SOLICITATION NO. DACA63-02-R-0002
DATE: JANUARY 2002

US Army Corps
of Engineers
Fort Worth District

U.S. ARMY ENGINEER DISTRICT, FT. WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

SOUTHWEST DIVISION (TEXAS, OKLAHOMA, ARKANSAS, LOUISIANA AND NEW MEXICO)

SPECIFICATIONS

FOR

FOUR (4) SWD-WIDE MULTIPLE AWARD TASK ORDER CONTRACTS (MATOCs)

SAMPLE TASK ORDER PROJECT
CAR WASH

NOTE
THIS IS AN UNRESTRICTED 8(A) NEGOTIATED SOLICITATION

SCHEDULE OF ITEMS
for
PROJECT FNWZ 02-3009
POV CAR WASH, BLDG 7210

Provide all plant, labor, equipment, materials, supervision, and incidentals necessary to accomplish Bid Item Nos. 001 & 002 in accordance with the specifications and drawings, subject to the terms and conditions of the contract complete:

Bid Item No.	Item Description	Estimated Quantity	Units	Unit Price	Total Amount
001	All work required by the plans and specifications less Bid Item 002. (Bid Item No. 001 work shall include receipt, handling, temporary storage, anchoring in place, and connection of utilities to the car wash equipment.)	1	LS	$_____	$_____
	SubTotal - Bid Item No. 001				$_____

002 All Car Wash equipment specified in Section 11000, Equipment; and work by the equipment manufacturer to install the equipment. (Unit prices in Bid Item Nos. 002a through 002o shall be the bare prices quoted from the equipment manufacturers; and shall include no prime contractor markup. Bid Item No.002p work by the car wash equipment manufacturer shall include installation of interconnecting hoses and interconnecting electrical wiring, startup, testing, adjusting and training.)

High Pressure Pump Unit and Fluid Module Manufacturer _____
(Name and Address)

002a	High Pressure Pump Unit	3	EA	$_____	$_____
002b	Fluid Module with System Controls	1	EA	$_____	$_____
002c	Coin Box, Coin Safe, and Large LED Unit	3	EA	$_____	$_____
002d	Bill Changer	1	EA	$_____	$_____
002e	Wand, Brush, Booms, Foam Generators, Holders, Mat Hangers, Signage & Hoses	3	EA	$_____	$_____
002f	Stainless Steel Sink	1	EA	$_____	$_____
002g	Water Softening Unit	1	EA	$_____	$_____

002h	Reverse Osmosis Unit, Storage Tank, & Re-pressurization Pump	1	EA	$_____	$_____
002i	Hot Water Heater, Storage Tank, & Circulating Pump	1	EA	$_____	$_____
002j	Air Compressor	1	EA	$_____	$_____
002k	Car Vacuum Unit	2	EA	$_____	$_____
002l	Vendor Dispensor Unit	1	EA	$_____	$_____
002m	Instruction Manuals	1	SET	$_____	$_____
002n	Spare Parts	1	LOT	$_____	$_____
002o	Initial Fill of Fluid Concentrate	1	LOT	$_____	$_____
002p	Labor by car wash equipment manufacturer to install the equipment and to train Government personnel	1	JOB	$_____	$_____

SubTotal - Bid Item No. 002 $_____

Total - Bid Item Nos. 001 & 002 $_____

TOTAL CONTRACT PERFORMANCE TIME....(CALENDAR DAYS)__180

PROJECT NUMBER: **FNWZ 02-3009**
SPECIFICATIONS FOR: **POV CAR WASH, BLDG 7210**

These specifications consist of the various parts and provisions listed in the Table of Contents below and all attachments thereto:

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NOT USED

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NOT USED

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NOT USED

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NOT USED

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TECHNICAL PROVISIONS
SECTION 00700 - GENERAL

1. SCOPE: The work covered by this project consists of the Contractor furnishing all layout, survey, plant, labor, supervision, quality control, materials, equipment, machines, tools, appliances, services, supplies, and incidentals and of performing all operations in connection with the POV (private operated vehicle) Car Wash, Bldg 7210, Dyess AFB, Texas, complete and in strict accordance with the plans and specifications."

2. WORKING CONDITIONS:

2.1 Work Plan: All work will be performed on Dyess Air Force Base. To permit essential military operations to continue and allow the Contractor to pursue work efforts under this contract, Contractor shall prepare a work plan and schedule all indicated work pursuant to these working conditions. Contractor shall prepare this schedule/work plan and submit such plan to the Contracting Officer for approval. The work plan shall address construction sequencing consistent with these working conditions. Should the Contracting Officer find any portion of the submitted work plan unsatisfactory, the contractor shall reaccomplish the work plan and resubmit for approval. No work shall start until the work plan has been approved by the Contracting Officer. The work plan shall address the following conditions:

a) Development/approval of submittals.
b) Contractor's procurement of a "Digging Permit".
c) Notification/coordination requirements.
d) Coordination requirements with Car Wash equipment manufacturer.
e) Partial installation requirements (Receiving, storing materials, etc).
f) Anticipated adverse weather delays.
g) Contractor's resources.
h) Car Wash equipment installation
i) Equipment startup and testing
j) Training
k) As Builts
l) Other appropriate situations.

