscellaneous metal items securely in place. Include for anchorage not otherwise specified or indicated 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. Do not use wood plugs in any material. Provide non-ferrous attachments for non-ferrous metal. Make exposed fastenings of compatible materials, generally matching in color and finish, to which fastenings are applied. Conceal fastenings where practicable.

3.3 BUILT-IN WORK

Form for anchorage metal work built-in with concrete or masonry, or provide with suitable anchoring devices as indicated or as required. Furnish metal work in ample time for securing in place as the work progresses.

3.4 WELDING

Perform welding, welding inspection, and corrective welding, in accordance with AWS D1.1. Use continuous welds on all exposed connections. Grind visible welds smooth in the finished installation.

3.5 FINISHES

3.5.1 Dissimilar Materials

Where dissimilar metals are in contact, protect surfaces with a coat conforming to FS TT-P-664 to prevent galvanic or corrosive action. Where aluminum is in contact with concrete, mortar, masonry, wood, or absorptive materials subject to wetting, protect with ASTM D 1187, asphalt-base emulsion.

3.5.2 Environmental Conditions

Do not clean or paint surface when damp or exposed to foggy or rainy weather, when metallic surface temperature is less than 5 degrees F above the dew point of the surrounding air, or when surface temperature is below 45 degrees F or over 95 degrees F, unless approved by the NTR.

-- End of Section --

SECTION 07160

BITUMINOUS DAMPPROOFING

12/94

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 41	1985 Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D 43	1973 (R 1988) Creosote Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D 226	1989 Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D 227	1989 Coal-Tar-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D 449	1989 Asphalt Used in Dampproofing and Waterproofing
ASTM D 450	1991 Coal-Tar Pitch Used in Roofing, Dampproofing and Waterproofing
ASTM D 4263	1983 (R 1993) Indicating Moisture in Concrete by the Plastic Sheet Method
ASTM D 4479	1993 Asphalt Roof Coatings - Asbestos Free

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1926	Safety and Health Regulations for Construction

1.2 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic Contract.

1.2.1 SD-02, Manufacturer's Catalog Data

a. Asphalt

b. Asphalt primer

c. Fibrous asphalt

d. Saturated felt

1.3 DELIVERY AND STORAGE

Deliver materials in sealed containers bearing manufacturer's original labels. Labels shall include date of manufacture and recommended shelf life.

PART 2 PRODUCTS

2.1 ASPHALT

ASTM D 449, Type I or Type II.

2.2 ASPHALT PRIMER

ASTM D 41.

2.3 FIBROUS ASPHALT

ASTM D 4479, Type I for horizontal surfaces, Type II for vertical surfaces.

2.4 SURFACE PROTECTION

2.4.1 Saturated Felt

ASTM D 226, Asphalt Saturated, Type I (15 pound); ASTM D 227, Coal-Tar Saturated.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Clean concrete and masonry surfaces to receive dampproofing of foreign matter and loose particles. Apply dampproofing to clean dry surfaces. Moisture test in accordance with ASTM D 4263. If test indicates moisture, allow a minimum of 7 additional days after test completion for curing. If moisture still exists, redo test until substrate is dry.

3.2 APPLICATION

Use cold-application method. Use cold-application method in confined spaces where hot bitumen would be hazardous. Prime surfaces to receive asphaltic dampproofing unless recommended otherwise by dampproofing materials manufacturer. Apply dampproofing after priming coat is dry, but prior to any deterioration of primed surface, and when ambient temperature is above 40 degrees F.

3.2.1 Surface Priming

Prime surfaces to receive coal-tar pitch dampproofing with creosote primer. Prime surfaces to receive asphalt or fibrous asphalt dampproofing with asphalt primer. Apply primer when ambient temperature is above 40 degrees F and at rate of approximately one gallon per 100 square feet, fully covering entire surface to be dampproofed.

3.3 PROTECTIVE COVERING

Protect dampproofed surfaces against which backfill will be placed with one layer of 15 pound saturated felt conforming to the requirements specified herein. Use asphalt-saturated felt where the dampproofing material is asphalt and use coal-tar-saturated felt where the dampproofing material is coal-tar pitch. Embed felts in the second coating of bitumen and lap edges and ends not less than one inch.

-- End of Section --

SECTION 07214

BOARD AND BLOCK THERMAL INSULATION

12/94

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 165	1992 Measuring Compressive Properties of Thermal Insulations
ASTM C 203	1992 Breaking Load and Flexural Properties of Block-Type Thermal Insulation
ASTM C 272	1991 Water Absorption of Core Materials for Structural Sandwich Constructions
ASTM C 578	1992 Rigid, Cellular Polystyrene Thermal Insulation
ASTM C 930	1992 Potential Health and Safety Concerns Associated with Thermal Insulation Materials and Accessories
ASTM D 828	1993 Tensile Properties of Paper and Paperboard Using Constant-Rate-of-Elongation Apparatus
ASTM D 1621	1973 (R 1979) Compressive Properties of Rigid Cellular Plastics
ASTM D 3833	1988 (R 1993) Water Vapor Transmission of Pressure-Sensitive Tapes
ASTM D 4397	1991 Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications
ASTM E 84	1991 (Rev. A) Surface Burning Characteristics of Building Materials
ASTM E 96	1994 Water Vapor Transmission of Materials
ASTM E 136	1993 (Rev. D) Behavior of Materials in a Vertical Tube Furnace at 750 Degrees C

ASTM E 154	1988 (R 1993) Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover

FEDERAL SPECIFICATIONS (FS)

FS HH-I-1972/1	Insulation Board, Thermal, Polyurethane or Polyisocyanurate, Faced with Aluminum Foil on Both Sides of the Foam

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 31	1992 Installation of Oil Burning Equipment
NFPA 54	1992 National Fuel Gas Code
NFPA 70	1993 National Electrical Code
NFPA 211	1992 Chimneys, Fireplaces, Vents, and Solid Fuel Burning Appliances

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY (TAPPI)

TAPPI T803 OM	1988 Puncture Test for Containerboard

1.2 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic Contract.

1.2.1 SD-02, Manufacturer's Catalog Data

a. Block or board insulation

b. Vapor retarder

c. Pressure sensitive tape

d. Protection board or coating

e. Accessories

1.2.2 SD-06, Instructions

a. Block or Board Insulation

b. Adhesive

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery

Deliver materials to the site in original sealed wrapping bearing manufacturer's name and brand designation, specification number, type,

grade, R-value, and class. Store and handle to protect from damage. Do not allow insulation materials to become wet, soiled, crushed, or covered with ice or snow. Comply with manufacturer's recommendations for handling, storing, and protecting of materials before and during installation.

1.3.2 Storage

Inspect materials delivered to the site for damage; unload and store out of weather in manufacturer's original packaging. Store only in dry locations, not subject to open flames or sparks, and easily accessible for inspection and handling.

1.4 SAFETY PRECAUTIONS

1.4.1 Other Safety Considerations

Consider safety concerns and measures as outlined in ASTM C 930.

PART 2 PRODUCTS

2.1 BLOCK OR BOARD INSULATION

Provide only thermal insulating materials recommended by manufacturer for type of application indicated. Provide board or block thermal insulation conforming to the following standards and the physical properties listed below:

a. Aluminum Foil Faced Polyurethane or Polyisocyanurate Board: FS HH-I-1972/1

2.1.1 Thermal Resistance

As indicated.

2.1.2 Fire Protection Requirement

a. Flame spread index of 75 or less when tested in accordance with ASTM E 84.

b. Smoke developed index of 200 or less when tested in accordance with ASTM E 84.

2.1.3 Other Material Properties

Provide thermal insulating materials with the following properties:

a. Rigid cellular plastics: Compressive Resistance at Yield: Not less than 25 pounds per square inch (psi) when measured according to ASTM D 1621.

b. Flexural strength: Not less than 50 psi when measured according to ASTM C 203.

c. Water Vapor Permeance: Not more than 1.1 Perms or less when measured according to ASTM E 96, desiccant method, in the

thickness required to provide the specified thermal resistance, including facings, if any.

d. Water Absorption: Not more than 2 percent by total immersion, by volume, when measured according to ASTM C 272.

2.1.4 Recycled Materials

Provide thermal insulation containing recycled materials to the extent practicable, provided that the material meets all other requirements of this section.

2.1.5 Prohibited Materials

Do not provide materials containing asbestos.

2.1.6 Vapor Retarder under Floor Slab

a. Water vapor permeance: 0.2 Perm or less when tested in accordance with ASTM E 96.

b. Puncture resistance: Maximum load no less than 40 pounds when tested according to ASTM E 154.

2.2 PRESSURE SENSITIVE TAPE

As recommended by manufacturer of vapor retarder and having a water vapor permeance rating of one perm or less when tested in accordance with ASTM D 3833.

2.3 PROTECTION BOARD OR COATING

As recommended by insulation manufacturer.

2.4 ACCESSORIES

2.4.1 Adhesive

As recommended by insulation manufacturer.

2.4.2 Mechanical Fasteners

Corrosion resistant fasteners as recommended by the insulation manufacturer.

PART 3 EXECUTION

3.1 EXISTING CONDITIONS

Before installing insulation, ensure that all areas that will be in contact with the insulation are dry and free of projections which could cause voids, compressed insulation, or punctured vapor retarders. If installing perimeter or under slab insulation, check that the fill is flat, smooth, dry, and well tamped. If moisture or other conditions are found that do not allow the proper installation of the insulation, do not proceed but notify

the NTR of such conditions.

3.2 INSTALLATION

3.2.1 Insulation Board

Install and handle insulation in accordance with the manufacturer's Installation Instructions. Keep material dry and free of extraneous materials. Observe safe work practices.

3.2.2 Electrical Wiring

Do not install insulation in a manner that would sandwich electrical wiring between two layers of insulation.

3.2.3 Cold Climate Requirement

Place insulation to the outside of pipes.

3.2.4 Continuity of Insulation

Butt tightly against adjoining boards, studs, rafters, joists, sill plates, headers and obstructions. Provide continuity and integrity of insulation at corners, wall to ceiling joint, roof, and floor. Avoid creating any thermal bridges or voids.

3.3 INSTALLATION ON WALLS

3.3.1 Installation on Masonry Walls

Apply board directly to masonry with adhesive or fasteners as recommended by the insulation manufacturer. Fit between obstructions without impaling board on ties or anchors. Apply in parallel courses with joints breaking midway over course below. Put ends in moderate contact with adjoining insulation without forcing. Cut and shape as required to fit around wall penetrations, projections or openings to accommodate conduit or other services. Seal around cut-outs with sealant. Install board in wall cavities so that it leaves at least a nominal one inch free air space outside of the insulation to allow for cavity drainage. Foil is to face to inside.

3.3.2 Adhesive Attachment to Concrete and Masonry Walls

Apply adhesive to wall and completely cover wall with insulation.

a. As recommended by the insulation manufacturer.

b. Use only full back method for pieces of one square foot or less.

c. Butt all edges of insulation and seal edges with tape.

3.3.3 Mechanical Attachment on Concrete and Masonry Walls

Cut insulation to cover walls. Apply adhesive to wall and set clip or other mechanical fastener in adhesive as recommended by manufacturer.

After curing of adhesive, install insulation over fasteners, bend split prongs flush with insulation. Butt all edges of insulation and seal with tape.

3.3.4 Protection Board or Coating

Install protection board or coating in accordance with manufacturer's instructions. Install protection over all exterior exposed insulation board and down to 1 foot below grade.

3.4 PERIMETER AND UNDER SLAB INSULATION

Install perimeter thermal insulation where heated spaces are adjacent to exterior walls or slab edges in slab-on-grade or floating-slab construction.

3.4.1 Manufacturer's Instructions

Install, attach, tape edges, provide vapor retarder and other requirements such as protection against vermin, insects, damage during construction as recommended in manufacturer's instructions.

3.4.2 Insulation on Vertical Surfaces

Install thermal insulation below grade and on edges of slabs on grade. Fasten insulation with adhesive or mechanical fasteners.

3.4.3 Insulation Under Slab

Provide insulation horizontally under slab on grade as indicated. Install insulation on top of vapor retarder and turn retarder up over the outside edge of insulation to top of slab.

3.4.4 Protection of Insulation

Protect insulation on vertical surfaces from damage during construction and back filling by application of protection board or coating. Do not leave installed vertical insulation unprotected overnight. Provide protection extending at least 1 foot below grade.

3.5 VAPOR RETARDER

Apply a continuous vapor retarder as indicated. Overlap all joints at least 6 inches and seal with pressure sensitive tape. Seal at sill, header, windows, doors and utility penetrations. Repair punctures or tears with pressure sensitive tape.

-- End of Section --

SECTION 07220

ROOF INSULATION

12/94

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 208	1994 Cellulosic Fiber Insulating Board
ASTM C 552	1991 Cellular Glass Thermal Insulation
ASTM C 578	1992 Rigid, Cellular Polystyrene Thermal Insulation
ASTM C 728	1991 Perlite Thermal Insulation Board
ASTM C 984	1983 Perlite Board and Rigid Cellular Polyurethane Composite Roof Insulation
ASTM C 1050	1991 Rigid Cellular Polystyrene-Cellulosic Fiber Composite Roof Insulation
ASTM D 41	1985 Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D 312	1989 Asphalt Used in Roofing
ASTM D 2178	1989 Asphalt Glass Felt Used in Roofing and Waterproofing
ASTM D 4586	1993 Asphalt Roof Cement, Asbestos-Free
ASTM D 4601	1991 Asphalt-Coated Glass Fiber Base Sheet Used in Roofing
ASTM D 4897	1989 Asphalt-Coated Glass-Fiber Venting Base Sheet Used in Roofing
ASTM E 84	1991 (Rev. A) Surface Burning Characteristics of Building Materials

FACTORY MUTUAL ENGINEERING AND RESEARCH CORPORATION (FM)

FM A/S4470	1986 (Supp. 1, 2, and 3) Class I Roof Covers

FM P7825	1994 Approval Guide

FEDERAL SPECIFICATIONS (FS)

FS HH-I-1972/1	Insulation Board, Thermal, Polyurethane or Polyisocyanurate, Faced with Aluminum Foil on Both Sides of the Foam
FS HH-I-1972/2	Insulation Board, Thermal, Polyurethane or Polyisocyanurate Faced with Asphalt/Organic Felt, Polymer/Organic Mat, Asphalt/Glass Mat or Polymer/Glass Mat on Both Sides of the Foam
FS HH-I-1972/3	Insulation Board, Thermal, Polyurethane or Polyisocyanurate Faced with Perlite Insulation Board on One Side and Asphalt/Organic Felt or Asphalt/Glass Fiber Felt on Other Side of the Foam
FS HH-I-1972/5	Insulation Board, Thermal, Polyurethane or Polyisocyanurate Faced with Perlite Board on Both Sides of the Foam

UNDERWRITERS LABORATORIES INC. (UL)

UL BMD	1994 Building Materials Directory

1.2 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic Contract.

1.2.1 SD-02, Manufacturer's Catalog Data

a. Fasteners

b. Insulation

Include minimum thickness of insulation for steel decks and fastener pattern for insulation on steel decks.

1.2.2 SD-04, Drawings

a. Installation drawings

Show a complete description of the procedures for the installation of each phase of the system indicating the type of materials, thicknesses, identity codes, sequence of laying insulation, location of ridges and valleys, special methods for cutting and fitting of insulation, and special precautions. The drawings shall be based on field measurements.

1.2.3 SD-06, Instructions

a. Fasteners

b. Roof insulation, including field of roof and perimeter attachment requirements.

1.2.3.1 Requirement

Submit certificate from the insulation manufacturer attesting that the installer has the proper qualifications for installing tapered roof insulation systems.

1.2.4 SD-10, Test Reports

a. Flame spread and smoke developed ratings

Submit in accordance with ASTM E 84.

1.3 QUALITY ASSURANCE

1.3.1 Insulation on Steel Decks

Roof insulation shall have a flame spread rating not greater than 75 and a smoke developed rating not greater than 150, exclusive of covering, when tested in accordance with ASTM E 84. Insulation bearing the UL label and listed in the UL BMD as meeting the flame spread and smoke developed ratings will be accepted in lieu of copies of test reports. Compliance with flame spread and smoke developed ratings will not be required when insulation has been tested as part of a roof construction assembly of the type used for this project and the construction is listed as fire-classified in the UL BMD or listed as Class I roof deck construction in the FM P7825. Insulation tested as part of a roof construction assembly shall bear UL or FM labels attesting to the ratings specified herein.

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 Delivery

Deliver materials to site in manufacturer's unopened and undamaged standard commercial containers bearing the following legible information:

a. Name of manufacturer;

b. Brand designation;

c. Specification number, type, and class, as applicable, where materials are covered by a referenced specification; and

Deliver materials in sufficient quantity to allow continuity of the work.

1.4.2 Storage and Handling

Store and handle materials in a manner to protect from damage, exposure to open flame or other ignition sources, and from wetting, condensation or moisture absorption. Store in an enclosed building or trailer that provides a dry, adequately ventilated environment. Store felt rolls on ends. For the 24 hours immediately before application of felts, store felts in an area maintained at a temperature no lower than 50 degrees F. Replace damaged material with new material.

1.5 ENVIRONMENTAL CONDITIONS

Do not install roof insulation during inclement weather or when air temperature is below 40 degrees F or when there is ice, frost, or moisture visible on the roof deck.

1.5.1 Flame-Heated Equipment

Locate and use flame-heated equipment so as not to endanger the structure or other materials on the site or adjacent property. Do not place flame-heated equipment on the roof. Provide and maintain a fire extinguisher near each item of flame-heated equipment.

1.5.2 Protective Coverings

Install protective coverings at paving and building walls adjacent to hoist and kettles prior to starting the work. Lap protective coverings at least 6 inches, secure them against wind, and vent them to prevent collection of moisture on the covered surfaces. Keep protective coverings in place for the duration of the work with asphalt products.

1.5.3 Special Protection

Provide special protection approved by the insulation manufacturer, or avoid heavy traffic on completed work when ambient temperature is above 80 degrees F.

1.5.4 Drippage of Bitumen

Seal joints in and at edges of deck as necessary to prevent drippage of asphalt into building or down exterior walls.

PART 2 PRODUCTS

2.1 INSULATION

2.1.1 Insulation Types

Roof insulation shall be one or an assembly of a maximum of three of the following materials and compatible with attachment methods for the specified insulation and roof membrane:

a. Expanded Perlite Board: ASTM C 728. Minimum 3/4 inch thick when both top and bottom surfaces will be in contact with asphalt.

b. Polyisocyanurate Board: FS HH-I-1972/2 (Felt-faced) or FS HH-I-1972/1 (Foil-faced), except minimum compressive strength shall be 20 pounds per square inch (psi).

c. Composite Boards: FS HH-I-1972/3 (Polyisocyanurate-perlite), Style 1 or 2; FS HH-I-1972/5 (Polyisocyanurate-perlite); ASTM C 984 (Polyisocyanurate-perlite) ; or ASTM C 1050 (Polystyrene-wood fiberboard), Type III, Grade 1, Class A.

2.1.2 Insulation Thickness

As necessary to provide a thermal resistance (R value) as indicated on Drawings. Thickness shall be based on the "R" value for aged insulation. Insulation over steel decks shall satisfy both specified R value and minimum thickness for width of rib opening recommended in insulation manufacturer's published literature.

2.1.3 Tapered Roof Insulation

One layer of the tapered roof insulation assembly shall be factory tapered to a slope of not less than 1/8 inch per foot. Provide starter and filler blocks as required to provide the total thickness of insulation necessary to meet the specified slope and thermal conductance. Mitered joints shall be factory fabricated and shall consist of two diagonally cut boards or one board shaped to provide the required slopes. Identify each piece of tapered insulation board by color or other identity coding system, allowing the identification of different sizes of tapered insulation board required to complete the roof insulation system.

2.1.4 Cants and Tapered Edge Strips

Provide preformed cants and tapered edge strips of the same material as the roof insulation; or, when roof insulation material is unavailable, provide pressure-preservative treated wood, wood fiberboard, or rigid perlite board cants and edge strips as recommended by the roofing manufacturer, unless otherwise indicated. Face of cant strips shall have incline of 45 degrees and vertical height of 4 inches. Taper edge strips at a rate of one to 1 1/2 inch per foot down to approximately 1/8 inch thick.

2.2 BITUMENS

2.2.1 Asphalt Primer

ASTM D 41.

2.2.2 Asphalt

ASTM D 312, Type III or IV.

2.2.3 Asphalt Roof Cement

ASTM D 4586, Type I for horizontal surfaces, Type II for vertical and sloped surfaces.

2.3 MOISTURE CONTROL

2.3.1 Vapor Retarder

2.3.1.1 Asphalt-Saturated Felt Base Sheet for Single Layer Application

ASTM D 4601, weighing not less than 35 pounds per 100 square feet.

2.3.1.2 Asphalt-Coated Glass Felt

ASTM D 2178, Type IV.

2.4 FASTENERS

Flush-driven through flat round or hexagonal steel or plastic plates. Steel plates shall be zinc-coated, flat round not less than 1 3/8 inch diameter or hexagonal not less than 28 gage. Plastic plates shall be high-density, molded thermoplastic with smooth top surface, reinforcing ribs and not less than 3 inches in diameter. Fastener head shall recess fully into the plastic plate after it is driven. Plates shall be formed to prevent dishing. Do not use bell-or cup-shaped plates. Minimum withdrawal resistance of fasteners from deck shall be 120 lbs each in steel deck.

2.4.1 Fasteners for Steel Decks

Approved hardened penetrating fasteners or screws conforming to FM A/S4470 and listed in FM P7825 for Class I roof deck construction. Quantity and placement to withstand an uplift pressure of 90 psf\ conforming to FM P7825.

PART 3 EXECUTION

3.1 EXAMINATION AND PREPARATION

3.1.1 Surface Inspection

Surfaces shall be clean, smooth, and dry. Surfaces receiving vapor retarder shall be free of projections which might puncture the vapor retarder. Check roof deck surfaces, including surfaces sloped to roof drains and outlets, for defects before starting work. The NTR shall inspect and approve the surfaces immediately before starting installation. Prior to installing insulation, perform the following:

a. Examine steel decks to ensure that panels are properly secured to structural members and to each other and that surfaces of top flanges are flat or slightly convex.

3.1.2 Surface Preparation

Correct defects and inaccuracies in roof deck surface to eliminate poor drainage and hollow or low spots and perform the following:

a. Cover steel decks with a layer of insulation board of sufficient thickness to span the width of a deck rib opening, and conforming to fire safety requirements. Secure with piercing or

self-drilling, self-tapping fasteners of quantity and placement conforming to FM P7825. Insulation joints parallel to ribs of deck shall occur on solid bearing surfaces only, not over open ribs.

3.2 INSULATION INSTALLATION

Apply insulation in two layers with staggered joints when total required thickness of insulation exceeds 1/2 inch. Lay insulation so that continuous longitudinal joints are perpendicular to direction of felts for the built-up roofing, as specified in Section 07513, "Mineral Surfaced Bituminous Built-Up Roofing", and end joints of each course are staggered with those of adjoining courses. When using multiple layers of insulation, joints of each succeeding layer shall be parallel and offset in both directions with respect to layer below. Keep insulation 1/2 inch clear of vertical surfaces penetrating and projecting from roof surface.

3.3 PROTECTION

3.3.1 Protection of Applied Insulation

Completely cover each day's installation of insulation with the finished roofing specified in Section 07513, "Mineral Surfaced Bituminous Built-Up Roofing" on same day. Do not permit phased construction. Protect open ends of each day's work with temporary water cutoffs, and 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 are applied. Do not permit storing, walking, wheeling, or trucking directly on insulation or on roofed surfaces. Provide smooth, clean board or plank walkways, runways, and platforms near supports, as necessary, to distribute weight to conform to indicated live load limits of roof construction a 20 psf live load limit.

3.3.2 Damaged Work and Materials

Restore work and materials that become damaged during construction to original condition or replace with new materials.

-- End of Section --

SECTION 07513

MINERAL SURFACED BITUMINOUS BUILT-UP ROOFING

12/94

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 41	1985 Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D 312	1989 Asphalt Used in Roofing
ASTM D 2170	1992 Kinematic Viscosity of Asphalts (Bitumens)
ASTM D 2178	1989 Asphalt Glass Felt Used in Roofing and Waterproofing
ASTM D 3617	1983 Sampling and Analysis of New Built-Up Roof Membranes
ASTM D 3909	1991 Asphalt Roll Roofing (Glass Felt) Surfaced with Mineral Granules
ASTM D 4402	1987 (R 1991) Viscosity Determinations of Unfilled Asphalts Using the Brookfield Thermosel Apparatus
ASTM D 4586	1993 Asphalt Roof Cement, Asbestos-Free
ASTM D 4601	1991 Asphalt-Coated Glass Fiber Base Sheet Used in Roofing
ASTM D 4897	1989 Asphalt-Coated Glass-Fiber Venting Base Sheet Used in Roofing

1.2 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic Contract.

1.2.1 SD-02, Manufacturer's Catalog Data

a. Asphalt

b. Felts

c. Fasteners

d. Primer

e. Asphalt roof cement

f. Moisture release vents

g. Warranty certificate

1.2.1.1 Submittal Sample

Submit roofing system manufacturer's warranty stamped "Sample" or "Facsimile."

1.2.2 SD-06, Instructions

a. Asphalt

b. Felts, including flashing felts

c. Primer

d. Asphalt roof cement

Explicity identify, in writing, differences between manufacturer's instructions and requirements specified herein.

1.2.3 SD-08, Statements

a. Bill of lading

Submit when labels of asphalt containers do not bear the flash point, finished blowing temperature and equiviscous temperature.

b. Qualifications of Applicator

Submit evidence of the roofing system manufacturer's approval.

1.2.4 SD-12, Field Test Reports

a. Samples of built-up roofing

Submit test results on roofing field samples as required, verifying composition of sample. Submit six copies of laboratory analysis within 30 calendar days after samples are taken. Submit reports in accordance with ASTM D 3617.

1.2.5 SD-18, Records

a. Information card

1.2.5.1 Information Card Contents

For each roofing installation, submit a typewritten card or photoengraved aluminum card containing the information listed on Form 1 located at the end of this section.

1.3 QUALITY ASSURANCE

1.3.1 Qualifications of Applicator

The roofing system applicator shall be approved, authorized, or licensed in writing by the roofing system manufacturer and be approved at a level capable of providing the specified warranty.

1.3.2 Preroofing Conference

After submittals have been approved but before roofing and insulation work, including associated work, is performed, the NTR will hold a preroofing conference to review the following:

a. The drawings and specifications.

b. Procedure for onsite inspection and acceptance of roofing substrate and pertinent structural details relating to roofing system.

c. Contractor's plan for coordination of work of the various trades involved in providing roofing system and other components secured to roofing.

d. Safety requirements.

The preroofing conference shall be attended by the Contractor and personnel directly responsible for the roofing and insulation installation, flashing and sheet metal work, mechanical and electrical work, and representative of the roofing materials manufacturer. Conflicts among those attending the preroofing conference shall be resolved and confirmed in writing before roofing work, including associated work, is begun.

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 Delivery

Deliver materials in manufacturers' original unopened containers and rolls with manufacturer's labels intact and legible. Mark and remove wet or damaged materials from site. Where materials are covered by a referenced specification, container shall bear the specification number, type, and class, as applicable. Indicate on labels or bill of lading for roofing asphalt the asphalt type, finished blowing temperature (FBT), flash point (FP), and equiviscous temperature (EVT), that is, the temperature at which the viscosity is either 125 centistokes when tested in accordance with ASTM D 2170 or 75 centipoise when tested in accordance with ASTM D 4402. Deliver materials in sufficient quantity to allow the work to proceed without interruption.

1.4.2 Storage

Protect materials against moisture absorption. Store roll materials on end on clean raised platforms in dry locations in enclosed buildings or trailers with adequate ventilation. Do not store roll materials in buildings under construction until concrete, mortar, and plaster work are finished and dry. For a 24-hour period immediately prior to application, maintain roll materials at temperatures above 50 degrees F. Place only those materials to be used during one day's work on roof at one time. Remove materials from roof at end of each day's work.

1.4.3 Handling

Select and operate material handling equipment so as not to damage applied roofing. Prevent damage to edges and ends of roll materials.

1.5 ENVIRONMENTAL CONDITIONS

Do not install roofing during precipitation or fog, or when air temperature is below 40 degrees F, or when there is ice, frost, moisture or visible dampness on roof deck. Restriction on application of roofing materials below 40 degrees F may be waived if Contractor devises a means, satisfactory to NTR, of: (1) maintaining surrounding temperature above 40 degrees F; and (2) maintaining application temperature of heated materials without exceeding maximum specified heating temperature.

1.6 PROTECTION OF PROPERTY

1.6.1 Protective Coverings

Install protective coverings at paving and building walls adjacent to hoist and kettles prior to starting work. Lap protective coverings not less than 6 inches, secure against wind, and vent to prevent collection of moisture on covered surfaces. Keep protective coverings in place for duration of roofing work.

1.6.2 Flame-Heated Equipment

Do not place flame-heated equipment on roof unless approved in writing by NTR. Provide and maintain a fire extinguisher adjacent to flame-heated equipment and on the roof.

1.7 WARRANTY

Furnish the roofing system manufacturer's warranty for the roofing system. The warranty period shall not be less than 5 years from the date of Government acceptance of the work. The warranty shall be issued directly to the Government and shall not be limited in dollar value. The warranty shall provide that if within the warranty period, the built-up roofing system including membrane, membrane flashing, insulation and accessories becomes non-watertight, blisters or shows evidence of excessive weathering due to deterioration of the roofing system resulting from defective materials or workmanship, the repair of the defective materials or workmanship shall be the responsibility of the manufacturer. While roofing is under warranty, perform repairs that become necessary due to defective

materials or workmanship within 72 hours of notification, unless additional time is approved by NTR. Failure to perform repairs within specified period of time will constitute grounds for the Government having repairs performed by others and cost billed to Contractor.

PART 2 PRODUCTS

2.1 ROOFING SYSTEM

Glass felt, asphalt bitumen, mineral surfaced, ballasted system at 12 lbs per sq. ft.

Substrate: Roof Insulation Components:	Quantity:
Felt:	
Ply Felt (GA)	3 Plies
Mineral Surfaced Cap Sheet (GC)	1 Ply
Asphalt: (See a. below)	
Between Substrate and First Ply	20-35 lbs/100 sq. ft.
Between Each Ply	20-35 lbs/100 sq. ft.

a. Provide asphalt quantities within the indicated ranges, unless recommended otherwise in the roofing materials manufacturer's printed data.

2.2 MATERIALS

2.2.1 Asphalt

Roof Slope, in./ft	Specification
1/8 to 1/2	ASTM D 312, Type II

2.2.2 Felts

For built-up roofing and flashing:

Designation	Use	Felt	Impregnant	Coating	Specification
GB	Base Sheet	Glass	Asphalt	Asphalt	ASTM D 4601, Type II, without perforations
GA	Ply Felt	Glass	Asphalt	None	ASTM D 2178, Type IV or VI
FF	Flashing Felt	Glass	Asphalt	Asphalt	(See a. below)

Designation	Use	Felt	Impregnant	Coating	Specification
GC	Mineral Surfaced Cap Sheet	Glass	Asphalt	Asphalt	ASTM D 3909

a. Provide flashing felt specifically prepared in the manufacturing process for use in two-ply base flashing construction of either: a single thickness of glass felt conforming to the properties listed in ASTM D 2178, for Type IV; or glass felt factory-laminated to a woven glass fiber scrim or cotton fabric; or styrene-butadiene-styrene (SBS) or atactic polypropylene (APP) modified bitumen. Factory-coat each type of flashing construction on both sides with an asphaltic coating which includes a water-insoluble, fine mineral stabilizer and a fine mineral surfacing.

2.2.3 Primer

ASTM D 41.

2.2.4 Asphalt Roof Cement

ASTM D 4586, Type II for vertical surfaces and built-up bituminous flashings; Type I for horizontal surfaces.

2.2.5 Unsaturated Felt or Rosin-Sized Building Paper

Minimum weight, 5 pounds per 100 square feet.

2.2.6 Fasteners

Provide nonferrous or galvanized fasteners, except where in contact with copper, aluminum, or stainless steel. Use hard copper fasteners in contact with copper; aluminum or stainless steel fasteners in contact with aluminum; and stainless steel fasteners in contact with stainless steel. For fastening only roofing felts, use fasteners driven through metal 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.

2.2.6.1 Masonry Walls and Vertical Surfaces

Provide hardened steel nails with flat heads, diamond shaped points, and mechanically deformed shanks not less than one inch long for securing felts and metal items. Use power-driven fasteners only when approved in writing by the NTR.

2.2.7 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 inch in diameter. Form discs to prevent dishing. Do not use bell or cup-shaped caps. Omit disc when one-piece composite fasteners are used.

2.2.8 Moisture Release Vents

Provide vents especially manufactured for the purpose of releasing moisture and vapor from the roofing system by heat and pressure. Vents shall be one-way design to prevent reverse flow of moisture laden air into roofing system. Valve cap shall effectively seal out wind-blown rain and snow and shall not permit water entry when submerged.

PART 3 EXECUTION

3.1 CONDITION OF SURFACES

Ensure that the following conditions exist prior to application of the roofing materials:

a. Scupper, curbs, cants, perimeter walls, roof penetrating components, and equipment supports are in place.

b. Surfaces are rigid, dry, smooth, and free from cracks, holes, and sharp changes in elevation. Joints in substrate are sealed to prevent drippage of bitumen into building or down exterior walls.

c. Plane of substrate does not vary more than 1/4 inch within an area 10 feet by 10 feet when checked with a 10-foot straight edge placed anywhere on substrate.

d. Substrate is sloped as indicated to provide drainage.

e. Walls and vertical surfaces are constructed to receive counterflashing.

f. Cants are securely fastened in place in the angles formed by walls and other vertical surfaces. The angle of the cant is approximately 45 degrees and the height of the vertical leg is not less than nominal 4 inches. Cants are constructed of wood fiberboard roof insulation.

g. 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.

h. Insulation boards are installed smoothly and evenly, and are not broken, cracked, or curled. Insulation is being roofed over on the same day the insulation is installed.

3.2 PREPARATION

Coordinate work with other trades to ensure that components which are to be secured to or stripped into the roofing system are available and that permanent flashings and counterflashings are installed as the work progresses.

3.2.1 Priming of Surfaces

Prime surfaces at rate of 0.75 gallon per 100 square feet.

3.2.1.1 Priming of Concrete and Masonry Surfaces

After surface dryness requirements have been met, coat concrete and masonry surfaces which are to receive roofing and base flashing uniformly with asphalt primer. Allow primer to dry before application of roofing and flashing materials.

3.2.1.2 Priming of Metal Surfaces

Prime flanges of metal gravel stops, edging strips, flashing collars, roof drain flashing, and accessories before stripping into roofing system.

3.2.2 Heating of Asphalt

Break up solid asphalt on surface free of dirt and debris. Heat in kettle designed to prevent contact of flame with surfaces in contact with asphalt. Kettles shall have visible thermometer and thermostatic controls set to specified temperature limits. Keep controls in working order and calibrated. Use immersion thermometer, accurate within a tolerance of plus or minus 2 degrees F, for frequent checking of asphalt temperature. If temperature exceeds maximum specified, remove asphalt from site. If asphalt temperature, at the instant of application, is below minimum specified, take a field sample of the affected roofing, analyze as specified, and replace with new material if deficiencies are disclosed. Cutting back, adulterating, or fluxing of asphalt are prohibited.

3.3 APPLICATION

Apply roofing materials as specified and as recommended by manufacturer's printed application instructions. Keep roofing materials dry before and during application. Phased construction is prohibited. Complete application of roofing in a continuous operation. Begin and apply only as much roofing in one day as can be completed that same day. Maintain specified temperatures for asphalt.

3.3.1 Bitumen Stops

Provide bitumen stops at roof edges, openings, and vertical projections before applying roofing felts unless recommended otherwise by manufacturer's printed application instructions. Form bitumen stops with two 12 inch wide strips of organic ply felt. Laminate with and set strips into a coating of asphalt roof 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 on center in addition to embedding in asphalt roof cement. After cap sheet is in place, fold free portion of the strips back over cap sheet and embed in a continuous coating of asphalt roof cement. Secure with roofing nails spaced 3 inches on center.

3.3.2 Mechanically Fastened Base Sheets

Apply sheets shingle fashion and in same direction as ply felts with each sheet lapping not less than 2 inches over the preceding. Lap ends not less than 6 inches and stagger a minimum of 36 inches. Apply sheets with fasteners at 9-inch intervals along the laps and with fasteners down center of sheets in two rows approximately 11 inches apart. Space nails 18 inches on center. Throughout the area extending 10 feet in from the edge of the roof, provide fasteners at 5-inch intervals along laps and staggered down center of sheets in two rows approximately 11 inches apart, with nails spaced at 9 inches on center.

3.3.3 Ply Felts

Apply ply felts shingle fashion in hot-moppings of asphalt. Apply felts in a continuous operation. Provide starter sheets of ply felt to maintain the specified number of plies throughout the roofing. Apply felts with side laps in accordance with the material manufacturer's printed instructions and in uniform alignment. Lap ends not less than 6 inches and stagger 36 inches minimum. Apply felts at right angles to roof slope so that direction of water flow is over and not against laps. Extend felts approximately 2 inches above top of cant strips at vertical surfaces and to top of cant strips elsewhere. Trim felts to a neat fit around vent pipes, roof drains, and other projections.

3.3.4 Mineral Surfaced Cap Sheet

Prior to laying mineral surfaced cap sheets, cut rolls into sheets 12 to 18 feet long, and stack in flat protected piles for not less than 24 hours. Sheets shall not be buckled or wrinkled. Apply shingle fashion and in same direction as ply felts. Maintain 19 inch side laps and 6-inch end laps. Stagger end laps not less than 12 inches. Apply sheets firmly in hot-moppings of asphalt the full width under sheets. Seal edges of sheets.

3.3.5 Hot-Mopping of Ply Felts and Mineral Surfaced Cap Sheets

Bond ply felts to each other, to base sheets substrate, and to the mineral surfaced cap sheet with hot asphalt. Apply felts immediately following application of hot asphalt. Do not work ahead with asphalt. At the instant felts come into contact with asphalt, asphalt shall be completely fluid, with mop temperatures within specified EVT range. Apply asphalt uniformly in a full, continuous, firmly bonding film at the rate specified. As felts are being rolled into the hot asphalt, immediately squeegee, roll or broom down to eliminate trapped air and to provide tight, smooth laminations without wrinkles, buckles, kinks, or fish mouths. The completed roofing system shall be free of pockets, felt delaminations, ridges, fishmouths, dry laps, or blisters. Do not lay felts dry, turning back laps for mopping between plies.

3.3.5.1 Temperature Limitations for Asphalt

Heat and apply asphalt at the temperatures specified below unless specified otherwise by the manufacturer. Use thermometer to check temperature during heating and application. Have kettle attended constantly during heating process to ensure specified temperatures are maintained. Do not heat asphalt above its finished blowing temperature (FBT). Do not heat asphalt

to the flash point (FP). Apply asphalt and embed roofing felts when asphalt temperature is within plus or minus 25 degrees F of the equiviscous temperature (EVT). Before heating asphalt refer to manufacturer's label or bill of lading for the FBT, FP and EVT of the asphalt used.

3.3.6 Flashing

Provide bituminous flashing in the angles formed where 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, including the mineral surfaced cap sheet. Metal flashings are specified under Section 07600, "Flashing and Sheet Metal." Except for SBS modified bitumen flashing, do not set built-up bituminous or metal flashing in hot asphalt.

3.3.6.1 Base Flashing

Mechanically secure base flashing to vertical surfaces using one of the following base flashing systems as recommended by the manufacturer of the ply felt:

a. Three-Ply Bituminous Built-Up Base Flashing: Provide three plies of specified GA ply felt. Embed each in a uniform trowelling of asphalt roof cement not less than 1/8 inch thick. Smooth and press felts firmly into place. Extend felts not less than 6, 9, and 12 inches, respectively, over the roofing membrane beyond toe of cant, and not less than 4 inches nor more than 10 inches above top of cant on vertical surfaces. Lap ends not less than 12 inches and seal watertight with asphalt roof 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 4 inches on center on a line 1 1/2 inches below the top edge of the base flashing. Coat the finished base flashing with asphalt roof cement not less than 1/8 inch thick, extending from one inch above the top of base flashing on the vertical surface to one inch beyond edge of base flashing on the roofing membrane.

b. Two-Ply Bituminous Built-Up Base Flashing: Provide one ply of GA ply felt and one ply of flashing felt, FF, in accordance with the manufacturer's printed installation instructions and graphic details.

c. Modified Bitumen Base Flashing: Provide SBS base flashing standard with the roofing system manufacturer in accordance with printed installation instructions and graphic details.

3.3.6.2 Strip Flashing

Set flanges of horizontal sheet metal work which are to be incorporated into roofing system into a uniform coating of asphalt roof cement not less than 1/16 inch thick applied over mineral surfaced cap sheets. Strip-in with either two layers of ply felt or one layer of modified bitumen sheet cemented to flange tops, roofing surface, and to each other. Use coatings of asphalt roof cement not less than 1/16 inch thick for ply

felt. Use hot steep asphalt for modified bitumen sheet. Extend felts 3 and 6 inches, respectively, or modified bitumen sheet 6 inches beyond flange edges and onto cap sheet surface. Coat finished felt strip flashing with asphalt roof cement not less than 1/8 inch thick.

3.3.7 Protection of Applied Roofing

3.3.7.1 Protection Against Moisture Absorption

When precipitation is imminent and at the end of each day's work, protect applied felts as follows:

a. Temporary Flashing: Provide temporary flashing at drains, curbs, walls, and other penetrations and terminations of roofing felts until roofing membrane is complete, and permanent flashings are applied. Use one ply of felt applied in trowel coat of asphalt roof cement over primed surface. Finish with a surface coat of asphalt roof cement. Remove temporary flashing before applying permanent flashing.

3.3.7.2 Temporary Walkways, Runways, and Platforms

Storing, walking, wheeling, and trucking directly on applied roofing materials is prohibited. Provide temporary walkways, runways, and platforms of smooth clean boards or planks as necessary to avoid damage to applied roofing materials, and to distribute weight to conform to indicated live load limits of roof construction. Use rubber-tired equipment for roofing work.

3.3.8 Stack Venting

Distribute moisture release vents uniformly at a minimum rate of one vent for each 1000 square feet of roof area. Cut a hole, of diameter to suit base opening size of vent, through the roofing membrane and insulation. Replace cut out or crumbled insulation in the hole. Set vent flange over hole on top of roofing membrane in a 1/8 inch thick bed of asphalt roof cement or special adhesive or cement recommended by vent manufacturer. Strip-in vent flanges with two layers of ply felt in accordance with the vent manufacturer's printed instructions and details.

3.4 FIELD QUALITY CONTROL

Perform field tests in the presence of the NTR. Notify the NTR one day before performing tests.

3.4.1 Test for Surface Dryness

Before starting work on area to be roofed, perform test for surface dryness in accordance with the following:

a. Foaming: When poured on the surface to receive felts, one pint of asphalt heated in the range of 350 to 400 degrees F, shall not foam upon contact.

b. Strippability: After asphalt used in foaming test application has

cooled to ambient temperature, test for adherence. If a portion of the sample is readily stripped clean from the surface, do not consider the surface to be dry and do not start application. If rain occurs during application, stop work and do not resume until surface has been tested by the method above and found dry.

3.4.2 Samples of Built-Up Roofing

After application of specified roofing felts and prior to applying surfacing, take field samples of built-up roofing in the presence of the NTR. Take and test samples in accordance with ASTM D 3617 and at locations selected by the NTR immediately prior to cutting. Cut 4 by 40 inch samples across felt laps in a manner to expose the specified number of plies. The 4 inch edge shall coincide with an edge lap of felt and shall not be positioned over an end lap. The 4 by 40 inch samples will be used by the NTR to inspect for the specified number of plies, bond between plies, skips in interply moppings, uniform asphalt mopping, presence of excessive voids or large voids in the ply construction, presence of harmful foreign materials, visible presence of moisture in the sandwich and wet insulation. 12 by 12 inch cut samples will be used to calculate bitumen quantities in accordance with ASTM D 3617 when necessary and directed by the NTR. Do not proceed with surfacing until all deficiencies disclosed as a result of "cut tests" have been corrected and approved.

3.4.2.1 Number of Cut Tests

Take not less than two samples from each 100 squares of roofed area, and take at least one sample from each day's application, regardless of quantity applied. If samples show any deficiency, no matter how slight, take additional sample to determine extent of deficiency.

3.4.2.2 Sample Cutting Device

Provide a rectangular, 4 by 40 inch template and 12 by 12 inch template, of a type that will permit accurate cutting of samples with standard roofing knives. Keep cutting edge of knife clean by washing in solvent after each cut.

3.4.2.3 Patching Cut-Out Area

Immediately after inspection, replace cut-out sample. When sample is needed for laboratory analysis or other circumstance makes it unavailable, substitute a new section of equivalent size and structure. For non-nailable decks, replace sample in hot asphalt. For nailable decks, insert one ply of felt into the opening from which sample was taken and sprinkle nail to hold in place; coat felt heavily with asphalt roof cement and press the cutout sample firmly into the asphalt roof cement. Cover area over replaced samples with 3 plies of felt and one ply of cap sheet, hot mopped in place with first ply overlapping the cutout area 3 inches on all sides and each succeeding ply overlapping previous ply 3 inches on all sides.

3.4.3 Correction of Deficiencies

Where interply moppings are too light, apply additional 2 plies of felt in full moppings of asphalt. Apply with 4 inch side and end laps. Where free water, skips, excessive voids, dry laps, disbonding or any form of delamination are discovered between the plies, remove and rebuild affected area. Correction of inadequate number of plies, improper lap widths, or nonuniform or excessive asphalt mopping shall be as directed by the NTR. Where insulation is found to be wet, remove insulation and provide new built-up roofing and insulation.

3.5 INFORMATION CARD

For each roof, provide a typewritten card, laminated in plastic for interior display, or a photoengraved 0.032-inch thick aluminum card for exterior display. Card shall be 8 1/2 by 11 inches minimum and contain the information listed on Form 1 located at the end of this section. Install card near point of access to roof or where indicated. Send photostatic paper copy to LANTNAVFACENGCOM, Code 1613, Norfolk, VA 23511-6287.

-- End of Section --

FORM 1 - ROOFING SYSTEM DESCRIPTION

1. Location _____ 2. Bldg. Name _____

3. Bldg. No. _____ 4. Roof Area (SF) _____ 5. Contract No. _____

6. New Construction ( ) Yes ( ) No 7. Deck Slope: _____

8. Type of Deck:
   ( ) Metal
   ( ) Cast-In-Place Concrete
   ( ) Precast/Prestressed Concrete
   ( ) Wood Plank or Plywood
   ( ) Other _____

9. Type of Insulation Board:
   ( ) Polyisocyanurate/Composite
   ( ) Polystyrene/Composite
   ( ) Perlite
   ( ) Other _____
   ( ) Polyisocyanurate Foam
   ( ) Polystyrene
   ( ) Mineral Fiber

10. Insulation Manufacturer: _____

11. Insulation Thickness: _____

12. Vapor Treatment: Total Coverage ( ) Yes ( ) No
   ( ) No Vapor Retarder
   ( ) One Way Roof Vents
   ( ) Other _____
   ( ) Bituminous Vapor Retarder
   ( ) Laminated Kraft Paper

13. Vapor Treatment Manufacturer(s): _____

14. Roofing Type:
   ( ) Built-Up (Asphalt)
   ( ) Built-Up (Coal-Tar)
   ( ) Metal
   ( ) Shingles
   ( ) PIB
   ( ) Modified Bitumen
   ( ) CSPE
   ( ) Other _____
   ( ) TPA
   ( ) EPDM
   ( ) PVC

15. Roofing Manufacturer: _____

16. Roofing Installer/Warrantor: _____

17. Roofing Application Method:
   ( ) Bitumen
   ( ) Mechanically Fastened
   ( ) Mechanically Fastened/Fully Adhered
   ( ) Fully Adhered
   ( ) Torched
   ( ) Loose-Laid Ballasted
   ( ) Other _____

18. Warranty Period: From _____ To _____

19. Warranty Serial Number: _____

20. Date Roofing Completed: _____ 21. Inspector: _____

22. Prime Contractor Name/Address: _____

Signature: _____ Date: _____

SECTION 07600

FLASHING AND SHEET METAL

03/95

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 209	(1993) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM D 41	(1985) Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D 4586	(1993) Asphalt Roof Cement, Asbestos-Free

AMERICAN WELDING SOCIETY, INC. (AWS)

AWS D1.2	(1990) Structural Welding Code Aluminum

FEDERAL SPECIFICATIONS (FS)

FS UU-B-790	(Rev. A Reinst) Building Paper, Vegetable Fiber: (Kraft, Waterproofed, Water Repellent and Fire Resistant)

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION, INC. (SMACNA)

SMACNA ASMM	(1993) Architectural Sheet Metal Manual

1.2 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic Contract.

1.2.1 SD-04, Drawings

a. Covering on flat, sloped, or curved surfaces

b. Base flashing

c. Counterflashing

d. Flashing at roof penetrations

e. Flashing for roof scupper

f. Scuppers

g. Downspout

h. Conductor head

Indicate thicknesses, dimensions, fastenings and anchoring methods, expansion joints, and other provisions necessary for thermal expansion and contraction. Scaled manufacturer's catalog data may be submitted for factory fabricated items.

1.2.2 SD-18, Records

Submit Quality Control Plan for sheet metal work as specified in paragraph entitled "Field Quality Control."

1.3 DELIVERY, HANDLING, AND STORAGE

Package and protect materials during shipment. Uncrate and inspect materials for damage, dampness, and wet-storage stains upon delivery to the job site. Remove from the site and replace damaged materials that cannot be restored to like-new condition. Handle sheet metal items to avoid damage to surfaces, edges, and ends. Store materials in dry, weather-tight, ventilated areas until immediately before installation.

PART 2 PRODUCTS

2.1 MATERIALS

Furnish sheet metal items in 8 to 10 foot lengths. Single pieces less than 8 feet long may be used to connect to factory-fabricated inside and outside corners, and at ends of runs. Factory fabricate corner pieces with minimum 12 inch legs. Provide accessories and other items essential to complete the sheet metal installation. These accessories shall be made of the same materials as the items to which they are applied. Fabricate sheet metal items of the materials specified below and to the gage, thickness, or weight shown in Table I at the end of this Section. Sheet metal items shall have mill finish unless specified otherwise. Where more than one material is listed for a particular item in Table I, each is acceptable and may be used.

2.1.1 Exposed Sheet Metal Items

Shall be of the same material. The following items shall be considered as exposed sheet metal: downspouts; flashings and related accessories.

2.1.2 Drainage

Do not use copper for an exposed item if drainage from that item will pass over exposed masonry, stonework or other metal surfaces. In addition to the metals listed in Table I, lead-coated copper may be used for such items.

2.1.3 Aluminum Alloy Sheet and Plate

ASTM B 209, form alloy, and temper appropriate for use.

2.1.3.1 Alclad

When fabricated of aluminum, the following items shall be fabricated of Alclad 3005, clad on both sides.

a. Downspouts, and hangers

b. Conductor head and hangers

2.1.3.2 Finish

Exposed exterior sheet metal items of aluminum shall have a baked-on, factory-applied color coating of polyvinylidene flouride (PVF2) or other equivalent fluorocarbon coating applied after metal substrates have been cleaned and pretreated. Finish coating dry-film thickness shall be to 1.3 mils, and color shall be selected by the Owner.

2.1.4 Through-Wall Flashing

Through-wall flashing for masonry is specified in Section 04200, "Unit Masonry."

2.1.5 Fasteners

Use the same metal or a metal compatible with the item fastened. Use stainless steel fasteners to fasten dissimilar materials.

2.1.6 Stainless Steel

ASTM A 167, Type 302 or 304, 2D Finish, fully annealed, dead-soft temper.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Requirements

Make surfaces to receive sheet metal plumb and true, clean, even, smooth, dry, and free of defects and projections which might affect the application. For installation of items not shown in detail or not covered by specifications conform to the applicable requirements of SMACNA ASMM, Architectural Sheet Metal Manual. Provide sheet metal flashing in the angles formed where roof decks abut walls, curbs, ventilators, pipes, or other vertical surfaces and wherever indicated and necessary to make the work watertight. Join sheet metal items together as shown in Table II.

3.1.2 Workmanship

Make lines, arrises, and angles sharp and true. Free exposed surfaces from visible wave, warp, and buckle, and tool marks. Fold back exposed edges

neatly to form a 1/2 inch hem on the concealed side. Make sheet metal exposed to the weather watertight with provisions for expansion and contraction.

3.1.3 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. Secure one end of the cleat with two nails and the cleat folded back over the nailheads. Lock the other end into the seam. Pretin cleats for soldered seams.

3.1.4 Bolts, Rivets, and Screws

Install bolts, rivets, and screws where indicated or required. Provide compatible washers where required to protect surface of sheet metal and to provide a watertight connection.

3.1.5 Seams

Straight and uniform in width and height with no solder showing on the face.

3.1.5.1 Flat-lock Seams

Finish not less than 3/4 inch wide.

3.1.5.2 Lap Seams

Finish soldered seams not less than one inch wide. Overlap seams not soldered, not less than 3 inches.

3.1.5.3 Flat Seams

Make seams in the direction of the flow.

3.1.6 Soldering

Where soldering is specified, it shall apply to copper, terne-coated stainless steel, zinc-coated steel, and stainless steel items.

3.1.6.1 Edges

Pretin edges of sheet metals before soldering. Slowly solder with well heated soldering irons so as to thoroughly heat the seams and completely sweat the solder through the full width of the seam. Scrape or wire-brush the edges of lead-coated material to be soldered to produce a bright surface. Flux brush the seams in before soldering. Treat with soldering acid flux the edges of stainless steel to be pretinned. Solder immediately after application of the flux. Upon completion of soldering, the acid flux residue shall be thoroughly cleaned from the sheet metal with a solution of washing soda in water and rinsed with clean water. Seal the joints in aluminum sheets of 0.040 inch or less in thickness with specified sealants.

Do not solder aluminum.

3.1.7 Protection from Contact with Dissimilar Materials

3.1.7.1 Metal Surfaces

Paint surfaces in contact with mortar, concrete, or other masonry materials with alkali-resistant coatings such as heavy-bodied bituminous paint.

3.1.7.2 Wood or Other Absorptive Materials

Paint surfaces that may become repeatedly wet and in contact with metal with two coats of aluminum paint or a coat of heavy-bodied bituminous paint.

3.1.8 Base Flashing

Extend up vertical surfaces of the flashing not less than 8 inches and not less than 4 inches under the roof covering. Where finish wall coverings form a counterflashing, extend the vertical leg of the flashing up behind the applied wall covering not less than 6 inches. Overlap the flashing strips with the previously laid flashing not less than 3 inches. Fasten the strips at their upper edge to the deck, with compatible, large-head roofing nails. Solder end laps and provide for expansion and contraction. Extend the metal flashings onto the roof covering not less than 4.5 inches at the lower side of vertical surfaces extending through the roof decks. Install and fit the flashings so as to be completely weathertight. Base flashing for interior and exterior corners shall be factory-fabricated.

3.1.9 Counterflashing

Except where indicated or specified otherwise, insert counterflashing in reglets located from 9 to 10 inches above roof decks, extend down vertical surfaces over upturned vertical leg of base flashings not less than 3 inches. Fold the exposed edges of counterflashings 1/2 inch. Provide end laps in counterflashings not less than 3 inches and make it weathertight with plastic cement. Do not make lengths of metal counterflashings exceed 10 feet. Form the flashings to the required shapes before installation. Factory-form the corners not less than 12 inches from the angle. Secure the flashings in the reglets with lead wedges and space not more than 18 inches apart; on short runs, place wedges closer together. Fill calked-type reglets or raked joints which receive counterflashing with calking compound. Calking is covered in Section 07920, "Sealants." Turn up the concealed edge of counterflashings built into masonry or concrete walls not less than 1/4 inch and extend not less than 2 inches into the walls. Install counterflashing to provide a spring action against base flashing.

3.1.10 Metal Reglets

Calked type or friction type reglets shall be factory fabricated with a minimum opening of 1/4 inch and a depth of 1 1/4 inches, as approved.

3.1.10.1 Calked Reglets

Provide with rounded edges and metal strap brackets or other anchors for securing to the concrete forms. Provide reglets with a core to protect them from injury during the installation. Provide built-up mitered corner pieces for internal and external angles. Wedge the flashing in the reglets with lead wedges every 18 inches, calked full and solid with an approved compound.

3.1.11 Downspouts

Types, shapes and sizes are indicated. Provide complete including elbows and offsets. Provide downspouts in approximately 10 foot lengths. Provide end joints to telescope not less than 1/2 inch and lock logitudinal joints. Provide gutter outlets with wire ball strainers for each outlet. Provide strainers to fit tightly into outlets and be of the same material used for gutters. Keep downspouts not less than one inch away from walls. Fasten to the walls at top, bottom, and at an intermediate point not to exceed 5 feet on centers with leader straps or concealed rack-and-pin type fasteners. Form straps and fasteners of metal compatible with the downspouts.

3.1.11.1 Terminations

Provide downspouts terminating at splash blocks with elbow type fittings.

3.1.12 Scuppers

Line interior of scupper openings with sheet metal. Extend the lining through and project outside of the wall to form a drip on the bottom edge and form to return not less than one inch against the face of the outside wall at the top and sides. Fold outside edges under 1/2 inch on all sides around the perimeter of the scupper. Join the top and sides of the lining on the roof deck side to a closure flange by a locked and soldered joint. Join the bottom edge by a locked and soldered joint to the closure flange, where required, form with a ridge to act as a gravel lining and coat with bituminous plastic cement. Mechanically fasten joints in aluminum and seal.

3.1.13 Conductor Heads

Type indicated and fabricated of the same material as the downspouts. Set the depth of top opening equal to two-thirds of the width. Provide outlet tubes not less than 4 inches long. Flat-lock solder the seams except the mechanically fastened aluminum joints filled with a hard setting sealant. Where conductor heads are used in conjunction with scuppers, set the conductor a minimum of 2 inches wider than the scupper. Attach conductor heads to the wall with masonry fasteners, and loose-lock to provide conductor heads with screens of the same material. Securely fasten screens to the heads.

3.1.14 Expansion Joints

Provide expansion joints for roofs, walls, and floors where indicated and conform to the requirements of Table I.

3.1.15 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.

3.1.15.1 Single Pipe Vents

See Table I, footnote (d) of this specification section. Set flange of sleeve in bituminous plastic cement and nail 3 inches on centers. Bend the top of sleeve over and extend down into the vent pipe a minimum of 2 inches. For long runs or long rises above the deck, where it is impractical to cover the vent pipe with lead, use a two-piece formed metal housing. Set metal housing with a metal sleeve having a 4 inch roof flange in bituminous plastic cement and nailed 3 inches on centers. Extend sleeve a minimum of 8 inches above the roof deck and lapped a minimum of 3 inches by a metal hood secured to the vent pipe by a draw band. Seal the area of hood in contact with vent pipe with an approved sealant. Sealants are covered under Section 07920, "Sealants."

3.2 PAINTING

Field-paint sheet metal for separation of dissimilar materials. Finish painting is specified in Section 09900, "Painting."

3.3 CLEANING

Clean exposed sheet metal work at completion of installation. Remove grease and oil films, handling marks, contamination from steel wool, fittings and drilling debris, and scrub-clean. Free the exposed metal surfaces of dents, creases, waves, scratch marks, and solder or weld marks.

3.4 REPAIRS TO FINISH

Scratches, abrasions, and minor surface defects of finish may be repaired in accordance with the manufacturer's printed instructions and as approved. Repair damaged surfaces caused by scratches, blemishes, and variations of color and surface texture. Replace items which cannot be repaired.

3.5 FIELD QUALITY CONTROL

Establish and maintain a quality control procedure for sheet metal used in conjunction with roofing to assure compliance of the installed sheet metalwork with the contract requirements. Work not in compliance with the contract shall be promptly removed and replaced or corrected. Quality control shall include, but not be limited to, the following:

a. Observation of environmental conditions; number and skill level of sheet metal workers; condition of substrate.

b. Verification of compliance before, during, and after installation.

c. Inspection of sheet metalwork, for proper size and thickness, fastening and joining, and proper installation.

3.5.1 Procedure

Submit for approval prior to start of roofing work. Include a checklist of points to be observed. Document the actual quality control observations and inspections. Furnish a copy of the documentation to the NTR at the end of each day.

TABLE I. SHEET METAL WEIGHTS, THICKNESSES, AND GAGES

Sheet Metal Items	Copper, kilograms Per Square meter	Aluminum, mm	Stainless Steel, mm	Terne-Coated Stainless Steel, mm	Zinc-Coated Steel, mm
Downspouts and leaders.....	16	.032	.015	.015	24
Downspout clips and anchors.....	-	.040 clip	-	-	-
	-	.125 anchor	-	-	-
Conductor heads	16	.032	.015	.015	-
Scupper lining.....	6.125	0.81	0.38	0.38	-
Flashings:					
Base.....	6.125	1.02	0.46	0.46	0.6
Cap (Counter-flashing)	4.9	0.81	0.38	0.38	0.5
Bond barrier.....	4.9	-	0.38	0.38	-
Flashings:					
Base.....	20	.040	.018	.018	24
Cap (Counter-flashing)	16	.032	.015	.015	26
Bond barrier.....	16	-	.015	.015	-

TABLE II. SHEET METAL JOINTS

TYPE OF JOINT

Item Designation	Copper, Terne-Coated Stainless Steel, Zinc-Coated Steel and Stainless Steel	Aluminum	Remarks
Flashings			
Base		One inch (25.4 mm) flat locked, soldered; sealed; 3 inch lap for expansion joint	Aluminum producer's recommended hard setting sealant for locked aluminum joints. Fill each metal expansion joint with a joint sealing compound. See Section 07920, "Joint Sealants."
Cap-in reglet		3 inch lap	Seal groove with joint sealing compound. See Section 07920, "Joint Sealants."
Reglets			Seal reglet groove with joint sealing compound. See Section 07920, "Joint Sealants."

-- End of Section --

SECTION 07920

SEALANTS

03/95

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 834	(1991) Latex Sealants
ASTM C 920	(1987) Elastomeric Joint Sealants

1.2 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic Contract.

1.2.1 SD-02, Manufacturer's Catalog Data

a. Sealants G

b. Primers

c. Bond breakers

d. Backstops

Data for the sealants shall include shelf life, recommended cleaning solvents, and color.

1.3 ENVIRONMENTAL CONDITIONS

The ambient temperature shall be within the limits of 40 and 100 degrees F when sealant is applied.

1.4 DELIVERY AND STORAGE

Deliver materials to the job site in unopened manufacturers' external shipping containers, with brand names, date of manufacture, color, and material designation clearly marked thereon. Elastomeric sealant containers shall be labeled to identify type, class, grade, and use. Carefully handle and store materials to prevent inclusion of foreign materials or subjection to sustained temperatures exceeding 100 F degrees or less than 40 degrees F.

PART 2 PRODUCTS

2.1 SEALANTS

Provide sealant that has been tested and found suitable for the substrates to which it will be applied.

2.1.1 Interior Sealant

ASTM C 920, Type S or M, Grade NS, Class 12.5, Use NT. Location(s) and color(s) of sealant shall be as follows:

	LOCATION	COLOR
a.	Small voids between walls and door frames, built-in or surface-mounted equipment and fixtures, and similar items.	As selected
b.	Perimeter of frames at doors, which adjoin exposed interior concrete and masonry surfaces.	As selected
c.	Interior locations, not otherwise indicated or specified, where small voids exist between materials specified to be painted.	As selected

2.1.2 Exterior Sealant

For joints in vertical surfaces, provide ASTM C 920, Type S or M, Grade NS, Class 25, Use NT. For joints in horizontal surfaces, provide ASTM C 920, Type S or M, Grade P, Class 25, Use T. Location(s) and color(s) of sealant shall be as follows:

	LOCATION	COLOR
a.	Joints and recesses formed where frames and subsills of doors, louvers, and vents adjoin masonry, concrete, or metal frames. Use sealant at both exterior and interior surfaces of exterior wall penetrations.	Match adjacent surface color
b.	Masonry joints where shelf angles occur.	Match adjacent surface color
c.	Joints in wash surfaces of stonework.	Match adjacent surface color
d.	Voids where items pass through exterior walls.	Match adjacent surface color
e.	Metal-to-metal joints where sealant is indicated or specified.	Match adjacent surface color

2.1.3 Floor Joint Sealant

ASTM C 920, Type S or M, Grade P, Class 25, Use T. Location(s) and color(s) of sealant shall be as follows:

LOCATION	COLOR
a. Seats of metal thresholds for exterior doors.	As selected
b. Control and expansion joints in floors, slabs, ceramic tile, and walkways.	As selected

2.2 PRIMERS

Provide a nonstaining, quick-drying type and consistency recommended by the sealant manufacturer for the particular application.

2.3 BOND BREAKERS

Provide the type and consistency recommended by the sealant manufacturer for the particular application.

2.4 BACKSTOPS

Provide glass fiber roving or neoprene, butyl, polyurethane, or polyethylene foams free from oil or other staining elements as recommended by sealant manufacturer. Backstop material shall be compatible with sealant. Do not use oakum and other types of absorptive materials as backstops.

2.5 CLEANING SOLVENTS

Provide type(s) recommended by the sealant manufacturer except for aluminum and bronze surfaces that will be in contact with sealant.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Surfaces shall be clean, dry to the touch, and free from dirt frost, moisture, grease, oil, wax, lacquer, paint, or other foreign matter that would tend to destroy or impair adhesion. When resealing an existing joint, remove existing calk or sealant prior to applying new sealant.

3.1.1 Steel Surfaces

Remove loose mill scale by sandblasting or, if sandblasting is impractical or would damage finish work, scraping and wire brushing. Remove protective coatings by sandblasting or using a residue-free solvent.

3.1.2 Aluminum 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. For removing protective coatings and final cleaning, use nonstaining solvents recommended by the manufacturer of the item(s) containing aluminum or bronze surfaces.

3.2 SEALANT PREPARATION

Do not add liquids, solvents, or powders to the sealant. Mix multicomponent elastomeric sealants in accordance with manufacturer's instructions.

3.3 APPLICATION

3.3.1 Joint Width-To-Depth Ratios

a. Acceptable Ratios:

JOINT WIDTH	JOINT DEPTH Minimum	JOINT DEPTH Maximum
For metal, glass, or other nonporous surfaces:		
1/4 inch (minimum)	1/4 inch	1/4 inch
over 1/4 inch	1/2 of width	Equal to width
For wood, concrete, masonry, stone:		
1/4 inch (minimum)	1/4 inch	1/4 inch
Over 1/4 inch to 1/2 inch	1/4 inch	Equal to width
Over 1/2 inch to 2 inches	1/2 inch	5/8 inch
Over 2 inches	(As recommended by sealant manufacturer)	

b. Unacceptable Ratios: Where joints of acceptable width-to-depth ratios have not been provided, clean out joints to acceptable depths and grind or cut to acceptable widths without damage to the adjoining work. Grinding shall not be required on metal surfaces.

3.3.2 Backstops

Install backstops dry and free of tears or holes. Tightly pack the back or bottom of joint cavities with backstop material to provide a joint of the depth specified. Install backstops in the following locations:

a. Where indicated.

b. Where backstop is not indicated but joint cavities exceed the acceptable maximum depths specified in paragraph entitled, "Joint Width-to-Depth Ratios."

3.3.3 Primer

Immediately prior to application of the sealant, clean out loose particles from joints. Where recommended by sealant manufacturer, apply primer to joints in concrete masonry units, wood, and other porous surfaces in accordance with sealant manufacturer's instructions. Do not apply primer to exposed finish surfaces.

3.3.4 Bond Breaker

Provide bond breakers to the back or bottom of joint cavities, as recommended by the sealant manufacturer for each type of joint and sealant used, to prevent sealant from adhering to these surfaces. Carefully apply the bond breaker to avoid contamination of adjoining surfaces or breaking bond with surfaces other than those covered by the bond breaker.

3.3.5 Sealants

Provide a sealant compatible with the material(s) to which it is applied. Do not use a sealant that has exceeded shelf life or has jelled and can not be discharged in a continuous flow from the gun. Apply the sealant in accordance with the manufacturer's instructions with a gun having a nozzle that fits the joint width. Force sealant into joints to fill the joints solidly without air pockets. Tool sealant after application to ensure adhesion. Sealant shall be uniformly smooth and free of wrinkles. Upon completion of sealant application, roughen partially filled or unfilled joints, apply sealant, and tool smooth as specified.

3.4 PROTECTION AND CLEANING

3.4.1 Protection

Protect areas adjacent to joints from sealant smears. Masking tape may be used for this purpose if removed 5 to 10 minutes after the joint is filled.

3.4.2 Final Cleaning

Upon completion of sealant application, remove remaining smears and stains and leave the work in a clean and neat condition.

a. Masonry and Other Porous Surfaces: Immediately scrape off fresh sealant that has been smeared on masonry and rub clean with a solvent as recommended by the sealant manufacturer. Allow excess sealant to cure for 24 hour then remove by wire brushing or sanding.

b. Metal and Other Non-Porous Surfaces: Remove excess sealant with a solvent-moistened cloth.

-- End of Section --

SECTION 08110

STEEL DOORS AND FRAMES

03/95

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 526/A 526M	(1990) Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Commercial Quality
ASTM A 591/A 591M	(1989; R 1994) Steel Sheet, Electrolytic Zinc-Coated, for Light Coating Mass Applications
ASTM C 591	(1985) Unfaced Preformed Rigid Cellular Polyurethane Thermal Insulation
ASTM D 2863	(1991) Measuring the Minimum Oxygen Concentration to Support Candle-Like Combustion of Plastics (Oxygen Index)

MILITARY SPECIFICATIONS (MIL)

MIL-P-21035	(Rev. B) Paint, High Zinc Dust Content, Galvanizing Repair (Metric)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80	(1992) Fire Doors and Fire Windows
NFPA 105	(1993) Smoke-Control Door Assemblies
NFPA 252	(1990) Fire Tests of Door Assemblies

STEEL DOOR INSTITUTE (SDI)

ANSI/SDI 100	(1991) Standard Steel Doors and Frames
SDI 105	(1992) Recommended Erection Instructions for Steel Frames
SDI 107	(1984) Hardware on Steel Doors (Reinforcement - Application)
SDI 111F	Recommended Completed Opening Anchors for

Standard Steel Doors and Frames

ANSI/SDI A151.1	(1987) Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors and Hardware Reinforcings

1.2 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic Contract.

1.2.1 SD-02, Manufacturer's Catalog Data

a. Doors

b. Frames

c. Weatherstripping

Submit manufacturer's descriptive literature for doors, frames, and accessories. Include data and details on door construction, panel (internal) reinforcement, insulation, and door edge construction. When "custom hollow metal doors" are provided in lieu of "standard steel doors," provide additional details and data sufficient for comparison to ANSI/SDI 100 requirements.

1.2.2 SD-03, Manufacturer's Standard Color Charts

a. Factory-applied enamel finish G

Where colors are not indicated, submit manufacturer's standard colors and patterns to the NTR for selection.

1.2.3 SD-04, Drawings

a. Doors G

b. Frames

c. Accessories

Show elevations, construction details, metal gages, hardware provisions, method of glazing, and installation details.

1.2.4 SD-07, Schedules

a. Doors G

b. Frames

Submit door and frame locations.

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver doors, frames, and accessories undamaged and with protective wrappings or packaging. Provide temporary steel spreaders securely fastened to the bottom of each welded frame. Store doors and frames on platforms under cover in clean, dry, ventilated, and accessible locations, with 1/4-inch airspace between doors. Remove damp or wet packaging immediately and wipe affected surfaces dry. Replace damaged materials with new.

PART 2 PRODUCTS

2.1 STANDARD STEEL DOORS

ANSI/SDI 100, except as specified otherwise. Prepare doors to receive hardware specified in Section 08710, "Finish Hardware." Undercut where indicated. Exterior doors shall have top edge closed flush and sealed to prevent water intrusion. Doors shall be 1 3/4 inches thick, unless otherwise indicated.

2.2 ACCESSORIES

2.2.1 Astragals

For pairs of exterior steel doors which will not have aluminum astragals or removable mullions, as specified in Section 08710, "Finish Hardware," provide overlapping steel astragals with the doors.

2.3 INSULATION CORES

Insulated cores shall be of type specified, shall provide maximum assembly U-value of .48 in accordance with SDI 113 and shall conform to:

a. Rigid Polyurethane Foam: ASTM C 591, Type 1 or 2, foamed-in-place or in board form, with oxygen index of not less than 22 percent when tested in accordance with ASTM D 2863; or

2.4 STANDARD STEEL FRAMES

ANSI/SDI 100, except as otherwise specified. Form frames to sizes and shapes indicated, with welded corners. Provide steel frames for doors unless otherwise indicated.

2.4.1 Welded Frames

Continuously weld frame faces at corner joints. Mechanically interlock or continuously weld stops and rabbets. Grind welds smooth.

2.4.2 Stops and Beads

Form stops and beads from 20-gage steel. Provide for glazed and other openings in standard steel frames. Secure beads to frames with oval-head, countersunk Phillips self-tapping sheet metal screws or concealed clips and fasteners. Space fasteners approximately 12 to 16 inches on centers. Miter molded shapes at corners. Butt or miter square or rectangular beads at corners.

2.4.3 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.

2.4.3.1 Wall Anchors

Provide at least three anchors for each jamb. For frames which are more than 7.5 feet in height, provide one additional anchor for each jamb for each additional 2.5 feet or fraction thereof.

a. Masonry: Provide anchors of corrugated or perforated steel straps or 3/16 inch diameter steel wire, adjustable or T-shaped;

2.5 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 SDI 107 and ANSI/DHI A115. Drill and tap for surface-applied hardware at the project site. Build additional reinforcing for surface-applied hardware into the door at the factory. Locate hardware in accordance with the requirements of ANSI/SDI 100, as applicable. Punch door frames, with the exception of frames that will have weatherstripping gasketing, to receive a minimum of two rubber or vinyl door silencers on lock side of single doors and one silencer for each leaf at heads of double doors. Set lock strikes out to provide clearance for silencers.

2.6 FINISHES

2.6.1 Factory-Primed Finish

Unless specified otherwise, phosphate treat and factory prime metal doors and frames as specified in ANSI/SDI 100. , or paintable A25 galvannealed steel without primer. Where coating is removed by welding, apply touchup of factory primer.

2.6.2 Hot-Dip Zinc-Coated and Factory-Primed Finish

Fabricate doors, frames and louvers from galvanized steel, ASTM A 526/A 526M, Coating Designation G90. Repair damaged zinc-coated surfaces by the application of zinc dust paint conforming to MIL-P-21035. Phosphate treat and factory prime zinc-coated surfaces as specified in ANSI/SDI 100. Provide for door openings as indicated.

2.7 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.

2.7.1 Grouted Frames

For frames to be installed in exterior walls and to be filled with mortar or grout, fill the stops with strips of rigid insulation to keep the grout out of the stops and to facilitate installation of stop-applied head and jamb seals.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Frames

Set frames in accordance with SDI 105. Plumb, align, and brace securely until permanent anchors are set. Anchor bottoms of frames with expansion bolts or powder-actuated fasteners. Build in or secure wall anchors to adjoining construction. Backfill frames with mortar. When an additive is provided in the mortar, coat inside of frames with corrosion-inhibiting bituminous material. For frames in exterior walls, ensure that stops are filled with rigid insulation before grout is placed.

3.1.2 Doors

Hang doors in accordance with clearances specified in ANSI/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 rusted frames until rust is removed. Clean thoroughly. Apply an all-over coat of rust-inhibitive paint of the same type used for shop coat.

3.3 CLEANING

Upon completion, clean exposed surfaces of doors and frames thoroughly. Remove mastic smears and other unsightly marks.

-- End of Section --

SECTION 08710

FINISH HARDWARE

03/95

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 283	(1991) Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM F 883	(1990) Padlocks

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION, INC. (BHMA)

ANSI/BHMA A156.1	(1988) Butts and Hinges (BHMA 101)
ANSI/BHMA A156.2	(1989) Bored and Preassembled Locks and Latches (BHMA 601)
ANSI/BHMA A156.3	(1989) Exit Devices (BHMA 701)
ANSI/BHMA A156.4	(1992) Door Controls - Closers
ANSI/BHMA A156.5	(1992) Auxiliary Locks & Associated Products
ANSI/BHMA A156.6	(1994) Architectural Door Trim (BHMA 1001)
ANSI/BHMA A156.7	(1988) Template Hinge Dimensions
ANSI/BHMA A156.8	(1988) Door Controls - Overhead Holders (BHMA 311)
ANSI/BHMA A156.12	(1992) Interconnected Locks & Latches (BHMA 611)
ANSI/BHMA A156.13	(1987) Mortise Locks & Latches (BHMA 621)
ANSI/BHMA A156.15	(1986) Closer Holder Release Devices (BHMA 321)
ANSI/BHMA A156.16	(1989) Auxiliary Hardware (BHMA 1201)

ANSI/BHMA A156.17 (1993) Self Closing Hinges & Pivots

ANSI/BHMA A156.18 (1993) Materials and Finishes (BHMA 1301)

ANSI/BHMA A156.21 (1989) Thresholds

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101 (1994) Code for Safety to Life from Fire in Buildings and Structures

STEEL DOOR INSTITUTE (SDI)

ANSI/SDI 100 (1991) Standard Steel Doors and Frames

1.2 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the basic Contract.

1.2.1 SD-02, Manufacturer's Catalog Data

a. Hardware items G

1.2.2 SD-06, Instructions

a. Installation

1.2.3 SD-07, Schedules

a. Hardware schedule G

b. Keying system

1.2.3.1 Hardware Schedule

Prepare and submit hardware schedule in the following form:

Hardware Item	Quantity	Size	Reference Publication Type No.	Finish	Mfr. Name and Catalog No.	Key Control Symbols	UL Mark (If fire rated and listed)	ANSI/BHMA Finish Designation

1.2.4 SD-18, Records

a. Key bitting

1.2.5 SD-19, Operation and Maintenance Manuals

a. Hardware Schedule items, Data Package 1

Submit data package in accordance with Section 01730, "Operation and

Maintenance Data."

1.3 QUALITY ASSURANCE

1.3.1 Hardware Manufacturers and Modifications

Provide, as far as feasible, locks, hinges, and closers of one lock, hinge, or closer manufacturer's make. Modify hardware as necessary to provide features indicated or specified.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver hardware in original individual containers, complete with necessary appurtenances including fasteners and instructions. Mark each individual container with item number as shown in hardware schedule. Deliver permanent keys and removable cores to the NTR, either directly or by certified mail. Deliver construction master keys with the locks.

PART 2 PRODUCTS

2.1 TEMPLATE HARDWARE

Hardware to be applied to metal prefinished doors shall be made to template. Promptly furnish template information or templates to door and frame manufacturers. Template hinges shall conform to ANSI/BHMA A156.7. Coordinate hardware items to prevent interference with other hardware.

2.2 HARDWARE FOR EXIT DOORS

Provide all hardware necessary to meet the requirements of NFPA 101 for exit doors, as well as to other requirements specified, even if such hardware is not specifically mentioned under paragraph entitled, "Hardware Schedule."

2.3 HARDWARE ITEMS

Hinges, pivots, locks, latches, exit devices, bolts, and closers shall be clearly and permanently marked with the manufacturer's name or trademark where it will be visible after the item is installed. For closers with covers, the name or trademark may be beneath the cover.

2.3.1 Hinges

ANSI/BHMA A156.1, 5 by 4 1/2 inches heavy weight unless otherwise specified. Construct loose pin hinges for exterior doors and reverse-bevel interior doors so that pins will be nonremovable when door is closed. Other antifriction bearing hinges may be provided in lieu of ball-bearing hinges.

2.3.2 Locks and Latches

2.3.2.1 Mortise Locks and Latches

ANSI/BHMA A156.13, Series 1000, Operational Grade 1, Security Grade 2. Provide mortise locks with escutcheons not less than 7 by 2 1/4 inches with a bushing at least 1/4 inch long. Cut escutcheons to suit cylinders and provide trim items with straight, beveled, or smoothly rounded sides, corners, and edges. Knobs and roses of mortise locks shall have screwless shanks and no exposed screws.

2.3.3 Cylinders and Cores

Provide cylinders and cores for new locks, including locks provided under other sections of this specification. Cylinders and cores shall have seven pin tumblers. Cylinders shall be products of one manufacturer, and cores shall be the products of one manufacturer. Rim cylinders, mortise cylinders, and knobs of bored locksets shall have interchangeable cores which are removable by special control keys. Stamp each interchangeable core with a key control symbol in a concealed place on the core.

2.3.4 Keying System

Provide an extension of the existing keying system.

2.3.5 Lock Trim

Cast, forged, or heavy wrought construction and commercial plain design.

2.3.5.1 Knobs and Roses

In addition to meeting test requirements of ANSI/BHMA A156.2 and ANSI/BHMA A156.13, knobs, roses, and escutcheons shall be 0.050 inch thick if unreinforced. If reinforced, outer shell shall be 0.035 inch thick and combined thickness shall be 0.070 inch, except knob shanks shall be 0.060 inch thick.

2.3.6 Keys

Furnish one file key, one duplicate key, and one working key for each key change. Stamp each key with appropriate key control symbol and "U.S. property - Do not duplicate." Do not place room number on keys.

2.3.7 Overhead Holders

ANSI/BHMA A156.8.

2.3.8 Door Protection Plates

ANSI/BHMA A156.6.