3. WORK SCHEDULE:

Working hours for the Contractor will normally be between the hours of 7:30 a.m. and 4:30 p.m. excluding Saturdays, Sundays, and Federal holidays. If the Contractor desires to work during periods other than above, additional government inspection forces may be required. The Contractor must make his/her request to the Contracting Officer five (5) calendar days in advance of his/her intention to work during other periods to allow assignment of additional inspection forces. If such force is reasonably available, the Contracting Officer may authorize the Contractor to perform work during periods other than normal duty hours/days.

4. SAFETY AND HEALTH:

4.1 All Contractor operations shall be conducted and performed in accordance with Department of Labor, OSHA requirements found in 29 CFR 1910 and 29 CFR 1926, project identified national standards, military manuals, instructions, pamphlets, standards and handbooks, and with the Corps of Engineers (COE) Safety Manual 385-1-1 dated 03 Sep 96.

4.2 All companies who conduct business within the state of Texas must, in accordance with Texas Workman Compensation laws (Texas House Bill 62), have an approved company safety policy and an Accident Prevention Plan. The plan, approved by the Texas Workman Compensation Commission (TWCC), shall be submitted in accordance with paragraph SUBMITTAL REQUIREMENTS. In addition to meeting the TWCC requirements; the plan must also include the requirements of COE Safety Manual
385-1-1.

4.3 All holes/pits/trenches/manway openings, etc, that are to be left open shall be surrounded with a 48 inch high mesh fence with highly visible orange plastic coating. The fence shall be securely anchored with tension wires and posts as required to prevent sagging and located a minimum of 3 feet from the opening so as to prevent an individual, should they fall across the fencing, from falling into the opening. Holes shall also be covered, when not being worked in, with three quarter inch plywood or a metal grating that will prevent small children from entering the hole.

4.4 Radiation Permits and Authorizations: Contractors contemplating the use of devices containing radioactive materials (i.e., soil moisture/density probes) or non-ionizing radiation producing equipment (radio frequency radiation emitters or lasers) while performing work on this contract must obtain written authorization/permit from the Dyess AFB Radiation Safety Officer (RSO). To obtain the required authorization permit, an application to bring a radioactive device on Dyess AFB must be forwarded to the base RSO at 7 ADOS/ SGPB, 697 Hospital Road, Dyess AFB, TX 79607-1367 (this is mailing address, physical address is 880 Third St.) or (915)696-2325/3289, at least 45 days prior to the anticipated use. Without the proper authorization, Contractors will not be allowed to bring these devices on base.

4.5 Confined Space Entry: All operations involving entry into confined spaces shall meet the requirements of OSHA 29 CFR 1910.146, AFOSH Std 91-25, and specifically the following:

a. All entry supervisors, attendees, and confined space entrants shall have been properly trained in the safety hazards, proper use of Personal Protective Equipment (PPE), entry procedures, and self-rescue. Records of this training must be readily available.

b. Entry supervisors shall maintain a Master Entry Plan (MEP) consisting of:

(1) Descriptions of confined spaces to be entered including location, classification, and acceptable entry conditions

(2) Designation of authorized entry supervisors, entrants, and attendees

(3) Identification of the types of tasks to be performed in the confined space, including duration

(4) Procedures for entry, and emergency rescue

(5) Identification of Personal Protective Equipment (PPE), communication equipment, rescue equipment, and monitoring equipment; conditions under which they will be used; and verification of condition of equipment

(6) Designation of frequency and type of atmospheric monitoring

(7) Designation of controls required (e.g., lockout/tagout, ventilation, etc.)

(8) Procedures for communication during confined space operations

c. All confined spaces shall be tested by a qualified person using a properly calibrated monitor for percent oxygen, lower explosive limit (LEL), and toxicity each time before entry and periodically during operations that have the potential to alter atmospheric conditions. Supervisors shall contact 7 BW/SEG when these or any other entry conditions are not consistent with the MEP.

5. STREET CLOSINGS:

5.1 Street closures are not permitted. Two lanes of traffic shall be maintained at all times unless otherwise approved in writing by the Contracting Officer.

5.2 Contractor shall provide 14-day advance written notice to Contracting Officer prior to any street work that is disruptive to traffic to insure that Fire Department and Emergency personnel are notified.

5.3. The final street repair shall be completed within 14 days after the start of any street demolition for utility crossings or other purposes. Any part of the street returned to service prior to final repair shall be maintained smooth with hot-mix cold-lay surface course.