2.3.8.1 Sizes of Kick Plates

Width for single doors shall be 2 inches less than door width; width for pairs of doors shall be one inch less than door width. Height of kick plates shall be 10 inches for flush doors.

2.3.9 Door Silencers

ANSI/BHMA A156.16. Silencers Type L03011. Provide three silencers for each single door, two for each pair.

2.3.10 Thresholds

ANSI/BHMA A156.21. Use J35100, with vinyl or silicone rubber insert in face of stop, for exterior doors opening out, unless specified otherwise.

2.3.11 Weather Stripping

A set shall include head and jamb seals, sweep strips, and, for pairs of doors, astragals. Air leakage of weather stripped doors shall not exceed 1.25 cubic feet per minute of air per square foot of door area when tested in accordance with ASTM E 283. Weather stripping shall be one of the following:

2.3.12 Special Tools

Provide special tools, such as spanner and socket wrenches and dogging keys, required to service and adjust hardware items.

2.4 FASTENERS

Provide fasteners of proper type, quality, size, quantity, and finish with hardware. Fasteners exposed to weather shall be of nonferrous metal or stainless steel. Provide fasteners of type necessary to accomplish a permanent installation.

2.5 FINISHES

ANSI/BHMA A156.18. Hardware shall have BHMA 630 finish (satin stainless steel), unless specified otherwise. Provide items not manufactured in stainless steel in BHMA 626 finish (satin chromium plated) over brass or bronze, except surface door closers which shall have aluminum paint finish, and except steel hinges which shall have BHMA 652 finish (satin chromium plated) BHMA 600 finish (primed for painting). Hinges for exterior doors shall be stainless steel with BHMA 630 finish or chromium plated brass or bronze with BHMA 626 finish.

PART 3 EXECUTION

3.1 INSTALLATION

Install hardware in accordance with manufacturers' printed instructions. Fasten hardware to wood surfaces with full-threaded wood screws or sheet metal screws. Provide machine screws set in expansion shields for fastening hardware to solid concrete and masonry surfaces. Provide toggle bolts where required for fastening to hollow core construction. Provide through bolts where necessary for satisfactory installation.

3.1.1 Weather Stripping Installation

Handle and install weather stripping so as to prevent damage. Provide full contact, weather-tight seals. Doors shall operate without binding.

3.1.1.1 Stop-Applied Weather Stripping

Fasten in place with color-matched sheet metal screws not more than 9 inches o.c. after doors and frames have been finish painted.

3.1.2 Threshold Installation

Extend thresholds the full width of the opening and notch end for jamb stops. Set thresholds in a full bed of sealant and anchor to floor with cadmium-plated, countersunk, steel screws in expansion sleeves.

3.2 HARDWARE LOCATIONS

ANSI/SDI 100, unless indicated or specified otherwise.

a. Kick and Armor Plates: Push side of single-acting doors.

3.3 FIELD QUALITY CONTROL

After installation, protect hardware from paint, stains, blemishes, and other damage until acceptance of work. Submit notice of testing 15 days before scheduled, so that testing can be witnessed by the Contracting Officer. Adjust hinges, locks, latches, bolts, holders, closers, and other items to operate properly. Demonstrate that permanent keys operate respective locks, and give keys to the NTR. Correct, repair, and finish, as directed, errors in cutting and fitting and damage to adjoining work.

3.4 HARDWARE SETS

LIST OF HARDWARE SETS

HW-1 (Door 1 each pair)

3 Pair Hinges	A2112 x 626 x NRP
2 Locksets	F04 X 630
1 Removable Mullion	Type 22
2 Overhead Holders	C12511 X 626
2 Kick Plates	J102 x 630
1 Threshold	Type 26 x insert
1 Set Weatherstripping	As specified

-- End of Section --

SECTION 09900

PAINTING

09/95

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)

ACGIH TLV-BKLT	(1991-1992) Threshold Limit Values (TLVs) for Chemical Substances and Physical Agents and Biological Exposure Indices (BEIs)
ACGIH TLV-DOC	Documentation of Threshold Limit Values and Biological Exposure Indices, Sixth Edition

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 669	(1994) Glazing Compounds for Back Bedding and Face Glazing of Metal Sash
ASTM C 920	(1994) Elastomeric Joint Sealants
ASTM D 2092	(1986; R 1993) Preparation of Zinc-Coated (Galvanized) Steel Surfaces for Painting
ASTM D 4214	(1989) Evaluating Degree of Chalking of Exterior Paint Films
ASTM D 4263	(1983; R 1993) Indicating Moisture in Concrete by the Plastic Sheet Method

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910.1000	Air Contaminants
29 CFR 1910.1001	Asbestos, Tremolite, Anthophyllite, and Actinolite
29 CFR 1910.1025	Lead
29 CFR 1926.62	Lead Exposure in Construction

COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-341	(Rev. A) Pigment, Aluminum, Powder and Paste

CID A-A-1500	(Rev. A) Sealer, Surface (Latex Block Filler)
CID A-A-1558	(Rev. A) Paint, Stencil

FEDERAL STANDARDS (FED-STD)

FED-STD-313	(Rev. C) Material Safety Data, Transportation Data and Disposal Data for Hazardous Materials Furnished to Government Activities

FEDERAL SPECIFICATIONS (FS)

FS TT-P-19	(Rev. D; Am. 1) Paint, Latex (Acrylic Emulsion, Exterior Wood and Masonry)
FS TT-P-28	(Rev. G) Paint, Aluminum, Heat Resisting (1200 DEG. F)
FS TT-P-29	(Rev. K) Paint, Latex Base, Interior, Flat, White and Tints
FS TT-P-38	(Rev. E) Paint, Aluminum (Ready-Mixed)
FS TT-V-81	(Rev. G) Varnish: Mixing, for Aluminum Paint
FS TT-P-95	(Rev. C; Am. 1) Paint, Rubber: For Swimming Pools and Other Concrete and Masonry Surfaces
FS TT-P-102	(Rev. F) Paint, Oil (Alkyd Modified, Exterior, White and Tints)
FS TT-V-119	(Rev. D; Am. 2) Varnish, Spar, Phenolic-Resin
FS TT-S-176	(Rev. E; Am. 1) Sealer, Surface, Varnish Type, Floor, Wood and Cork
FS TT-T-291	(Rev. F; Am. 2) Thinner, Paint, Mineral Spirits, Regular and Odorless
FS TT-E-487	(Rev. E; Am. 1) Enamel: Floor and Deck
FS TT-E-489	(Rev. J) Enamel, Alkyd, Gloss, Low VOC Content
FS TT-C-498	(Rev. C) Coating Compound, Bituminous, Fillers, Solvent Type, Aluminum Pigmented
FS TT-E-505	(Rev. B) Enamel (Odorless, Alkyd, Interior, High Gloss)

FS TT-E-509	(Rev. C) Enamel, Odorless, Alkyd, Interior, Semigloss, White and Tints
FS TT-C-542	(Rev. E) Coating, Polyurethane, Oil-Free, Moisture Curing
FS TT-E-545	(Rev. C) Primer, (Enamel-Undercoat, Alkyd, Odorless, Interior, Flat, Tints and White)
FS TT-C-555	(Rev. B; Am. 1) Coating, Textured (for Interior and Exterior Masonry Surfaces)
FS TT-P-645	(Rev. B) Primer, Paint, Zinc-Molybdate, Alkyd Type
FS TT-P-650	(Rev. D) Primer Coating, Latex Base, Interior, White (for Gypsum Wallboard or Plaster)
FS TT-P-664	(Rev. D) Primer Coating, Alkyd, Corrosion-Inhibiting, Lead and Chromate Free, VOC-Compliant
FS TT-S-708	(Rev. A; Am. 2) Stain, Oil: Semi-Transparent, Wood, Exterior
FS TT-S-711	(Rev. C) Stain; Oil Type, Wood, Interior
FS TT-P-00791	(Rev. B; Am. 2) Putty: Linseed Oil Type, (For Wood-Sash-Glazing)
FS TT-P-1511	(Rev. B) Paint, Latex (Gloss and Semigloss, Tints and White) (for Interior Use)
FS TT-E-1593	(Rev. B) Enamel, Silicone Alkyd Copolymer, Gloss (For Exterior and Interior Use)
FS TT-P-001984	Primer Coating, Latex Base, Exterior (Undercoat for Wood), White and Tints
FS TT-S-001992	Stain, Latex, Exterior for Wood Surfaces
FS TT-P-002119	Paint, Latex-Base, High-Traffic Area, Flat and Eggshell Finish (Low Lustre), (for Interior Use)

MILITARY SPECIFICATIONS (MIL)

MIL-P-24441	(Rev. B; Supp. 1) Paint, Epoxy-Polyamide
MIL-E-24635	(Rev. A) Enamel, Silicone Alkyd Copolymer

	(Metric)
DOD-P-24648	(Am. 1) Primer Coating, Zinc Dust Pigmented for Exterior Steel Surfaces (Metric)
MIL-C-24667	(Rev. A) Coating System, Nonskid, for Roll or Spray Application (Metric)
MIL-P-28577	(Rev. B) Primer, Water-Borne, Acrylic or Modified Acrylic, for Metal Surfaces
MIL-P-28578	(Rev. B) Paint, Water-Borne, Acrylic or Modified Acrylic, Semigloss, for Metal Surfaces
MIL-P-28582	Primer Coating, Exterior, Lead Pigment-Free (Undercoat for Wood, Ready-Mixed, White and Tints)
MIL-C-83286	(Rev. B) Coating Urethane, Aliphatic Isocyanate, for Aerospace Applications
MIL-C-85285	(Rev. B; Am. 2) Coatings: Polyurethane, High-Solids

MILITARY STANDARDS (MIL-STD)

MIL-STD-101	(Rev. B) Color Code for Pipelines and for Compressed Gas Cylinders

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC Guide 6I (CON)	(1992) Containing Debris Generated During Paint Removal Operations
SSPC Guide 7I (DIS)	(1992) Disposal of Lead-Contaminated Surface Preparation Debris
SSPC QP 1	(1989) Evaluating Qualifications of Painting Contractors (Field Application to Complex Structures)
SSPC PA 1	(1991) Shop, Field, and Maintenance Painting
SSPC PA 3	(1991) Safety in Paint Application
SSPC VIS 1	(1989) Visual Standard for Abrasive Blast Cleaned Steel (Standard Reference Photographs)
SSPC SP 1	(1982) Solvent Cleaning
SSPC SP 2	(1989) Hand Tool Cleaning

SSPC SP 3	(1989) Power Tool Cleaning
SSPC SP 6	(1991) Commercial Blast Cleaning
SSPC SP 7	(1991) Brush-Off Blast Cleaning
SSPC SP 10	(1991) Near-White Blast Cleaning
SSPC Paint 20	(1991) Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic")

1.2 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic Contract.

1.2.1 SD-02, Manufacturers Catalog Data

a. Coating G

b. Sealant

1.2.1.1 Requirements

For each type of coating, sealant, or other product furnished:

a. Submit data from the manufacturer's paint laboratory indicating that the product conforms to requirements of the referenced specification.

1.2.2 SD-06, Instructions

a. Application instructions

b. Manufacturer's material safety data sheets

Submit Manufacturer's material safety data sheets for coatings, solvents, and other potentially hazardous materials, as defined in FED-STD-313.

1.2.3 SD-07, Schedules

a. Piping identification

Submit color stencil codes.

1.2.4 SD-08, Statements

a. Applicator's qualifications

b. Evidence of acceptable variation G

1.2.4.1 Applicator's Qualifications

Submit evidence that Contractor or his subcontractor has satisfactorily applied paint by airless spray at minimum of two sites. Indicate names and locations of sites, and type and design of equipment used, including safety devices.

1.2.4.2 Evidence of Acceptable Variation

If a product proposed for use does not conform to requirements of the referenced specification, submit for approval to the NTR, evidence from the paint manufacturer's laboratory that the proposed product is either equal to or better than the product specified. The submittal shall include the following:

a. Identification of the proposed substitute;

b. Reason why the substitution is necessary;

c. A comparative analysis of the specified product and the proposed substitute, including tabulations of the composition of pigment and vehicle;

d. The differences between the specified product and the proposed substitute; and

e. Other information necessary for an accurate comparison of the proposed substitute and the specified product.

1.2.5 SD-14, Samples

a. Color G

Submit manufacturer's samples of paint colors. Cross reference color samples to color scheme as indicated.

1.3 QUALITY ASSURANCE

1.3.1 Qualifications of Airless Spray Applicators

Satisfactory application of paint by airless spray at a minimum of two sites.

1.3.2 Field Samples and Tests

The Government will take one pint samples of paint at random from the products delivered to the job site and test them to verify that the products either conform to the referenced specifications or the approved substitution. Products which do not conform shall be removed from the job site and replaced with new products that conform to the referenced specification or the approved substitution.

1.4 REGULATORY REQUIREMENTS

1.4.1 Lead Content

Do not use coatings having a lead content over 0.06 percent by weight of nonvolatile content.

1.4.2 Chromate Content

Do not use coatings containing zinc-chromate or strontium-chromate.

1.4.3 Asbestos Content

Materials shall not contain asbestos.

1.4.4 Mercury Content

Materials shall not contain mercury or mercury compounds.

1.4.5 Silica Sand

The use of silica sand is prohibited.

1.5 PACKAGING, LABELING, AND STORAGE

Paints shall be in sealed containers that legibly show the contract specificaiton number, designation name, formula or specificaiton number, batch number, color, quantity, date of manufacture, manufacturer's formulation number, manufacturer's directions including any warnings and special precautions, and name and address of manufacturer. Pigmented paints shall be furnished in containers not larger than 5 gallons. Paints and thinners shall be stored in accordance with the manufacturer's written directions, and as a minimum, stored off the ground, under cover, with sufficient ventilation to prevent the buildup of flammable vapors, and at temperatures between 40 to 95 degrees F.

1.6 SAFETY METHODS

Apply coating materials using safety methods and equipment in accordance with the following:

1.6.1 Safety Methods Used During Coating Application

Comply with the requirements of SSPC PA 3.

1.6.2 Toxic Materials

To protect personnel from overexposure to toxic materials, conform to the most stringent guidance of:

a. The chemical manufacturer when using mineral spirits, or other chemicals. Use impermeable gloves, chemical goggles or faceshield, and other recommended protective clothing and equipment to avoid exposure of skin, eyes, and respiratory system. Conduct work in a manner to minimize exposure of building occupants and the general

public.

b. The appropriate OSHA standard in 29 CFR 1910.1025 and 29 CFR 1926.62 for surface preparation on painted surfaces containing lead. Removal and disposal of coatings which contain lead is specified in Section 02090, "Removal and Disposal of Lead-Containing Paint." Additional guidance is given in SSPC Guide 6I (CON) and SSPC Guide 7I (DIS).

c. 29 CFR 1910.1001.

d. ACGIH TLV-BKLT, threshold limit values.

e. Manufacturer's material safety data sheets (MSDS).

1.7 ENVIRONMENTAL CONDITIONS

1.7.1 Exterior Coatings

Do not apply coating to surfaces during foggy or rainy weather, or under the following surface temperature conditions:

a. Less than 5 degrees F above dew point;

b. Below 40 degrees F (for oil-based paints), 50 degrees F (for latex paints or over 95 degrees F, unless approved by the NTR.

1.7.2 Interior Coatings

Apply coatings when surfaces to be painted are dry and the following surface temperatures can be maintained:

a. Between 65 and 95 degrees F during application of enamels and varnishes;

b. Between 50 and 95 degrees F during application of other coatings.

1.8 COLOR SELECTION

Color Coding for Shore-to-Ship Utility Connections

Service	Color	FED-STD-595 No.
Potable Water*	Blue	15044
Water Provided for Fire Protection**	Red	11105
Chilled Water	Striped Blue/White	15044/17886
Oily Waste Water	Striped Yellow/Black	13538/17038
Sewer	Gold	17043

Color Coding for Shore-to-Ship Utility Connections

Service	Color	FED-STD-595 No.
Steam	White	17886
High Pressure Air	Gray	16081
Low Pressure Air	Tan	10324
Fuel	Yellow	13655

Colors of finish coats shall be as indicated or specified. Where not indicated or specified, colors shall be selected by the NTR. Manufacturers' names and color identification are used for the purpose of color identification only. Named products are acceptable for use only if they conform to specified requirements. Products of other manufacturers are acceptable if the colors approximate colors indicated and the product conforms to specified requirements.

1.9 LOCATION AND SURFACE TYPE TO BE PAINTED

1.9.1 Painting Included

Where a space or surface is indicated to be painted, include the following unless indicated otherwise.

a. Surfaces behind portable objects and surface mounted articles readily detachable by removal of fasteners, such as screws and bolts.

b. New factory finished surfaces that require identification or color coding and factory finished surfaces that are damaged during performance of the work.

c. Existing coated surfaces that are damaged during performance of the work.

1.9.2 Painting Excluded

Do not paint the following unless indicated otherwise.

a. Surfaces concealed and made inaccessible by panelboards, fixed ductwork, machinery, and equipment fixed in place.

b. Surfaces in concealed spaces. Concealed spaces are defined as enclosed spaces above suspended ceilings, furred spaces, attic spaces, crawl spaces, and chases.

c. Steel to be embedded in concrete.

d. Copper, stainless steel, aluminum, brass, and lead except existing coated surfaces.

1.9.3 Exterior Painting

Includes new surfaces of the building and appurtenances as indicated. Also included are existing coated surfaces made bare by cleaning operations.

1.9.4 Interior Painting

Includes all new ferrous and galvanized metal surfaces of the building and appurtenances as indicated and existing coated surfaces made bare by cleaning operations.

1.9.5 Mechanical and Electrical Painting

Includes field coating of interior new surfaces.

a. Where a space or surface is indicated to be painted, include the following items unless indicated otherwise.

(1) Exposed piping, conduit, and ductwork;

(2) Miscellaneous metalwork and insulation coverings.

b. Do not paint the following, unless indicated otherwise:

(1) New zinc-coated, aluminum, and copper surfaces under insulation ;

(2) New aluminum jacket on piping ; and

(3) New interior ferrous piping under insulation.

PART 2 PRODUCTS

2.1 MATERIALS

Conform to the specifications and standards referenced in PART 3.

2.1.1 Latex Block Filler

CID A-A-1500.

PART 3 EXECUTION

3.1 PROTECTION OF AREAS AND SPACES

Prior to surface preparation and coating applications, remove, mask, or otherwise protect, hardware, hardware accessories, machined surfaces, radiator covers, plates, lighting fixtures, public and private property, and other such items not to be coated that are in contact with surfaces to be coated. Following completion of painting, workmen skilled in the trades involved shall reinstall removed items. Restore surfaces contaminated by coating materials, to original condition and repair damaged items.

3.2 SURFACE PREPARATION

Remove dirt, splinters, loose particles, grease, oil, disintegrated coatings, and other substances deleterious to coating performance as specified for each substrate.

Before application of coatings, perform the following on surfaces covered by soundly-adhered coatings, defined as those which cannot be removed with a putty knife:

a. Wipe previously painted surfaces to receive solvent-based coatings, except stucco and similarly rough surfaces clean with a clean, dry cloth saturated with mineral spirits, FS TT-T-291. Allow surface to dry. Wiping shall immediately precede the application of the first coat of any coating, unless specified otherwise.

b. Sand existing enamel and other glossy surfaces to remove gloss. Brush, and wipe clean with a dry cloth.

c. The requirements specified are minimum. Comply also with the application instructions of the paint manufacturer.

3.3 PREPARATION OF METAL SURFACES

3.3.1 Existing and New Ferrous Surfaces

a. Shop-coated Surfaces and Small Areas That Contain Rust, Mill Scale and Other Foreign Substances: Solvent clean in accordance with SSPC SP 1 to remove oil and grease. Where shop coat is missing or damaged, clean according to SSPC SP 2, SSPC SP 3, SSPC SP 6, or SSPC SP 10. Brush-off blast remaining surface in accordance with SSPC SP 7; Water blast between 2000 and 3000 psi, may be used to remove loose coating and other loose materials. Use inhibitor as recommended by coating manufacturer to prevent premature rusting.

b. Surfaces With More Than 20 Percent Rust, Mill Scale, and Other Foreign Substances: Clean entire surface in accordance with SSPC SP 6.

3.3.2 Final Ferrous Surface Condition:

Cleaned surface shall be similar to photographs in SSPC VIS 1 as follows:

Degree of Cleaning	100% Adherent Mill Scale	Mill Scale and Rust	100% Rust	100% Rust with Pits
Hand Tool Cleaning SSPC SP 2	(1)	B St 2	C St 2	D St 2
Power Tool Cleaning SSPC SP 3	(1)	B St 3	C St 3	D St 3

Degree of Cleaning	100% Adherent Mill Scale	Mill Scale and Rust	100% Rust	100% Rust with Pits
Commercial Blast Cleaning SSPC SP 6	**	B SP 6	C SP 6	D SP 6
Brush-Off Blast Cleaning SSPC SP 7	*	B SP 7	C SP 7	D SP 7
Near White Blast Cleaning SSPC SP 10	A SP 10	B SP 10	C SP 10	D SP 10

Note: (1) No photograph is available or recommended for comparison.

3.3.3 Galvanized Surfaces

a. New or Existing Galvanized Surfaces With Only Dirt and Zinc Oxidation Products: Clean with solvent, steam, or non-alkaline detergent solution in accordance with SSPC SP 1. If the galvanized metal has been passivated or stabilized, the coating shall be completely removed by brush-off abrasive blast or other treatment, or the surface shall be primed with a primer which is specifically recommended by the paint manufacturer for use on passivated or stabilized galvanized steel. For new galvanized steel to be coated, if absence of hexavalent stain inhibitors is not documented, test as described in ASTM D 2092, Appendix X2, and remove by one of the methods described therein.

c. Pretreatment: Apply DOD-P-15328 as a pretreatment on galvanized surfaces.

3.4 APPLICATION

3.4.1 Coating Application

Apply coating materials in accordance with SSPC PA 1. SSPC PA 1 methods are applicable to all substrates, except as modified herein. Thoroughly work coating materials into joints, crevices, and open spaces. Touch up damaged coatings before applying subsequent coats. Interior areas shall be broom clean and dust free before and during the application of coating material.

a. Drying Time: Allow time between coats, as recommended by the coating manufacturer, to permit thorough drying, but not to present topcoat adhesion problems. Provide each coat in specified condition to receive next coat.

b. Primers, and Intermediate Coats: Do not allow primers or intermediate coats to dry more than 30 days, or longer than recommended by manufacturer, before applying subsequent coats. Follow manufacturer's recommendations for surface preparation if

primers or intermediate coats are allowed to dry longer than recommended by manufacturers of subsequent coatings. Each coat shall cover surface of preceding coat or surface completely, and there shall be a visually perceptible difference in shades of successive coats.

c. Finished Surfaces: Provide finished surfaces free from runs, drops, ridges, waves, laps, brush marks, and variations in colors.

3.4.2 Equipment

Apply coatings with approved brushes, approved rollers, or approved spray equipment, unless specified otherwise. Spray areas made inaccessible to brushing by items such as ducts and other equipment.

3.4.3 Thinning of Paints

Reduce paints to proper consistency by adding fresh paint, except when thinning is mandatory for the type of paint being used. Obtain written permission from the NTR to use thinners. The written permission shall include quantities and types of thinners to use.

3.4.4 Coating Systems

a. Systems by Substrates: Apply coatings that conform to the respective specifications listed in the following Tables:

Table

1 Exterior Metal Surfaces
2 Interior Metal Surfaces
3 Building Systems Surfaces: Interior and Exterior

b. Minimum Dry Film Thickness (DFT): Apply paints, primers, varnishes, enamels, undercoats, and other coatings to a minimum dry film thickness of 1.5 mil each coat unless specified otherwise in the Tables. Coating thickness where specified, refers to the minimum dry film thickness. The DFT range specified for MIL-C-24667 represents minimum peak and valley measurements.

c. Coatings for Surfaces Not Specified Otherwise: Coat surfaces which have not been specified, the same as surfaces having similar conditions of exposure.

d. Existing Surfaces Damaged During Performance of the Work, Including New Patches In Existing Surfaces: Coat surfaces with the following:

(1) One coat of primer.

(2) One coat of undercoat or intermediate coat.

(3) One topcoat to match adjacent surfaces.

e. Existing Coated Surfaces To Be Painted: Apply coatings conforming

to the respective specifications listed in the Tables herein, except that pretreatments, sealers and fillers need not be provided on surfaces where existing coatings are soundly adhered and in good condition. Do not omit undercoats or primers.

3.5 COATING SYSTEMS FOR METAL

a. Primer: Apply specified ferrous metal primer on the same day that surface is cleaned. If flash rusting occurs, re-clean the surface prior to application of primer.

(1) Inaccessible Surfaces: Prior to erection, use two coats of specified primer on metal surfaces that will be inaccessible after erection.

(2) Shop-primed Surfaces: Touch up exposed substrates and damaged coatings to protect from rusting prior to applying field primer.

(3) Surface Previously Coated with Epoxy or Urethane: Apply MIL-P-24441/1, Formula 150, 1.5 mils DFT immediately prior to application of epoxy or urethane coatings.

(4) Pipes and Tubing: Semitransparent film applied to pipes and tubing at the mill is not to be considered a shop coat. Apply specified ferrous metal primer prior to application of subsequent coats.

(5) Exposed Nails, Screws, Fasteners, and Miscellaneous Ferrous Surfaces. On surfaces to be coated with water thinned coatings, spot prime exposed nails and other ferrous metal with latex primer, MIL-P-28577.

b. Apply coatings of Tables 1, 2 and 3. "DFT" means dry film thickness in mils.

3.6 PIPING IDENTIFICATION

Piping Identification, Including Surfaces In Concealed Spaces: Provide in accordance with MIL-STD-101. Place stenciling in clearly visible locations. On piping not covered by MIL-STD-101, stencil approved names or code letters, in letters a minimum of 1/2 inch high for piping and a minimum of 2 inches high elsewhere. Stencil arrow-shaped markings on piping to indicate direction of flow. Use black stencil paint, CID A-A-1558.

3.7 INSPECTION AND ACCEPTANCE

In addition to meeting previously specified requirements, demonstrate mobility of moving components, including swinging and sliding doors, cabinets, and windows with operable sash, for inspection by the NTR. Perform this demonstration after appropriate curing and drying times of coatings have elapsed and prior to invoicing for final payment.

TABLE 1

EXTERIOR METAL SURFACES

SURFACE/ AREA	PRIMER	DFT MILS	INTERMEDIATE COAT	DFT MILS	TOPCOAT	DFT MILS
******* FERROUS SURFACES *******						
A. New Steel That Has Been Blast-cleaned (Up to SSPC SP 6	FS TT-P-645	1.5	FS TT-E-489	1.5	FS TT E 489	0.0375 1.5
B. New and Existing Steel that Has been Blasted to SSPC SP 10	MIL-P-24441/1 Formula 150 Type I	3.0	MIL-P-24441/1 Formula 152 Type II	3.0	FS TT-P-19	2.0
******* GALVANIZED SURFACES *******						
C. New Galva-nized Surfaces	FS TT-P-19	1.5	N.A.		FS TT-P-19	1.5
D. Galva-nized Surfaces With Slight Coating Deterioration; Little or No rusting	Spot Prime MIL-P-28577	3.0	N.A.		MIL-P-28578	1.5

TABLE 2

INTERIOR METAL SURFACES

SURFACE/ AREA	PRIMER	DFT	INTERMEDIATE COAT	DFT	TOPCOAT	DFT
A. Metal Except Floors, Not Specified Otherwise	FS TT-P-664 on non-shop-primed surfaces	2.0	FS TT-E-545	1.5	FS TT-E-509	1.5

TABLE 3

BUILDING SYSTEMS SURFACES: INTERIOR AND EXTERIOR

SURFACE/ AREA	PRIMER	DFT	INTERMEDIATE COAT	DFT	TOPCOAT	DFT
1. Mechanical, Electrical, conduit, hangers, supports, 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.						
A. Surfaces Not Adjacent to Painted Surfaces	FS TT-P-645	2.0	FS TT-E-489	1.5	FS TT-E-489	1.5
B. Surfaces Adjacent to Painted Surfaces	Coating systems as specified. Color of topcoat to match adjacent surfaces. 1.5 mils dry film thickness for each coat.					

-- End of Section --

SECTION 10201

METAL WALL LOUVERS

03/95

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

THE ALUMINUM ASSOCIATION, INCORPORATED (AA)

AA 45	(1980) Aluminum Finishes

ARCHITECTURAL ALUMINUM MANUFACTURERS ASSOCIATION (AAMA)

AAMA 603.8	(1992; Addendum 1993) Pigmented Organic Coatings on Extruded Aluminum

AIR MOVEMENT AND CONTROL ASSOCIATION, INC. (AMCA)

AMCA 500	(1991) Louvers, Dampers and Shutters
AMCA 511	(1986) Certified Ratings Program for Air Control Devices

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 209	(1993) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 221	(1993) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes

FEDERAL SPECIFICATIONS (FS)

FS RR-W-365	(Rev. A; Int Am. 1) Wire Fabric (Insect Screening)

1.2 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic Contract.

1.2.1 SD-03, Manufacturer's Standard Color Charts

a. Wall louvers G

Colors of finishes shall closely approximate colors indicated. Where color is not indicated, submit the manufacturer's standard colors to the

NTR for selection.

1.2.2 SD-04, Drawings

a. Wall louvers G

Show all information necessary for fabrication and installation of louvers. Indicate materials, sizes, thicknesses, fastenings, and profiles.

1.3 DELIVERY, STORAGE, AND PROTECTION

Deliver materials to the site in an undamaged condition. Carefully store materials off the ground to provide proper ventilation, drainage, and protection against dampness. Louvers shall be free from nicks, scratches, and blemishes. Replace defective or damaged materials with new.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Extruded Aluminum

ASTM B 221, alloy 6063-T5 or -T52.

2.2 METAL WALL LOUVERS

Weather resistant type, with bird screens and made to withstand a wind load of not less than 30 pounds per square foot. Wall louvers shall bear the AMCA certified ratings program seal for air performance and water penetration in accordance with AMCA 511. The rating shall show that louver will pass a maximum free area velocity of 600 FPM with less than 0.02 in WG pressure drop and less than 0.01 ounces of water penetration per square foot of free area during a 15 minute period.

2.2.1 Extruded Aluminum Louvers

Fabricated of extruded 6063-T5 or -T52 aluminum with a wall thickness of not less than 0.081 inch.

2.2.2 Screens and Frames

For aluminum louvers, provide 1/2-inch square mesh, 14-or 16-gage aluminum bird screening. Mount screens in removable, rewirable frames of same material and finish as the louvers.

2.2.3 Stationary Louvers

Provide drainable extruded aluminum stationalry louver where indicated on contract drawings. Blades shall be fixed at 45 degree angle. Louver Model LE-33 as manufactured by American Warming and Ventilating meets the intent of this specification.

2.3 FASTENERS AND ACCESSORIES

Provide stainless steel screws and fasteners for aluminum louvers. Provide other accessories as required for complete and proper installation.

2.4 FINISHES

2.4.1 Aluminum

Provide factory-applied organic coating.

2.4.1.1 Organic Coating

Clean and prime exposed aluminum surfaces and apply a baked enamel finish conforming to AAMA 603.8, 0.8 mil minimum dry film thickness. Manufacturer's standard color as selected from color list by NTR.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Wall Louvers

Install using stops or moldings, flanges, strap anchors, or jamb fasteners as appropriate for the wall construction and in accordance with manufacturer's recommendations.

3.1.2 Screens and Frames

Attach frames to louvers with screws or bolts.

3.2 PROTECTION FROM CONTACT OF DISSIMILAR MATERIALS

3.2.1 Aluminum

Where aluminum contacts metal other than zinc, paint the dissimilar metal with a primer and two coats of aluminum paint.

3.2.2 Metal

Paint metal in contact with mortar, concrete, or other masonry materials with alkali-resistant coatings such as heavy-bodied bituminous paint.

-- End of Section --

SECTION 15011

MECHANICAL GENERAL REQUIREMENTS

03/95

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C2	(1993) National Electrical Safety Code

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 117	(1994) Operating Salt Spray (Fog) Testing Apparatus

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910.147	Control of Hazardous Energy (Lock Out/Tag Out)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(1993) Motors and Generators
NEMA MG 10	(1983; R 1988) Energy Management Guide for Selection and Use of Polyphase Motors
NEMA MG 11	(1977; R 1992) Energy Management Guide of Selection and Use of Single-Phase Motors

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1993) National Electrical Code

1.2 RELATED REQUIREMENTS

This section applies to Division 2, "Site Work"; and all sections of Division 15, "Mechanical" of this project specification, unless specified otherwise in the individual section.

1.3 QUALITY ASSURANCE

1.3.1 Material and Equipment Qualifications

Provide materials and equipment that are standard products of manufacturers regularly engaged in the manufacture of such products, which are of a similar material, design and workmanship. Standard products shall have

been in satisfactory commercial or industrial use for 2-years prior to bid opening. The 2-year use shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period.

1.3.2 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturer's factory or laboratory tests, can be shown.

1.3.3 Service Support

The equipment items shall be supported by service organizations. Submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. These service organizations shall be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.3.4 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.3.5 Modification of References

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer.

1.4 DELIVERY, STORAGE, AND HANDLING

Handle, store, and protect equipment and materials to prevent damage before and during installation in accordance with the manufacturer's recommendations, and as approved by the Contracting Officer. Replace damaged or defective items.

1.5 SAFETY REQUIREMENTS

1.5.1 Equipment Safety

Provide positive means of locking out equipment so that equipment cannot be accidentally started during maintenance procedures.

1.5.2 Lockout of Energy Sources

Provide appropriate lockout devices for machines or other equipment to prevent unexpected start-up or release of stored electrical, mechanical or

other energy in accordance with 29 CFR 1910.147. Electrical isolation of machines or other equipment shall be in accordance with requirements of DIVISION 16 "Electrical."

1.6 ELECTRICAL REQUIREMENTS

Furnish motors, controllers, disconnects and contactors with their respective pieces of equipment. Motors, controllers, disconnects and contactors shall conform to and 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 shall have 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 System."

1.7 INSTRUCTION TO GOVERNMENT PERSONNEL

When specified in other sections, furnish the services of competent instructors to give full instruction to the designated Government personnel in the adjustment, operation, and maintenance (including pertinent safety requirements) of the specified equipment or system. Instructors 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. One 8-hour man-day of instruction shall be provided. When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instruction to acquaint the operating personnel with the changes or modifications.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 PAINTING OF NEW EQUIPMENT

Equipment painting, factory applied or shop applied, shall be as specified herein, and provided under each individual section.

3.1.1 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 conducted in accordance with ASTM B 117. Acceptance criteria for the test shall be as follows: 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 on surfaces subject to temperatures above 120 degrees F, submit certifications that the manufacturer's standard factory painting system conforms to the heat resistance requirement in addition to other certifications.

3.1.2 Shop Painting Systems for Metal Surfaces

Clean, pretreat, prime and paint metal surfaces. Aluminum surfaces need not be painted. Apply coatings to clean dry surfaces. Clean surfaces to remove dust, dirt, rust, oil and grease by wire brushing and solvent degreasing prior to application of paint. Metal surfaces subject to temperatures in excess of 120 degrees 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 each succeeding coat. Color of finish coat shall be aluminum or light gray.

a. Metal surfaces subject to temperatures less than 120 Degrees F: Immediately after cleaning, surfaces shall receive one coat of pretreatment primer applied to a minimum dry film thickness of 0.3 mil, one coat of primer applied to a minimum dry film thickness of one mil; and two coats of enamel applied to a minimum dry film thickness of one mil per coat.

-- End of Section --

SECTION 15054

NONLUBRICATED ROTARY SCREW AIR COMPRESSORS (100 HP AND LARGER)

03/95

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ANTI-FRICTION BEARING MANUFACTURERS ASSOCIATION (AFBMA)

AFBMA 9	(1990) Load Ratings and Fatigue Life for Ball Bearings
AFBMA 11	(1990) Load Ratings and Fatigue Life for Roller Bearings

AMERICAN GEAR MANUFACTURERS ASSOCIATION, INC. (AGMA)

AGMA 390.03A	(1980; Errata 1983) Gear Handbook Gear Classification, Materials and Measuring Methods for Bevel, Hypoid, Fine Pitch Wormgearing and Racks Only as Unassembled Gears

AMERICAN PETROLEUM INSTITUTE (API)

API STD 619	(1985; R 1991) Rotary-Type Positive Displacement Compressors for General Refinery Services

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ANSI/ASME B1.20.1	(1983; R 1992) Pipe Threads, General Purpose (Inch)
ASME/ANSI B16.1	(1989) Cast Iron Pipe Flanges and Flanged Fittings
ASME/ANSI B16.5	(1988; Errata 1988) Pipe Flanges and Flanged Fittings
ANSI/ASME B40.1	(1991; Special Notice 1992) Gauges - Pressure Indicating Dial Type - Elastic Element
ASME PTC 9	(1970; Errata 1972, R 1992) Displacement Compressors, Vacuum Pumps and Blowers
ASME BPVC SEC VIII D1	(1992; Addenda 1992 and 1993) Boiler and

	Pressure Vessel Code: Section VIII Pressure Vessels, Division 1

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M	(1993; Rev. A) Structural Steel
ASTM B 111	(1993) Copper and Copper-Alloy Seamless Condenser Tubes and Ferrule Stock
ASTM B 171	(1993) Copper-Alloy Plate and Sheet for Pressure Vessels, Condensers and Heat Exchangers
ASTM B 209	(1993) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM C 553	(1992) Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM E 84	(1991; Rev. A) Surface Burning Characteristics of Building Materials

COMPRESSED AIR AND GAS INSTITUTE (CAGI)

CAGI PNEUROP	(1971) Test Code for the Measurement of Sound from Pneumatic Equipment

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910.219	Mechanical Power Transmission Apparatus

COMPRESSED GAS ASSOCIATION, INC. (CGA)

CGA G-7.1	(1989) Commodity Specification for Air

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC. (IEEE)

IEEE 112	(1991) Polyphase Induction Motors and Generators

MILITARY SPECIFICATIONS (MIL)

MIL-A-3316	(Rev. C; Am. 2) Adhesives, Fire-Resistant, Thermal Insulation
MIL-T-19646	(Rev. A) Thermometer, Gas Actuated, Remote Reading

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 2	(1993) Controllers, Contactors and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC

NEMA ICS 6 (1993) Control and Systems Enclosures

NEMA MG 1 (1993) Motors and Generators

1.2 GENERAL REQUIREMENTS

Section 15011, "Mechanical General Requirements," applies to this section except as specified herein.

1.3 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic Contract.

1.3.1 SD-02, Manufacturer's Catalog Data

a. Air compressor G

b. Inlet air filters

c. Line silencer

d. Air flow rate and pressure recorder

e. Filter housing

Submit manufacturer's catalog data for compressor and auxiliary equipment in the format provided in API STD 619, Appendix A. For air compressors, include intercoolers, oil cooler, lubrication system, and control valves. Submit air compressor, intercooler, aftercooler, and bypass cooler performance curves at specified summer and winter design conditions.

1.3.2 SD-04, Drawings

a. Air compressor system G

1.3.2.1 Air Compressor System

Include wiring diagrams of the air compressor with all accessories. The minimum acceptable scale is 1/4 inch to one foot.

1.3.3 SD-08, Statements

a. Work plan

b. Factory test procedures G

c. Factory testing certification

d. Qualifications of field supervisors

e. Field test procedures

f. Training material

1.3.3.1 Work Plan

Submit a written schedule of dates of installation, start-up, checkout, and test of equipment.

1.3.3.2 Factory Testing Certification

Submit a statement that the air compressor factory is equipped to perform all required factory tests. Submit in accordance with paragraph entitled "Manufacturer's Certifications."

1.3.3.3 Qualifications of Field Supervisors

Submit the name and certified written resume of the engineer or technician, listing education, factory training and installation, start-up, and testing supervision experience for at least two projects involving compressors similar to those in this contract.

1.3.3.4 Training Material

Submit a detailed training program syllabus for training government personnel, including instructional materials at least three weeks prior to start of tests.

1.3.4 SD-11, Factory Test Reports

a. Air compressor performance tests

b. Sound level and run-in tests

Obtain approval prior to shipping compressor.

1.3.5 SD-12, Field Test Reports

a. Air compressor performance tests

b. Instrumentation test

c. Sound level tests

d. Air compressor system test

The test supervisor shall certify performance by test to be in compliance with specifications.

1.3.6 SD-13, Certificates

a. Air compressor system

b. Air compressor system installation

1.3.6.1 System Installation

Submit certification of performance conforming to ASME PTC 9 and ASME BPVC SEC VIII D1. Submit certification of proper installation in accordance with paragraph entitled "Supervision."

1.3.7 SD-18, Records

a. Posted operating instructions for air compressor

Submit text.

1.3.8 SD-19, Operation and Maintenance Manuals

a. Air compressor system, Data Package 3 G

Submit operation and maintenance data in accordance with Section 01010, "General Paragraphs." Data shall contain information required for maintenance and repair and shall contain no evidence that proprietary maintenance arrangements with the manufacturer will be necessary. Compressors which will require proprietary maintenance arrangement with the manufacturer require Government review and approval. The compressors may be disapproved if circumstances do not justify approval of compressors with limited availability of maintenance.

1.4 SAFETY

Construct all components of the unit in accordance with the requirements of OSHA 29 CFR 1910.219. Requirements include shaft coupling guards as specified in Section 15011, "Mechanical General Requirements" insulation and jacketing with manufacturer standard covering or aluminum sheet of all surfaces at 125 degrees F and higher within a height of 7 feet from floor level, and use of electrical safety devices. Thermal insulation, furnished by equipment manufacturer, shall conform to ASTM C 553, Type I (flexible resilient), Class B-5 (up to 400 degrees F), 2 pcf nominal. Cement insulation to surface with MIL-A-3316, Class 2, adhesive and fasten with 16-gage wire bands at maximum 16 inches on center spacing. Cover insulation with ASTM B 209 sheet aluminum jacket. However, insulation is not required for hot piping inside sound enclosure.

1.5 EQUIPMENT ARRANGEMENT

Arrangement selected shall maintain 3 foot clearance for access passage and 4 foot clearance for personnel to operate equipment. There are substantial physical and connection point differences among the several air compressors which comply with this specification. The Contractor shall be responsible for selecting equipment and submitting arrangement drawings covering required changes for approval by the NTR. Changes from the equipment arrangement shown on the contract drawings shall be performed by the Contractor at no additional cost to the Government.

1.6 ELECTRICAL REQUIREMENTS

Comply with the requirements of Section 16402, "Interior Wiring Systems,".

1.7 SUPERVISION

The Contractor shall obtain the services of a qualified engineer or technician from the compressor manufacturer to supervise installation, start-up, and testing of the compressor. After satisfactory installation of the equipment, the engineer or technician shall provide a signed certification that the equipment is installed in accordance with the manufacturer's recommendations.

1.8 DEFINITIONS

Conform to API STD 619 and the following:

a. Compressor power is shaft power at shaft coupling, including all losses and connected appurtenances.

1.9 INSULATION

Thermal and acoustical insulation shall have flame spread rating not higher than 75, and smoke developed rating not higher than 150 when tested in accordance with ASTM E 84.

1.10 POSTED OPERATING INSTRUCTIONS

Provide for air compressor. Include start-up and shutdown sequence instructions.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Materials and equipment complete with accessories shall be selected by the Contractor for performance compatibility.

2.2 AIR COMPRESSOR

The air compressors shall be packaged, positive displacement rotary screw compressors capable of delivering oil-free air. No lubricant shall be used within the compression chamber. Include air compressor, electric motor driver, coolers, lubrication system, and regulation and control systems mounted on a common base frame, and completely enclosed for noise control.

2.2.1 Manufacturer's Certifications

The manufacturer shall certify that the air compressors proposed are of the same design, construction, size, and of equal or not more than 10 percent smaller in capacity as compressors which have been in satisfactory continuous service for at least 2 years at not less than two locations. Furnish the name of the owner, the address of the installation, and the name of a person at the installation who can be contacted for verification. The manufacturer shall also certify that the factory is equipped to perform all required factory tests.

2.2.2 Guaranteed Performance

a. Net compressed air output (All seal losses shall be considered internal and not included in the net output) (plus or minus 2 percent): 100 and 165 SCFM

b. Output pressure immediately downstream of aftercooler (minus zero plus 4 percent): 125 psig

c. Output air maximum temperature downstream of aftercooler: 100 degrees F

d. Inlet air pressure at first stage: 14.7 psia

e. Inlet air temperature at first stage: 91 degrees F

f. Inlet air filtration efficiency: 99.9 percent of 0.5 micron size

g. Barometric pressure: 14.7 psia

h. Relative humidity: 52 percent

i. Cooling water inlet temperature: 70 degrees F

j. Total cooling water flow rate: as required up to 5 gpm

k. Maximum cooling water pressure drop through the compressor and any intercooler, aftercooler, or oil cooler: 8 psig

l. Maximum compressor power required. (Plus or minus 4 percent): 50 and 100 hp

m. Unloaded compressor power (maximum): 50 and 100 hp

n. Maximum sound levels one meter horizontal from compressor and 1.5 meters above floor as measured per CAGI PNEUROP Test Code for the Measurement of Sound from Pneumatic Equipment: 84 dBA, 90dB for any octave band.

2.2.3 Additional Performance Requirements

2.2.3.1 Air Quality

Air at compressor intake will be considered breathing air quality conforming to CGA G-7.1, Type I, Grade D or better. Air compressors shall introduce no material, gases, or particles, or chemically alter any materials that will adversely affect or reduce the quality of the air passing through the unit.

2.2.3.2 Ambient and Inlet Conditions Operating Ranges

Allowing for rational engineering performance adjustments due to variations in ambient and inlet conditions, the compressor shall be designed, equipped, and furnished to be fully operational without abnormal wear throughout the entire range between and including the limits of the winter

and summer design conditions specified.

a. Summer Design Conditions:

Inlet Air: 91 degrees F dry bulb and 76 degrees F wet bulb temperatures, 52 percent relative humidity, Inlet Cooling Water: 70 degrees F, Ambient Compressor Room Temperature: 90 degrees F, Barometric Pressure: 14.7 psia

b. Winter Design Conditions:

Inlet Air: 22 degrees F dry bulb. Inlet Cooling Water: 60 degrees F, Ambient Compressor Room Temperature: 55 degrees F, Barometric Pressure: 14.7 psia.

2.2.3.3 Critical Speeds

Actual critical speeds shall not encroach upon operating speed ranges at specified loads ranges. Rotors shall be of a stiff shaft construction with the first actual rotor bending critical speed at least 120 percent of the maximum operating speed.

2.2.3.4 Vibration and Balance

Major parts of rotating elements, such as rotors, gears, and similar items shall be individually dynamically balanced. During the factory and site tests of the assembled machine at operating speed, the double amplitude of vibration in any plane measured on the shaft adjacent and relative to a radial bearing shall not exceed the limits of API STD 619, paragraph 2.7.2.5. For shafts which are not accessible, the manufacturer shall submit a testing procedure to the NTR for approval.

2.2.4 Electrical Service Conditions

2.2.4.1 Air Compressor Drive Motor

460 volts, 3 phase, 3 wire, 60 hertz electrical service.

2.2.4.2 Accessory electrical Service

See Table I.

TABLE I - COMPRESSOR ACCESSORY ELECTRICAL SERVICE SCHEDULE

Item	Voltage	Phase	Frequency
Control Power and Motors under 1/2 hp	120	1	60 Hz
Accessory Power	460	3	60 Hz

2.2.5 Compressor Controls

Provide a complete load regulation and control system with the compressor. Provide additional electrical, electro-pneumatic, or solid state electronic

controls for other specified control and monitor functions. All electrical controls shall conform to NEMA ICS 2 as selected by the compressor manufacturer. Control system enclosure shall conform to NEMA ICS 6. Controls shall be suitable for individual operation of the compressor or parallel operation with one or more other compressors.

2.2.5.1 Compressor Start-Up

The compressor shall start unloaded. The manual starting circuit for the compressor shall have interlocks to prevent the compressor drive motor from starting until pre-lubrication pump (if provided), oil pressure, and cooling water pump water flow have been established to the required values for safe operation as determined by the compressor manufacturer.

2.2.5.2 Load Regulation

The compressor shall operate continuously at constant speed after being started. Provide means to load and unload the compressor automatically at preset minimum and maximum pressure settings. Minimum pressure shall be 100 psig, and maximum pressure shall be 125 psig. Unloading shall be accomplished by a combination of closing the inlet valve and bypassing or venting the outlet of the compressor; however, input power at fully unloaded operation shall not exceed 20 percent of full load input. Bypassed air shall be cooled by the bypass cooler and if returned to the inlet of the first stage through an internal loop and shall be limited to the minimum flow required to maintain compressor cooling. Air vented to the atmosphere when unloading need not be cooled.

2.2.5.3 Monitor and Safety Controls

Provide supplementary electric, electro-pneumatic, or solid state electronic controls to provide alarm and shutdown requirements, plus interlocks with accessories. Requirements are as follows:

a. Shutdown requirements shall cause the controlled compressor to shut down, energize alarms, and light labeled red lights.

b. Alarm only requirements shall not cause the controlled compressor to shut down, but shall sound the same alarms and light labeled amber lights.

c. Light only requirements shall not cause the controlled compressor to shut down, but shall light labeled amber lights.

d. The individual monitor and safety controls shall be as shown on Table 2.

TABLE 2 - MONITOR AND SAFETY CONTROL SCHEDULE

Item	Shutdown	Light and Alarm	Indicating Light Only
1. High Discharge Air Temperature 275 degrees F	Yes	Yes	-
2. High Intercooler Discharge Water Temperature, Each Intercooler	No	Yes	-
3. High Aftercooler Discharge Water Temperature	No	Yes	-
4. High Cooling Water Supply Temperature	No	Yes	-
5. High Lube Oil Temperature	Yes	Yes	-
6. Low Lube Oil Pressure	Yes	Yes	-
7. Low Cooling Water Flow	No	Yes	-
8. Low Oil Reservoir Level	No	Yes	-
9. High Condensate Level Intercoolers (wired to one light)	No	No	Yes
10. High Bleed-Off Air Pressure	Yes	Yes	-
11. High Motor Stator Temperature	Yes	Yes	-
12. High Condensate Level Aftercooler	No	No	Yes
13. High Inlet Pressure Drop Across Inlet Air Filters (combined, 3 stage)	No	Yes	-
14. High CO Level	Yes	Yes	-

2.2.5.4 Monitoring Instruments

Provide the following monitoring instruments in addition to the monitor and safety controls. Pressure gages shall conform to ANSI/ASME B40.1, 4 1/2 inch diameter, red marking pointer, single bourdon tube, brass case, black enamel finish. Provide pressure gages with a pressure snubber and a stainless steel barstock needle isolation valve. Thermometers shall be extended stainless steel sheathed bimetallic stem, 3 1/2 inch dial, and separable 4 inch stainless steel wells. Temperature measurements at inaccessible locations shall be made with remote reading thermometers conforming to MIL-T-19646, Class C separable well of Type 304 stainless steel. Select pressure and temperature gage ranges to give a normal operating reading near the midpoint of the scale range.

a. Oil cooler outlet temperature gages for oil.

b. Oil cooler inlet temperature gages for water.

c. Lubrication oil bearing supply pressure gage.

d. Compressor seal air pressure gage (if applicable).

e. Inlet air filter differential pressure gage with 8, zero, 8 inch water gage. Provide selector valve, tubing, and tap to measure static gage pressure downstream of each filter stage.

f. Total running time readout.

g. Cooling water supply to compressor pressure gage.

h. Cooling water return from compressor pressure gage.

i. Interstage air pressure gages for each interstage.

j. Compressed air pressure downstream of aftercooler pressure gage.

k. Compressed air temperature downstream of aftercooler temperature gage.

l. Compressed air temperature at discharge of each stage of compression before cooling temperature gages.

m. Interstage air temperature after intercooler of each stage temperature gages.

n. Compressor inlet air temperature gage.

o. Cooling water to compressor temperature gage.

p. Cooling water outlet temperature at each outlet of each intercooler, aftercooler, and bypass air cooler temperature gages.

2.2.6 Compressor Design Features

The compressor shall be a multistage, oil-free rotary screw compressor, with a minimum of two compressor stages, flanged to an integral speed increaser. Each stage shall be driven from a common bull gear to ensure optimum speed and efficiency. An intercooler shall be provided between stages and aftercooler shall be provided after the final stage of compression. Silencers, lubricating system, cooling system, control system, and driver shall be mounted as part of the package. Provide a common base frame for the compressor system and driver. Provide a sound enclosure over the compressor and driver. Equipment shall be designed for economical and rapid maintenance. Casing components, bearing housings, and other major parts shall be shouldered, dowelled, or designed with other provisions to facilitate accurate alignment or reassembly. Shaft seals and bearings shall be accessible for inspection or replacement with a minimum of disassembly; however, compressors with compression elements (air end) provided as a factory-assembled not repairable in the field may be approved by the NTR if determined to be in the interest of the Government.

2.2.6.1 Casings

Casings shall be cast iron, ductile iron, cast steel, or fabricated steel. Casing stresses shall be within the limits allowed by ASME BPVC SEC VIII D1. Casings, supports, and baseplates shall be designed and fabricated to preclude excessive and injurious distortion from temperatures, pressures, and forces encountered in service conditions. Provide jackscrews, lifting lugs, eyebolts, guide dowels, and casing alignment dowels to facilitate disassembly and reassembly. When using jackscrews for parting contacting faces, relieve one of the faces by counterboring or recessing to prevent marring the face, which result in leaking or improper fit. Provide lifting lugs or eyebolts for removable portions of the casings. Flanged casing connections for external piping shall conform to ASME/ANSI B16.1 or ASME/ANSI B16.5. Threaded connections for external piping shall conform to ANSI/ASME B1.20.1. Air compression portion of the casing shall be one-piece and shall be provided with integral coolant passages and a large inlet port. Gear cases shall be enclosed, accessible, force lubricated, and designed with seals and slingers to keep oil out of air system.

2.2.6.2 Shafts

Shafts shall be of forged or rolled alloy steel and shall have a machined finish throughout their entire length. All rotating components shall be positively secured to shafts by approved mechanical means or interference shrink fits.

2.2.6.3 Rotors

Rotors shall be steel, and of one-piece construction, with an asymmetric profile to minimize leakage losses, and ensure high efficiency. Rotors shall be treated for corrosion resistance. It rotors are welded to the shaft, the assembly shall be stress relieved and heat treated for proper strength. Rotors shall be dynamically balanced to ensure vibration-free operation.

2.2.6.4 Gears

Gears shall be of alloy steel, AGMA 390.03A Quality Number 12 or better for both bull and pinion gears. Gears shall be hardened to 275 Brinell for bull gear and 320 Brinell for pinion, unless otherwise approved. Gears shall be ground to the required contours, checked for proper contact during assembly at the factory, and shall not require a break-in period in the field for proper operation. All gears shall be pressure lubricated.

a. Timing gears shall be provided on the rotor shafts to maintain the rotors in correct relative position. The compressor design shall allow the timing gears to absorb no more than 10 percent of the total input power at full load.

2.2.6.5 Seals

Separate air and oil shaft seals shall be provided to confine air in the casing and prevent contamination of the air stream by lubricating oil.

Shaft seals shall be the restrictive ring type. The seal rings shall be stainless steel, brass, or carbon, and retainers shall be made of stainless steel. Provide an air space vented to the atmosphere between the air and oil seals. Seals shall be suitable for all operating conditions including suction throttling, start-up, and shutdown.

2.2.6.6 Thrust Bearings

Thrust bearings shall be anti-friction ball or roller type or hydrodynamic (fluid film) type. Anti-friction bearings shall have an L-10 life of 80,000 hours in accordance with AFBMA 9 or AFBMA 11. Axial rotor thrusts due to air compression shall be absorbed by main thrust bearings or transferred to auxiliary thrust bearings by a load balancing arrangement. Hydrodynamic thrust bearings shall be Kingsbury type or other approved type and shall be adequate to accommodate all operating conditions. Speed increaser bull gear thrust bearings shall be sized for equal thrust in both directions and shall be adequate for any axial loads transmitted through the driver coupling.

2.2.6.7 Radial Bearings

Radial bearings shall be anti-friction roller or ball type or hydrodynamic type. Anti-friction bearings shall have an L-10 life of 40,000 hours in accordance with AFBMA 9 or AFBMA 11. Hydrodynamic bearings shall be precision bored sleeve or pad type, designed for easy replacement by a split design or axially removable arrangement. High speed hydrodynamic pinion bearings shall be anti-oil whip, tilting pad type. Hydrodynamic bearing design shall provide low vibration and sufficient damping at rated speed and all operating modes, including rated capacity and unloading down to 20 percent of unloaded power.

2.2.6.8 Speed Increaser

The speed increaser shall be an integral part of the compressor unit and shall include the main drive shaft and bull gear. The main drive shaft shall be supported through anti-friction bearings.

2.2.6.9 Intercoolers, Aftercooler, Bypass Cooler, and Oil Coolers

Intercoolers, aftercooler, bypass cooler, and oil cooler shall include ASTM B 111 admiralty brass or other corrosion resistant tubes in ASTM B 171 admiralty or steel tube sheets and baffles for optimum cooling and fouling resistance using fresh water. Provide an intercooler between stages of compression factory assembled on unit base with piping. The aftercooler shall be mounted on the unit base. Intercoolers, aftercooler, bypass cooler, and oil cooler shall be factory tested at 1.5 times operating pressure. External intercoolers and aftercooler shall be constructed in accordance with ASME BPVC SEC VIII D1 requirements and be ASME code stamped for 150 psig working pressure. Intercoolers and aftercooler shall be capable of one piece bundle removal. Intercoolers and aftercooler shall be equipped with an integral or direct connected moisture separator with condensate trap assembly. Design intercoolers and aftercooler for 20 and 15 degrees F approach, respectively; however, the approach temperature used to size the coolers shall be reduced if required to meet aftercooler maximum air outlet temperature specified. Nonstandard

coolers shall be provided if required to meet the aftercooler maximum air outlet temperature requirement. All coolers shall be of counter-flow design, with a fouling factor of 0.002 for both sides of the coolers.

2.2.6.10 Lubrication System

Include an integral sump, positive displacement pump, oil cooler, and twin filter\strainer (readily replaceable cartridges while operating). Provide a prelube lubrication oil pump for start-up and standby for hydrodynamic bearings or if required by the compressor design. System shall be factory assembled and tested. Lubricating oil shall conform to recommendations of the compressor manufacturer. Spray lubricate drive gear, anti-friction bearings, and timing gear in each stage. Pressure lubricate hydrodynamic bearings. Provide the oil sump with a level indicator and drain and fill connections.

a. Prelubrication pump, if required, or motor-driven main lubrication pump shall be sized by air compressor manufacturer for the requirements of the system, but shall meet the following requirements. Pump shall be positive displacement gear pump separately mounted with motor on a common base plate with drip lip and drain.

   (1) Performance: Pump shall have separate safety valve bypass set at 25 psi above peak expected pressure.

   (2) Materials shall be hardened steel gears and shaft, cast iron case, bronze bearings, mechanical seal.

   (3) Flexible coupling with shaft guard shall be provided, except that these items are not required for a close-coupled pump.

   (4) Motor shall be NEMA MG 1, Design A or B, Class B insulation, of open drip-proof type. Furnish combination type starter for motor.

b. Lube Oil Heater: Provide thermostatically controlled electric heater in lubrication oil sump of sufficient capacity to heat up and maintain manufacturer's recommended oil temperature when unit is cold at 32 degrees F ambient. Provide low oil level indicator with light for protection of heater.

2.2.7 Electric Motors

2.2.7.1 Main Electric Drive Motor

The main drive motor for each compressor shall be an induction, or a sychronous motor, 50 and 100 horsepower (hp), with a continuous service factor of 1.0. Size the motor so that the name plate hp rating is not exceeded under the entire range of operating conditions specified. Induction motor shall be high efficiency type not less than 95 percent rated based upon IEEE 112, testing and labeling. Electrical service will be as specified. Motor shall be designed for reduced voltage starting at 50 65 80 percent of full voltage, allowing for characteristics of the connected load, and shall start without undervoltage tripping. Provide

resistance temperature detectors (RTD) attached to or imbedded in motor winding for control system. The motor shall meet the requirements of NEMA MG 1 with Class F insulation. Provide space heaters for protection of windings during motor shutdowns.

2.2.7.2 Accessory and Related Equipment Motors

Motors less than 1/2 hp shall be single-phase induction motors and shall conform to NEMA MG 1. Motors 1/2 through 5 hp shall be three-phase induction motors and shall conform to NEMA MG 1. Single-phase and three-phase motors shall have bimetallic disk thermostats attached to or imbedded in the motor winding. Motors shall have NEMA MG 1 Class B insulation.

2.2.8 Control Panel

Control unit panel shall conform to NEMA ICS 6, floor or frame mounted, factory designed, and assembled, and shall be provided complete. The panel shall be fabricated of formed stretcher leveled sheet steel, reinforced, and assembled into a rigid unit. Gasketed access doors shall be provided as required. Panel shall be factory finish painted. The panel shall meet NEMA 12, requirements.

a. Panel shall contain electric and safety control work required, including either alarm annunciator or individual labeled pilot lights arranged in a group. Panel shall contain alarm device with light and silencing. Generalized arrangement in accordance with drawings.

b. Panel shall contain start and stop buttons (the latter with lockout feature), discharge air pressure gage, control test switch and lights, reset button, green unit running light, and control selector switch.

c. Oil pressure gages shall be mounted separately from panel.

2.2.9 Accessories

Required accessories include:

2.2.9.1 Control Valves

Pneumatically or hydraulically controlled valves on suction inlet of compressor and on bypass or vent line.

2.2.9.2 Intake Devices

Compressor air inlet shall be piped to the outside of the building and consist of the following:

a. Intake weather hood with rain hood and bird screen. Material shall be galvanized steel or aluminum alloy, minimum 20 gage.

b. Intake pipe, ASTM A 36/A 36M steel galvanized, 12 gage or Schedule 5 minimum, from intake weather hood to filter housing

flange, welded construction.

c. Filter housing by filter manufacturer to include filter frames, access door(s). Material for housing shall be 0.065 inch thick, Class 5000 aluminum alloy. Unit shall be rigid and free from distress with all seams sealed.

d. Intake Pipe from Filter Enclosure to Compressor: Aluminum alloy ASTM B 209, Alclad alloy 5052-H32 or equivalent, minimum 10 gage, flanged, welded with 5XXX welding rod using TIG method and including expansion bellows.

2.2.9.3 Outlet Connectors

Compressor air outlet flexible connection of stainless steel bellows with braided steel cover jacket, with stainless steel liner sleeve, 18-inch (457-mm) nominal length bellows, flanged ends, Class 150. If air bypass connects separately to the compressor from the outlet line, provide a second flexible connection of stainless steel bellows with braided jacket for the bypass.

2.2.10 Inlet Air Filters

Provide a three-stage filter system, complete with mounting racks (horizontal flow), interstage seals, and replaceable filters. Filter unit shall be provided complete including enclosure or housing, and frames. Enclosure shall be Class 5000 aluminum alloy with inlet and outlet flanges. Construction shall be welded or, where welding is not practical, close riveted and caulked, weathertight, with access doors for filter replacement and cleaning. Access doors shall be reinforced, fully gasketed with continuous flexible neoprene gaskets, corrosion-resistant continuous hinges and quarter-turn latches to ensure tightness. All internal ferrous surfaces, including galvanized, shall receive a factory-applied epoxy prime and finish coat for corrosion resistance. Filters shall consist of three separate stages and sized to fit the available space.

2.2.10.1 First-Stage

First-stage filter shall be flat, 2 inch thickness, replaceable media, and rated for the required air quantity at 500 FPM nominal face velocity, friction clean 0.25 inch water gage, efficiency 98 percent of 15 microns and 90 percent of 5 microns.

2.2.10.2 Second-Stage

Second-stage filter shall be deep pleated type, 9 inches nominal depth and rated for the required air quantity at 350 FPM nominal face velocity, friction clean 0.20 inch water gage, efficiency 98 percent of 5 microns and 90 percent of 3 microns.

2.2.10.3 Third-Stage

Third-stage filter shall be deep pleated type 12 inches minimum depth and rated for the required air quantity at 350 FPM nominal face velocity, friction clean 0.30 inch water gage, efficiency 99.9 percent of 0.5 micron.

2.2.10.4 Filter Ratings

Filter media shall be rated and listed UL Class 2. Filter efficiencies shall be based on National Bureau of Standards (NBS) type discoloration gravimetric test method using atmospheric dust.

2.2.11 Bypass or Vent Line Silencer

A bypass or vent line silencer shall be furnished with each compressor as selected by compressor manufacturer for sufficient noise attenuation to meet OSHA sound level criteria, but not greater than 84 dBA measured at an elevation of 5 feet, and 10 feet horizontally from silencer.

2.2.12 Sound Attenuating Enclosure

The compressor package, including the driver motor, shall be contained within a noise reducing enclosure. Design of the enclosure shall be such as to limit noise transmission to 84 dBA or less at a distance of one meter from the compressor in any direction.

2.2.12.1 Enclosure Frame

The enclosure frame shall be designed to support the weight of the sound suppression panels and easily demountable. Connections to the base frame shall be designed to allow the enclosure frame to be detached and lifted away without damage to the connections, enclosure frame or base frame, and to allow accessibility and replacement of any component.

2.2.12.2 Panels

The panels shall be of rigid construction to allow repeated access without damage or distortion. Sound absorbing material shall be mineral fiber, treated to preclude shedding of fibers. Other approved insulation may be used except that polyurethane foam shall not be permitted. Top panels shall be secured to the enclosure frame with quick disconnect fittings and fabricated to allow easy hand removal for maintenance. End and side panels shall be hinged or lift out with positive closure latches. Panels shall be designed to allow the maximum access area when opened. Provide acoustic seals as required. Controls and instrumentation mounted on the panels shall have flexible connections for panel opening and disconnects for enclosure removal. Disconnects shall be of the male-female plug type. Panels shall split around all piping connections to allow enclosure removal without detaching piping. Controls shall be visible and operable from outside the enclosure.

2.2.12.3 Ventilation

Fan(s) and sound baffled ventilation grilles shall be provided as part of the enclosure. Ventilation shall be sufficient to limit interior temperature to that required for cooling the motor.

2.2.13 Isolating Pad

If specifically recommended by the compressor manufacturer, each compressor steel or iron base frame shall be mounted on a neoprene waffle or rib type isolator pad which extends uniformly and continuously along the base mounting surface. The neoprene material shall be of bridge bearing pad quality neoprene and shall be formulated for 40 durometer hardness. The maximum bearing pressure on the isolating pad shall be 50 psi. The pads shall be composed of two layers or 5/16 inch neoprene bonded to and sandwiching 16 gage galvanized steel. Compressor bolt down through the pad shall be accomplished using 1/4 inch thick neoprene impregnated duck washers. Neoprene bushings are not acceptable.

2.3 AIR FLOW RATE AND PRESSURE RECORDER AND MEASUREMENT

Provide a complete flow and pressure measurement and recording package. Provide orifice flanges with pressure taps, square edged stainless steel paddle orifice plate. The orifice plate shall be concentric type, of 0.125 inch thickness and shall meet ASME Standards. Orifice shall be sized for 40 inch water column differential at a full scale flow rate of 200 SCFM at compressor based on 120 psig upstream pressure. Static gage pressure measurement device of the recorder shall have a range of zero to 200 psig. Provide copper interconnecting tubing between the pressure taps and the recorder as part of this measurement and recording package. Provide a two-pen recorder for the measurement station. Pens shall record pressure (0 to 200 psig range) and air flow (0 to 200 SCFM). Recorder shall be electric drive and housed in dust-tight steel cabinet. Charts shall be 12 inch diameter with evenly divided graduations. Drive shall be 7 day circle. Provide continuous flow integration of a 7 digit counter type. Pens shall be supplied with long-life cartridges and capillary supply. Chart case shall be internally illuminated. Access to charts shall be through front access window door. Calibrated overall accuracy of the recorded measurements shall be within plus or minus 1.0 percent of full scale. Furnish a supply of 400 charts with the recorder.

2.4 SOURCE QUALITY CONTROL

2.4.1 Factory Test Procedures

The completely assembled air compressor package including the actual contract drive motor, intercooler, lubrication system, and control panel shall be subjected to performance tests and sound level and run-in tests. Unit shall comply with guarantee requirements applying engineering adjustments to guarantee conditions. Test shall be certified by the manufacturer. Test may be run on the manufacturer's test stand using driver for this contract. Tests shall be in accordance with ASME PTC 9 format. Full-range performance tests shall indicate performance at maximum rated flow, rating point, and unloaded conditions. All accessory performance conditions shall be reported, including intercoolers, aftercoolers, and lubrication and control systems. Completed unit shall be factory tested with sound meters in accordance with CAGI PNEUROP. Location shall be one horizontal meter from unit at 1.5 meters above the floor. Test shall include readings at each octave band midpoint and the "A" scale, and shall not exceed 84 dBA and 90 decibels at any octave band. Results of test shall be included in the factory test report on the CAGI

PNEUROP format. Factory test data may be corrected to the levels of an equivalent background noise level of 60 dBA showing calculations for reference use.

2.4.2 Supervision of Testing

System and components testing shall be conducted or supervised by either a designated authorized and factory trained representative of the compressor manufacturer supplying the unit or a registered Mechanical Engineer experienced in such work.

2.4.3 System Test

Testing of system shall conform to requirements outlined and shall be witnessed by the NTR.

2.4.4 Approval of Testing Procedure

Proposed testing procedure shall be approved by the NTR and the individual in charge of testing prior to conducting tests.

2.4.5 Certification of Performance Tests

The test supervisor shall certify performance by test to be in compliance with specifications.

PART 3 EXECUTION

3.1 INSTALLATION

The Contractor shall install the air compressors and accessories in accordance with manufacturer's recommendations and as indicated on the drawings. All equipment shall be installed plumb and level and anchored to structure, matching holes provided. Install the compressor under the direct supervision of an authorized representative of the manufacturer.

3.1.1 Cooling Water Supply

Compressor installation shall include the extension of the potable (cooling) water supply to the compressor and the installation of a drain from the compressor to the nearest storm sewer. Cooling water supply shall be copper tubing systems as specified in Section 15400, "Plumbing Systems". Terminate copper tubing with a hose bibb and make final connection to compressor with reinforced neoprene rubber hose. Drain piping shall be copper tubing. Provide dielectric fittings, as necessary, to join dissimilar metals.

3.2 GENERAL REQUIREMENTS FOR INSTALLING AIR COMPRESSORS

Air compressors with contract motor and accessories shall be factory assembled, run in, and tested complete before shipment to job site. The Contractor is advised that there are limitations to door opening sizes and available crane lifting capacity. Crane unit is specified to permit single lifts of complete compressor under special approval only. Should the unit require disassembly for installation, reassembly shall be under the direct

supervision of the compressor manufacturer's authorized representative. Complete unit shall be mounted on a rigid single or equivalent mechanically joined steel or iron base. Submit installation sequence plans to the NTR for approval prior to installation.

3.2.1 Prompt Installation

The Contractor is advised that any compressor received shall be installed and placed in operation promptly to prevent time deterioration when not installed. Should the Contractor sustain a delay exceeding 90 days prior to actual installation, the NTR shall have the option of requiring breakdown and reassembly to inspect and clean prior to placing in operation. This work shall be at no additional cost to the Government.

3.2.2 Start-Up Services

The Contractor shall furnish the services of a compressor manufacturer's authorized representative to supervise prestart checkout, initial start-up, performance testing, and operator instruction. Time available shall be as required to properly start up but not less than 3 consecutive days for the compressor.

3.3 FIELD QUALITY CONTROL

3.3.1 Field Test Procedures

Complete field performance testing of the total system shall be performed by the Contractor and witnessed by the NTR. Air compressor system test shall be conducted by either a compressor manufacturer's factory trained and authorized representative approved by the Contracting Officer or a qualified registered Mechanical Engineer. Tests may be run on individual components or on the system as a whole at Contractor option. Field tests require use of the actual compressor drive motor. Test shall include operation at rated capacity for not less than 4 hours.

3.3.1.1 Air Compressor Performance Tests

Complete performance test shall be run at maximum load, rated load, at point of unload but prior to unload, and unloaded condition. Data shall be recorded listing:

a. Air flow, inlet pressure and temperature, humidity; discharge pressure and temperature.

b. Intercooler water flows, temperatures, and pressures.

c. Aftercooler water flow, temperatures, and pressures.

d. Bypass cooler water flow, temperatures, and pressures.

e. Lube oil cooling water flow, temperatures, and pressures.

f. Lube oil flow, pressures, and temperature.

g. Cooling water pump flow, pressures, and motor amperage.

h. Cooling tower Closed circuit cooler air flow, water and air temperatures, water pressure, and motor amperage.

i. Electrical load in volts and amperes for compressor motor (loaded and unloaded), prelube oil pump motor, and compressor auxiliaries.

j. Intake filter pressure differential (clean).

k. Start-up sequence, alarm signals and automatic system shutdown.

l. Test compressor intake and discharge for conformance to CGA G-7.1. Compressor discharge shall show no increase in contaminants.

3.3.1.2 Instrumentation Test

The Contractor may use instrumentation provided in the contract and instrumentation provided by the Contractor to conduct the test. The testing procedure and instrumentation shall be submitted to the Contracting Officer for approval prior to conducting tests. The format of ASME PTC 9 is required. It is intended that a full field test be performed. However, in lieu of precise instrumentation, the Contractor may use certified cooling water pump curves and fan curves. Shutdown signals shall be caused by throttling selected fluids. Test data, such as air intake temperature and humidity, shall be mathematically corrected to performance test requirement levels.

3.3.1.3 Sound Level Tests

Sound level tests shall be conducted concurrently. Broad Band "A" scale readings and Octave Band readings shall be taken and recorded at the same positions as on the factory testing. Maximum permissible level shall be 84 decibels one horizontal meter from the compressor and 1.5 meters above the floor, with unit in operation and all other significant equipment not required for test within the same building bay shutdown at the same location previously described. A background noise correction to 60 decibels is permissible.

3.3.1.4 Operational Deficiencies

Any operational deficiencies noted in the tests shall be promptly corrected and affected portions of the test rerun.

3.3.1.5 Testing Tolerances

A tolerance of plus or minus 2 percent on flow, plus or minus 4 percent on power, or plus or minus 5 percent on any other variable for each item of equipment or fluid with all others conforming is permissible on field test results when compared to factory test data and to guarantee performance data except that compressor air flow, discharge pressure, and motor power shall be met.

3.3.2 Approval of Testing Procedure

Proposed testing procedure shall be approved by the NTR and the individual in charge of testing prior to conducting tests.

3.4 TRAINING OF GOVERNMENT PERSONNEL

During start-up and field testing, train Government station personnel in the operation and maintenance of compressor, associated equipment, and all control and safety devices. Training shall not commence until equipment is operational and station personnel are in attendance. At least one day of classroom training and one day of field training shall be furnished for each designated Government personnel. When factory training is required by the compressor manufacturer for proper maintenance and overhaul of the compressors, such training shall be furnished by the compressor manufacturer at no additional cost to the Government. The Government will bear the cost of travel and living expenses for Government personnel as necessary for the factory training.

-- End of Section --

SECTION 15055

NONLUBRICATED ROTARY SCREW VACUUM PUMPS

03/95

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ANTI-FRICTION BEARING MANUFACTURERS ASSOCIATION (AFBMA)

AFBMA 9	(1990) Load Ratings and Fatigue Life for Ball Bearings
AFBMA 11	(1990) Load Ratings and Fatigue Life for Roller Bearings

AMERICAN GEAR MANUFACTURERS ASSOCIATION, INC. (AGMA)

AGMA 390.03A	(1980; Errata 1983) Gear Handbook Gear Classification, Materials and Measuring Methods for Bevel, Hypoid, Fine Pitch Wormgearing and Racks Only as Unassembled Gears

AMERICAN PETROLEUM INSTITUTE (API)

API STD 619	(1985; R 1991) Rotary-Type Positive Displacement Compressors for General Refinery Services

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ANSI/ASME B1.20.1	(1983; R 1992) Pipe Threads, General Purpose (Inch)
ASME/ANSI B16.1	(1989) Cast Iron Pipe Flanges and Flanged Fittings
ASME/ANSI B16.5	(1988; Errata 1988) Pipe Flanges and Flanged Fittings
ANSI/ASME B40.1	(1991; Special Notice 1992) Gauges - Pressure Indicating Dial Type - Elastic Element
ASME PTC 9	(1970; Errata 1972, R 1992) Displacement Compressors, Vacuum Pumps and Blowers
ASME BPVC SEC VIII D1	(1992; Addenda 1992 and 1993) Boiler and

	Pressure Vessel Code: Section VIII Pressure Vessels, Division 1

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M	(1993; Rev. A) Structural Steel
ASTM B 111	(1993) Copper and Copper-Alloy Seamless Condenser Tubes and Ferrule Stock
ASTM B 171	(1993) Copper-Alloy Plate and Sheet for Pressure Vessels, Condensers and Heat Exchangers
ASTM B 209	(1993) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM C 553	(1992) Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM E 84	(1991; Rev. A) Surface Burning Characteristics of Building Materials

COMPRESSED AIR AND GAS INSTITUTE (CAGI)

CAGI PNEUROP	(1971) Test Code for the Measurement of Sound from Pneumatic Equipment

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910.219	Mechanical Power Transmission Apparatus

COMPRESSED GAS ASSOCIATION, INC. (CGA)

CGA G-7.1	(1989) Commodity Specification for Air

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC. (IEEE)

IEEE 112	(1991) Polyphase Induction Motors and Generators

MILITARY SPECIFICATIONS (MIL)

MIL-A-3316	(Rev. C; Am. 2) Adhesives, Fire-Resistant, Thermal Insulation
MIL-T-19646	(Rev. A) Thermometer, Gas Actuated, Remote Reading

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 2	(1993) Controllers, Contactors and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC

NEMA ICS 6 (1993) Control and Systems Enclosures

NEMA MG 1 (1993) Motors and Generators

1.2 GENERAL REQUIREMENTS

Section 15011, "Mechanical General Requirements," applies to this section except as specified herein.

1.3 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic Contract.

1.3.1 SD-02, Manufacturer's Catalog Data

a. Vacuum Pump G

b. Inlet air filters

c. Line silencer

d. Air flow rate and pressure recorder

e. Filter housing

Submit manufacturer's catalog data for vacuum pump and auxiliary equipment in a format similar to API STD 619, Appendix A. For vacuum pumps, include intercoolers, oil cooler, lubrication system, and control valves. Submit vacuum pump, intercooler, aftercooler, and bypass cooler performance curves at specified summer and winter design conditions.

1.3.2 SD-04, Drawings

a. Vacuum pump system G

1.3.2.1 Vacuum Pump System

Include wiring diagrams of the vacuum pump with all accessories. The minimum acceptable scale is 1/4 inch to one foot.

1.3.3 SD-08, Statements

a. Work plan

b. Factory test procedures G

c. Factory testing certification

d. Qualifications of field supervisors

e. Field test procedures

f. Training material

1.3.3.1 Work Plan

Submit a written schedule of dates of installation, start-up, checkout, and test of equipment.

1.3.3.2 Factory Testing Certification

Submit a statement that the vacuum pump factory is equipped to perform all required factory tests. Submit in accordance with paragraph entitled "Manufacturer's Certifications."

1.3.3.3 Qualifications of Field Supervisors

Submit the name and certified written resume of the engineer or technician, listing education, factory training and installation, start-up, and testing supervision experience for at least two projects involving equipment similar to those in this contract.

1.3.3.4 Training Material

Submit a detailed training program syllabus for training government personnel, including instructional materials at least three weeks prior to start of tests.

1.3.4 SD-11, Factory Test Reports

a. Vacuum pump performance tests

b. Sound level and run-in tests

Obtain approval prior to shipping pump.

1.3.5 SD-12, Field Test Reports

a. Vacuum pump performance tests

b. Instrumentation test

c. Sound level tests

d. Vacuum pump system test

The test supervisor shall certify performance by test to be in compliance with specifications.

1.3.6 SD-13, Certificates

a. Vacuum pump system

b. Vacuum pump system installation

1.3.6.1 System Installation

Submit certification of performance conforming to ASME PTC 9 and ASME BPVC SEC VIII D1. Submit certification of proper installation in accordance with paragraph entitled "Supervision."

1.3.7 SD-18, Records

a. Posted operating instructions for vacuum pump

Submit text.

1.3.8 SD-19, Operation and Maintenance Manuals

a. Vacuum pump system, Data Package 3 G

Submit operation and maintenance data in accordance with Section 01010, "General Paragraphs." Data shall contain information required for maintenance and repair and shall contain no evidence that proprietary maintenance arrangements with the manufacturer will be necessary. Pumps which will require proprietary maintenance arrangement with the manufacturer require Government review and approval. The pumps may be disapproved if circumstances do not justify approval of pumps with limited availability of maintenance.

1.4 SAFETY

Construct all components of the unit in accordance with the requirements of OSHA 29 CFR 1910.219. Requirements include shaft coupling guards as specified in Section 15011, "Mechanical General Requirements" insulation and jacketing with manufacturer standard covering or aluminum sheet of all surfaces at 125 degrees F and higher within a height of 7 feet from floor level, and use of electrical safety devices. Thermal insulation, furnished by equipment manufacturer, shall conform to ASTM C 553, Type I (flexible resilient), Class B-5 (up to 400 degrees F), 2 pcf nominal. Cement insulation to surface with MIL-A-3316, Class 2, adhesive and fasten with 16-gage wire bands at maximum 16 inches on center spacing. Cover insulation with ASTM B 209 sheet aluminum jacket. However, insulation is not required for hot piping inside sound enclosure.