6. DISPOSITION OF WASTE AND EXCESS MATERIALS:

6.1 The Contractor shall make waste determinations for all wastes generated in the performance of this contract, in accordance with the provisions set out in 40 Code of Federal Register (CFR) Part 261, at the time and point of generation. The Contractor shall properly sample, analyze, or by use of process knowledge classify all wastes in accordance with Title 30 Texas Administrative Code (TAC), Chapter 335, Subchapter R at no additional cost to the Government. Unless it is positively known by the Contractor that a waste is non-hazardous, the Contractor shall manage the waste as a hazardous waste until sample test results prove otherwise. All non-hazardous wastes, special wastes, and hazardous wastes (including but not limited to construction debris, material containers, material residues and unwanted excess materials) resulting from the performance of work under this contract shall be removed from and disposed of off Dyess AFB by the Contractor at no additional cost to the Government and in accordance with all applicable Federal, State, and local laws, rules and regulations. Under no circumstances shall the Contractor dispose of wastes or excess material in trash dumpsters, storm sewers, sanitary sewers, creeks, streams or other property of Dyess AFB. The Contractor and the Government will be co-generators of all wastes resulting from the performance of this contract. Contractor's attention is directed to Section 01700, Environmental Protection, the paragraph Disposal of Wastes, for special requirements on disposal of waste types.

6.2 Dumping/cleaning out of concrete trucks on Dyess AFB is prohibited. Concrete truck chutes only may be rinsed at the construction site. Wastewater and concrete from this rinse shall be collected in a high density polyethylene (HDPE) plastic-lined box or pit provided by the Contractor at the site. At the end of pouring operations, the Contractor shall excavate all the waste and liner and properly dispose of same. The pit shall be completely backfilled and the site restored to original conditions.

6.3 All equipment and materials to be removed from the project site not specifically identified for turn-in to the Government shall become the property of the Contractor. The Contractor shall turn-in all materials specifically designated for turn-in to the Government to a location at Dyess AFB, as designated by the Contracting Officer. The Contractor shall obtain a receipt from the government employee responsible for receiving the returned equipment or material as evidence of compliance. A copy of the receipt(s) shall be submitted to the Contracting Officer prior to final inspection of the project. Following is a list of equipment or materials to be turned-in:

None

7. STORAGE AREA (I.E. TEMPORARY FIELD OFFICE, STAGING AREAS, TOOL/JOB SHACKS, AND OTHER CONSTRUCTION FACILITIES):

There are no Government furnished covered or secure storage areas. Limited on-base, off site storage will be permitted on a space available basis. The location on Dyess AFB of the Contractor's temporary field office, storage, and other construction buildings required temporarily in the performance of the work, shall require written approval of the Contracting Officer. Plans showing temporary field office, storage, and other construction buildings shall be submitted for approval of the Contracting Officer. Utilities at the storage area may or may not be available for Contractor use. The Government implies no responsibility for lost or stolen materials, equipment or tools, the security of which lies solely with the Contractor. Contractor shall keep his storage areas clean, neat and orderly and will keep grass mowed to a maximum height of 4 inches. Temporary fencing used by the Contractor to delineate constructor sites shall be securely anchored with tension wires and posts as required to prevent sagging and an unsightly appearance. Fencing shall be maintained by the Contractor in this manner throughout the life of the contract. Due to high winds in west Texas, Contractor shall take every precaution to preclude trash from blowing off site.

8. TOILET FACILITIES: There are no toilet facilities available for Contractor use. Contractor shall provide his own portable/temporary toilet facilities.

9. CLEAN-UP: The Contractor shall at all times keep the construction site and storage area(s) free from accumulation of waste, rubbish, or construction debris. All loose or light weight materials shall be secured to prevent blowing or scattering. The burning of trash or construction debris is strictly prohibited on Dyess AFB. Prior to final inspection, the Contractor shall remove all construction debris, tools, equipment, and materials not the property of the Government. Upon completion of the work, the Contractor shall leave the work site and storage area(s) in a clean, neat and workmanlike condition satisfactory to the Contracting Officer.

Contractor's attention is directed to Section 01700 - Environmental Protection, the paragraph Post-Construction Cleanup or Obliteration.

10. FINAL INSPECTION:

The Contractor shall advise the Contracting Officer of the Contractor's desired final inspection date seven (7) calendar days in advance of that desired date to permit proper coordination. The date selected shall provide adequate time for Contractor performed corrections of final inspection deficiencies within the contract performance time. The Contracting Officer will be the final authority for determining whether or not the Contractor's performance is sufficiently advanced to warrant a final inspection.

11. TESTING:

Costs of all tests, unless specifically indicated as being performed by the Government, will be at the Contractor's expense. It is the responsibility of the Contractor to schedule all tests and to notify the Contracting Officer or his representative in a timely manner prior to any required testing. All test results shall be submitted to the Contracting Officer on AF Form 3000, Material Approval Submittal.

12. AS-BUILT DRAWINGS:

The Contractor shall maintain two sets of project drawings for "as-built" notations and marking. The Contractor shall update these plans to indicate "as-built" construction and shall submit them to the Contracting Officer prior to final inspection under the cover of an AF Form 3000. Updated notations and markings shall be neat, clear, and legible in all respects. Additionally, the Contractor shall furnish an electronic copy of as-built construction in AutoCad 2000 format on a CD to the Contracting Officer prior to final inspection. Original AutoCad 2000 drawings are available from the Government at 7 CES, 710 3rd Street, Dyess AFB, TX.

12.1 INSTRUCTION MANUALS:

Three copies of the required instruction manuals shall be provided in three ring binders with tabs and an index/table of contents. Provide permanent label on front and side with project title, project number, facility number, street address, Contractor/Subcontractor name, address, phone number(s), and manual title/contents description. Include all wiring diagrams and parts lists. Manuals shall be submitted to the Contracting Office for approval prior to Final Inspection.

12.2 TRAINING REQUIREMENTS: The Contractor shall provide specified training to Government Personnel scheduled to operate the Car Wash. Additionally, Contractor shall video tape this training and furnish three copies of the video tape to Contracting Officer prior to final inspection.

13. SECURITY REQUIREMENTS:

Dyess AFB security may be viewed as being one of three broad levels, the level in effect being dependent on the location or area of Dyess AFB in question.

a. The lowest level of security exists in general access areas. These areas are all of Dyess AFB outside of the "USAF Controlled" and "USAF Restricted" areas.

b. USAF controlled access areas are the mid-level security areas. Presence within the controlled access area is by authorization; however, the movement of authorized personnel in and out of these areas is generally not impeded. Contractor personnel are given access to these areas.

c. The third and highest level of security on Dyess AFB is that within the USAF Restricted areas. These areas are further subdivided to be known as Priority A, Priority B, or Priority C areas.

13.1 Referencing the above, the work on this contract will be in a **general access area**.

13.2 Requests for changes to the work schedule for work in USAF restricted areas, must be submitted a minimum of 7 calendar days in advance for approval and coordination of Dyess AFB Security Forces.

13.3 Dyess Air Force Base is a closed base. All personnel entering must have specific permission of the installation commander for entry. This permission is granted when a Contractor employee is issued an identification card. Information necessary to obtain identification cards will be provided by the Contracting Officer at the pre-performance conference. The Contractor shall be responsible to ensure that all of its employees obtain, and keep on their person at all times while working on the base, a USAF identification card. Upon completion of the work or termination of an employee, the Contractor shall be responsible for turn in of identification cards no longer needed to the Contracting Officer or to the Pass and Registration Office of the Security Forces.

a. The Contractor shall supply a list of employees in three copies on the Dyess AFB Form Letter 173. All three (3) copies of the completed list must be reviewed and approved by the Contracting Officer. After review and approval, those listed personnel being authorized entry to Dyess AFB shall proceed to Building 9265, 1518 E Arnold Blvd, Pass and Registration for issuance of their Contractor Employee Identification card. The Contractor or his designated representative must sign each copy of the list.

b. Names must be listed alphabetically on each form. The following information must be listed for each individual, directly opposite his name: Date of Birth, Weight, Height, Color of Hair, Color of Eyes, Social Security Number, Current Address, Drivers License Number (if none, so state), Employer's Company Name, Employer's Company Address and phone number, start and termination date of contract, and sponsor's name, organization, phone.

c. Changes to the list must be submitted as they occur. Additions must meet the same requirements as the original list. For deletions, only the name of the individual and a reference to the date and contract number of the original list is needed. Contractors must ensure that the pass for any individual deleted from the list is returned to the Pass and Registration Section. If the pass cannot be returned; a letter, signed by the Contractor, shall be submitted stating that the pass could not be retrieved including an explanation why. The list shall be updated quarterly omitting all previously deleted names.

d. The Dyess AFB Form Letter 173 is subject to the privacy act of 1974, Authority: 10 U.S.C. 8012 and 5 U.S.C. 552a(b)(7).
Principle purposes: To provide the 7th Security Forces Squadron, and other authorized agencies, with a listing of personnel authorized access to Dyess Air Force Base, Texas as Contractors or Contractor employees.
Routine Uses: To verify the identity of personnel entering Dyess AFB as Contractors.

Disclosure is Mandatory: Failure to provide the information and Social Security Number (SSN) could result in denied access to the Dyess AFB installation.

14. IDENTIFICATION OF CONTRACTOR VEHICLES: Contractor vehicles must be marked on each side with company name with either permanent or semi-permanent/magnetic signage.