1.5 EQUIPMENT ARRANGEMENT

Arrangement selected shall maintain 3 foot clearance for access passage and 4 foot clearance for personnel to operate equipment. There are substantial physical and connection point differences among the several vacuum pumps which comply with this specification. The Contractor shall be responsible for selecting equipment and submitting arrangement drawings covering required changes for approval by the NTR. Changes from the equipment arrangement shown on the contract drawings shall be performed by the Contractor at no additional cost to the Government.

1.6 ELECTRICAL REQUIREMENTS

Comply with the requirements of Section 16402, "Interior Wiring Systems,".

1.7 SUPERVISION

The Contractor shall obtain the services of a qualified engineer or technician from the vacuum pump manufacturer to supervise installation, start-up, and testing of the pump. After satisfactory installation of the equipment, the engineer or technician shall provide a signed certification that the equipment is installed in accordance with the manufacturer's recommendations.

1.8 DEFINITIONS

Conform to API STD 619 and the following:

a. Vacuum pump power is shaft power at shaft coupling, including all losses and connected appurtenances.

1.9 INSULATION

Thermal and acoustical insulation shall have flame spread rating not higher than 75, and smoke developed rating not higher than 150 when tested in accordance with ASTM E 84.

1.10 POSTED OPERATING INSTRUCTIONS

Provide for vacuum pump. Include start-up and shutdown sequence instructions.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Materials and equipment complete with accessories shall be selected by the Contractor for performance compatibility.

2.2 VACUUM PUMP

The vacuum pump shall be packaged, positive displacement rotary screw vacuum pump. No lubricant shall be used within the compression chamber. Include vacuum pump, electric motor driver, coolers, lubrication system, and regulation and control systems mounted on a common base frame, and completely enclosed for noise control.

2.2.1 Manufacturer's Certifications

The manufacturer shall certify that the vacuum pumps proposed are of the same design, construction, size, and of equal or not more than 10 percent smaller in capacity as vacuum pumps which have been in satisfactory continuous service for at least 2 years at not less than two locations. Furnish the name of the owner, the address of the installation, and the name of a person at the installation who can be contacted for verification. The manufacturer shall also certify that the factory is equipped to perform all required factory tests.

2.2.2 Guaranteed Performance

a. Net free air output (All seal losses shall be considered internal and not included in the net output) (plus or minus 2 percent): 350 and 900 CFM

b. Vacuum pressure at inlet (minus zero plus 4 percent): 6-inches Hg.

c. Inlet air filtration efficiency: 99.9 percent of 0.5 micron size

d. Barometric pressure: 14.7 psia

e. Cooling water inlet temperature: 70 degrees F

f. Total cooling water flow rate: as required up to 5 gpm

g. Maximum cooling water pressure drop through the vacuum pump and any intercooler, aftercooler, or oil cooler: 8 psig

h. Maximum vacuum pump power required. (Plus or minus 4 percent): 25 and 50 hp

i. Unloaded pump power (maximum): 25 and 50 hp

j. Maximum sound levels one meter horizontal from vacuum pump and 1.5 meters above floor as measured per CAGI PNEUROP Test Code for the Measurement of Sound from Pneumatic Equipment: 84 dBA, 90dB for any octave band.

2.2.3 Additional Performance Requirements

2.2.3.1 Critical Speeds

Actual critical speeds shall not encroach upon operating speed ranges at specified loads ranges. Rotors shall be of a stiff shaft construction with the first actual rotor bending critical speed at least 120 percent of the maximum operating speed.

2.2.3.2 Vibration and Balance

Major parts of rotating elements, such as rotors, gears, and similar items shall be individually dynamically balanced. During the factory and site tests of the assembled machine at operating speed, the double amplitude of vibration in any plane measured on the shaft adjacent and relative to a radial bearing shall not exceed the limits of API STD 619, paragraph 2.7.2.5. For shafts which are not accessible, the manufacturer shall submit a testing procedure to the NTR for approval.

2.2.4 Electrical Service Conditions

2.2.4.1 Vacuum Pump Drive Motor

460 volts, 3 phase, 3 wire, 60 hertz electrical service.

2.2.4.2 Accessory electrical Service

See Table I.

TABLE I - VACUUM PUMP ACCESSORY ELECTRICAL SERVICE SCHEDULE

Item	Voltage	Phase	Frequency
Control Power and Motors under 1/2 hp	120	1	60 Hz
Accessory Power	460	3	60 Hz

2.2.5 Vacuum Pump Controls

Provide a complete load regulation and control system with the vacuum pump. Provide additional electrical, electro-pneumatic, or solid state electronic controls for other specified control and monitor functions. All electrical controls shall conform to NEMA ICS 2 as selected by the vacuum pump manufacturer. Control system enclosure shall conform to NEMA ICS 6. Controls shall be suitable for individual operation of the vacuum pump or parallel operation with one or more other pumps.

2.2.5.1 Vacuum Pump Start-Up

The vacuum pumps shall start unloaded. The manual starting circuit for the pump shall have interlocks to prevent the pump drive motor from starting until pre-lubrication pump (if provided), oil pressure, and cooling water pump water flow have been established to the required values for safe operation as determined by the manufacturer.

2.2.5.2 Load Regulation

The vacuum pump shall operate continuously at constant speed after being started. Provide means to load and unload the vacuum pump automatically at preset minimum and maximum vacuum pressure settings. Minimum pressure shall be 0-inches Hg, and maximum vacuum shall be 8-inches. Unloading shall be accomplished by a combination of closing the inlet valve and bypassing or venting the outlet of the pump; however, input power at fully unloaded operation shall not exceed 20 percent of full load input. Bypassed air shall be cooled by the bypass cooler and if returned to the inlet of the first stage through an internal loop and shall be limited to the minimum flow required to maintain vacuum pump cooling. Air vented to the atmosphere when unloading need not be cooled.

2.2.5.3 Monitor and Safety Controls

Provide supplementary electric, electro-pneumatic, or solid state electronic controls to provide alarm and shutdown requirements, plus interlocks with accessories. Requirements are as follows:

a. Shutdown requirements shall cause the controlled vacuum pump to shut down, energize alarms, and light labeled red lights.

b. Alarm only requirements shall not cause the controlled vacuum pump to shut down, but shall sound the same alarms and light labeled amber lights.

c. Light only requirements shall not cause the controlled vacuum pump to shut down, but shall light labeled amber lights.

d. The individual monitor and safety controls shall be as shown on Table 2.

TABLE 2 - MONITOR AND SAFETY CONTROL SCHEDULE

Item	Shutdown	Light and Alarm	Indicating Light Only
1. High Discharge Air Temperature 275 degrees F	Yes	Yes	-
2. High Intercooler Discharge Water Temperature, Each Intercooler	No	Yes	-
3. High Aftercooler Discharge Water Temperature	No	Yes	-
4. High Cooling Water Supply Temperature	No	Yes	-
5. High Lube Oil Temperature	Yes	Yes	-
6. Low Lube Oil Pressure	Yes	Yes	-
7. Low Cooling Water Flow	No	Yes	-
8. Low Oil Reservoir Level	No	Yes	-
9. High Condensate Level Intercoolers (wired to one light)	No	No	Yes
10. High Bleed-Off Air Pressure	Yes	Yes	-
11. High Motor Stator Temperature	Yes	Yes	-
12. High Condensate Level Aftercooler	No	No	Yes
13. High Inlet Pressure Drop Across Inlet Air Filters (combined, 3 stage)	No	Yes	-

2.2.5.4 Monitoring Instruments

Provide the following monitoring instruments in addition to the monitor and safety controls. Vacuum gages shall conform to ANSI/ASME B40.1, 4 1/2 inch diameter, red marking pointer, single bourdon tube, brass case, black enamel finish. Provide vacuum gages with a pressure snubber and a stainless steel barstock needle isolation valve. Thermometers shall be extended stainless steel sheathed bimetallic stem, 3 1/2 inch dial, and

separable 4 inch stainless steel wells. Temperature measurements at inaccessible locations shall be made with remote reading thermometers conforming to MIL-T-19646, Class C separable well of Type 304 stainless steel. Select pressure and temperature gage ranges to give a normal operating reading near the midpoint of the scale range.

a. Oil cooler outlet temperature gages for oil.

b. Oil cooler inlet temperature gages for water.

c. Lubrication oil bearing supply pressure gage.

d. Vacuum seal air pressure gage (if applicable).

e. Inlet air filter differential pressure gage with 8, zero, 8 inch water gage. Provide selector valve, tubing, and tap to measure static gage pressure downstream of each filter stage.

f. Total running time readout.

g. Cooling water supply to vacuum pump pressure gage.

h. Cooling water return from vacuum pump pressure gage.

i. Interstage air pressure gages for each interstage.

l. Air temperature at discharge of each stage of compression before cooling temperature gages.

m. Interstage air temperature after intercooler of each stage temperature gages.

n. Vacuum pump inlet air temperature gage.

o. Cooling water to vacuum pump temperature gage.

p. Cooling water outlet temperature at each outlet of each intercooler, aftercooler, and bypass air cooler temperature gages.

2.2.6 Vacuum Pump Design Features

The vacuum pump shall be a multistage, oil-free rotary screw vacuum pump, with a minimum of two vacuum pump stages, flanged to an integral speed increaser. Each stage shall be driven from a common bull gear to ensure optimum speed and efficiency. An intercooler shall be provided between stages and aftercooler shall be provided after the final stage of compression. Silencers, lubricating system, cooling system, control system, and driver shall be mounted as part of the package. Provide a common base frame for the vacuum pump system and driver. Provide a sound enclosure over the vacuum pump and driver. Equipment shall be designed for economical and rapid maintenance. Casing components, bearing housings, and other major parts shall be shouldered, dowelled, or designed with other provisions to facilitate accurate alignment or reassembly. Shaft seals and bearings shall be accessible for inspection or replacement with a minimum of disassembly; however, vacuum pumps with compression elements (air end)

provided as a factory-assembled not repairable in the field may be approved by the NTR if determined to be in the interest of the Government.

2.2.6.1 Casings

Casings shall be cast iron, ductile iron, cast steel, or fabricated steel. Casing stresses shall be within the limits allowed by ASME BPVC SEC VIII D1. Casings, supports, and baseplates shall be designed and fabricated to preclude excessive and injurious distortion from temperatures, pressures, and forces encountered in service conditions. Provide jackscrews, lifting lugs, eyebolts, guide dowels, and casing alignment dowels to facilitate disassembly and reassembly. When using jackscrews for parting contacting faces, relieve one of the faces by counterboring or recessing to prevent marring the face, which result in leaking or improper fit. Provide lifting lugs or eyebolts for removable portions of the casings. Flanged casing connections for external piping shall conform to ASME/ANSI B16.1 or ASME/ANSI B16.5. Threaded connections for external piping shall conform to ANSI/ASME B1.20.1. Air compression portion of the casing shall be one-piece and shall be provided with integral coolant passages and a large inlet port. Gear cases shall be enclosed, accessible, force lubricated, and designed with seals and slingers to keep oil out of air system.

2.2.6.2 Shafts

Shafts shall be of forged or rolled alloy steel and shall have a machined finish throughout their entire length. All rotating components shall be positively secured to shafts by approved mechanical means or interference shrink fits.

2.2.6.3 Rotors

Rotors shall be steel, and of one-piece construction, with an asymmetric profile to minimize leakage losses, and ensure high efficiency. Rotors shall be treated for corrosion resistance. It rotors are welded to the shaft, the assembly shall be stress relieved and heat treated for proper strength. Rotors shall be dynamically balanced to ensure vibration-free operation.

2.2.6.4 Gears

Gears shall be of alloy steel, AGMA 390.03A Quality Number 12 or better for both bull and pinion gears. Gears shall be hardened to 275 Brinell for bull gear and 320 Brinell for pinion, unless otherwise approved. Gears shall be ground to the required contours, checked for proper contact during assembly at the factory, and shall not require a break-in period in the field for proper operation. All gears shall be pressure lubricated.

a. Timing gears shall be provided on the rotor shafts to maintain the rotors in correct relative position. The vacuum pump design shall allow the timing gears to absorb no more than 10 percent of the total input power at full load.

2.2.6.5 Seals

Separate air and oil shaft seals shall be provided to confine air in the casing and prevent contamination of the air stream by lubricating oil. Shaft seals shall be the restrictive ring type. The seal rings shall be stainless steel, brass, or carbon, and retainers shall be made of stainless steel. Provide an air space vented to the atmosphere between the air and oil seals. Seals shall be suitable for all operating conditions including suction throttling, start-up, and shutdown.

2.2.6.6 Thrust Bearings

Thrust bearings shall be anti-friction ball or roller type or hydrodynamic (fluid film) type. Anti-friction bearings shall have an L-10 life of 80,000 hours in accordance with AFBMA 9 or AFBMA 11. Axial rotor thrusts due to air compression shall be absorbed by main thrust bearings or transferred to auxiliary thrust bearings by a load balancing arrangement. Hydrodynamic thrust bearings shall be Kingsbury type or other approved type and shall be adequate to accommodate all operating conditions. Speed increaser bull gear thrust bearings shall be sized for equal thrust in both directions and shall be adequate for any axial loads transmitted through the driver coupling.

2.2.6.7 Radial Bearings

Radial bearings shall be anti-friction roller or ball type or hydrodynamic type. Anti-friction bearings shall have an L-10 life of 40,000 hours in accordance with AFBMA 9 or AFBMA 11. Hydrodynamic bearings shall be precision bored sleeve or pad type, designed for easy replacement by a split design or axially removable arrangement. High speed hydrodynamic pinion bearings shall be anti-oil whip, tilting pad type. Hydrodynamic bearing design shall provide low vibration and sufficient damping at rated speed and all operating modes, including rated capacity and unloading down to 20 percent of unloaded power.

2.2.6.8 Speed Increaser

The speed increaser shall be an integral part of the vacuum pump unit and shall include the main drive shaft and bull gear. The main drive shaft shall be supported through anti-friction bearings.

2.2.6.9 Intercoolers, Aftercooler, Bypass Cooler, and Oil Coolers

Intercoolers, aftercooler, bypass cooler, and oil cooler shall include ASTM B 111 admiralty brass or other corrosion resistant tubes in ASTM B 171 admiralty or steel tube sheets and baffles for optimum cooling and fouling resistance using fresh water. Provide an intercooler between stages of compression factory assembled on unit base with piping. The aftercooler shall be mounted on the unit base. Intercoolers, aftercooler, bypass cooler, and oil cooler shall be factory tested at 1.5 times operating pressure. External intercoolers and aftercooler shall be constructed in accordance with ASME BPVC SEC VIII D1 requirements and be ASME code stamped for 150 psig working pressure. Intercoolers and aftercooler shall be capable of one piece bundle removal. Intercoolers and aftercooler shall be equipped with an integral or direct connected

moisture separator with condensate trap assembly. Design intercoolers and aftercooler for 20 and 15 degrees F approach, respectively; however, the approach temperature used to size the coolers shall be reduced if required to meet aftercooler maximum air outlet temperature specified. Nonstandard coolers shall be provided if required to meet the aftercooler maximum air outlet temperature requirement. All coolers shall be of counter-flow design, with a fouling factor of 0.002 for both sides of the coolers.

2.2.6.10 Lubrication System

Include an integral sump, positive displacement pump, oil cooler, and twin filter\strainer (readily replaceable cartridges while operating). Provide a prelube lubrication oil pump for start-up and standby for hydrodynamic bearings or if required by the vacuum pump design. System shall be factory assembled and tested. Lubricating oil shall conform to recommendations of the manufacturer. Spray lubricate drive gear, anti-friction bearings, and timing gear in each stage. Pressure lubricate hydrodynamic bearings. Provide the oil sump with a level indicator and drain and fill connections.

a. Prelubrication pump, if required, or motor-driven main lubrication pump shall be sized by vacuum pump manufacturer for the requirements of the system, but shall meet the following requirements. Pump shall be positive displacement gear pump separately mounted with motor on a common base plate with drip lip and drain.

   (1) Performance: Pump shall have separate safety valve bypass set at 25 psi above peak expected pressure.

   (2) Materials shall be hardened steel gears and shaft, cast iron case, bronze bearings, mechanical seal.

   (3) Flexible coupling with shaft guard shall be provided, except that these items are not required for a close-coupled pump.

   (4) Motor shall be NEMA MG 1, Design A or B, Class B insulation, of open drip-proof type. Furnish combination type starter for motor.

b. Lube Oil Heater: Provide thermostatically controlled electric heater in lubrication oil sump of sufficient capacity to heat up and maintain manufacturer's recommended oil temperature when unit is cold at 32 degrees F ambient. Provide low oil level indicator with light for protection of heater.

2.2.7 Electric Motors

2.2.7.1 Main Electric Drive Motor

The main drive motor for each vacuum pump shall be an induction, or a sychronous motor, 25 and 50 horsepower (hp), with a continuous service factor of 1.0. Size the motor so that the name plate hp rating is not exceeded under the entire range of operating conditions specified. Induction motor shall be high efficiency type not less than 95 percent

rated based upon IEEE 112, testing and labeling. Electrical service will be as specified. Motor shall be designed for reduced voltage starting at 50 65 80 percent of full voltage, allowing for characteristics of the connected load, and shall start without undervoltage tripping. Provide resistance temperature detectors (RTD) attached to or imbedded in motor winding for control system. The motor shall meet the requirements of NEMA MG 1 with Class F insulation. Provide space heaters for protection of windings during motor shutdowns.

2.2.7.2 Accessory and Related Equipment Motors

Motors less than 1/2 hp shall be single-phase induction motors and shall conform to NEMA MG 1. Motors 1/2 through 5 hp shall be three-phase induction motors and shall conform to NEMA MG 1. Single-phase and three-phase motors shall have bimetallic disk thermostats attached to or imbedded in the motor winding. Motors shall have NEMA MG 1 Class B insulation.

2.2.8 Control Panel

Control unit panel shall conform to NEMA ICS 6, floor or frame mounted, factory designed, and assembled, and shall be provided complete. The panel shall be fabricated of formed stretcher leveled sheet steel, reinforced, and assembled into a rigid unit. Gasketed access doors shall be provided as required. Panel shall be factory finish painted. The panel shall meet NEMA 12, requirements.

a. Panel shall contain electric and safety control work required, including either alarm annunciator or individual labeled pilot lights arranged in a group. Panel shall contain alarm device with light and silencing. Generalized arrangement in accordance with drawings.

b. Panel shall contain start and stop buttons (the latter with lockout feature), discharge air pressure gage, control test switch and lights, reset button, green unit running light, and control selector switch.

c. Oil pressure gages shall be mounted separately from panel.

2.2.9 Accessories

Required accessories include:

2.2.9.1 Control Valves

Pneumatically or hydraulically controlled valves on suction inlet of vacuum pump and on bypass or vent line.

2.2.9.2 Intake Devices

Vacuum pump outlet shall be piped to the outside of the building and consist of the following:

a. Weather hood with rain hood and bird screen. Material shall be

galvanized steel or aluminum alloy, minimum 20 gage.

b. Exhaust pipe, ASTM A 36/A 36M steel galvanized, 12 gage or Schedule 5 minimum.

c. Filter housing by filter manufacturer to include filter frames, access door(s). Material for housing shall be 0.065 inch thick, Class 5000 aluminum alloy. Unit shall be rigid and free from distress with all seams sealed.

d. Intake Pipe to Vacuum Pump: Aluminum alloy ASTM B 209, Alclad alloy 5052-H32 or equivalent, minimum 10 gage, flanged, welded with 5XXX welding rod using TIG method and including expansion bellows.

2.2.10 Bypass or Vent Line Silencer

A bypass or vent line silencer shall be furnished with each vacuum pump as selected by manufacturer for sufficient noise attenuation to meet OSHA sound level criteria, but not greater than 84 dBA measured at an elevation of 5 feet, and 10 feet horizontally from silencer.

2.2.11 Sound Attenuating Enclosure

The vacuum pump package, including the driver motor, shall be contained within a noise reducing enclosure. Design of the enclosure shall be such as to limit noise transmission to 84 dBA or less at a distance of one meter from the vacuum pump in any direction.

2.2.11.1 Enclosure Frame

The enclosure frame shall be designed to support the weight of the sound suppression panels and easily demountable. Connections to the base frame shall be designed to allow the enclosure frame to be detached and lifted away without damage to the connections, enclosure frame or base frame, and to allow accessibility and replacement of any component.

2.2.11.2 Panels

The panels shall be of rigid construction to allow repeated access without damage or distortion. Sound absorbing material shall be mineral fiber, treated to preclude shedding of fibers. Other approved insulation may be used except that polyurethane foam shall not be permitted. Top panels shall be secured to the enclosure frame with quick disconnect fittings and fabricated to allow easy hand removal for maintenance. End and side panels shall be hinged or lift out with positive closure latches. Panels shall be designed to allow the maximum access area when opened. Provide acoustic seals as required. Controls and instrumentation mounted on the panels shall have flexible connections for panel opening and disconnects for enclosure removal. Disconnects shall be of the male-female plug type. Panels shall split around all piping connections to allow enclosure removal without detaching piping. Controls shall be visible and operable from outside the enclosure.

2.2.11.3 Ventilation

Fan(s) and sound baffled ventilation grilles shall be provided as part of the enclosure. Ventilation shall be sufficient to limit interior temperature to that required for cooling the motor.

2.2.12 Isolating Pad

If specifically recommended by the manufacturer, each vacuum pump steel or iron base frame shall be mounted on a neoprene waffle or rib type isolator pad which extends uniformly and continuously along the base mounting surface. The neoprene material shall be of bridge bearing pad quality neoprene and shall be formulated for 40 durometer hardness. The maximum bearing pressure on the isolating pad shall be 50 psi. The pads shall be composed of two layers or 5/16 inch neoprene bonded to and sandwiching 16 gage galvanized steel. Vacuum pump bolt down through the pad shall be accomplished using 1/4 inch thick neoprene impregnated duck washers. Neoprene bushings are not acceptable.

2.3 AIR FLOW RATE AND PRESSURE RECORDER AND MEASUREMENT

Provide a complete flow and pressure measurement and recording package. Provide orifice flanges with pressure taps, square edged stainless steel paddle orifice plate. The orifice plate shall be concentric type, of 0.125 inch thickness and shall meet ASME Standards. Orifice shall be sized for 40 inch water column differential at a full scale flow rate. Provide copper interconnecting tubing between the pressure taps and the recorder as part of this measurement and recording package. Provide a two-pen recorder for the measurement station. Pens shall record pressure (0 to 10-inch Hg) and air flow. Recorder shall be electric drive and housed in dust-tight steel cabinet. Charts shall be 12 inch diameter with evenly divided graduations. Drive shall be 7 day circle. Provide continuous flow integration of a 7 digit counter type. Pens shall be supplied with long-life cartridges and capillary supply. Chart case shall be internally illuminated. Access to charts shall be through front access window door. Calibrated overall accuracy of the recorded measurements shall be within plus or minus 1.0 percent of full scale. Furnish a supply of 400 charts with the recorder.

2.4 SOURCE QUALITY CONTROL

2.4.1 Factory Test Procedures

The completely assembled vacuum pump package including the actual contract drive motor, intercooler, lubrication system, and control panel shall be subjected to performance tests and sound level and run-in tests. Unit shall comply with guarantee requirements applying engineering adjustments to guarantee conditions. Test shall be certified by the manufacturer. Test may be run on the manufacturer's test stand using driver for this contract. Tests shall be in accordance with ASME PTC 9 format. Full-range performance tests shall indicate performance at maximum rated flow, rating point, and unloaded conditions. All accessory performance conditions shall be reported, including intercoolers, aftercoolers, and lubrication and control systems. Completed unit shall be factory tested with sound meters in accordance with CAGI PNEUROP.

Location shall be one horizontal meter from unit at 1.5 meters above the floor. Test shall include readings at each octave band midpoint and the "A" scale, and shall not exceed 84 dBA and 90 decibels at any octave band. Results of test shall be included in the factory test report on the CAGI PNEUROP format. Factory test data may be corrected to the levels of an equivalent background noise level of 60 dBA showing calculations for reference use.

2.4.2 Supervision of Testing

System and components testing shall be conducted or supervised by either a designated authorized and factory trained representative of the manufacturer supplying the unit or a registered Mechanical Engineer experienced in such work.

2.4.3 System Test

Testing of system shall conform to requirements outlined and shall be witnessed by the NTR.

2.4.4 Approval of Testing Procedure

Proposed testing procedure shall be approved by the NTR and the individual in charge of testing prior to conducting tests.

2.4.5 Certification of Performance Tests

The test supervisor shall certify performance by test to be in compliance with specifications.

PART 3 EXECUTION

3.1 INSTALLATION

The Contractor shall install the vacuum pumps and accessories in accordance with manufacturer's recommendations and as indicated on the drawings. All equipment shall be installed plumb and level and anchored to structure, matching holes provided. Install the vacuum pump under the direct supervision of an authorized representative of the manufacturer.

3.1.1 Cooling Water Supply

Vacuum pump installation shall include the extension of the potable (cooling) water supply to the vacuum pump and the installation of a drain from the vacuum pump to the nearest storm sewer. Cooling water supply shall be copper tubing systems as specified in Section 15400, "Plumbing Systems". Terminate copper tubing with a hose bibb and make final connection to vacuum pump with reinforced neoprene rubber hose. Drain piping shall be copper tubing. Provide dielectric fittings, as necessary, to join dissimilar metals.

3.2 GENERAL REQUIREMENTS FOR INSTALLING VACUUM PUMPS

Vacuum pumps with contract motor and accessories shall be factory assembled, run in, and tested complete before shipment to job site. The

Contractor is advised that there are limitations to door opening sizes and available crane lifting capacity. Crane unit is specified to permit single lifts of complete unit under special approval only. Should the unit require disassembly for installation, reassembly shall be under the direct supervision of the manufacturer's authorized representative. Complete unit shall be mounted on a rigid single or equivalent mechanically joined steel or iron base. Submit installation sequence plans to the NTR for approval prior to installation.

3.2.1 Prompt Installation

The Contractor is advised that any equipment received shall be installed and placed in operation promptly to prevent time deterioration when not installed. Should the Contractor sustain a delay exceeding 90 days prior to actual installation, the NTR shall have the option of requiring breakdown and reassembly to inspect and clean prior to placing in operation. This work shall be at no additional cost to the Government.

3.2.2 Start-Up Services

The Contractor shall furnish the services of a manufacturer's authorized representative to supervise prestart checkout, initial start-up, performance testing, and operator instruction. Time available shall be as required to properly start up but not less than 3 consecutive days for the vacuum pump.

3.3 FIELD QUALITY CONTROL

3.3.1 Field Test Procedures

Complete field performance testing of the total system shall be performed by the Contractor and witnessed by the NTR. Vacuum pump system test shall be conducted by either a manufacturer's factory trained and authorized representative approved by the Contracting Officer or a qualified registered Mechanical Engineer. Tests may be run on individual components or on the system as a whole at Contractor option. Field tests require use of the actual vacuum pump drive motor. Test shall include operation at rated capacity for not less than 4 hours.

3.3.1.1 Vacuum Pump Performance Tests

Complete performance test shall be run at maximum load, rated load, at point of unload but prior to unload, and unloaded condition. Data shall be recorded listing:

a. Air flow, inlet vacuum pressure and temperature, humidity; discharge pressure and temperature.

b. Intercooler water flows, temperatures, and pressures.

c. Aftercooler water flow, temperatures, and pressures.

d. Bypass cooler water flow, temperatures, and pressures.

e. Lube oil cooling water flow, temperatures, and pressures.

f. Lube oil flow, pressures, and temperature.

g. Cooling water pump flow, pressures, and motor amperage.

h. Cooling tower Closed circuit cooler air flow, water and air temperatures, water pressure, and motor amperage.

i. Electrical load in volts and amperes for vacuum pump motor (loaded and unloaded), prelube oil pump motor, and vacuum pump auxiliaries.

j. Start-up sequence, alarm signals and automatic system shutdown.

k. Test vacuum pump intake and discharge for conformance to CGA G-7.1. Vacuum pump discharge shall show no increase in contaminants.

3.3.1.2 Instrumentation Test

The Contractor may use instrumentation provided in the contract and instrumentation provided by the Contractor to conduct the test. The testing procedure and instrumentation shall be submitted to the Contracting Officer for approval prior to conducting tests. The format of ASME PTC 9 is required. It is intended that a full field test be performed. However, in lieu of precise instrumentation, the Contractor may use certified cooling water pump curves and fan curves. Shutdown signals shall be caused by throttling selected fluids. Test data, such as air intake temperature and humidity, shall be mathematically corrected to performance test requirement levels.

3.3.1.3 Sound Level Tests

Sound level tests shall be conducted concurrently. Broad Band "A" scale readings and Octave Band readings shall be taken and recorded at the same positions as on the factory testing. Maximum permissible level shall be 84 decibels one horizontal meter from the vacuum pump and 1.5 meters above the floor, with unit in operation and all other significant equipment not required for test within the same building bay shutdown at the same location previously described. A background noise correction to 60 decibels is permissible.

3.3.1.4 Operational Deficiencies

Any operational deficiencies noted in the tests shall be promptly corrected and affected portions of the test rerun.

3.3.1.5 Testing Tolerances

A tolerance of plus or minus 2 percent on flow, plus or minus 4 percent on power, or plus or minus 5 percent on any other variable for each item of equipment or fluid with all others conforming is permissible on field test results when compared to factory test data and to guarantee performance data except that vacuum pump air flow, discharge pressure, and motor power shall be met.

3.3.2 Approval of Testing Procedure

Proposed testing procedure shall be approved by the NTR and the individual in charge of testing prior to conducting tests.

3.4 TRAINING OF GOVERNMENT PERSONNEL

During start-up and field testing, train Government station personnel in the operation and maintenance of vacuum pump, associated equipment, and all control and safety devices. Training shall not commence until equipment is operational and station personnel are in attendance. At least one day of classroom training and one day of field training shall be furnished for each designated Government personnel. When factory training is required by the vacuum pump manufacturer for proper maintenance and overhaul of the vacuum pumps, such training shall be furnished by the manufacturer at no additional cost to the Government. The Government will bear the cost of travel and living expenses for Government personnel as necessary for the factory training.

-- End of Section --

SECTION 15400

PLUMBING SYSTEMS

06/95

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A112.21.2M	(1983) Roof Drains
ANSI A112.36.2M	(1991) Cleanouts
ANSI B16.18	(1984; R 1994) Cast Copper Alloy Solder Joint Pressure Fittings
ANSI B16.23	(1992; Errata 1994) Cast Copper Alloy Solder Joint Drainage Fittings - DWV

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A112.21.1M	(1991) Floor Drains
ANSI/ASME B16.3	(1992) Malleable Iron Threaded Fittings
ASME/ANSI B16.22	(1989) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ANSI/ASME B16.29	(1986) Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 47	(1990) Ferritic Malleable Iron Castings
ASTM A 53	(1993; Rev. A) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 74	(1994) Cast Iron Soil Pipe and Fittings
ASTM A 536	(1984; R 1993) Ductile Iron Castings
ASTM B 32	(1994) Solder Metal
ASTM B 42	(1993) Seamless Copper Pipe, Standard Sizes

ASTM B 88	(1993; Rev. A) Seamless Copper Water Tube
ASTM B 306	(1992) Copper Drainage Tube (DWV)
ASTM C 564	(1993) Rubber Gaskets for Cast Iron Soil Pipe and Fittings

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C651	(1992) Disinfecting Water Mains

BUILDING OFFICIALS & CODE ADMINISTRATORS INTERNATIONAL, INC. (BOCA)

BOCA IPC	(1995) International Plumbing Code

CAST IRON SOIL PIPE INSTITUTE (CISPI)

CISPI HSN	(1985) Neoprene Rubber Gaskets for Hub and Spigot Cast Iron Soil Pipe and Fittings
CISPI 301	(1990) Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
CISPI 310	(1990) Couplings Joint for Use in Connection with Hubless Cast Iron Soil Pipe and Fitting

FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH (FCCCHR)

FCCCHR-USC	(1992) List of Approved Backflow Prevention Assemblies

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY, INC. (MSS)

MSS SP-58	(1993) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	(1991) Pipe Hangers and Supports - Selection and Application

1.2 RELATED REQUIREMENTS

Section 15011, "Mechanical General Requirements," applies to this section with the additions and modifications specified herein.

1.3 SYSTEM DESCRIPTION

Provide plumbing systems, complete and ready for operation. Plumbing systems including manufacturer's products shall be in accordance with the required and advisory provisions of the BOCA NPC. Plumbing systems include piping less than 5 feet outside of building walls and piping beyond

5 feet outside of building walls including connections to existing exterior distribution systems.

1.4 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic Contract.

1.4.1 SD-02, Manufacturer's Catalog Data

a. Pipe and fittings

b. Valves

c. Pipe hangers and supports

d. Floor Drain/Separators

1.5 QUALITY ASSURANCE

Plumbing systems including fixtures, equipment, materials, installation, and workmanship shall be in accordance with the 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 NTR. Capacity of equipment shall be not less than that indicated.

PART 2 PRODUCTS

2.1 DRAIN, WASTE, AND VENT (DWV) PIPE AND FITTINGS

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

Provide piping up to but not more than 6 inches aboveground or floor slab on grade.

2.1.1.1 Cast-Iron Hub and Spigot Pipe and Fittings

ASTM A 74 with ASTM C 564 or CISPI HSN rubber compression gasket joints.

2.1.2 Aboveground Piping

2.1.2.1 Cast-Iron Hubless Pipe and Fittings

CISPI 301 with CISPI 310 couplings.

2.1.2.2 Cast-Iron Hub and Spigot Pipe and Fittings

ASTM A 74 with ASTM C 564 or CISPI HSN rubber compression gasket joints.

2.1.2.3 Copper Tubing

ASTM B 306, with ANSI B16.23, ANSI/ASME B16.29, or ANSI/ASME B16.32 solder joint fittings using ASTM B 32, 95-5 tin-antimony or Grade Sn96 tin-silver solder, and flux containing not more than 0.2 percent lead.

2.1.3 Cleanouts

ANSI A112.36.2M; provide threaded bronze or thermoplastic or PVC plastic cleanout plugs.

2.1.3.1 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. Provide cleanouts flush with finished grade or concrete slab.

2.1.4 Drains

ASME A112.21.1M; provide cast-iron drains and clamping rings for use with membrane waterproofing where required. Provide P-traps for each floor drain.

2.1.4.1 Flush Strainer Floor Drain/Separators

Provide floor drain/separators of all-welded steel construction with 2-inch tapped outlets; visible, double-wall outside trap seal; easily removable inlet grate of steel with slotted inlet grate openings; and removable sediment and mud pan, separator screen and filter screen. Grating shall be suitable for pedestrian traffic. Unit shall be enamel-coated on inside and asphalt-coated on outside.

Floor drain/separators shall have a static liquid holding capacity of 3.5 gallons and a greasy sludge capacity of 12 pounds. Units shall have overall dimensions of approximately 12-inches long x 10-inches wide x 15-inches tall with an open grate area of 16 square inches. Model SD-18 manufactured by Rockford Sanitary Systems, Incorporated is typical of this type of drain/separator.

2.2 DOMESTIC WATER PIPING

2.2.1 Buried Piping and Aboveground Piping

2.2.1.1 Copper Tubing

ASTM B 88, Type L for aboveground piping, Type K for buried piping, with ANSI B16.18 or ASME/ANSI B16.22 solder joint fittings; or with ASME/ANSI B16.26 flared joint fittings. Provide ASTM B 42 copper pipe nipples with

threaded end connections. Provide ASTM B 32, 95-5 tin-antimony solder, or provide Plumbing Code approved lead-free solder. Provide copper tubing for pipe sizes 4 inches or smaller.

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. Ball valves may be provided in lieu of gate valves. Provide blue finish and red finish on handwheels for valves in cold domestic water piping and hot domestic water piping, respectively.

2.2.2.1 Gate Valves

MSS SP-80, Class 125.

2.2.2.2 Ball Valves

Full port design, copper alloy. Valves shall have two-position lever handles.

2.2.2.3 Hose Bibbs

Provide angle type copper alloy hose bibb with lockshield and handwheel. Inlet shall have internal threads. Outlet shall have vacuum breaker with 0.75 inch external hose threads.

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.

2.3 MISCELLANEOUS PIPING MATERIALS

2.3.1 Escutcheon Plates

Provide one piece or split hinge metal plates for piping entering floors, walls, and ceilings in exposed spaces. Provide chromium-plated or polished stainless steel finish on copper alloy plates in finished spaces. Provide paint finish on metal in unfinished spaces.

2.3.2 Pipe Sleeves

2.3.2.1 Sleeves in Concrete, Floors

ASTM A 53, Schedule 40 or Standard Weight, hot-dip galvanized steel pipe sleeves.

PART 3 EXECUTION

3.1 INSTALLATION

Installation of plumbing systems including fixtures, materials, and workmanship shall be in accordance with the Plumbing Code, except as modified herein.

3.1.1 Threaded Connections

Jointing compound for pipe threads shall be polytetrafluoroethylene (PTFE) pipe thread paste, pipe cement and oil, or PTFE powder and oil; apply only on male threads. Provide exposed ferrous pipe threads with one coat of primer applied to a minimum dry film thickness of 1.0 mil.

3.1.2 Solder End Valves

Remove stems and washers and other item subject to damage by heat during installation. Reassemble valve after soldering is completed. Valves without heat sensitive parts do not require disassembly but shall be opened at least two turns during soldering.

3.1.3 Encased Buried Piping

Completely encase buried copper water piping and cast iron DWV and water piping with polyethylene tube or sheet in accordance with AWWA C105/A21.5.

3.1.4 Installation of Pipe Sleeves

Provide pipe sleeves where piping passes through walls and floors. Secure sleeves in proper position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls and floors. Provide not less than 0.25 inch space between exterior of piping or pipe insulation and interior of sleeve. Firmly pack space with mineral wool insulation. Seal at both ends of the sleeve with a mechanically adjustable segmented elastomeric seal. 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.

3.2 CONNECTIONS TO EXISTING WATER SUPPLY SYSTEMS

Use tapping or drilling machine valve and mechanical joint type sleeves for connections to be made under pressure. Bolt sleeves around mains; bolt valve conforming to AWWA C500 to the branch. Open valve, attach drilling machine, make tap, close valve, and remove drilling machine, without interruption of service. Notify the Contracting Officer in writing at least 15 days prior to the date the connections are required; receive approval before any service is interrupted. Provide materials required to make connections into the existing water supply systems and perform excavating, backfilling, and other incidental labor as required. Furnish the labor and the tapping or drilling machine for making the actual connections to the existing systems.

3.3 FIELD QUALITY CONTROL

3.3.1 Inspections

Prior to initial operation, inspect piping system for compliance with drawings, specifications, and manufacturer's submittals.

3.3.2 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 Plumbing Code, except as modified herein. Correct defects in the work provided by the Contractor, and repeat tests until work is in compliance with contract requirements. Furnish water, electricity, instruments, connecting devices, and personnel for performing tests.

3.3.2.1 Domestic Water Piping

Before applying insulation, hydrostatically test each piping system at not less than 120 psig with no leakage or reduction in gage pressure for 2 hours.

3.3.2.2 DWV Piping

Before the installation of fixtures, cap ends of each system, fill piping with water to the roof, and allow to stand until a thorough inspection has been made. If the system is tested in sections, each opening shall be plugged and each section tested with not less than a 10 foot head or water. The entire system shall be proven absolutely tight under such test.

3.4 DISINFECTION

Disinfect new water piping and existing water piping affected by Contractor's operations in accordance with AWWA C651. Fill piping systems with solution containing minimum of 50 parts per million (ppm) of available chlorine and allow solution to stand for minimum of 24 hours. Flush solution from the systems with domestic water until maximum residual chlorine content is within the range of 0.2 to 0.5 ppm, or the residual chlorine content of domestic water supply. Obtain at least two consecutive satisfactory bacteriological samples from new water piping, analyze by a certified laboratory, and submit the results prior to the new water piping being placed into service. Disinfection of systems supplied by nonportable water is not required.

-- End of Section --

SECTION 15501

HEATING AND VENTILATING SYSTEM

12/94

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AIR MOVEMENT AND CONTROL ASSOCIATION, INC. (AMCA)

ANSI/AMCA 210	1985 Testing Fans for Rating
AMCA 300	1985 Certified Sound Rating for Air Moving Devices
AMCA 301	1976 Calculating Fan Sound Ratings from Laboratory Test Data

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 653/A 653M	(1994) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed by the Hot-Dip Process

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	1993 National Electrical Code
NFPA 90A	1993 Installation of Air Conditioning and Ventilating Systems

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION, INC. (SMACNA)

SMACNA DCS	1985 HVAC Duct Construction Standards - Metal and Flexible

UNDERWRITERS LABORATORIES INC. (UL)

UL BMD	1994 Building Materials Directory
UL EAUED	1994 Electrical Appliance and Utilization Equipment Directory
UL 181	1994 Factory-Made Air Ducts and Air Connectors
UL 507	1994 Bul. 1994 Electric Fans

1.2 SYSTEM DESCRIPTION

Provide new heating and ventilating (H&V) system complete and ready for operation. H&V system shall include equipment as shown on the drawings.