15. WARRANTIES:

Any warranties given to the Contractor or sub-Contractor at any tier from a manufacturer of equipment or other items which are provided under this contract shall be transferred to the government upon final acceptance. Contractor shall submit in writing a single listing with all applicable warranties attached. Negative responses are likewise required in writing.

16. SUBMITTAL REQUIREMENTS:

16.1 The submittals specified in all sections of the Technical Specifications shall be submitted for approval or information using AF Form 3000. Where a submittal cannot be provided within the required submission date, Contractor shall submit in writing a letter stating the reasons why and furnishing a new projected submission date.

16.2 Items such as mill certificates or other test data that are usually unavailable until the equipment/material is actually manufactured/fabricated must still be identified on the initial AF Form 3000. An explanation stating this data shall be submitted later by Submittal Number (fill in Submission Number) after materials are manufactured/fabricated (or other explanations as appropriate) shall be included with this identification. A separate submittal for long lead time equipment or material may be made if sufficient data is furnished to show contract compliance. (An explanation shall be provided on a separate sheet, if necessary, explaining why a partial submittal is being made. Explanation shall include the estimated delivery date of the equipment/ material and the Submission Number of the submittal that shall contain data required by the particular specification section for the remaining equipment/materials.) Samples of materials must be submitted along with technical data, not under separate transmittals.

16.3 Submittal Review:

a. The Contractor is responsible for controlling and ensuring all data submitted is complete and in full compliance with contract requirements.

b. A separate submittal shall be made for each technical section with submittals.

c. The government will provide written comments and/or approval/ disapproval action as appropriate. One (1) copy of the submittal, along with any comments, will be provided to the Contractor. The Contractor shall provide a resubmittal with all data necessary to show compliance with Government comments on all disapproved submittals.

16.4 Variations/Deviations/Departures from the Contract Drawings or Specifications:

a. Contractor proposed variations, deviations or departures from the contract requirements shall be noted/marked in red on each copy of the submittal data and shall be provided with a letter attachment to the AF Form 3000 summarizing the proposed variation, deviation, or departure. Variations, deviations, or departures will be processed and approved the same submittals. Variations, deviations, or departures shall contain sufficient information to permit complete evaluation. Additional sheets may be used to fully explain why a variation, deviation, or departure is requested. The Government reserves the right to disapprove or rescind inadvertent approval of submittals containing unnoted/ unmarked variations, deviations or departures.

b. Any submittal annotated by a supplier/vendor with “Field Verify,” “Select Color,” and the like must be accompanied by the Contractor’s written response to the supplier’s query.

* * *END OF SECTION***

TECHNICAL PROVISIONS
SECTION 01200 - UTILITIES (CONTRACTOR IDENTIFIED)

1. SCOPE: This section covers identification, interruption and use of utilities.

2. IDENTIFICATION: THE GOVERNMENT DOES NOT KNOW THE LOCATION OF UTILITIES IN THE WORK AREA. Accordingly, the Contractor shall be SOLELY RESPONSIBLE for locating and marking the exact location of all existing utilities within the contract work area prior to any excavating, trenching, backfilling or disturbance. The Contractor is SOLELY RESPONSIBLE for any and all damage to existing utilities in the contract work area. Upon request by the Contractor, the Government shall furnish all available information in its possession concerning utilities in the contract work area. However, the accuracy of the information provided by the Government is not guaranteed and is only intended to provide some measure of assistance to the Contractor. The Contractor shall call 7 CS/SCMO (Mr. Lowe) at 696-4391 a minimum of five (5) calendar days in advance to have underground communications cable routes marked. Base Civil Engineering does not have nor shall it provide record drawings of Bell Telephone cable plant. In the event the Contractor identifies utilities in the contract work area which interfere with the newly proposed construction, the Contracting Officer shall be immediately notified and the Government shall take necessary corrective action at no cost to the Contractor. The Contractor shall furnish to the Contracting Officer as-built drawings clearly identifying the exact location of all utilities identified in the work area prior to project final inspection.

2.1 Contractor must initiate a Work Clearance Request AF Form 103 (digging permit) from 7 CES/ CECC a minimum of seven (7) calendar days prior to the start of any construction work. Excavation is not authorized without issuance of a completed and approved AF Form 103. After initial issue, it is the Contractor's responsibility to keep the Work Clearance Request coordinated and up-to-date/current through the remainder of the contract.

2.2 Any removal/relocation/reconnection of any communication device shall be coordinated in advance with 7 CS/SCMO (Mr. Lowe) at 696-4391. Any removal/relocation/reconnection of any Cable TV device shall be also be coordinated in advance with 7 CS/SCMO (ask for the NCOIC of Cable TV) at 696-2400. Communications and Cable TV devices to remain shall be protected as required when work proximity dictates.

2.3 Any removal/relocation/reconnection of any fire protection device or intrusion detection systems shall be coordinated in advance with 7 CES/CEOIE at 696-5184.