1.3 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic Contract.

1.3.1 SD-02, Manufacturer's Catalog Data

a. Unit heaters G

b. Exhaust fans G

1.3.2 SD-06, Instructions

a. Installation manual

1.3.2.1 Installation Manual

Provide for each item of equipment.

1.3.3 SD-19, Operation and Maintenance Manuals

a. Unit heaters, Data Package 2

b. Exhaust fans, Data Package 2

Submit in accordance with Section 01010, "General Paragraphs."

PART 2 PRODUCTS

2.1 EQUIPMENT

2.1.1 Unit Heaters

Unit heaters shall be self-contained and factory-assembled, propeller fan type with capacities expressed as Btu per hour output and cubic feet-per-minute air delivery, operating conditions, and mounting arrangements as indicated. Average fan bearing life shall be minimum 200,000 hours at operating conditions. Provide fan motor with direct drive. Construct fan-guard motor mount of steel wire. Equip each heater with individually adjustable package discharge louvers. Provide thermostats and other accessories as indicated. Furnish circuit breaker disconnect switch.

Unit heaters shall be UL listed with wattage, voltage, phase, and number of steps as indicated. Provide control-circuit terminals and single source of power supply. Heaters shall be three-phase, with load balanced on each of the three phases. Limit leaving air temperature below 140 degrees F at 55 degrees F entering air.

Unit Heater Model MUH-03-4 as manufactured by Chromalox meets the intent of

this specification.

2.1.1.1 Casing

Minimum 18 gage steel.

2.1.1.2 Heating Element

Nickel-chromium heating wire element, free from expansion noise and 60 Hz hum. Embed element in magnesium-oxide insulating refractory. Seal element in high-mass steel or corrosion-resisting metallic sheath with fins. Enclose element ends in terminal box. Space fins at maximum six fins per inch. Limit fin surface temperature 550 degrees F at any point during normal operation.

2.1.1.3 Controls

Include limit controls for thermal overheat protection of heaters. For remote thermostatic operation, provide contractor rated for 100,000 duty cycles, Provide a control transformer to supply 120-volt thermostat control circuit for each heater. Provide room thermostat as indicated.

2.1.1.4 Wiring

Completely factory-prewired to terminal strips, ready to receive branch circuit and control connections for 140 degrees F copper wiring.

2.1.2 Propeller Exhaust Fans

Provide propeller exhaust fans which comply with ANSI/AMCA 210 and bear the AMCA seal. Provide V-belt driven propeller type exhaust fans with shaped steel blade impeller with heavy hubs, statistically and dynamically balanced, keyed and locked to shaft. Provide accessory wall mount collar, external motor side guard, adjustable motor mounts, disconnect, backdraft damper and weather hood.

Total sound power level of the fan shall not exceed 90 dBA when tested per AMCA 300 and rated per AMCA 301; statically and dynamically balanced, with air capacities, brake horsepowers, fan types, fan arrangement, sound power levels or loudness level, and static pressure as indicated. Fan bearing life shall have a minimum average life of 200,000 hours at design operating conditions. Provide nominal 2 mesh 0.063 inch wire diameter, aluminum bird screens for weather hood outlet. Have thermal overload protection in the operating disconnect switches within the building. Construct housings and impellers of steel, except as specified otherwise. For wiring terminations, provide terminal lugs to match branch circuit conductor quantities, sizes, and materials. Enclose terminal lugs in terminal box sized to NFPA 70.

Propeller exhaust fans manufactured by Greenheck, Model SPFE 24 with accessories indicated, meet the intent of this specification.

2.2 ELECTRICAL

2.2.1 Electrical Motors, Controllers, Contactors, and Disconnects

Furnish with respective pieces of equipment. Motors, controllers, contactors, and disconnects for mechanical equipment shall be provided as work of this section. Electrical devices shall be as indicated on the Drawings and shall conform to the requirements of the National Electrical Code and Section 16402, "Interior Wiring Systems." Provide electrical connections under Section, 16402, "Interior Wiring Systems." Provide controllers and contactors with maximum of 120-volt control circuits, and auxiliary contacts for use with 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.

2.2.2 Electrical Work

Provide under Section 16402, "Interior Wiring Systems." Provide control wiring under Section 15971, "Space Temperature Control Systems.

2.2.3 Louvers

Louvers are specified in Section 10201, "Metal Wall Louvers."

2.3 METAL DUCT SYSTEMS

Provide shop-fabricated, zinc-coated ducts conforming to ASTM A 653/A 653M coating designation G90. Fabricate, construct, brace, reinforce, install, support, and seal ducts and accessories in accordance with SMACNA DCS. Provide rectangular ductwork for low pressure applications as indicated. Cover duct transverse joints with single component synthetic rubber type compound suitable for use with passivated coating on zinc-coated steel. Lap joints in direction of flow. Provide ducts straight and smooth on inside with neatly finished airtight joints.

2.3.1 Low Pressure Ductwork

Construction, metal gage, hangers and supports, and reinforcements shall conform with SMACNA DCS. Ductwork shall be airtight and shall not vibrate or pulsate when system is in operation. Pressure sensitive tape shall not be used as a primary sealant on ductwork. Air leakage shall be less than 5 percent of the system capacity. Construct ductwork of galvanized steel.

2.3.1.1 Laps

Make laps at joints in the direction of air flow. Space button-punch or bolt-connection in standing seams at fixed centers not greater than 6 inches. Longitudinal locks or seams, known as "button-punch snap lock," may be used in lieu of Pittsburgh Lock.

2.3.1.2 Fittings

Transitions shall conform with SMACNA DCS, Section 2.

2.3.2 Flexible Duct Connectors

Provide airtight flexible duct connectors between air compressors and intake louvers. Support connector at each end with metal angle frame bands, securely bolted in place. Provide not less than 20 ounce glass fabric duct connectors coated on both sides with neoprene.

2.3.3 Louvers

Louvers are specified in Section 10201, "Metal Wall Louvers."

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 H&V System

Installation of H&V system including equipment, materials, installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing shall be in accordance with NFPA 70, and in accordance with the manufacturer's recommendations.

3.2 ADJUSTMENTS

Adjust controls and equipment so as to give satisfactory operation.

3.3 INSTRUCTING OPERATING PERSONNEL

Upon completion of work and at time designated by NTR, provide services of competent technicians for period of not less than eight (8) hours for instruction of Government operating personnel in proper operation and maintenance of H&V equipment and controls.

3.4 FIELD QUALITY CONTROL

Upon completion and before final acceptance of work, test each H&V system to demonstrate compliance with the contract requirements. Adjust controls and balance systems prior to final acceptance of completed systems. Test controls through every cycle of operation. Test safety controls to demonstrate performance of required function. Correct defects in work provided by Contractor and repeat tests. Furnish all instrumentation; electricity, tools, connecting devices, and personnel required for tests. Clean equipment.

3.4.1 Equipment

3.4.1.1 Field Testing

Test each item of equipment in operation for continuous period of not less than 24 hours under every condition of operation in accordance with each equipment manufacturer's recommendation. Verify that the equipment

operating parameters are within limits recommended by the manufacturer.

-- End of Section --

SECTION 15971

SPACE TEMPERATURE CONTROL SYSTEMS

03/95

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(1991) Enclosures for Electrical Equipment (1000 Volts Maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1993) National Electrical Code

UNDERWRITERS LABORATORIES INC. (UL)

UL 508	(1993; Bul. 1993 and 1994, R 1994) Industrial Control Equipment

1.2 SYSTEM REQUIREMENTS

Provide electric field installed control systems.

1.3 PERFORMANCE REQUIREMENTS

Provide control systems to maintain the required heating and ventilating (H&V) conditions by performing the functions and sequences of operations indicated. Control systems shall be complete, including all equipment and appurtenances, and ready for operation. Control systems shall be furnished, installed, tested, calibrated, and started up by, or under the supervision of trained technicians certified by the Contractor as qualified and regularly employed in such work. Control system equipment shall bear the manufacturer's nameplate.

1.4 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic Contract.

1.4.1 SD-02, Manufacturers Catalog Data

a. Actuators G

b. Thermostats G

c. End switches G

1.4.2 SD-04, Drawings

a. Control system diagram for system G

b. Ladder diagram coordinated by line number and device number with the control system diagram G

c. Sequence of operation G

d. Arrangement drawing G

e. Wiring diagram G

1.4.2.1 Control System Diagram

Indicate H&V process flow and location of devices relative to flow and to the H&V controls, the connections of control devices in control loops, references of control device contacts and device operating coils to line numbers of a ladder diagram and sequencing diagrams showing the operation of valves, dampers, and contacts relative to controller output, and H&V process variables.

1.4.2.2 Ladder Diagram

Indicate connections and interlocks to control system devices and other devices such as starters, drives, and H&V equipment panels.

1.4.2.3 Wiring Diagram

Indicate terminal blocks, wire marker identification, connections to control system devices, external and internal power sources, and connections to external devices, starters, drives, jumpers, and ground connections.

1.4.2.4 Sequence of Operation

Sequence of operation for each H&V control system coordinated with device identifiers on control system diagram and ladder diagram.

1.4.2.5 Arrangement Drawing

Arrangement diagram of each H&V control system coordinated with device identifiers on the control system diagram and the ladder diagram.

1.4.3 SD-18, Records

a. Training course documentation G

b. Qualified service organization list G

c. Certification of completion G

1.4.4 SD-19, Operation and Maintenance Manuals

a. Space temperature control system, Data Package 3 G

Submit operation and maintenance data in accordance with Section 01010, "General Paragraphs."

1.4.4.1 Space Temperature Control System, Data Package 3

Include items of equipment listed under paragraph entitled "Manufacturer's Catalog Data." Manual shall contain full hardware support documentation, which shall include but not be limited to the following:

a. General description and specifications

b. Installation and initial checkout procedures

c. Detailed electrical and logical description

d. Troubleshooting procedures, diagrams, and guidelines

e. Alignment and calibration procedures for components

f. Preventive maintenance requirements and a maintenance checklist

g. Detailed schematics and assembly drawings

h. Spare parts list data, including required tool kits and suggested method of repairs such as field repair, factory repair, or item replacement

i. Complete as-built control drawings, schedules, and sequence of operation

j. Step-by-step procedures required for start-up, operation, shutdown, recovery, and fault of diagnosis of each control system.

k. Manufacturer supplied operator manuals for equipment

l. Qualified service organization list

1.5 QUALITY ASSURANCE

1.5.1 Standard Products

a. Material and equipment shall be standard products of manufacturers regularly engaged in the manufacturing of such products, using similar materials, design and workmanship. The standard products shall have been in satisfactory commercial or industrial use for 2-years prior to bid opening. The 2-year use shall include applications of similarly sized equipment and materials used under similar circumstances. The 2-years experience must be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures.

b. The equipment items shall be supported by a service organization.

1.5.2 Verification of Dimensions

Contractor shall become familiar with details of work, shall verify dimensions in the field, and shall advise NTR of any discrepancy before performing work.

1.5.3 Modification of References

Accomplish work in accordance with NFPA 70, except as modified herein or indicated otherwise for equipment, materials, installation, examination, inspection, and testing. Consider the advisory or recommended provisions to be mandatory, as though the word "shall" had be substituted for the words "should" or "could" or "may," wherever they appear. Interpret reference to "authority having jurisdiction" and "owner" to mean the NTR.

1.6 DELIVERY, STORAGE, AND HANDLING

Protect materials from the weather, humidity, and temperature variations, dirt and dust, and other contaminants, within the storage condition limits published by the equipment manufacturer.

PART 2 PRODUCTS

2.1 COMPONENTS

Provide components factory ordered for this project. Rebuilt equipment, warehoused equipment, or earlier generation equipment shall not be acceptable. Electrical devices shall have a NEMA 250 Type 1 enclosure in accordance with NEMA 250 unless otherwise specified. Actuators shall operate within temperature limit ratings of plus 35 to 150 degrees F. Panel mounted instruments shall operate within limit ratings of 35 to 120 degrees F and 10 percent to 95 percent relative humidity, noncondensing.

2.2 ACTUATORS

Provide electric actuators. Actuators shall function as required within 85 to 110 percent of their power supply rating. Actuators shall fail to their spring return positions on power failure. Actuators shall have visible position indicators. Actuators shall have positive spring returns for fail-safe operation. Actuators shall open or close the devices to which they are applied within 60 seconds after a full scale signal input change.

2.2.1 Operable Louver Actuators

Operable louver actuators shall be rated for at least 125 percent of the motive power necessary to operate the connected operable louver. The actuator stroke shall be limited by an adjustable stop in the direction of the return stroke. Actuators shall be provided with mounting and connecting hardware.

2.3 THERMOSTATS

Provide line voltage, single pole, single throw (SPST) industrial grade, wall-mounted thermostats.

2.3.1 Ranges

Thermostat ranges shall be selected so that the setpoint is adjustable without tools between plus or minus 10 degrees F of the setpoint indicated.

2.3.2 Nonmodulating Electric Room Thermostats

Contacts shall be single-pole single-throw (SPST), hermetically sealed, and wired to identified terminals. Maximum differential shall be 2 degrees F. Thermostat covers shall be of metal and shall be capable of being locked by an Allen wrench or special tool. Thermostats shall have manual switches as required by the application and a minimum range of 45 to 90 degrees F.

2.4 END SWITCHES

Provide industrial grade, hermetically sealed end switches for mounting on operable louvers to indicate that louvers are in their fully-open position.

2.5 CONTROL WIRING

Provide control wiring in compliance with NFPA 70, Section 16402, "Interior Wiring Systems" as described below.

2.5.1 Wiring

a. Terminal blocks shall be insulated, modular, feed-through, clamp style with recessed captive screw-type clamping mechanisms. Terminal blocks shall be rail mounted, and shall have end plates, partition plates or enclosed sides for separation.

b. Control wiring for 24-V circuits shall be 18 AWG minimum and shall be rated for 300-V service.

c. Wiring for circuits operating at more than 100 V shall be 14 AWG minimum and shall be rated for 600-V service.

PART 3 EXECUTION

3.1 INSTALLATION

Perform installation under the supervision of competent technicians regularly employed in the installation of control systems. Provide components for a complete and operational control system. Provide control system complete and ready for operation, as specified and indicated. Provide dielectric isolation where dissimilar metals are used for connection and support. Control system installation shall provide adequate clearance for control system maintenance. Control system installation shall not interfere with the clearance requirements for mechanical and electrical system maintenance. Install devices in accordance with

manufacturer's recommendations and as indicated on contract documents. Certify that installation of control system is complete and technical requirements of this section have been met.

3.1.1 Operable Louver Actuators

Mount operable louver actuators so that the operable louver closing action is smooth throughout the entire range of motion. Provide actuators and linkages such that operable louvers are driven to their fully closed and their fully open position. Multiple actuators operating a common damper shall be connected to a common drive shaft.

3.1.2 Wiring

a. All control wiring shall be in metallic raceways. Install wiring between thermostats, actuators and other control devices without intermediate splices. Tag cables, conductors, and wires at both ends, with identifiers indicated on shop drawings.

b. Other electrical work shall be specified in Section 16402, "Interior Wiring Systems."

3.1.3 Control Drawings

Post laminated copies of as-built control system drawings in each mechanical room.

3.2 ADJUSTMENTS

Calibrate instrumentation and controls, and verify specified accuracy using test equipment traceable to National Institute for Science and Technology (NIST) standards. Adjust controls and equipment to maintain conditions indicated, to perform the functions indicated, and to operate in the sequence specified.

3.3 FIELD QUALITY CONTROL

Demonstrate compliance of H&V control systems. Furnish personnel, equipment, instrumentation, and supplies necessary to perform calibration and site testing. Calibrate test equipment in accordance with NIST standards. Ensure that tests are performed or supervised by competent employees of the control system installer or the control system manufacturer regularly employed in testing and calibration of control systems.

3.3.1 Contractor's Field Testing

Calibrate field equipment and verify equipment and system operation before system is placed on line. Include the following tests in field testing.

3.3.1.1 Wiring Integrity Tests

Test wiring for continuity, ground faults, and open and short circuits.

3.3.1.2 System Inspection

Observe H&V control system in shutdown condition. Check dampers and valves for proper normal positions.

3.4 TRAINING

Provide a qualified instructor to conduct an eight (8) hour training course for designated personnel in maintenance and operation of control systems. Orientate training to the specific system being installed under the contract. For guidance, assume that the attendees have a high school education and are familiar with H&V systems. Training shall occur within 30 days of the date of substantial completion. Submit planned training schedule, agenda, and class materials to the Government at least 45 days prior to training.

3.4.1 Training Course Documentation

Training shall be based on the operation and maintenance manuals and control system training manual. Deliver manuals for each trainee with two additional sets for archiving at the project site. Include an agenda, defined objectives, and a detailed description of subject matter for each lesson.

3.4.2 Operator Training

Training shall be conducted in the field, at the project site. Maximum of 5 personnel shall attend the course. Course shall be structured to address specific topics that the students need to discuss and to answer questions concerning operation of the system. Upon completion of the course, students shall be proficient in system operation and shall have no unanswered questions regarding operation of the installed system. Course shall include but not be limited to the following:

a. Physical layout for each piece of hardware

b. Troubleshooting and diagnostics procedures

c. Repair instructions

d. Preventive maintenance procedures and schedule

e. Calibration procedures

3.5 QUALIFIED SERVICE ORGANIZATION LIST

The qualified service organization list shall include names and telephone numbers of organizations qualified to service H&V control systems.

-- End of Section --

SECTION 16011

ELECTRICAL GENERAL REQUIREMENTS

03/95

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C2	(1993) National Electrical Safety Code

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910.147	Control of Hazardous Energy (Lock Out/Tag Out)

FEDERAL SPECIFICATIONS (FS)

FS L-P-387	(Rev. A; Int Am. 2) Plastic Sheet, Laminated, Thermosetting (for Design Plates)

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC. (IEEE)

IEEE 100	(1992) Dictionary of Electrical and Electronics Terms

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 6	(1993) Enclosures for Industrial Control and Systems
NEMA MG 1	(1993) Motors and Generators
NEMA MG 10	(1983; R 1988) Energy Management Guide for Selection and Use of Polyphase Motors
NEMA MG 11	(1977; R 1992) Energy Management Guide of Selection and Use of Single-Phase Motors

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1993) National Electrical Code

1.2 RELATED REQUIREMENTS

This section applies to certain sections of Division 2, "Site Work," Division 13, "Special Systems," and Division 15, "Mechanical". This section applies to all sections of Division 16, "Electrical," of this

project specification unless specified otherwise in the individual sections.

1.3 DEFINITIONS

a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE 100.

b. The technical sections referred to herein are those specification sections that describe products, installation procedures, and equipment operations and that refer to this section for detailed description of submittal types.

c. The technical paragraphs referred to herein are those paragraphs in PART 2 - PRODUCTS and PART 3 - EXECUTION of the technical sections that describe products, systems, installation procedures, equipment, and test methods.

1.4 ELECTRICAL CHARACTERISTICS

Electrical characteristics for this project shall be 11.5 kV primary, three phase, three wire, 60 Hz, and 480 volts secondary, three phase, four wire. Final connections to the power distribution system at the existing manhole shall be made by the Contractor as directed by the NTR.

1.5 SUBMITTALS

Submittals required in the sections which refer to this section shall conform to the requirements of Section C, Part 7 of the Basic Contract, and to the following additional requirements. Submittals shall include the manufacturer's name, trade name, place of manufacture, catalog model or number, nameplate data, size, layout dimensions, capacity, project specification and technical paragraph reference. Submittals shall also include applicable federal, military, industry, and technical society publication references, and years of satisfactory service, and other information necessary to establish contract compliance of each item to be provided. Photographs of existing installations are unacceptable and will be returned without approval.

1.5.1 Manufacturer's Catalog Data

Submittals for each manufactured item shall be current manufacturer's descriptive literature of cataloged products, equipment drawings, diagrams, performance and characteristic curves, and catalog cuts. Handwritten and typed modifications and other notations not part of the manufacturer's preprinted data will result in the rejection of the submittal. Should manufacturer's data require supplemental information for clarification, the supplemental information shall be submitted as specified for certificates of compliance.

1.5.2 Drawings

Submit drawings a minimum of 14 inches by 20 inches in size using a minimum scale of 1/8 inch per foot. Include wiring diagrams and installation

details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure 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.

1.5.3 Instructions

Where installation procedures or part of the installation procedures are required to be in accordance with manufacturer's instructions, submit printed copies of those instructions prior to installation. Installation of the item shall not proceed until manufacturer's instructions are received. Failure to submit manufacturer's instructions shall be cause for rejection of the equipment or material.

1.5.4 Certificates

Submit manufacturer's certifications as required for products, materials, finishes, and equipment as specified in the technical sections. Certificates from material suppliers are not acceptable. Preprinted certifications and copies of previously submitted documents will not be acceptable. The manufacturer's certifications shall name the appropriate products, equipment, or materials and the publication specified as controlling the quality of that item. Certification shall not contain statements to imply that the item does not meet requirements specified, such as "as good as"; "achieve the same end use and results as materials formulated in accordance with the referenced publications"; or "equal or exceed the service and performance of the specified material." Certifications shall simply state that the item conforms to the requirements specified. Certificates shall be printed on the manufacturer's letterhead and shall be signed by the manufacturer's official authorized to sign certificates of compliance.

1.5.4.1 Reference Standard Compliance

Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations such as American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), National Electrical Manufacturers Association (NEMA), Underwriters Laboratories Inc. (UL), and Association of Edison Illuminating Companies (AEIC), submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance.

1.5.4.2 Independent Testing Organization Certificate

In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the NTR. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.

1.5.5 Operation and Maintenance Manuals

Comply with the requirements of Section 01010 and the technical sections.

1.5.5.1 Operating Instructions

Submit text of posted operating instructions for each system and principal item of equipment as specified in the technical sections.

1.6 QUALITY ASSURANCE

1.6.1 Material and Equipment Qualifications

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. 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 item need not be the products of the same manufacturer unless stated in the technical section.

1.6.2 Regulatory Requirements

Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70.

1.6.3 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.6.4 Service Support

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.6.5 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.6.6 Modification of References

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the NTR.

1.7 POSTED OPERATING INSTRUCTIONS

Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:

a. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.

b. Start up, proper adjustment, operating, lubrication, and shutdown procedures.

c. Safety precautions.

d. The procedure in the event of equipment failure.

e. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

1.8 NAMEPLATES

FS L-P-387. Provide laminated plastic nameplates for each panelboard, equipment enclosure, relay, switch, and device; as specified in the technical sections or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style.

1.9 WARNING SIGNS

Provide warning signs for the enclosures of electrical equipment including substations, transformers, generators, and switchgear having a nominal rating exceeding 600 volts. When such equipment is guarded by a fence, mount signs on the fence. Provide metal signs having nominal dimensions of 14 inches by 10 inches with the legend "DANGER HIGH VOLTAGE KEEP OUT" printed in three lines of nominal 3-inch high white letters on a red and black field.

1.10 CABLE TAGS IN MANHOLES, HANDHOLES, AND VAULTS

Provide tags for each cable or wire located in manholes, handholes, and vaults. Tag only new wire and cable provided by this contract. The first position on the tag shall denote the voltage. The second through sixth positions on the tag shall identify the circuit. The next to last position shall denote the phase of the circuit and shall include the Greek "phi" symbol. The last position shall denote the cable size. The tags shall be polyethylene. Do not provide handwritten letters. As an example, a tag could have the following designation: "11.5 NAS 18ØA500," denoting that the tagged cable is on the 11.5kV system circuit number NAS 18, underground, Phase A, sized at 500 kcmil.

1.10.1 Polyethylene Cable Tags

Provide tags of polyethylene that have an average tensile strength of 3250 pounds per square inch; and that are 0.08 inch thick minimum, non-corrosive non-conductive; resistive to acids, alkalis, organic solvents, and salt water; and distortion resistant to 170 degrees F. Provide 0.05 inch (minimum) thick black polythylene tag holder. Provide a one-piece nylon, self-locking tie at each end of the cable tag. Ties shall have a minimum loop tensile strength of 175 pounds. The cable tags shall have black block letters, numbers, and symbols one inch high on a yellow background. Letters, numbers, and symbols shall not fall off or change positions regardless of the cable tags' orientation.

1.11 ELECTRICAL REQUIREMENTS

Electrical installations shall conform to ANSI C2, NFPA 70, and requirements specified herein.

1.11.1 Motors and Equipment

Provide motors, controllers, integral disconnects, and contactors 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, integral disconnects, and contactors shall conform to Section 16402, "Interior Wiring Systems". Extended voltage range motors shall not be permitted. Control voltage for controllers and contactors shall not exceed 120 volts nominal. 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. Where fuse protection is specifically recommended by the equipment manufacturer, provide fused switches in lieu of non-fused switches indicated.

1.11.2 Wiring and Conduit

Provide internal wiring for components of packaged equipment as an integral part of the equipment. Provide power wiring and conduit for field-installed equipment, under Section 16402, "Interior Wiring Systems." Power wiring and conduit shall conform to Section 16402, "Interior Wiring Systems." Control wiring and conduit shall be provided under, and conform to the requirements of the section specifying the

associated equipment.

1.12 INSTRUCTION TO GOVERNMENT PERSONNEL

Where specified in the technical sections, furnish the services of competent instructors to give full instruction to designated Government personnel in the adjustment, operation, and maintenance of the specified systems and equipment, including pertinent safety requirements as required. Instructors 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 man-days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with equipment or system. When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instructions to acquaint the operating personnel with the changes or modifications.

1.13 LOCKOUT REQUIREMENTS

Provide disconnecting means capable of being locked out for machines and other equipment to prevent unexpected startup or release of stored energy in accordance with 29 CFR 1910.147. Mechanical isolation of machines and other equipment shall be in accordance with requirements of Division 15, "Mechanical."

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 PAINTING OF EQUIPMENT

3.1.1 Factory Applied

Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA ICS 6 corrosion-resistance test.

3.1.2 Field Applied

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting shall be as specified in Section 09900, "Painting".

3.2 NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two

sheet-metal screws or two rivets.

3.3 WARNING SIGN MOUNTING

Provide the number of signs required to be readable from each accessible side, but space the signs a maximum of 30 feet apart.

3.4 CABLE TAG INSTALLATION

Install cable tags in each manhole, handhole, and vault as specified, including each splice. Install cable tags over the fireproofing, if any, and locate the tags so that they are clearly visible without disturbing any cabling or wiring in the manholes, handholes, and vaults.

-- End of Section --

SECTION 16301

UNDERGROUND ELECTRICAL WORK

04/95

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (ASHTO)

AASHTO HB14	1992 Highway Bridges
AASHTO M198	1975 (R 1993) Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 315	1992 Details and Detailing of Concrete Reinforcement
ACI 318	1989 (R 1992) Building Code Requirements for Reinforced Concrete

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C2	1993 National Electrical Safety Code
ANSI C119.1	1986 Electric Connectors - Sealed Insulated Underground Connector Systems Rated 600 Volts

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 1	1990 Hard-Drawn Copper Wire
ASTM B 8	1993 Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM C 32	1993 Sewer and Manhole Brick (Made from Clay or Shale)
ASTM C 139	1973 (R 1989) Concrete Masonry Units for Construction of Catch Basins and Manholes
ASTM C 260	1986 Air-Entraining Admixtures for Concrete

ASTM C 309	1991 Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 478	1993 Precast Reinforced Concrete Manhole Sections

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

AEIC CS1	1990 Impregnated Paper Insulated, Lead Covered Cable, Solid Type
AEIC CS5	1987 Thermoplastic and Cross-linked Polyethylene Insulated Shielded Power Cable Rated 5 Through 35 kV
AEIC CS6	1987 (R 1989) Ethylene Propylene Rubber Insulated Shielded Power Cables Rated 5 through 69 kV

FEDERAL SPECIFICATIONS (FS)

FS RR-F-621	(Rev. E) Frames, Covers, Gratings, Steps, Sump and Catch Basin, Manhole

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC. (IEEE)

IEEE 48	1990 High-Voltage Alternating-Current Cable Terminations
IEEE 404	1986 Cable Joints for Use with Extruded Dielectric Cable Rated 5000 V Through 46,000 V and Cable Joints for Use with Laminated Dielectric Cable Rated 2500 V Through 500,000 V

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	1991 Electrical Power Distribution Equipment and Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA RN 1	1989 Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA TC 2	1990 Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80)
NEMA TC 3	1990 PVC Fittings for Use with Rigid PVC Conduit and Tubing
NEMA TC 6	1990 PVC and ABS Plastic Utilities Duct for Underground Installation

NEMA TC 9	1990 Fittings for ABS and PVC Plastic Utilities Duct for Underground Installation
NEMA WC 7	1993 Cross-Linked Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
NEMA WC 8	1993 Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	1993 National Electrical Code
NFPA 70B	1994 Electrical Equipment Maintenance

UNDERWRITERS LABORATORIES INC. (UL)

UL 6	1993 (Bul. 1993) Rigid Metal Conduit
UL 83	1991 (Bul. 1991, 1992, and 1993) (R 1993) Thermoplastic-Insulated Wires and Cables
UL 467	1993 (Bul. 1994) Grounding and Bonding Equipment
UL 486A	1991 (Errata 1991 and 1992) (R 1992) (Bul. 1993 and 1994) Wire Connectors and Soldering Lugs for Use with Copper Conductors
UL 486B	1991 (Errata 1992) (R 1992) (Bul. 1994) Wire Connectors for Use with Aluminum Conductors
UL 510	1986 (R 1986) (Bul. 1993 and 1994) Insulating Tape
UL 514A	1991 (R 1993) (Bul. 1993 and 1994) Metallic Outlet Boxes
UL 514B	1989 (Errata 1991) (R 1993) (Bul. 1993 and 1994) Fittings for Conduit and Outlet Boxes
UL 651	1989 (R 1989) (Bul. 1993) Schedule 40 and 80 Rigid PVC Conduit
UL 854	1991 (Bul. 1992, 1993, and 1994) (R 1993) Service-Entrance Cables
UL 1242	1983 (R 1993) (Bul. 1993) Intermediate Metal Conduit

1.2 RELATED REQUIREMENTS

Section 16011, "Electrical General Requirements" applies to this section with additions and modifications specified herein.

1.2.1 Underground Service

Terminate underground service into building at a point 5 feet outside the building and projections thereof, except that service conductors shall be continuous to the interior terminating point indicated. Connections of the service to the service switch, panelboard, or load center is included in Section 16402, "Interior Wiring Systems." Protect ends of underground conduit with threaded metal caps or plastic plugs as applicable until connections are made.

1.3 DEFINITIONS

a. In the text of this section, the words conduit and duct are used interchangeably and have the same meaning.

b. In the text of this section, "medium voltage cable splices," and "medium voltage cable joints" are used interchangeably and have the same meaning.

1.4 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic Contract.

1.4.1 SD-02, Manufacturer's Catalog Data

a. Medium voltage cable G

b. Medium voltage cable terminations G

c. Medium voltage cable joints G

1.4.3 SD-08, Statements

a. Cable splicer qualifications G

1.4.1.1 Cable Splicer Qualifications

a. In order to establish the cable workman's competency, the Contractor shall be required to submit the following within 30 days prior to commencement of the splice/termination:

(1) Documentation to verify that the individual has completed a splice/termination of the type to be installed under this contract. The test splice/termination shall be performed at the job site for this contract under the supervision of the cable accessory manufacturer or his representative and witnessed by the Government.

(2) Documentation that said splice/termination has undergone and passed the following tests by the splice/termination manufacturer or an independent testing laboratory.

	Minimum Value		
TEST	5 kV	15 kV	35 kV
Discharge Ext. Value with 3 pc or less	13 kV	20 kV	35 kV
AC withstand, 1 minute	35 kV	50 kV	75 kV
DC withstand, 15 minutes	65 kV	70 kV	100 kV

These results shall be attached for review

(3) A statement of the number of years in which the individual has been splicing/terminating medium voltage cable.

b. Criteria for Waiver

Items a.1 and a.2 above may be waived on subsequent jobs provided the following criteria is satisfied:

(1) Documentation of prior completion of items a.1 and a.2 be submitted.

(2) A list of the last three jobs where the specific splices/ terminations were installed within the past 12 consecutive months. The tabulation shall include splice/termination manufacturer, catalog number, and the number of splices/terminations installed.

c. Requalification

Requalification to items a.1 and a.2 in above paragraph may be required by LANTNAVFACENGCOM if the splice installer can not demonstrate a prior history of splice/termination installation during the previous 12 consecutive months. The contractor shall furnish the material for splices and terminations.

1.4.2 SD-09, Reports

a. Arc-proofing test for cable fireproofing tape G

b. Medium voltage cable qualification and production tests G

1.4.2.1 Arc-Proofing Test for Cable Fireproofing Materials

Manufacturer shall test one sample assembly consisting of a straight lead tube 12 inches long with a 2 1/2-inch outside diameter, and a 1/8-inch thick wall, and covered with one-half lap layer of arc and fireproofing material per manufacturer's instructions. The arc and fireproofing tape shall withstand extreme temperature of a high-current fault arc 13,000 degrees K for 70 cycles as determined by using an argon directed plasma jet capable of constantly producing and maintaining an arc temperature of

13,000 degrees K. Temperature (13,000 degrees K) of the ignited arc between the cathode and anode shall be obtained from a DC power source of 305 (plus or minus 5) amperes and 20 (plus or minus 1) volts. The arc shall be directed toward the sample assembly accurately positioned 5 (plus or minus 1) millimeters downstream in the plasma from the anode orifice by fixed flow rate of argon gas (0.18 g per second). Each sample assembly shall be tested at three unrelated points. Start time for tests shall be taken from recorded peak current when the specimen is exposed to the full test temperature. Surface heat on the specimen prior to that time shall be minimal. The end point is established when the plasma or conductive arc penetrates the protective tape and strikes the lead tube. Submittals for arc-proofing tape shall indicate that the test has been performed and passed by the manufacturer.

1.4.2.2 Medium Voltage Cable Qualification and Production Tests

Results of AEIC CS5 and AEIC CS6 qualification and production tests as applicable for each type of medium voltage cable.

1.4.3 SD-12, Field Test Reports

a. Acceptance Checks and Tests G

Identify each cable for 600-volt, and medium voltage cable tests. When testing grounding electrodes and systems, identify each electrode and system for each test, as well as the resistance and soil conditions at the time the measurements were made.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

2.1.1 Conduit

2.1.1.1 Rigid Metal Conduit

UL 6, galvanized steel, threaded type.

2.1.1.2 Rigid Metal Conduit, PVC Coated

UL 6, galvanized steel, threaded type, coated with a polyvinyl chloride (PVC) sheath bonded to the galvanized exterior surface, nominal 40 mils thick, conforming to NEMA RN 1, Type A40, except that hardness shall be nominal 85 Shore A durometer, dielectric strength shall be minimum 400 volts per mil at 60 Hz, tensile strength shall be minimum 3500 psi, and aging shall be minimum 1000 hours in an Atlas Weatherometer.

2.1.1.3 Plastic Utilities Duct for Concrete Encasement

NEMA TC 6, Type EB.

2.1.2 Fittings

2.1.2.1 Metal Fittings

UL 514B, threaded type.

2.1.2.2 PVC Conduit Fittings

NEMA TC 3, UL 514B.

2.1.2.3 PVC Duct Fittings

NEMA TC 9.

2.1.3 Medium Voltage Cable

Cable (conductor) sizes are designated by American Wire Gauge (AWG) and Thousand Circular Mils (Kcmil). Conductor and conduit sizes indicated are for copper conductors unless otherwise noted. Insulated conductors shall have the date of manufacture and other identification imprinted on the outer surface of each cable at regular intervals throughout cable length. Wires and cables manufactured more than 24 months prior to date of delivery to the site shall not be accepted.

Cable for 11.5 kV underground distribution system shall be Ozone resistant ethylene-propylene-rubber-insulated (EPR) cable conforming to NEMA WC 8. Cable shall be single conductor, employing concentric, Class B stranded copper conductors. Cable shall have conductor and insulation shielding. Insulation shielding shall be metal tape type consisting of a concentric serving of tape according to NEMA WC 8. Cable shall be rated 15 kV with insulation and jacket thickness of 220 and 80 mils, respectively. Cable shall have a polyvinyl chloride jacket.

2.1.4 Medium Voltage Cable Terminations

IEEE 48 Class 1. Provide terminations including stress control terminator, ground clamp, connectors, and lugs. The terminator shall be the product of one manufacturer, suitable for the type and materials of the cable terminated. Furnish components in the form of a "UL listed" kit, including complete instructions which shall be followed for assembly and installation. Provide terminator as specified herein for terminating single conductor, solid insulated, nonmetallic jacketed type cables for service voltage up to 35 KV indoor and outdoor. Do not use separate parts of copper or copper alloy in contact with aluminum or aluminum alloy parts in the construction or installation of the terminator.

2.1.4.1 Indoor Terminations / Terminations Within Equipment Enclosures

The indoor terminator shall be cold-shrink type or heat shrinkable type.

a. Cold-Shrink Type

Terminator shall be a one-piece design, where high-dielectric constant (capacitive) stress control is integrated within a skirted insulator made of silicone rubber, munsel gray in color. Termination shall not require heat or flame for installation. Termination kit shall contain all necessary materials (except for

the lugs). Termination shall be designed for installation in low or highly contaminated indoor and outdoor locations and shall be rated for continuous operation at 90 degree C, with an emergency overload temperature rating of 130 degree C.

b. Heat Shrinkable Type

Terminator shall consist of a uniform cross section heat shrinkable polymeric construction stress relief tubing and environmentally sealed outer covering that is nontracking, resists heavy atmospheric contaminants, ultra violet rays and oxidative decomposition. Provide heat shrinkable sheds or skirts of the same material.

2.1.4.2 Termination; Separable Insulated Connector Type

Provide as specified in Section 16462, "Pad-Mounted Transformers."

2.1.5 Medium Voltage Cable Joints

Provide joints (splices) in accordance with IEEE 404 suitable for the rated voltage, insulation level, and insulation type of the cable. Upon request, supply manufacturer's design qualification test report in accordance with IEEE 404. Connectors for joint shall be tin-plated electrolytic copper, having ends tapered and having center stops to equalize cable insertion. Connectors shall be rated for voltage of 35 kV minimum.

a. Heat-Shrinkable Joint: Consists of a uniform cross-section heat-shrinkable polymeric construction with a linear stress relief system, a high dielectric strength insulating material, and an integrally bonded outer conductor layer for shielding. Replace original cable jacket with a heavy-wall heat-shrinkable sleeve with waterproof mastic seal on both ends.

b. Watertight Taped-Type Joint: Consists of an approved connector, self-fusing or self-bonding insulating tape, self-fusing semiconducting tape, tinned copper shielding tape or braid, and plastic tape.

2.1.6 Tape

2.1.6.1 Insulating Tape

UL 510, plastic insulating tape, capable of performing in a continuous temperature environment of 80 degrees C.

2.1.6.2 Buried Warning and Identification Tape

Provide detectable aluminum foil plastic-backed tape or detectable magnetic plastic tape manufactured specifically for warning and identification of buried cable and conduit. Tape shall be detectable by an electronic detection instrument. Provide tape in rolls, 2 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 ELECTRIC , TELEPHONE CABLE BELOW or similar. Use permanent code and letter coloring unaffected by moisture and other substances contained in trench backfill material.

2.1.6.3 Fireproofing Tape

Furnish tape composed of a flexible conformable unsupported intumescent elastomer. Tape shall be not less than .030 inch thick by 3 inches wide, noncorrosive to cable sheath, self-extinguishing, noncombustible, and shall not deteriorate when subjected to oil, water, gases, salt water, sewage, and fungus.

2.1.7 Pull Rope

Shall be plastic having a minimum tensile strength of 200 pounds.

2.1.8 Grounding and Bonding Equipment

UL 467. Ground rods shall be 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.

2.1.9 Cable Tags

Provide as specified in 16011, "Electrical General Requirements."

PART 3 EXECUTION

3.1 INSTALLATION

Underground installation shall conform to ANSI C2 except as otherwise specified or indicated.

3.1.1 Contractor Damage

The Contractor shall promptly repair any indicated utility lines or systems damaged by Contractor operations. Damage to lines or systems not indicated, which are caused by Contractor 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 NTR of any such damage.

3.1.2 Concrete

Concrete work for electrical requirements shall be 3000 psi minimum ultimate 28-day compressive strength with 1-inch minimum aggregate conforming to the requirements of Section 03300, "Cast-in-Place Concrete."

3.1.3 Underground Duct with Concrete Encasement

Construct underground duct banks of individual conduits encased in concrete. Except where rigid galvanized steel conduit is indicated or

specified, the conduit shall be PVC, Type EPC-40-PVC. Do not mix different kinds of conduit in any one duct bank. Ducts shall be a minimum of 4 inches in diameter unless otherwise indicated. The concrete encasement surrounding the bank shall be rectangular in cross-section and shall provide at least 3 inches of concrete cover around ducts. Separate conduits by a minimum concrete thickness of 2 1\2 inches, except separate light and power conduits from control, signal, and telephone conduits by a minimum concrete thickness of 3 inches. Provide color, type and depth of warning tape as specified in paragraph "BURIED WARNING AND IDENTIFICATION TAPE" herein.