2.4 The locating and marking devices utilized by the contractor for existing utilities or proposed work is limited to flags with contractor’s identification. Paint or wooden stakes can be utilized only with approval of the Contracting Officer.

3. INTERRUPTIONS:

3.1 Planned Utility Outages: The Contractor shall coordinate all requests for utility outages with the Contracting Officer in writing fourteen (14) calendar days prior to date of requested outage. Water, gas, steam, sewer and electrical outages shall be held to a maximum duration of 2 hours

unless otherwise approved in writing. See Contractor Request for Utility Outage included on page 01200-3.

3.2 Unplanned Utility Outages (Accidental Disruption of Utilities): In the event of accidental disruption of any utility, the Contractor shall immediately notify the Contracting officer of the unplanned outage. The Contractor shall immediately take every reasonable step to repair the damage in a manner acceptable to the Government and will restore the utility to full use as soon as practicable. If the Contractor so desires, and the Government agrees, the Government may complete necessary repairs to the damaged utility and withhold from payments due to the Contractor the necessary amount to defray all costs associated with the repair of the utility.

4. USE: All reasonable quantities of existing utilities will be made available to the Contractor without charge. Any temporary connections or lines required shall be installed, maintained, and removed at the Contractor's expense. Any damage associated with the use of these utilities shall be repaired and/or replaced in a manner satisfactory to the Contracting Officer at Contractor's expense. See Contractor Request for Use of Dyess AFB Fire Hydrants included on page 01200-4.

* * *END OF SECTION***

The following information must be prepared and forwarded, on AF Form 3000, Material Approval Submittal, to the Operational Contracting Division for approval and coordination with Civil Engineering.

Request For Utility Outage

From: _____

Contract No:_____**Description and Location of Contract**: _____

Date of Outage Requested:_____**Type of Outage**:_____

Location Affected by Outage:

Description of Work to be performed and Other Utilities Affected:

Requested Civil Engineer Support:

Date:_____ Time:_____

Type of Support:

Electrical X-5184_____ Water X-4481_____

Access X-4155_____ Road Closure X-4155_____

Alarms X-5195_____ Fire Dept Standby X-4930_____

Duration of Outage: Start:_____ Completed:_____

Signature:

_____ _____
Contractor Representative: Date:

The following information must be prepared and forwarded, on AF Form 3000, Material Approval Submittal, to the Operational Contracting Division for approval and coordination with Civil Engineering's Fire Dept and Utilities Element prior to use of base fire hydrants.

Contractor Request for Use of Dyess AFB Fire Hydrants.

Project Title _____

1. The _____._____ Company requests the use of fire hydrant number_____ for the purpose of filling _____ used in the performance of the contract to _____. Period of hydrant use will be_____ to _____. I understand approval is contingent on:

a. The company providing a suitable connection with a Class III Back Flow Preventer (reduced pressure principle device) and screw type globe valve to be attached to the hydrant. The connection will be 2 1/2" National Standard fire thread. The backflow device and valve shall be properly supported to prevent damage to fire hydrant threads.

b. Leaving the connection in place during approval period.

c. Insuring the hydrant is fully opened and left in that position during approval period, except in periods of freezing weather.

d. Insuring an approved fire hydrant wrench is used to open/close the hydrant.

e. Insuring all servicing from the hydrant is done at the top of the vehicle or tank. No bottom servicing will be permitted.

f. Using no quick opening valves causing excess water hammer in the main.

g. Discontinuing hydrant use if there is any hydrant malfunction or leakage from underground and reporting same to the fire department, 696-2486.

2. I understand and agree that _____Company assumes full responsibility for any damage to the hydrant, water mains, adjacent grounds, vegetation, buildings, or streets resulting from filling operations.

_____ _____
(Signature) (Date)

_____ _____
(Print Name) (Print Title)

TECHNICAL PROVISIONS
SECTION 01700 - ENVIRONMENTAL PROTECTION

1. APPLICABLE ENVIRONMENTAL REGULATIONS, LAWS, AND PUBLICATIONS: The documents listed below form a part of this specification. The documents are referred to in the text by the basic designation only.

1.1 Engineering Technical Letters (ETLs):

ETL 91-7	Chlorofluorocarbon (CFC) Limitation in Heating, Ventilation, and Air-Conditioning (HVAC) Systems

1.2 Dyess AFB Instructions:

32-2001	Base Fire Regulation
32-7001	Conservation and Management of Natural Resources

1.3 Code of Federal Regulations (CFR):

29 CFR	Code of Federal Regulations, Occupational Safety and Health Administration (OSHA) Rules
29 CFR, Part 1910	Hazardous Waste Operation and Emergency Response
40 CFR	Code of Federal Regulations, Environmental Protection Agency (EPA) Rules
40 CFR, Part 82	Protection of Stratospheric Ozone
40 CFR, Part 117	Determination of Reportable Quantities for Hazardous Substances
40 CFR, Parts 260 - 282	Solid Waste Regulations
40 CFR, Part 302	Designation, Reportable Quantities, and Notification
49 CFR	Code of Federal Regulations, Department of Transportation (DOT) Rules