3.1.3.1 Depth of Encasement

The top of the concrete envelope shall be a minimum of 18 inches below grade, except under roads and pavement, concrete envelope shall be a minimum of 24 inches below grade.

3.1.3.2 Slope of Encasement

Duct banks shall have a continuous slope downward toward underground structures and away from buildings with a minimum pitch of 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 composed 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. Excavate trenches 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.

3.1.3.3 Conduit

Terminate conduits in end-bells where ducts enter underground structures. Stagger the joints of the conduits by rows and layers to strengthen the duct bank. Provide plastic duct spacers that interlock vertically and horizontally. Spacer assembly shall consist of base spacers, intermediate spacers, and top spacers 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. Before pouring concrete, anchor duct bank assemblies to prevent the assemblies from floating during concrete pouring. Anchoring shall be done by driving reinforcing rods adjacent to every other duct spacer assembly and attaching the rod to the spacer assembly.

3.1.3.4 Test Mandrel

As each section of a duct bank is completed from structure to structure, a testing mandrel not less than 12 inches long with a diameter 1/4 inch less than the inside diameter of the conduit shall be drawn through each conduit, after which a stiff-bristled brush, having the diameter of the conduit shall be drawn through until the conduit is clear of earth, sand, and gravel particles. Conduit plugs shall then be immediately installed.

3.1.3.5 Conduit Plugs and Pull Rope

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. Provide a plastic pull rope having 3 feet of slack at each end of unused or empty conduits.

3.1.3.6 Connections to Existing Manholes

For duct bank connections to existing structures, break the structure wall out to the dimensions required and preserve the steel in the structure wall. Cut the steel and bend out to tie into the reinforcing of the duct bank envelope. Chip the perimeter surface of the duct bank opening to form a key or flared surface, providing a positive connection with the duct bank envelope.

3.1.3.7 Partially Completed Duct Banks

During construction wherever a construction joint is necessary in a duct bank, prevent debris such as mud, sand, and dirt from entering ducts by providing suitable conduit plugs. Fit concrete envelope of a partially completed duct bank with reinforcing steel extending a minimum of 2 feet back into the envelope and a minimum of 2 feet beyond the end of the envelope. Provide one No. 4 bar in each corner, 3 inches from the edge of the envelope. Secure corner bars with two No. 3 ties, spaced approximately 1 foot apart. Restrain reinforcing assembly from moving during concrete pouring.

3.1.4 Underground Conduit for Service Feeders Into Buildings

Shall be galvanized rigid steel or PVC coated galvanized rigid steel from the service equipment to a point 5 feet beyond the building and projections thereof. Protect the ends of the conduit by threaded metal caps or bushings; coat the threads with graphite grease or other coating. Clean and plug conduit until conductors are installed. Encase the underground portion of the conduit in a concrete envelope and bury as specified for underground duct with concrete encasement.

3.1.5 Conduit Protection at Concrete Penetrations

Galvanized conduits which penetrate concrete (slabs, pavement, and walls) in wet locations shall be PVC coated and shall extend from at least 2 inches within the concrete to the first coupling or fitting outside the concrete (minimum of 6 inches from penetration).

3.1.6 Buried Warning and Identification Tape

Bury tape with the printed side up at a depth of 12 inches below the top surface of earth or the top surface of the subgrade under pavements.

3.1.7 Cable Pulling

Test existing ducts with a mandrel and thoroughly swab out to remove foreign material before pulling cables. Pull cables down grade with the feed-in point at the manhole or buildings of the highest elevation. Use flexible cable feeds to convey cables through manhole opening and into duct runs. Do not exceed the specified cable bending radii when installing cable under any conditions, including turnups into transformers, switchboards, and other enclosures. Cable with tape shield shall have a bending radius not less than 12 times the overall diameter of the completed cable. If basket-grip type cable-pulling devices are used to pull cable in place, cut off the section of cable under the grip before splicing and terminating.

3.1.7.1 Cable Lubricants

Use lubricants that are specifically recommended by the cable manufacturer for assisting in pulling jacketed cables.

3.1.7.2 Cable Pulling Tensions

Tensions shall not exceed the maximum pulling tension recommended by the cable manufacturer.

3.1.7.3 Installation of Cables in Manholes

Do not install cables utilizing the shortest route, but route along those walls providing the longest route and the maximum spare cable lengths. Form cables to closely parallel walls, without interference to duct entrances, and support on brackets and cable insulators at a maximum of 4 feet. Support cable splices in underground structures by racks on each side of the splice. Locate splices to prevent cyclic bending in the spliced sheath. Install cables at middle and bottom of cable racks, leaving top space open for future cables, except as otherwise indicated for existing installations. Provide one spare three-insulator rack arm for each cable rack in each underground structure. In existing manholes, handholes and vaults where new ducts are to be terminated or where new cables are to be installed, modify the existing installation of cables, cable supports and grounding as required for a uniform installation with cables carefully arranged and supported in the same manner as specified for new cables.

3.1.7.4 Cable Markers (or Tags) in Manholes

Provide as specified in Section 16011, "Electrical General Requirements."

3.1.7.5 Conductors Installed in Parallel

Conductors shall be grouped such that each conduit of a parallel run contains 1 Phase A conductor, 1 Phase B conductor, 1 Phase C conductor, and 1 neutral conductor, unless otherwise indicated.

3.1.8 600 Volt Cable Splicing and Terminating

Provide splices and terminations to protect 600 volt insulated power and lighting cables from accidental contact, deterioration of coverings and moisture. Make terminations and splices with materials and methods as indicated or specified herein and as designated by the written instructions of the manufacturer. Do not allow the cables to be moved until after the splicing material has completely set.

3.1.9 Medium Voltage Cable Terminations

Provide terminating devices and materials to protect medium voltage cable terminations from accidental contact, deterioration of coverings, and moisture. Make terminations by using materials and methods specified herein and as designated by the written instruction of the cable manufacturer and termination kit manufacturer. Termination for high-voltage cables shall be rated, and be capable of withstanding test voltages, in accordance with IEEE 48. Terminations of single- and multiconductor cables shall include the securing and sealing of the sheath and insulation of the cable conductors, stress relief and grounding of cable shields of shielded cable, and grounding of neutral conductors, metallic sheaths, and armor. Adequately support cables and cable terminations to avoid any excessive strain on the termination and the conductor connection.

3.1.10 Medium Voltage Cable Joints

Provide power cable joints (splices) suitable for continuous immersion in water. Make joints only in accessible locations in manholes or handholes by using materials and methods specified herein and as designated by the written instructions of the cable manufacturer and the joint kit manufacturer. Size connectors properly for the cable being connected and crimp using a full circle compression tool.

3.1.10.1 Joints in Shielded Cables

Cover the joined area with metallic tape, or material like the original cable shield and connect it to the cable shield on each side of the splice. Insulate cable shield for 34.5 kV system splices into sections at each splice to prevent circulating currents in the shield. Ground each insulated section at one point only. Ground ends of insulated sections terminating in potheads at the pothead terminal only. Provide a bare copper ground connection brought out in a watertight manner and grounded to a ground rod as part of the splice installation. Ground conductors, connections, and rods shall be as specified elsewhere in this section. Wire shall be trained to the sides of the enclosure to prevent interference with the working area.

3.1.11 Cable End Caps

Cable ends shall be sealed at all times with coated heat shrinkable end caps. Cables ends shall be sealed when the cable is delivered to the job site, while the cable is stored and during installation of the cable. The caps shall remain in place until the cable is spliced or terminated. Sealing compounds and tape are not acceptable substitutes for heat

shrinkable end caps. Cable which is not sealed in the specified manner at all times will be rejected.

3.1.12 Fireproofing of Cables in Manholes, Handholes and Vaults

Fireproof (arc proof) wire and cables which will carry current at 2200 volts or more in manholes, handholes, and vaults.

3.1.12.1 Fireproofing Tape

Tightly wrap strips of fireproofing tape around each cable spirally in half-lapped wrapping. Install tape in accordance with manufacturer's instructions.

3.1.13 Grounding Systems

Noncurrent-carrying metallic parts associated with electrical equipment shall have a maximum resistance to solid earth ground not exceeding the following values:

Pad-mounted transformers without protective fences	5 ohms
Grounded secondary distribution system neutral and noncurrent-carrying metal parts associated with distribution systems and grounds not otherwise covered	5 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.

3.1.13.1 Grounding Electrodes

Provide cone pointed ground rods driven full depth plus 6 inches, installed to provide an earth ground of the appropriate value for the particular equipment being grounded.

3.1.13.2 Grounding Connections

Make grounding connections which are buried or otherwise normally inaccessible, by exothermic weld or compression connector.

a. Make exothermic welds strictly in accordance with the weld manufacturer's written recommendations. Welds which are "puffed up" or which show convex surfaces indicating improper cleaning are not acceptable. Mechanical connectors are not required at exothermic welds.

3.1.13.3 Grounding Conductors

Grounding conductors shall be stranded-bare 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.

Cable sheaths, cable shields, conduit, and equipment shall be grounded with No. 6 AWG.

3.1.14 Special Conditions

During the construction of duct banks and underground structures located in streets, the streets shall remain open to traffic. Plan and execute the work to meet this condition.

3.1.15 Excavating, Backfilling, and Compacting

Provide under this section as specified in Section 02220, "General Excavation, Filling, and Backfilling."

3.1.16 Reconditioning of Surfaces

3.1.16.1 Unpaved Surfaces

Restore to their original elevation and condition unpaved surfaces disturbed during installation of duct. Preserve sod and topsoil removed during excavation and reinstall after backfilling is completed. Replace sod that is damaged by sod of quality equal to that removed. When the surface is disturbed in a newly seeded area, re-seed the restored surface with the same quantity and formula of seed as that used in the original seeding.

3.1.16.2 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, restore such surface treatment or pavement 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. make repairs in accordance with Section 02571 "Pavement Removal and Replacement."

3.2 FIELD QUALITY CONTROL

As an exception to requirements that may be stated elsewhere in the contract, notify the NTR 5 working days prior to each test.

Furnish labor, equipment, and incidentals required for testing, except that the Government will provide electric power required for the tests. Correct defects in the work provided by the Contractor and repeat tests until the work is in compliance with contract requirements.

3.2.1 Performance of Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations, NFPA 70B, NETA ATS, and referenced ANSI standards. Include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

3.2.1.1 Medium Voltage Cables

Perform tests after installation of cable, splices, and terminators and before terminating to equipment

a. Visual and Mechanical Inspection

(1) Inspect exposed cable sections for physical damage

(2) Verify that cable is supplied and connected in accordance with contract plans and specifications

(3) Inspect for proper shield grounding, cable support, and cable termination

(4) Verify that cable bends are not less than ICEA or manufacturer's minimum allowable bending radius

(5) Inspect for proper fireproofing

(6) If cables are terminated through window-type CT's, make an inspection to verify that neutrals and grounds are properly terminated for proper operation of protective devices

(7) Visually inspect jacket and insulation condition

(8) Inspect for proper phase identification and arrangement

b. Electrical Tests

(1) Perform a shield continuity test on each power cable by ohmmeter method; Record ohmic value, resistance values in excess of 10 ohms per 1000 feet of cable must be investigated and justified.

(2) Perform a DC high-potential test on all cables. Adhere to precautions and limits as specified in the applicable NEMA/ICEA Standard for the specific cable. Test procedure shall be as follows, and the results for each cable test shall be recorded as specified herein. Field acceptance test voltage for 15 kV cable shall be 53 kV DC.

(a) Current-sensing circuits in test equipment shall measure only the leakage current associated with the cable under test and shall not include internal leakage of the test equipment

(b) Record wet- and dry-bulb temperatures or relative humidity and temperature

(c) Test each section of cable individually

(d) Individually test each conductor with all other conductors grounded; Ground all shields

(e) Terminations shall be properly corona-suppressed by guard ring, field reduction sphere, or other suitable methods as necessary

(f) Ensure that the maximum test voltage does not exceed the limits for terminators specified in IEEE Standard 48 or manufacturer's specifications.

(g) Apply the DC high-potential test in at least five equal increments until maximum test voltage is reached. No increment shall exceed the voltage rating of the cable. Record DC leakage current at each step after a constant stabilization time consistent with system charging current.

(h) Raise the conductor to the specified maximum test voltage and hold for fifteen (15) minutes. Record readings of leakage current at 30 seconds and one minute and at one-minute intervals thereafter. Provide a graphic plot of readings with leakage current (X axis) versus voltage (Y axis) at each increment

(i) Reduce the conductor test potential to zero and measure residual voltage at discrete intervals.

(j) Apply grounds for a time period adequate to drain all insulation stored charge.

(k) When new cables are spliced into existing cables, the DC high-potential test shall be performed on the new cable prior to splicing. After test results are approved for new cable and the splice is completed, an insulation-resistance test and a shield-continuity test shall be performed on the length of new and existing cable including the splice. After a satisfactory insulation-resistance test, a DC high-potential test shall be performed on the completed cable system utilizing a test voltage 75% of new cable tested value.

3.2.1.2 Ground Rods

Perform ground resistance tests for ground rods before any wire is connected. Take measurements in normally dry weather, not less than 48 hours after rainfall. Ground resistance shall also be measured for each piece of equipment and medium voltage cable splice to the ground electrode. Use a portable ground testing megger in accordance with manufacturer's instructions 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.

-- End of Section --

SECTION 16402

INTERIOR WIRING SYSTEMS

03/95

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C80.1	(1990) Rigid Steel Conduit - Zinc Coated
ANSI C80.3	(1991) Electrical Metallic Tubing - Zinc Coated
ANSI C80.5	(1990) Rigid Aluminum Conduit

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 1	(1990) Hard-Drawn Copper Wire
ASTM B 8	(1993) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM E 814	(1994)Fire Tests of Through-Penetration Fire Stops

FEDERAL SPECIFICATIONS (FS)

FS W-P-115	(Rev. C) Panel, Power Distribution
FS W-C-375	(Rev. B) Circuit Breakers, Molded Case, Branch Circuit and Service
FS L-P-387	(Rev. A; Int Am. 2) Plastic Sheet, Laminated, Thermosetting (for Design Plates)
FS W-S-896	(Rev. E) Switches, Toggle (Toggle and Lock), Flush Mounted

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA AB 1	(1993) Molded Case Circuit Breakers and Molded Case Switches
NEMA BU 1	(1988) Busways
NEMA FU 1	(1986) Low Voltage Cartridge Fuses

NEMA ICS 1	(1993) Industrial Control and Systems
NEMA ICS 2	(1993) Controllers, Contactors and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC
NEMA ICS 4	(1993) Terminal Blocks for Industrial Use
NEMA ICS 6	(1993) Industrial Control and Systems Enclosures
NEMA KS 1	(1990) Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)
NEMA MG 1	(1993) Motors and Generators
NEMA MG 10	(1983; R 1988) Energy Management Guide for Selection and Use of Polyphase Motors
NEMA MG 11	(1977; R 1992) Energy Management Guide of Selection and Use of Single-Phase Motors
NEMA RN 1	(1989) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA ST 20	(1992) Dry-Type Transformers for General Applications
NEMA TC 2	(1990) Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80)
NEMA TC 3	(1990) PVC Fittings for Use with Rigid PVC Conduit and Tubing
NEMA TC 13	(1993) Electrical Nonmetallic Tubing
NEMA TC 14	(1984; R 1986) Filament-Wound Reinforced Thermosetting Resin Conduit and Fittings
NEMA VE 1	(1991) Metallic Cable Tray Systems
NEMA WD 1	(1983; R 1989) Wiring Devices
NEMA WD 6	(1988) Wiring Devices - Dimensional Requirements

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1993) National Electrical Code

UNDERWRITERS LABORATORIES INC. (UL)

UL 1	(1993; R 1993) Flexible Metal Conduit

UL 4	(1986; R 1990, Bul. 1992 and 1993) Armored Cable
UL 5	(1985; R 1990, Bul. 1990) Surface Metal Raceways and Fittings
UL 5A	(1994) Nonmetallic Surface Raceways and Fittings
UL 6	(1993; Bul. 1993) Rigid Metal Conduit
UL 44	(1991; Bul. 1992, 1993, and 1994, R 1994) Rubber-Insulated Wires and Cables
UL 50	(1992; R 1994) Safety Enclosures for Electrical Equipment
UL 67	(1988; R 1993, Bul. 1993) Panelboards
UL 83	(1991; Bul. 1991, 1992, and 1993, R 1993) Thermoplastic-Insulated Wires and Cables
UL 198C	(1986; Bul. 1991, 1992, and 1993, R 1993) High-Interrupting-Capacity Fuses, Current-Limiting Types
UL 198E	(1988; R 1988, Bul. 1991, 1992, and 1993) Class R Fuses
UL 198H	(1988; Bul. 1992, 1993, and 1994, R 1993) Class T Fuses
UL 360	(1986; Bul. 1991, R 1993) Liquid-Tight Flexible Steel Conduit
UL 467	(1993; Bul. 1994) Grounding and Bonding Equipment
UL 486A	(1991; Errata 1991 and 1992, R 1992, Bul. 1993 and 1994) Wire Connectors and Soldering Lugs for Use With Copper Conductors
UL 486B	(1991; Errata 1992, R 1992, Bul. 1994) Wire Connectors for Use with Aluminum Conductors
UL 486C	(1991; R 1992, Bul. 1994) Splicing Wire Connectors
UL 489	(1991; Bul. 1992, 1993, and 1994, R 1994) Molded-Case Circuit Breakers and Circuit-Breaker Enclosures
UL 498	(1991; R 1993, Bul. 1993 and 1994)

	Attachment Plugs and Receptacles
UL 506	(1989; R 1993) Specialty Transformers
UL 508	(1993; Bul. 1993 and 1994) Industrial Control Equipment
UL 510	(1986; R 1994) Chloride, Polyethylene, and Rubber Insulating Tape
UL 514A	(1991; R 1993, Bul. 1993 and 1994) Metallic Outlet Boxes
UL 514B	(1989; Errata 1991, R 1993, Bul. 1993 and 1994) Fittings for Conduit and Outlet Boxes
UL 514C	(1988; R 1989, Bul. 1993 and 1994) Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL 651	(1989; R 1989, Bul. 1993) Schedule 40 and 80 Rigid PVC Conduit
UL 719	(1985; Bul. 1992, 1993, and 1994, R 1993) Nonmetallic-Sheathed Cable
UL 797	(1993; R 1993) Electrical Metallic Tubing
UL 845	(1988; R 1993, Bul. 1994) Motor Control Centers
UL 854	(1991; Bul. 1992, 1993, and 1994, R 1993) Service-Entrance Cables
UL 857	(1990; R 1994, Bul. 1994) Busways and Associated Fittings
UL 869	(1989; R 1991, Bul. 1992 and 1993) Service Equipment
UL 870	(1991) Wireways, Auxiliary Gutters, and Associated Fittings
UL 886	(1994; R 1994, Bul. 1994) Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations
UL 943	(1993; R 1993, Bul. 1994) Ground-Fault Circuit Interrupters
UL 984	(1991; Bul. 1993) Hermetic Refrigerant Motor-Compressors
UL 1010	(1991; R 1991, Bul. 1993 and 1994) Receptacle-Plug Combination for Use in

	Hazardous (Classified) Locations
UL 1242	(1983; R 1993, Bul. 1993) Intermediate Metal Conduit
UL 1569	(1983; Bul. 1991, 1992, 1993, and 1994, R 1993) Metal-Clad Cables
UL 1660	(1987; Bul. 1991) Liquidtight Flexible Nonmetallic Conduit

1.2 RELATED REQUIREMENTS

Section 16011, "Electrical General Requirements," applies to this section with additions and modifications specified herein.

1.3 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic Contract.

1.3.1 SD-02, Manufacturer's Catalog Data

a. Switches G

b. Receptacles G

c. Circuit breakers G

d. Transformers G

e. Motor controllers G

f. Telecommunications cabling G

g. Building protector assemblies G

h. Telephone dialer G

1.3.2 SD-04, Drawings

a. Panelboards G

b. Transformers G

1.3.3 SD-08, Statements

a. Fuses G

Submit coordination data as specified in article entitled, "FUSES" of this section.

1.3.3.1 SD-09, Reports

a. Transformer design and prototype tests G

1.3.3.2 Transformer Design and Prototype Tests

Submittal shall contain the results of NEMA "design" and "prototype" tests that were made on transformers electrically and mechanically equal to those specified.

1.3.4 SD-12, Field Test Reports

a. 600-volt wiring test G

b. Grounding system test G

c. Transformer tests G

d. GFI receptacle test G

1.3.5 SD-19, Operation and Maintenance Manuals

a. Electrical Systems, Data Package 5

1.3.5.1 Electrical Systems

Submit operation and maintenance manuals for electrical systems that provide basic data relating to the design, operation, and maintenance of the electrical distribution system for the building. This shall include:

a. Single line diagram of the "as-built" building electrical system.

b. Schematic diagram of electrical control system (other than HVAC, covered elsewhere).

c. Manufacturers' operating and maintenance manuals on active electrical equipment.

1.4 QUALITY ASSURANCE

In each standard referred to herein, consider the advisory provisions to be mandatory, as though the word "shall" has been substituted for "should" wherever it appears. Interpret references in these standards to "authority having jurisdiction," or words of similar meaning, to mean Contracting Officer.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Materials, equipment, and devices shall, as a minimum, meet requirements of UL, where UL standards are established for those items, and requirements of NFPA 70.

2.2 CONDUIT AND FITTINGS

Shall be rigid steel (zinc-coated) conduit, rigid nonmetallic conduit, plastic coated rigid steel, and liquid-tight flexible conduit, conforming to the following:

2.2.1 Rigid Steel Conduit (Zinc-Coated)

ANSI C80.1, UL 6.

2.2.2 Rigid Nonmetallic Conduit

PVC Type EPC-40, in accordance with NEMA TC 2.

2.2.3 Plastic-Coated Rigid Steel

NEMA RN 1, Type 40 (40 mils thick).

2.2.3.1 Liquid-Tight Flexible Metal Conduit, Steel

UL 360.

2.2.4 Fittings for Metal Conduit, and Flexible Metal Conduit

UL 514B. Ferrous fittings shall be cadmium- or zinc-coated in accordance with UL 514B.

2.2.4.1 Fittings for Rigid Metal Conduit

Threaded-type. Split couplings unacceptable.

2.3 OUTLET BOXES AND COVERS

UL 514A, cadmium- or zinc-coated, if ferrous metal. UL 514C, if nonmetallic.

2.4 WIRES AND CABLES

Wires and cables shall meet applicable requirements of NFPA 70 and UL for type of insulation, jacket, and conductor specified or indicated. Wires and cables manufactured more than 12 months prior to date of delivery to site shall not be used.

2.4.1 Conductors

Conductors No. 8 AWG and larger diameter shall be stranded. Conductors No. 10 AWG and smaller diameter shall be solid, except that conductors for remote control, alarm, and signal circuits, classes 1, 2, and 3, shall be stranded unless specifically indicated otherwise. Conductor sizes and ampacities shown are based on copper, unless indicated otherwise. All conductors shall be copper.

2.4.1.1 Equipment Manufacturer Requirements

When manufacturer's equipment requires copper conductors at the terminations or requires copper conductors to be provided between components of equipment, provide copper conductors or splices, splice boxes, and other work required to satisfy manufacturer's requirements.

2.4.1.2 Minimum Conductor Sizes

Minimum size for branch circuits shall be No. 12 AWG.

2.4.2 Color Coding

Provide for service, feeder, branch, control, and signaling circuit conductors. Color shall be green for grounding conductors and white for neutrals; except where neutrals of more than one system are installed in same raceway or box, other neutral shall be white with colored (not green) stripe. Color of ungrounded conductors in different voltage systems shall be as follows:

a. 208/120 volt, 3-phase

(1) Phase A - black

(2) Phase B - red

(3) Phase C - blue

b. 480/277 volt, 3-phase

(1) Phase A - brown

(2) Phase B - orange

(3) Phase C - yellow

2.4.3 Insulation

Unless specified or indicated otherwise or required by NFPA 70, power and lighting wires shall be 600-volt, Type THWN/THHN remote-control and signal circuits shall be Type TW, THW, or TF. Conductors shall conform to UL 83. Where lighting fixtures require 90 degrees C conductors, provide only conductors with 90 degree C insulation or better.

2.4.4 Bonding Conductors

ASTM B 1, solid bare copper wire for sizes No. 8 AWG and smaller diameter; ASTM B 8, Class B, stranded bare copper wire for sizes No. 6 AWG and larger diameter.

2.5 SPLICES AND TERMINATION COMPONENTS

UL 486A for wire connectors and UL 510 for insulating tapes. Connectors for No. 10 AWG and smaller diameter wires shall be insulated, pressure-type in accordance with UL 486A or UL 486C (twist-on

splicing connector). Provide solderless terminal lugs on stranded conductors.

2.6 DEVICE PLATES

Provide UL listed, one-piece device plates for outlets to suit the devices installed. For metal outlet boxes, plates on unfinished walls shall be of zinc-coated sheet steel or cast metal having round or beveled edges. For nonmetallic boxes and fittings, other suitable plates may be provided. Screws shall be machine-type with countersunk heads in color to match finish of plate. Sectional type device plates will not be permitted. Plates installed in wet locations shall be gasketed and UL listed for "wet locations."

2.7 SWITCHES

2.7.1 Toggle Switches

NEMA WD 1, No. 1121 for single pole, totally enclosed with bodies of thermosetting plastic and mounting strap with grounding screw. Handles shall be brown. Wiring terminals shall be screw-type, side-wired. Switches shall be rated quiet-type AC only, 120/277 volts, with current rating and number of poles indicated.

2.7.2 Disconnect Switches

NEMA KS 1. Provide heavy duty-type switches where indicated, where switches are rated higher than 240 volts, and for double-throw switches. Fused switches shall utilize Class R fuseholders and fuses, unless indicated otherwise. Switches serving as motor-disconnect means shall be horsepower rated. Provide switches in NEMA 12, enclosure per NEMA ICS 6.

2.8 RECEPTACLES

UL 498 and NEMA WD 1, general grade, heavy-duty, grounding type. Ratings and configurations shall be as indicated. Bodies shall be of brown thermosetting plastic supported on a metal mounting strap. Dimensional requirements shall be per NEMA WD-6. Provide screw-type, side-wired wiring terminals. Connect grounding pole to mounting strap.

2.8.1 Duplex Receptacles

Duplex receptacles shall be 20 amperes, 125 volts.

2.8.2 Weatherproof Receptacles

Provide in cast metal box with gasketed, weatherproof, cast-metal cover plate and gasketed cap over each receptacle opening. Provide caps with a spring-hinged flap. Receptacle shall be UL listed for use in "wet locations."

2.8.3 Ground-Fault Circuit Interrupter (GFI) Receptacles

UL 943, duplex type for mounting in standard outlet box. Device shall be capable of detecting current leak of 6 milliamperes or greater and tripping per requirements of UL 943 for Class A GFI devices.

2.9 PANELBOARDS

UL 67 and UL 50 having a short-circuit current rating as indicated of 10,000 amperes symmetrical minimum. Panelboards for use as service disconnecting means shall additionally conform to UL 869. Panelboards shall be circuit breaker-equipped. Design shall be such that individual breakers can be removed without disturbing adjacent units or without loosening or removing supplemental insulation supplied as means of obtaining clearances as required by UL. "Specific breaker placement" is required in panelboards to match the breaker placement indicated in the panelboard schedule on the drawings. Use of "Subfeed Breakers" is not acceptable unless specifically indicated otherwise. Main breaker shall be "separately" mounted "above" or "below" branch breakers. Where "space only" is indicated, make provisions for future installation of breakers. Panelboard locks shall be keyed same. Directories shall indicate load served by each circuit in panelboard. Directories shall also indicate source of service to panelboard (e.g., Panel PA served form Panel MDP).

2.9.1 Panelboard Buses

Support bus bars on bases independent of circuit breakers. Main buses and back pans shall be designed so that breakers may be changed without machining, drilling, or tapping. Bus bars shall be copper or aluminum, and shall be tin plated or silver plated. Provide isolated neutral bus in each panel for connection of circuit neutral conductors. Provide separate ground bus identified as equipment grounding bus per UL 67 for connecting grounding conductors; bond to steel cabinet.

2.9.2 Circuit Breakers

UL 489, thermal magnetic-type having a minimum short-circuit current rating equal to the short-circuit current rating of the panelboard in which the circuit breaker shall be mounted. Breaker terminals shall be UL listed as suitable for type of conductor provided. Series rated circuit breakers and plug-in circuit breakers are unacceptable.

2.9.2.1 Multipole Breakers

Provide common trip-type with single operating handle. Breaker design shall be such that 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.

2.10 ENCLOSED CIRCUIT BREAKERS

UL 489. Individual molded case circuit breakers with voltage and continuous current ratings, number of poles, overload trip setting, and short circuit current interrupting rating as indicated. Enclosure type as indicated.

2.11 FUSES

NEMA FU 1. Provide complete set of fuses for each fusible switch and control center. Time-current characteristics curves of fuses serving motors or connected in series with circuit breakers shall be coordinated for proper operation. Submit coordination data for approval. Fuses shall have voltage rating not less than circuit voltage.

2.11.1 Cartridge Fuses, Current Limiting Type (Class R)

UL 198 E Class RK-1. Associated fuseholders shall be Class R only.

2.12 TRANSFORMERS

NEMA ST 20, general purpose, dry-type, self-cooled, ventilated. Provide transformers in NEMA 1 enclosure. Transformer shall have 220 degrees C insulation system for transformers 15 kVA and greater, and shall have 180 degrees C insulation for transformers rated 10 kVA and less, with temperature rise not exceeding 150 degrees C under full-rated load in maximum ambient of 40 degrees C. Transformer of 150 degrees C temperature rise shall be capable of carrying continuously 100 percent of nameplate kVA without exceeding insulation rating.

2.13 MOTORS

NEMA MG 1 hermetic-type sealed motor compressors shall also comply with UL 984. Provide the size in terms of HP, or kVA, or full-load current, or a combination of these characteristics, and other characteristics, of each motor as indicated or specified. Determine specific motor characteristics to ensure provision of correctly sized starters and overload heaters. Motors for operation on 208-volt, 3-phase circuits shall have terminal voltage rating of 200 volts, and those for operation on 480-volt, 3-phase circuits shall have terminal voltage rating of 460 volts. Motors shall be designed to operate at full capacity with voltage variation of plus or minus 10 percent of motor voltage rating.

2.13.1 Motor Sizes

Provide size for duty to be performed, not exceeding the full-load nameplate current rating when driven equipment is operated at specified capacity under most severe conditions likely to be encountered. When motor size provided differs from size indicated or specified, make adjustments to wiring, disconnect devices, and branch circuit protection to accommodate equipment actually provided.

2.14 MOTOR CONTROLLERS

UL 508, NEMA ICS 1, and NEMA ICS 2. Controllers shall have thermal overload protection in each phase and shall have 1 spare normally open and 1 spare normally closed auxiliary contact. Magnetic-type motor controllers shall have undervoltage protection when used with momentary-contact pushbutton stations or switches and shall have undervoltage release when used with maintained-contact pushbutton stations or switches. When used with pressure, float, or similar automatic-type or

maintained-contact switch, controller shall have hand/off/automatic selector switch. Connections to selector switch shall be such that only normal automatic regulatory control devices are bypassed when switch is in "hand" position. Safety control devices, such as low and high pressure cutouts, high temperature cutouts, and motor overload protective devices, shall be connected in motor control circuit in "hand" and "automatic" positions. Control circuit connections to hand/off/automatic selector switch or to more than one automatic regulatory control device shall be made in accordance with indicated or manufacturer's approved wiring diagram. Selector switch shall have means for locking in any position. For each motor not in sight of controller or where controller disconnecting means is not in sight of motor location and driven machinery location, controller disconnecting means shall be capable of being locked in open position. As an alternative, provide a manually operated, lockable, nonfused switch which disconnects motor from supply source within sight of motor. Overload protective devices shall provide adequate protection to motor windings; be thermal inverse-time-limit type; and include manual reset-type pushbutton on outside of motor controller case. Cover of combination motor controller and manual switch or circuit breaker shall be interlocked with operating handle of switch or circuit breaker so that cover cannot be opened unless handle of switch or circuit breaker is in "off" position.

2.14.1 Control Circuits

Control circuits shall have maximum voltage of 120 volts derived from control transformer in same enclosure. Transformers shall conform to UL 506, as applicable. Transformers, other than transformers in bridge circuits, shall have primaries wound for voltage available and secondaries wound for correct control circuit voltage. Size transformers so that 80 percent of rated capacity equals connected load. Provide disconnect switch on primary side. Provide fuses in each ungrounded primary feeder. One secondary lead shall be fused; other shall be grounded.

2.14.2 Enclosures for Motor Controllers

NEMA ICS 6.

2.14.3 Pushbutton Stations

Provide with "start/stop" momentary contacts having one normally open and one normally closed set of contacts, and red lights to indicate when motor is running. Stations shall be heavy duty, oil-tight design.

2.14.4 Pilot and Indicating Lights

Provide transformer, resistor, or diode type.

2.14.5 Terminal Blocks

NEMA ICS 4.

2.15 TELEPHONE SYSTEM

Provide system of telephone wire-supporting structures, including: conduits with wires, terminal boxes, outlet and junction boxes, other accessories for telephone outlets, and backboards.

2.15.1 Outlet Boxes for Telephone System

Standard type. Surface mount at height specified for outlet receptacles. Outlet boxes for wall-mounted telephones shall be 2 inches by 4 inches by 1-1/2 inches deep; mounted at height 60 inches above finished floor.

2.15.2 Cover Plates

Blank cover with same finish specified for receptacle and switch cover plates.

2.15.3 Conduit Sizing

Conduit for single outlets shall be minimum of 3/4 inch and for multiple outlets minimum of one inch.

2.15.4 Backboards

Interior grade plywood, 3/4-inch thick, paint with gray water-based paint 4 by 8 feet minimum.

2.15.5 Receptacles for Telephone Service

Provide receptacle, 125 volts, 20 amps, single phase, 60 Hz, adjacent to telephone backboards served from panelboard circuit.

2.15.6 Telecommunications Cabling

Cabling shall be UL listed for the application and shall comply with EIA/TIA-568 and NFPA 70. Cabling shall consist of UTP. Provide a labeling system for cabling as required by EIA/TIA-606 and UL 969. Cabling manufactured more than 12 months prior to date of installation shall not be used.

2.15.6.1 Backbone Cabling

Provide building entrance backbone cabling from existing manhole and from telecommunication terminals in existing building Q81 to new equipment buildings. Building entrance cables shall be terminated on protected entrance terminals, in terminal cabinets, using current industry standard practice.

ANSI/ICEA S-80-576 and UL 444. twisted pair cabling (UTP). Solid conductors shall be multipair 22 AWG for 100 ohm UTP formed into 4 pair binder groups covered with a thermoplastic jacket. Pair twist lengths and frequency per unit length shall be determined by the manufacturer. A minimum of two conductor twists per foot is required. Color coding shall comply with industry standards for 4 pair cables.

2.15.7 Building Protector Assemblies

Self-contained unit providing a field cable stub factory connected to protector socket blocks to terminate and accept protector modules for 6 pairs of outside cable. Building protector assembly shall have connector blocks for connection to interior cabling at full capacity.

2.15.7.1 Protector Modules

UL 497, REA TECM 823, three-electrode gas tube or solid state type rated for the application. Provide 6 pair surge protection modules equal to full capacity of the building protector assembly.

2.15.8 Telephone Dialer

Provide a autodialer with capacity to store and dial up to eight (32 digit) phone numbers to notify key personnel. Each of the 8 numbers shall be independently dialed in a voice or data mode. In any of the following communication modes, the autodialer shall dial numbers in sequence until it receives verification that an authorized person has been reached.

Voice Dial-out delivers alert messages in voice-synthesized English.

Data Mode - through standard phone lines, the system contacts personnel at their computer terminals.

Local Alarm - a local acoustic alarm is activated for immediate response of on-site personnel.

Beepers - dials directly to a beeper and delivers a code.

The autodialer shall have a call-in feature. Authorized personnel may access the system at any time to request a status report. In voice or data mode, the system shall report current levels and on/off status for any individual process.

The autodialer shall have battery back-up. Battery back-up shall consist of battery charger, batteries, low-battery detect and 14 hours of back-up time. The autodialer shall be applied from a 120 V, single phase, 60 Hz source.

2.15.9 Terminal Cabinets

Construct of zinc-coated sheet steel, 36 inches by 24 inches by 6 inches deep. Trim shall be fitted with hinged door and locking latch. Doors shall be maximum size openings to box interiors. Boxes shall be provided with 5/8 inch backboard with two-coat varnish finish. Match trim, hardware, doors, and finished with lighting panelboards. Provide label and identification systems telecommunications wiring consistent with EIA/TIA-606.

2.16 GROUNDING AND BONDING EQUIPMENT

UL 467. Ground rods shall be copper-clad steel, with minimum diameter of 3/4 inch and minimum length of 10 feet.

2.17 NAMEPLATES

FS L-P-387. Provide as specified in Section 16011, "Electrical General Requirements."

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations shall conform to requirements of NFPA 70 and to requirements specified herein.

3.1.1 Underground Service

Underground service conductors and associated conduit shall be continuous from service entrance equipment to outdoor power system connection.

3.1.2 Service Entrance Identification

Service entrance disconnect devices, switches, and enclosures shall be labeled and identified as such.

3.1.2.1 Labels

Wherever work results in service entrance disconnect devices in more than one enclosure, as permitted by NFPA 70, each enclosure, new and existing, shall be labeled as one of several enclosures containing service entrance disconnect devices. Label, at minimum, shall indicate number of service disconnect devices housed by enclosure and shall indicate total number of enclosures that contain service disconnect devices. Provide laminated plastic labels conforming to paragraph entitled "Nameplates." Use lettering of at least 0.25 inch in height, and engrave on black-on-white matte finish. Service entrance disconnect devices in more than one enclosure, shall be provided only as permitted by NFPA 70.

3.1.3 Wiring Methods

Provide insulated conductors installed in rigid steel conduit, or rigid nonmetallic conduit, except where specifically indicated or specified otherwise or required by NFPA 70 to be installed otherwise. Grounding conductor shall be separate from electrical system neutral conductor. Provide insulated, green equipment grounding conductor for circuit(s) installed in conduit or raceways. Minimum conduit size shall be 1/2 inch in diameter for low voltage lighting and power circuits.

3.1.3.1 Nonmetallic Conduit

a. Restrictions applicable to PVC Schedule 40 and PVC Schedule 80

(1) Do not use in areas where subject to severe physical damage, including but not limited to, mechanical equipment rooms, electrical equipment rooms, hospitals, power plants, missile magazines, and other such areas.

(2) Do not use in hazardous (classified) areas.

(3) Do not use in fire pump rooms.

3.1.3.2 Restrictions Applicable to Flexible Conduit

Use only as specified in paragraph entitled "Flexible Connections."

3.1.3.3 Service Entrance Conduit, Underground

PVC, Type-EB, or galvanized rigid steel. Underground portion shall be encased in minimum of 3 inches of concrete and shall be installed minimum 18 inches below slab or grade.

3.1.3.4 Underground Conduit Other Than Service Entrance

Plastic-coated rigid steel; PVC, Type EPC-40; or fiberglass. Convert nonmetallic conduit, other than PVC Schedule 40 or 80, to rigid steel conduit before rising through floor slab. Plastic coating shall extend minimum 6 inches above floor.

3.1.4 Conduit Installation

Conceal conduit under floor slabs where noted. Keep conduit minimum 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 conduit will be visible after completion of project.

3.1.4.1 Conduit Installed Under Floor Slabs

Conduit run under floor slab shall be located a minimum of 12 inches below the vapor barrier. Seal around conduits at penetrations thru vapor barrier.

3.1.4.2 Conduit Through Floor Slabs

Where conduits rise through floor slabs, curved portion of bends shall not be visible above finish slab.

3.1.4.3 Conduit Support

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; and by machine screws, welded threaded studs, or spring-tension clamps on steel work. Threaded C-clamps may be used on rigid steel conduit only. Do not weld conduits or pipe straps to steel structures. Load applied to fasteners shall not exceed one-fourth proof test load. Fasteners attached to concrete ceiling shall be vibration resistant and shock-resistant. Holes cut to depth of more than 1 1/2 inches in reinforced concrete beams or to depth of more than 3/4 inch in concrete joints shall not cut main reinforcing bars. Fill unused holes. In partitions of light steel construction, use sheet metal screws. Supporting means shall not be shared between electrical raceways and mechanical piping or ducts.

3.1.4.4 Directional Changes in Conduit Runs

Make changes in direction of runs with symmetrical bends or cast-metal fittings. Make field-made bends and offsets with 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 obstructions.

3.1.4.5 Pull Wire

Install pull wires in empty conduits. Pull wire shall be plastic having minimum 200-pound tensile strength. Leave minimum 36 inches of slack at each end of pull wire.