1.4 Environmental Protection Agency Publication (EPA):

EPA Publication No. SW-846	Test Methods for Evaluating Solid Waste

1.5 Environmental Laws:

Archaeological and Historic Preservation Act (AHPA), 1974

Archaeological Resources Protection Act (ARPA), 1979

Clean Air Act (CAA), 1970 and the 1990 CAA Amendments

Clean Water Act (CWA), 1977 as amended

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, 1980)

Endangered Species Act (ESA), 1973

Emergency Planning and Community Right-To-Know Act (EPCRA)

Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) as amended, 1972

Federal Water Pollution Control Act (FWPCA)

National Oil and Hazardous Substances Contingency Plan (NCP), 1980

Occupational Health and Safety Act (OSHA)

Oil Pollution Act (OPA) of 1990

Pollution Prevention Act (PPA), 1990

Resources Conservation and Recovery Act (RCRA), 1974

Safe Drinking Water Act (SDWA), 1973 as amended

Superfund Amendment and Reauthorization Act (SARA)

1.6 State Rules (Texas Administrative Code):

25 TAC
27 TAC
30 TAC
43 TAC

2. PROTECTION OF RESOURCES: Construction activities are NOT exempt from air emission, storm water, hazardous waste, and other environmental compliance rules and regulations. Contractor shall investigate, comprehend, and comply with all environmental rules and regulations applicable to his chosen method of accomplishment of the work under this contract.

2.1 Protection of Land Resources: The Contractor shall confine his construction activities to areas defined by the plans or specifications. Except in areas to be cleared, do not remove, cut,

deface, injure or destroy trees or shrubs without the Contracting Officer's approval. Do not fasten or attach ropes, cables, or guys to existing nearby trees for anchorage unless authorized by the Contracting Officer. Where such use of ropes, cables, or guys is authorized, the Contractor shall be responsible for any resultant damage.

2.1.1 Restoration or Replacement of Landscape Damage: Any trees or other landscape feature scarred or damaged by the Contractor’s equipment or operations shall be restored as nearly as possible to its original condition at the Contractor's expense. The Contracting Officer will decide what method of restoration shall be used, and whether damaged trees shall be treated or removed and disposed of under requirements for clearing and grubbing. If damaged trees are to be removed, they are to be replaced with equivalent, undamaged trees and landscaping features at the Contractors expense.

2.1.2 Post-Construction Cleanup or Obliteration: The Contractor shall obliterate all evidence of temporary construction facilities such as haul roads, work areas, structures, foundations of temporary structures, stockpiles of excess materials, or any other vestiges of construction. It is anticipated that excavation, filling, and plowing of roadways will be required to restore the area to near natural conditions which will permit the growth of vegetation thereon. The disturbed areas shall be graded and filled as required, and topsoil shall be spread to a depth of approximately four inches over the entire area and the entire area seeded with 30 pounds (pure live seed) of common Bermuda per 1000 square feet and then watered as required until a lush hardy growth is established to the satisfaction of the Contracting Officer. Restoration to original contours is required unless otherwise directed by the Contracting Officer.

2.2 Protection of the Stratospheric Ozone: The Contractor shall comply with 40 CFR Part 82. To the maximum extent practicable, the Contractor shall utilize safe alternatives and products made with or containing safe alternatives to Class I or II ozone depleting substances, identified under 42 U.S.C. 7671K. Class I Ozone Depleting Substance is defined in section 602 (a) of CAA and includes the following chemicals:

CFC-11	CFC-12	CFC-13	CFC-111	CFC-112
CFC-113	CFC-114	CFC-115	CFC-211	CFC-212
CFC-213	CFC-214	CFC-215	CFC-216	CFC-217
halon-1211	halon-1301	halon-2402	carbon tetrachloride	methyl chloroform

2.2.1 For New HVAC Equipment: Contractor shall utilize acceptable refrigerants per ETL 91-7 such as:

HCFC - 22 HCFC - 123 HFC - 134A

2.3 Protection of Historical and Archaeological Resources: All known Historical, Archaeological, and Cultural Resources, if any, within the Contractors work area will be designated on the contract drawings. The Contractor shall take precautions during the contract to preserve all resources as they existed at the time of contract award and comply with AHPA and ARPA. The Contractor shall provide all protective devices such as off limit markings, fencing, barricades or other devices as designated on the contract drawings and shall be responsible for preservation of the sites during this contract.