3.1.4.6 Telephone and Signal System Conduits

Install in accordance with specified requirements for conduit and with additional requirement that no length of run shall exceed 150 feet for trade sizes 2 inches and smaller and shall not contain more than two 90-degree bends or equivalent. Provide pull or junction boxes where necessary to comply with these requirements. Inside radii of bends in conduits one-inch trade size and larger shall be minimum five times nominal diameter. Terminate conduit at bottom edge of backboard with plastic bushing.

3.1.4.7 Locknuts and Bushings

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 minimum single locknut and bushing. Locknuts shall have sharp edges for digging into wall of metal enclosures. Install bushings on ends of conduits, and provide insulating type where required by NFPA 70.

3.1.4.8 Stub-Ups

Provide conduits stubbed up through concrete floor for connection to free-standing equipment with adjustable top or coupling threaded inside for plugs, set flush with finished floor. Extend conductors to equipment in rigid steel conduit, except that flexible metal conduit may be used 6 inches above floor. Where no equipment connections are made, install screwdriver-operated threaded flush plugs in conduit end.

3.1.4.9 Flexible Connections

Provide flexible steel conduit between 3 and 6 feet in length for equipment subject to vibration, noise transmission, or movement; and for motors. Install flexible conduit to allow 20 percent slack. Minimum flexible steel conduit size shall be 1/2 inch diameter. Provide liquidtight flexible nonmetallic conduit in wet and damp locations and in fire pump rooms for equipment subject to vibration, noise transmission, movement or motors. Provide separate ground conductor across flexible connections.

3.1.5 Boxes, Outlets, and Supports

Provide boxes in wiring or raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures. Boxes for metallic raceways shall be cast-metal, hub-type when surface mounted on outside of exterior surfaces, when surface mounted on interior walls and when specifically indicated. Each box shall have volume required by NFPA 70 for number of conductors enclosed in box. Boxes for mounting lighting fixtures shall be minimum 4 inches square, or octagonal, except that smaller boxes may be installed as required by fixture configurations, as approved. 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 outside of exterior surfaces. Provide separate boxes for flush or recessed fixtures when required by fixture terminal operating temperature; fixtures shall be readily removable for access to boxes unless ceiling access panels are provided. 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. 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. Where bar hangers are used, attach bar to raceways on opposite sides of box, and support raceway with approved-type fastener maximum 24 inches from box. When penetrating reinforced concrete members, avoid cutting reinforcing steel.

3.1.5.1 Boxes

Boxes for use with raceway systems shall be minimum 1 1/2 inches deep, except where shallower boxes required by structural conditions are approved. Boxes for other than lighting fixture outlets shall be minimum 4 inches square, except that 4-by 2-inch boxes may be used where only one raceway enters outlet and for wall-mounted telephones.

3.1.5.2 Pull Boxes

Construct of at least minimum size required by NFPA 70 and of cast-metal boxes are required in locations specified herein. Provide boxes with screw-fastened covers. Where several feeders pass through common pull box, tag feeders to indicate clearly electrical characteristics, circuit number, and panel designation.

3.1.6 Mounting Heights

Mount panelboards, enclosed circuit breakers, motor controllers and disconnecting switches so height of operating mechanism at its highest position is maximum 78 inches above floor. Mount lighting switches 48 inches above finished floor, receptacles 18 inches above finished floor. Outlet boxes for wall-mounted telephones shall be 2 by 4 inches; mounted at height 60 inches above finished floor as indicated. Measure mounting heights of wiring devices and outlets to center of device or outlet.

3.1.7 Conductor Identification

Provide conductor identification within each enclosure where tap, splice, or termination is made. For conductors No. 6 AWG and smaller diameter, color coding shall be by factory-applied, color-impregnated insulation. For conductors No. 4 AWG and larger diameter, color coding shall be by plastic-coated, self-sticking markers; colored nylon cable ties and plates; or heat shrink-type sleeves.

3.1.8 Splices

Make splices in accessible locations. Make splices in conductors No. 10 AWG and smaller diameter with insulated, pressure-type connector. Make splices in conductors No. 8 AWG and larger diameter with solderless connector, and cover with insulation material equivalent to conductor insulation.

3.1.9 Covers and Device Plates

Install with edges in continuous contact with finished wall surfaces without use of mats or similar devices. Plaster fillings are not permitted. Install plates with alignment tolerance of 1/16 inch. Use of sectional-type device plates are not permitted. Provide gasket for plates installed in wet locations.

3.1.10 Electrical Penetrations

Seal openings around electrical penetrations through fire resistance-rated walls, partitions, floors, and ceilings utilizing proper firestopping materials to maintain fire resistive integrity.

3.1.11 Grounding and Bonding

In accordance with NFPA 70. Ground exposed, non-current-carrying metallic parts of electrical equipment, metallic raceway systems, grounding conductor in metallic and nonmetallic raceways, grounding conductor of nonmetallic sheathed cables, and neutral conductor of wiring systems. Make ground connection at main service equipment. Make ground connection to driven ground rods on exterior of building.

3.1.11.1 Resistance

Maximum resistance-to-ground of grounding system shall not exceed 5 ohms under dry conditions. Where resistance obtained exceeds 5 ohms, contact NTR for further instructions.

3.1.11.2 Telephone Service

Provide main telephone service equipment ground consisting of separate No. 6 AWG ground wire in conduit between equipment backboard and readily accessible grounding connection. Equipment end of ground wire shall consist of coiled length at least twice as long as terminal cabinet or backboard height.

3.1.12 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 the section specifying the associated equipment.

3.2 FIELD QUALITY CONTROL

Furnish test equipment and personnel and submit written copies of test results. Give NTR 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.

3.2.2 600-Volt Wiring Test

Test 600-volt wiring and less to verify that no short circuits or accidental grounds exist. Perform insulation resistance tests on wiring No. 6 AWG and larger diameter using instrument which applies voltage of approximately 500 volts to provide direct reading of resistance. Minimum resistance shall be 250,000 ohms.

3.2.3 Transformer Tests

Perform test classified as routine in accordance with NEMA ST 20 on each transformer.

3.2.4 GFI Receptacle Test

Test GFI receptacles with a "load" (such as a plug in light) to verify that the "line" and "load" leads are not reversed.

3.2.5 Firestopping Field Test

Submit written reports indicating locations of electrical penetrations and type of firestopping used at each location. Type shall be recorded by UL listed print numbers.

3.2.6 Grounding System Test

Test grounding system to ensure continuity, and that resistance to ground does not exceed 5 ohms. Test each ground rod for resistance to ground before making connections to rod; tie grounding system together and test for resistance to ground. Make resistance measurements in dry weather, not earlier than 48 hours after rainfall. Submit written results of each test to NTR, and indicate location of rods as well as resistance and soil conditions at time measurements were made.

-- End of Section --

SECTION 16462

PAD-MOUNTED TRANSFORMERS

03/95

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C2	(1993) National Electrical Safety Code
ANSI C12.1	(1988) Code for Electricity Metering
ANSI C12.4	(1984; R 1990) Mechanical Demand Registers
ANSI C12.7	(1993) Watthour Meter Sockets
ANSI C12.10	(1987) Electromechanical Watthour Meters
ANSI C37.47	(1981; Supp. 1983, Correction 1984, R 1992) Distribution Fuse Disconnecting Switches, Fuse Supports, and Current-Limiting Fuses
ANSI C57.12.22	(1989) Transformers - Pad-Mounted, Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers with High-Voltage Bushings, 2500 kVA and Smaller: High Voltage, 34 500 GrdY /19 920 Volts and Below; Low Voltage, 480 Volts and Below
ANSI C57.12.26	(1987; Correction 1990) Transformers - Pad-Mounted Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers for Use with Separable Insulated High-Voltage Connectors, High-Voltage, 34 500 Grd Y/19 920 Volts and Below; 2500 kVA and Smaller
ANSI C57.12.28	(1988; Correction 1988) Switchgear and Transformers - Pad-Mounted Equipment - Enclosure Integrity

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167	(1994) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

ASTM D 92	(1990) Flash and Fire Points by Cleveland Open Cup
ASTM D 117	(1989) Electrical Insulating Oils of Petroleum Origin
ASTM D 877	(1987) Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes
ASTM D 1535	(1989) Specifying Color by the Munsell System
ASTM D 3455	(1989) Compatibility of Construction Material with Electrical Insulating Oil of Petroleum Origin
ASTM D 3487	(1988; R 1993) Mineral Insulating Oil Used in Electrical Apparatus

FACTORY MUTUAL ENGINEERING AND RESEARCH CORPORATION (FM)

FM P7825	(1994) Approval Guide

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC. (IEEE)

IEEE 386	(1985; R 1991) Separable Insulated Connector Systems for Power Distribution Systems Above 600 V
ANSI/IEEE C37.71	(1984; R 1990) Three-Phase, Manually Operated Subsurface Load-Interrupting Switches for Alternating-Current Systems
ANSI/IEEE C57.12.00	(1993) Liquid-Immersed Distribution, Power, and Regulating Transformers
ANSI/IEEE C57.12.80	(1978; R 1992) Power and Distribution Transformers
ANSI/IEEE C57.12.90	(1993) Liquid-Immersed Distribution, Power, and Regulating Transformers and Guide for Short-Circuit Testing of Distribution and Power Transformers
ANSI/IEEE C57.13	(1993) Instrument Transformers
ANSI/IEEE C57.98	(1986; R 1992) Transformer Impulse Tests
ANSI/IEEE C62.11	(1993) Metal-Oxide Surge Arresters for Alternating Current Power Circuits

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(1991) Electrical Power Distribution Equipment and Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA LI 1	(1989) Industrial Laminated Thermosetting Products

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1993) National Electrical Code
NFPA 70B	(1990) Electrical Equipment Maintenance

UNDERWRITERS LABORATORIES INC. (UL)

UL 467	(1993; Bul. 1994) Grounding and Bonding Equipment

1.2 RELATED REQUIREMENTS

Section 16011, "Electrical General Requirements," applies to this section, with the additions and modifications specified herein.

1.3 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic Contract. Code 404, Atlantic Division, Naval Facilities Engineering Command will review and approve all submittals in this section requiring Government approval. As an exception to this paragraph, transformers manufactured by ABB in Jefferson City, MO; by Cooper Power Systems in Waukesha, WI; by GE in Shreveport, LA; or by Howard Industries in Laurel, MS need not meet the submittal requirements of this contract. Instead, the following shall be required:

a. A certification, from the manufacturer, that the technical requirements of this specification shall be met.

b. An outline drawing of the transformer with devices identified (paragraph entitled "Pad-Mounted Transformer Drawings", item a), single copy for information only.

c. ANSI nameplate data of the transformer (paragraph entitled "Pad-Mounted Transformer Drawings", item b), single copy for information only.

d. Routine and other tests (paragraph entitled "Routine and Other Tests"), shall be conducted by the manufacturer and witnessed by the government (paragraph entitled "Source Quality Control"). Provide certified copies of the tests.

e. Provide field test reports (paragraph entitled "Field Test Reports").

f. Provide operation and maintenance manuals (paragraph entitled "Operation and Maintenance Manuals").

1.3.1 SD-01, Data

a. Tested transformer losses G

b. Transformer loss calculations G

1.3.2 SD-02, Manufacturer's Catalog Data

a. Pad-mounted transformers, dead-front G

Submittal shall include manufacturer's information for each component, device, and accessory provided with the transformer.

1.3.3 SD-04, Drawings

a. Pad-mounted transformer drawings G

1.3.3.1 Pad-Mounted Transformer Drawings

Drawings shall indicate, but not be limited to the following:

a. Overall dimensions, front view, and sectional views.

b. ANSI nameplate data, including manufacturer's name, catalog number, and ratings of fuses.

c. Elementary diagrams and wiring diagrams with terminals identified of watthour meter and current transformers.

d. One-line diagram, including switch(es), current transformers, meters, and fuses.

e. Manufacturer's published time-current curves (on full size logarithmic paper) of the transformer high side fuse.

1.3.4 SD-11, Factory Tests

a. Pad-mounted transformer design tests G

b. Pad-mounted transformer routine and other tests G

Submit certified copies of the following ANSI/IEEE C57.12.00 and ANSI/IEEE C57.12.90 transformer tests.

1.3.4.1 Design Tests

ANSI/IEEE C57.12.80, Section 5.1.2 states that "design tests are made only on representative apparatus of basically the same design." Submit design test reports (complete with test data, explanations, formulas, and results), in the same submittal package as the catalog data and drawings for the specified transformer(s).

a. Temperature rise: "Basically the same design" for the temperature rise test means a pad-mounted transformer with the same coil construction (such as wire wound primary and sheet wound

secondary), the same kVA, the same cooling type (OA), the same temperature rise rating, and the same insulating liquid as the transformer specified.

b. Lightning impulse: "Basically the same design" for the lightning impulse dielectric test means a pad-mounted transformer with the same BIL, the same coil construction (such as wire wound primary and sheet wound secondary), and a tap changer, if specified. Design lightning impulse tests shall include both the primary and secondary windings of that transformer.

(1) ANSI/IEEE C57.12.90 and ANSI/IEEE C57.98.

(2) State test voltage levels.

(3) Provide photographs of oscilloscope display waveforms or plots of digitized waveforms with test report.

c. Lifting and moving devices: "Basically the same design" for the lifting and moving devices test means a transformer in the same weight range as the transformer specified.

d. Pressure: "Basically the same design" for the pressure test means a pad-mounted transformer with a tank volume within 30 percent of the tank volume of the transformer specified.

1.3.4.2 Routine and Other Tests

Routine and other tests shall be performed by the manufacturer on each of the actual transformer(s) prepared for this project to ensure that the design performance is maintained in production. Submit test reports, by serial number and receive approval before delivery of equipment to the project site. Required tests and testing sequence shall be as follows:

a. Resistance measurements

b. Phase relation

c. Ratio

d. No-load losses (NLL) and excitation current

e. Load loss (LL) and impedance voltage

f. Lighting impulse:

(1) ANSI/IEEE C57.12.90 and ANSI/IEEE C57.98

(2) State test voltage levels

(3) Provide photographs of oscilloscope display waveforms or plots of digitized waveforms with test reports.

g. Low frequency dielectric

(1) Applied voltage

(2) Induced voltage

h. Leak

1.3.5 SD-12, Field Test Reports

a. Submit report of results of acceptance checks and tests specified by paragraph entitled "Field Quality Control" G

b. Ground resistance test reports G

1.3.5.1 Ground Resistance Test Reports

Upon completion and before energizing electrical equipment, submit the measured ground resistance of grounding system, and soil condition at the same time the measurements were taken.

1.3.6 SD-18, Records

a. Transformer test schedule G

1.3.6.1 Source Quality Control

The Government will witness tests. Provide transformer test schedule for tests to be performed at the manufacturer's test facility. Submit required test schedule and notify the Government 30 calendar days before scheduled test date. Notify NTR 15 calendar days in advance of changes to scheduled dates and locations for testing.

1.3.7 SD-19, Operation and Maintenance Manuals

a. Pad-mounted transformers, dead-front, Data Package 5 G

Submit operation and maintenance data in accordance with Section 01730, "Operation and Maintenance Data" and as specified herein.

1.3.7.1 Additions to Operation and Maintenance Manuals

In addition to requirements of Data Package 5, include the following on the actual pad-mounted transformer provided:

a. An instruction manual with pertinent items and information highlighted

b. An outline drawing, including front view and sectional views with items and devices identified

c. Prices for spare parts and supply list

d. Routine and field acceptance test reports

e. Fuse curves for primary fuses

f. Information on watthour demand meter, CT's, and fuse block

g. Actual nameplate diagram

h. Date of purchase

PART 2 PRODUCTS

2.1 PRODUCT COORDINATION

Products and materials not considered to be pad-mounted transformers and related accessories are specified in Section 16301, "Underground Electrical Work," and Section 16402, "Interior Wiring Systems".

2.2 THREE-PHASE PAD-MOUNTED TRANSFORMERS, DEAD-FRONT

ANSI C57.12.26 and ANSI C57.12.28 with separate high- and low-voltage compartments.

2.2.1 Compartments

Divide high- and low-voltage compartments into sections with steel isolating barriers extending the full height and depth of the compartment. Compartment doors: hinged lift-off type with stop in open position and three-point latching.

2.2.1.1 High Voltage

High-voltage compartment shall contain the incoming line, insulated high-voltage load-break connectors, bushing well inserts, six high-voltage bushing wells configured for radial application, load-break switch handle(s), access to dry-well fuse canisters, dead-front surge arresters, tap changer handle, connector parking stands and ground pad.

a. Insulated high-voltage load-break connectors: IEEE 386, rated 15 kV, 95 kV BIL. Current rating: 200 amperes rms continuous. Short time rating: 10,000 amperes rms symmetrical for a time duration of 0.17 seconds. Connectors and inserts shall be the product of a single manufacturer. Connector shall have a steel reinforced hook-stick eye, grounding eye, test point, and arc-quenching contact material.

b. Bushing well inserts: IEEE 386, 200 amperes, 15 kV Class. Provide a bushing well insert for each bushing well unless indicated otherwise.

c. Load-break switch

Radial-feed oil-immersed type rated at 15 kV, 95 kV BIL, with a continuous current rating and load-break rating of 200 amperes, and a make-and-latch rating of 10,000 rms amperes symmetrical. Locate the switch handle in the high-voltage compartment.

d. Current-limiting fuses, dry-well mount: ANSI C37.47. Provide fuses in air-insulated, oil-sealed, dead-front, non-load-break

dry-well fuse canisters, on the load side of the load-break switch serving the transformer. Interlock fuse canisters with the load-break switch so that the fuses may be removed and inserted only when the switch is in the "Off" position. Fuses shall remove the transformer from service in case of an internal fault. Size fuses to approximately 150 percent of the transformer primary full load current rating and in accordance with fuse manufacturer's recommendations for dry-well mounting. Fuses shall have an interrupting rating of 50,000 rms amperes symmetrical at the system voltage specified. Asymmetrical multiplying factor is 1.5. Furnish a spare fuse for each fuse provided.

d. Surge arresters: ANSI/IEEE C62.11, rated 12 kV, fully shielded, dead-front, elbow type suitable for plugging into bushing well inserts. Provide three arresters for radial feed circuits.

e. Parking stands: Provide a parking stand near each bushing well.

2.2.1.2 Low Voltage

Low-voltage compartment shall contain low-voltage bushings with NEMA spade terminals, accessories, metering, stainless steel diagrammatic transformer nameplate, and ground pad.

a. Accessories shall include drain valve with sampler device, fill plug, pressure relief device, liquid level gage, pressure-vacuum gage, and dial type thermometer with maximum temperature indicator.

b. Metering

Shall consist of a socket-mounted outdoor watthour meter surface mounted flush against the side of the low-voltage compartment as indicated.

(1) Meter: ANSI C12.10. Provide watthour meter coordinated to ratios of current transformers and transformer secondary voltage. Meter shall be Class 20, Form 9S, suitable for 480Y/277 volt, three-phase, four-wire system with three current transformers. Meter shall meet Class II finish requirements. Meter cover shall be polycarbonate and the entire meter and socket assembly shall be lockable to protect against tampering and unauthorized meter removal. Provide watthour meter with not less than four pointer-type kilowatt-hour registers and mechanical demand register. Demand register shall be Scale Class 6 and shall be sweep pointer indicating type, with a 15-minute interval conforming to ANSI C12.4. Meter accuracy shall be within plus or minus one percent. Provide correct multiplier on face of meter.

(2) Meter fusing: Provide a fuse block mounted in the secondary compartment containing one fuse per phase to protect the voltage input to the watthour meter. Size fuses as recommended by the meter manufacturer.

(3) Socket: ANSI C12.7. Provide NEMA Type 3R, box-mounted socket having automatic circuit-closing bypass and having jaws compatible with requirements of the meter. Cover unused hub openings with blank hub plates. Paint box Munsell 7GY3.25/1.5 green to match the pad-mounted transformer to which the box-mounted socket is attached. The Munsell color notation is specified in ASTM D 1535.

(4) Current transformers: ANSI/IEEE C57.13. Provide three current transformers with a metering accuracy Class of 0.3 through B-.01, with a minimum RF of 4.0 at 30 degrees C, with 600-volt insulation, and 10 kV BIL. Size current transformers as indicated. Provide butyl-molded window type current transformers mounted on the low-voltage bushings. Route current transformer leads in a location as remote as possible from the power transformer secondary cables to permit current measurements to be taken with hook-on-ammeters.

2.2.2 Transformer

a. Oil-insulated two winding, 60 hertz, 65 degrees C rise above a 30 degrees C average ambient, self-cooled type.

b. Transformer shall be rated 112.5 kVA, and 225 kVA as indicated on Drawings, 95 kV BIL.

c. Transformer voltage ratings: 11500 V - 480Y/277 V.

d. Tap changer shall be externally operated, manual type for changing tap setting when the transformer is de-energized. Provide four 2.5 percent full capacity taps, two above and two below rated primary voltage.

e. Minimum tested impedance shall not be less than 3.2 percent for 112.5 kVA and 3.4 percent for 225 kVA.

f. Audible sound levels shall comply with the following:

kVA	DECIBELS (MAX)
112.5	55
225	55

g. Transformer shall include lifting lugs and provisions for jacking under base. The transformer base construction shall be of the fabricated type and suitable for using rollers or skidding in any direction. Provide transformer top with an access handhole. Transformer shall have its kVA rating conspicuously displayed on its enclosure. The transformer shall have an insulated low-voltage neutral bushing with lugs for ground cable, and with removable ground strap.

2.2.2.1 Specified Transformer Losses

No-load losses (NLL) shall be 220 watts and load losses (LL) shall be 980 watts for a 112.5 kVA, 11500V-480Y/277 transformer.

No-load losses (NLL) shall be 360 watts and load losses (LL) shall be 1650 watts for a 225 kVA, 11500V-480Y/277 transformer.

2.2.2.2 Tested Transformer Losses

Submit certification from the manufacturer, with the design test submittal, that he can conform with the specified NLL and LL. The values for the specified losses shall be used for comparison with the losses determined during the routine tests. If the routine test values differ from the specified values by more than the tolerances allowed by Table 19 in ANSI/IEEE C57.12.00, the transformer is unacceptable.

2.2.3 Corrosion Protection

Bases and cabinets of transformers shall be corrosion resistant and shall be fabricated of stainless steel conforming to ASTM A 167, Type 304 or 304L. Base shall include any part of pad-mounted transformer that is within 3 inches of concrete pad. Form cabinets of stainless steel sheets no less than No. 13 U.S. gage. Paint bases, cabinets, and tanks Munsell 7GY3.29/1.5 green. Paint coating system shall comply with ANSI C57.12.28 regardless of base, cabinet, and tank material. The Munsell color notation is specified in ASTM D 1535.

2.2.4 Insulating Liquid

a. Mineral oil: ASTM D 3487, Type II, tested in accordance with ASTM D 117. Provide identification of transformer as "non-PCB" and "Type II mineral oil" on the nameplate.

2.3 WARNING SIGNS

Provide as specified in Section 16011, "Electrical General Requirements."

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations shall conform to ANSI C2, NFPA 70, and to requirements specified herein. Provide new equipment and materials unless indicated or specified otherwise.

3.2 GROUNDING

NFPA 70 and ANSI C2, except that grounding systems shall have a resistance to solid earth ground not exceeding 5 ohms.

3.2.1 Grounding Electrodes

Provide driven ground rods as specified in Section 16301, "Underground Electrical Work". Connect ground conductors to the upper end of ground rods by exothermic weld. Provide compression connectors at equipment end of ground conductors.

3.2.2 Pad-Mounted Transformer Grounding

Provide separate copper grounding conductors and connect them to the ground loop as indicated. When work in addition to that indicated or specified is required to obtain the specified ground resistance, the provision of the contract covering "Changes" shall apply.

3.2.3 Connections

Make joints in grounding conductors and loops by exothermic weld or compression connector. Exothermic welds and compression connectors shall be installed as specified in Section 16301, "Underground Electrical Work," paragraph entitled "Grounding."

3.2.4 Grounding and Bonding Equipment

UL 467, except as indicated or specified otherwise.

Provide a 1/0 bare copper-ground girdle around transformer. Girdle shall be buried one foot deep and placed 3 feet laterally from the transformer enclosure. Connect girdle to enclosure at two opposite places using 1/0 copper. Exothermically weld joints.

3.3 INSTALLATION OF EQUIPMENT AND ASSEMBLIES

Install and connect pad-mounted transformers furnished under this section as indicated on project drawings, the approved shop drawings, and as specified herein.

3.3.1 Meters and Current Transformers

ANSI C12.1.

3.4 FOUNDATION FOR EQUIPMENT AND ASSEMBLIES

Mount transformer on concrete slab. Unless otherwise indicated, the slab shall be at least 8 inches thick, reinforced with a 6 by 6 - W2.9 by W2.9 mesh placed uniformly 4 inches from the top of the slab. Slab shall be placed on a 6 inch thick, well-compacted gravel base. The top of the concrete slab shall be approximately 4 inches above the finished grade. Edges above grade shall have 1/2-inch chamfer. The slab shall be of adequate size to project at least 8 inches beyond the equipment. Provide conduit turnups and cable entrance space required by the equipment to be mounted. Seal voids around conduit openings in slab with water- and oil-resistant calking or sealant. Cut off and bush conduits 3 inches above slab surface. Concrete work shall be as specified in Section 03300, "Cast-In-Place Concrete".

3.5 FIELD QUALITY CONTROL

3.5.1 Performance of Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations, NFPA 70B, NETA ATS, and referenced ANSI standards. Include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

3.5.1.1 Pad-Mounted Transformers

a. Visual and mechanical inspection

(1) Compare equipment nameplate information with approved shop drawings

(2) Inspect for physical damage, cracked insulators, leaks, tightness of connections, and general mechanical and electrical conditions

(3) Verify proper liquid level in tank

(4) Perform specific inspections and mechanical tests as recommended by manufacturer

(5) Verify proper equipment grounding

b. Electrical tests

(1) Perform insulation-resistance tests

(2) Perform turns-ratio tests

(3) Sample insulating liquid. Sample shall be laboratory tested for:

(a) Dielectric breakdown voltage

(b) Acid neutralization number

(c) Specific gravity

(d Interfacial tension

(e) Color

(f) Visual condition

(g) Power factor

(h) Water content

(4) Perform dissolved gas analysis (DGA)

(5) Test for presence of PCB

(6) Perform insulation power-factor tests or dissipation-factor tests on windings

3.5.1.2 Current Transformers

a. Visual and mechanical inspection

(1) Inspect for physical damage and nameplate information for compliance with approved shop drawings

(2) Verify proper connection of transformers with system requirements

(3) Verify tightness of bolted connections and ensure that adequate clearances exist between primary circuits and secondary circuit wiring

(4) Verify that required grounding and shorting connections provide good contact

b. Electrical tests

(1) Perform insulation-resistance test

(2) Perform a polarity test

(3) Perform a ratio-verification test

3.5.1.3 Watthour Meter

a. Visual and mechanical inspection

(1) Examine for broken parts, shipping damage, and tightness of connections

(2) Verify that meter type, scales, and connections are in accordance with approved shop drawings

(3) Verify that when viewed from the top, the direction of rotation of the meter rotor is counter-clockwise.

b. Electrical tests

(1) Determine accuracy of meter

(2) Calibrate watthour meters to one-half percent

(3) Verify that correct multiplier has been placed on face of meter, where applicable

3.5.1.4 Grounding System

a. Visual and mechanical inspection

(1) Inspect ground system for compliance with contract plans and specifications

b. Electrical tests

(1) Perform ground-impedance measurements utilizing the three-point method

3.5.2 Follow-Up Verification

Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that circuits and devices are in good operating condition and properly performing the intended function. As an exception to requirements stated elsewhere in the contract, the NTR shall be given 5 working days advance notice of the dates and times of checking and testing.

-- End of Section --

SECTION 16510

INTERIOR AND EXTERIOR LIGHTING

03/95

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C78.41	(1987) Electric Lamps - Low-Pressure Sodium Lamps
ANSI C78.1350	(1990) Electric Lamps - 400-Watt, 100-Volt, S51 Single-Ended High-Pressure Sodium Lamps
ANSI C78.1351	(1989) Electric Lamps - 250-Watt, 100-Volt, S50 Single-Ended High-Pressure Sodium Lamps
ANSI C78.1352	(1990) Electric Lamps - 1000-Watt, 250-Volt, S52 Single-Ended High-Pressure Sodium Lamps
ANSI C78.1353	(1990) Electric Lamps - 70-Watt, 52-Volt, S62 Single-Ended High-Pressure Sodium Lamps
ANSI C78.1354	(1990) Electric Lamps - 100-Watt, 55-Volt, S54 Single-Ended High-Pressure Sodium Lamps
ANSI C78.1355	(1989) Electric Lamps - 150-Watt, 55-Volt, S55 High-Pressure Sodium Lamps
ANSI C78.1358	(1988; Supp. 1990) Electric Lamps - 35-Watt, 52-Volt, S76 Single-Ended High-Pressure Sodium Lamps
ANSI C78.1359	(1988) Electric Lamps - 50-Watt, S68 Single-Ended High-Pressure Sodium Lamps
ANSI C78.1375	(1990) Electric Lamps - 400-Watt, M59 Single-Ended Metal-Halide Lamps
ANSI C78.1376	(1990) Electric Lamps - 1000-Watt, M47 Single-Ended Metal-Halide Lamps
ANSI C78.1377	(1990) Electric Lamps - 175-Watt, M57

	Single-Ended Metal-Halide Lamps
ANSI C78.1378	(1990) Electric Lamps - 250 - Watt M58 Single-Ended Metal-Halide Lamps
ANSI C78.1381	(1989) Electric Lamps - 70 - Watt M85 Metal-Halide Lamps
ANSI C82.1	(1985; Supp. 1990 and 1991) Ballasts for Fluorescent Lamps
ANSI C82.2	(1984; R 1989) Fluorescent Lamp Ballasts - Methods of Measurement
ANSI C82.4	(1985; Supp. 1988) Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type)
ANSI C82.11	(1993) High-Frequency Fluorescent Lamp Ballasts
ANSI C136.10	(1988) Roadway Lighting Equipment - Locking-Type Photocontrol Devices and Mating Receptacles - Physical and Electrical Interchangeability and Testing

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 366/A 366M	(1991; R 1993) Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality
ASTM A 526/A 526M	(1990) Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Commercial Quality
ASTM A 580/A 580M	(1993) Stainless and Heat-Resisting Steel Wire
ASTM A 853	(1993) Steel Wire, Carbon, for General Use
ASTM B 633	(1985) Electrodeposited Coatings of Zinc on Iron and Steel

FEDERAL SPECIFICATIONS (FS)

FS QQ-N-281	(Rev. D; Am. 2) Nickel-Copper Alloy Bar, Rod, Plate, Sheet, Strip, Wire, Forgings, and Structural and Special Shaped Sections

ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA (IES)

IES LHBK	(1993) Lighting Handbook, Reference and Application

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 2	(1993) Controllers, Contactors and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC
NEMA ICS 6	(1993) Industrial Control and Systems Enclosures

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1993) National Electrical Code
NFPA 90A	(1993) Installation of Air Conditioning and Ventilating Systems
NFPA 101	(1994) Code for Safety to Life from Fire in Buildings and Structures

UNDERWRITERS LABORATORIES INC. (UL)

UL 20	(1986; Errata 1988, R 1993, Bul. 1993) General-Use Snap Switches
UL 595	(1985; R 1991, Bul. 1991, 1993, and 1994) Marine-Type Electric Lighting Fixtures
UL 773	(1987; R 1992) Plug-In, Locking Type Photocontrols for Use With Area Lighting
UL 773A	(1989; Bul. 1994) Nonindustrial Photoelectric Switches for Lighting Control
UL 844	(1990; R 1990, Bul. 1993 and 1994) Electric Lighting Fixtures for Use in Hazardous (Classified) Locations
UL 924	(1990; R 1993, Bul. 1993 and 1994) Emergency Lighting and Power Equipment
UL 935	(1993; Bul. 1993, R 1994) Fluorescent-Lamp Ballasts
UL 1029	(1994) High-Intensity-Discharge Lamp Ballasts
UL 1570	(1988; Bul. 1991, 1993, and 1994, R 1994) Fluorescent Lighting Fixtures
UL 1571	(1991; Bul. 1992, 1993, and 1994, R 1994) Incandescent Lighting Fixtures
UL 1572	(1991; Bul. 1993 and 1994, R 1994) High Intensity Discharge Lighting Fixtures

1.2 RELATED REQUIREMENTS

Section 16011, "Electrical General Requirements," applies to this section, with the additions and modifications specified herein. Materials not considered to be lighting equipment or lighting fixture accessories are specified in Section 16402, "Interior Wiring Systems." Lighting fixtures and accessories mounted on exterior surfaces of buildings are specified in this section.

1.3 DEFINITIONS

1.3.1 Average Life

Time after which 50 percent will have failed and 50 percent will have survived under normal conditions.

1.3.2 Total Harmonic Distortion (THD)

The root mean square (RMS) of all the harmonic components divided by the total fundamental current.

1.4 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic Contract. Data, drawings, and reports shall employ the terminology, classifications, and methods prescribed by the IES LHBK, as applicable, for the lighting system specified.

1.4.1 SD-02, Manufacturer's Catalog Data

a. Fluorescent lighting fixtures G

b. Fluorescent electronic ballasts G

c. Fluorescent lamps G

d. High-intensity-discharge (HID) lighting fixtures G

e. HID ballasts G

f. High-pressure sodium (HPS) lamps G

g. Photocell switch G

1.4.2 SD-08, Statements

a. Qualification of manufacturer G

Certify that the manufacturer of fluorescent electronic ballasts meets requirements specified under paragraph entitled "Qualification of Manufacturer."

1.4.3 SD-12, Field Test Reports

a. Operating test

Submit test results as stated in paragraph entitled "Field Quality Control."

1.4.4 SD-18, Records

a. Information card G

1.4.4.1 Information Card

For each electronic ballast manufacturer used in the construction, furnish a typewritten card, laminated in plastic. Card shall be 8 1/2 by 11 inches minimum and shall contain the information listed on Form 1 located at the end of this section. The card shall be turned over to the officer in charge of construction with warranty and equipment information. Send a photostatic paper copy to LANTNAVFACENGCOM, Code 1613, 1510 Gilbert Street, Norfolk, VA 23511-2699.

1.5 QUALITY ASSURANCE

1.5.1 Qualification of Manufacturer

Electronic ballast manufacturer shall be regularly employed in the manufacture of electronic ballasts and have a minimum of 3 years' experience in manufacturing electronic ballasts in the United States. The date for determination of the experience claimed by the Contractor shall be the date specified for receipt of bids as shown on Standard Form 1442.

1.6 ELECTRONIC BALLAST WARRANTY

Furnish the electronic ballast manufacturer's warranty. The warranty period shall not be less than 5 years from the date of manufacture of the electronic ballast. Ballast assembly in the lighting fixture, transportation, and on-site storage shall not exceed 12 months, thereby permitting 4 years of the ballast 5-year warranty to be in service and energized. The warranty shall state that the malfunctioning ballast shall be exchanged by the manufacturer and promptly shipped to the using Government facility. The replacement ballast shall be identical to, or an improvement upon, the original design of the malfunctioning ballast.

PART 2 PRODUCTS

2.1 FLUORESCENT LIGHTING FIXTURES

UL 1570. Fluorescent fixtures shall have electronic ballasts unless specifically indicated otherwise.

2.1.1 Fluorescent Electronic Ballasts

The electronic ballast shall as a minimum meet the following characteristics:

a. Ballast shall comply with UL 935, ANSI C82.11, and NFPA 70 unless specified otherwise. Ballast shall be designed for operation of the lamps in the indicated application. Ballasts shall be designed to operate on the voltage system to which they are connected.

b. Power factor shall be 0.95 (minimum). Lamp current crest factor shall be 1.7 (maximum).

c. Ballast shall operate at a frequency of 20,000 Hertz (minimum).

d. Ballast shall have light regulation of plus or minus 10 percent lumen output with a plus or minus 10 percent input voltage regulation. Ballast shall have 10 percent flicker (maximum) using any compatible lamp.

e. Ballast shall be UL listed Class P with a sound rating of "A."

f. Ballast enclosure size shall conform to standards of electromagnetic ballasts. Ballast shall have circuit diagrams and lamp connections displayed on ballast packages. Ballast shall operate lamps in a parallel circuit configuration that permits the operation of remaining lamps if one or more lamps fail or are removed. Ballast lamp lead wire color code shall comply with ANSI C82.11 for parallel or independent lamp operation.

g. Ballast shall operate in an instant start mode.

h. Ballast factor shall be 85 percent (minimum).

i. Electronic ballast shall have a full replacement warranty of 5 years from date of manufacture as specified in paragraph entitled "Electronic Ballast Warranty" herein.

2.1.1.1 T-8 Lamp Ballast

a. Ballast shall be capable of starting and maintaining operation at a minimum of 0 degrees F for F32T8 lamps, unless otherwise indicated.

b. Total harmonic distortion (THD): Shall be 20 percent maximum.

c. Input wattage:

(1) 62 watts (maximum) when operating two F32T8 lamps

2.1.2 Fluorescent Lamps

a. T-8 rapid start lamps shall be rated 32 watts (maximum), 2800 initial lumens (minimum), CRI of 75 (minimum), color temperature of 4100 K, and an average rated life of 20,000 hours.

Average rated life is based on 3 hours' operating per start.

2.2 HIGH-INTENSITY-DISCHARGE (HID) LIGHTING FIXTURES

UL 1572. Provide HID fixtures with tempered glass lenses when using metal-halide lamps.

2.2.1 HID Ballasts

UL 1029 and ANSI C82.4 and shall be constant wattage autotransformer (CWA) or regulator, high power factor type. Provide single-lamp ballasts which shall have a minimum starting temperature of minus 30 degrees C. Ballasts shall be:

a. Designed to operate on the voltage system to which they are connected.

b. Designed for installation in a normal ambient temperature of 40 degrees C.

c. Constructed so that open circuit operation will not reduce the average life.

High-pressure sodium (HPS) ballasts shall have a solid-state igniter/starter with an average life in the pulsing mode of 3500 hours at the intended ambient temperature. Igniter case temperature shall not exceed 90 degrees C in any mode.

2.2.2 High-Pressure Sodium (HPS) Lamps

HPS lamps shall be:

a 100 watt conforming to ANSI C78.1354

2.3 RECESS- AND FLUSH-MOUNTED FIXTURES

Provide type that can be relamped from the bottom. Access to ballast shall be from the bottom. Trim for the exposed surface of flush-mounted fixtures shall be as indicated.

2.4 PHOTOCELL SWITCH

UL 773 or UL 773A, hermetically sealed cadmium-sulfide cell rated 120 volts ac, 60 Hz with single-throw contacts rated 1000 watts and 120 volts. Provide switch integral to the fixture. Switch shall turn on below 3 footcandles and off at 3 to 10 footcandles. A time delay shall prevent accidental switching from transient light sources. Provide a directional lens 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 drawings. Installation shall meet

requirements of NFPA 70. Mounting heights specified or indicated shall be to the bottom of fixture for ceiling-mounted fixtures and to center of fixture for wall-mounted fixtures. Obtain approval of the exact mounting for lighting fixtures on the job before commencing installation and, where applicable, after coordinating with the type, style, and pattern of the ceiling being installed.

3.1.1 Photocell Switch Aiming

Aim switch according to manufacturer's recommendations.

3.2 FIELD QUALITY CONTROL

Upon completion of installation, conduct an operating test to show that equipment operates in accordance with requirements of this section.

-- End of Section --

FORM 1, ELECTRONIC BALLAST WARRANTY

1. Location _____ 2. Bldg. Name _____

3. Bldg. No. _____ 4. Installation Areas_____

5. Contract No. _____

6. Ballast Manufacturer Name/Address _____

7. Exchange Information _____

8. Warranty Return Number: _____

9. Warranty Period: From _____ To _____

10. Acceptance Date: _____ 11. Inspector: _____

12. Prime Contractor Name/Address: _____

Signature: _____ Date: _____

INSTRUCTIONS FOR FORM 1

1. Location: Name of activity as shown on contract.

2. Bldg. Name: As shown on contract or as provided by Contracting Officer.

3. Bldg. No.: As provided by Contracting Officer.

4. Installation Areas: Main areas in the building where ballasts are installed; floors, room numbers, lean-to, etc. A separate form is required for each ballast manufacturer used in the contract.

5. Contract No.: As shown on the contract.

6. Ballast Manufacturer Name/Address: Ballast manufacturer's name, address, and telephone number.

7. Exchange Information: Ballast exchange information such as point of contact, telephone number, shipping address if different from item 6, and any special shipping instructions.

8. Warranty Return Number: Return authorization number if required.

9. Warranty Period: Insert estimated start and end dates.

10. Acceptance Date: Show date ballasts were accepted by the Contracting Officer.

11. Inspector: Show Government inspector's name.

12. Prime Contractor Name/Address/Signature/Date: Shall be signed and dated by an official of the contracting firm.