2.3.1 Recording and Preserving Historical and Archaeological Finds: All items having any apparent historical or archaeological interest outside of designated areas which are discovered in the course of any construction activities shall be carefully preserved. The Contractor shall protect the find in-place by leaving the archaeological find undisturbed and by using flags to mark a 50 foot radius area around the find. The find shall be immediately reported to the Contracting Officer so that the proper authorities may be notified. All work shall be stopped in the immediate area of the discovery until directed by the Contracting Officer to resume work. Any work required to preserve or protect these finds shall be accomplished before work resumes.

2.4 Protection of Water Resources: The Contractor shall not pollute streams, lakes, or reservoirs with fuels, oils, bitumens, calcium chloride, acids, construction wastes, situation from stormwater runoff, or other harmful materials identified in 40 CFR Parts 117 and 302. It is the responsibility of the Contractor to investigate, comprehend, and comply with all applicable Federal, State, County, and Municipal laws concerning pollution of rivers and streams--particularly the CWA, FWPCA, NCP, OPA, SDWA, and PPA (And all subsequent Amendments). All work under this contract shall be performed in such a manner that objectionable or nuisance conditions will not be created in lakes, reservoirs, or streams through or adjacent to the project areas. For construction sites of more than 5 acres and at least 30 days prior to the start of construction, the Contractor shall file a Notice of Intent (NOI) EPA Form 3510-6 for stormwater construction activities with the EPA, showing the Contractor's proposed scheme for controlling erosion and pollution. Only 7 CES/CEV personnel may sign/certify the NOI under block V. There shall be no fill, to include trees and vegetation, placed in a wetland or water of the U.S. as they are defined by the CWA or the 1987 Corps of Engineers Manual for wetlands. Wetlands and/or possible wetlands in the work area will be delineated prior to awarding of the contract. The Contractor shall be aware of CWA Section 404 requirements and permits and shall be responsible for compliance. Vehicles shall not pass through wetlands unless absolutely necessary, and mats will be placed on the area for protection prior to driving.

2.4.1 Erosion Control: The Contractor shall control erosion and disposing of wastes. Surface drainage from cuts and fills within the construction limits, whether or not completed, and from borrow and waste disposal areas, shall, if turbidity producing materials are present, be held in suitable sedimentation ponds, or the areas shall be graded to control erosion within acceptable limits. Temporary erosion and sediment control measures such as berms, dikes, drains, or sedimentation basins, if required to meet the above standards, shall be provided and maintained until permanent drainage and erosion control facilities are completed and operative. The area of bare soil exposed at any one time during construction operations shall be held to a minimum. Unless otherwise approved by the Contracting Officer, the Contractor shall apply as soon as practicable an approved temporary mulch on denuded ground. This shall apply to all areas not subject to appreciable traffic during construction, including areas that are to receive some form of construction later, if ground is to be exposed 60 days or more. Stream crossing by fording with equipment shall be limited to control turbidity and in areas of frequent crossings temporary culverts or bridge structures shall be installed. Any temporary culverts or bridge structures shall be removed upon completion of the project. Fills and waste areas shall be constructed by selective placement to eliminate to the extent practicable silts or clays on the surface that will erode and contaminate adjacent streams or lakes.

2.5 Protection of Fish and Wildlife: The Contractor shall follow all Federal, State, County and Municipal laws regarding the protection of fish and wildlife--particularly the ESA. Dyess AFB Instruction 32-7001 shall be followed as well. The Contractor shall at all times perform all work and take such steps required to prevent any interference or disturbance to fish and wildlife. The Contractor shall not alter water flows or otherwise disturb native habitat adjacent to the project area which, in the opinion of the Contracting Officer, are critical to fish or wildlife. Construction of check dams in live streams will not be permitted. Fouling or polluting of water will not be permitted. Wash waters shall be processed, filtered, ponded, or otherwise treated prior to their release into a river or other body of water.

2.6 Protection of Air Quality: It is the responsibility of the Contractor to investigate, comprehend, and comply with all applicable Federal, State, County and Municipal laws concerning air pollution, particularly the CAA (And all subsequent Amendments). All work under this contract shall be performed in such a manner that objectionable or nuisance conditions will not be created in the air nor will objectionable particulates be released to the air. No material shall be burned at the project site.

2.6.1 Dust Control: The Contractor shall maintain all excavations, embankments, stockpiles, haul roads, permanent access roads, plant sites, waste areas, borrow areas, and all other work areas within or without the project boundaries free from dust in accordance with all applicable local, state, and Federal regulations for the control of dust and particulate emissions. Temporary methods of stabilization consisting of sprinkling with water are required to control dust. Sprinkling with water shall be repeated at such intervals as to keep all parts of the disturbed area at least damp at all times. Gravel paving shall be provided for entrance and exit drives, parking areas, and unpaved roads carrying more than 25 vehicles per day on the construction site.

3. <u>DISPOSAL OF WASTES (NON-HAZARDOUS, SPECIAL, AND HAZARDOUS) GENERATED AT DYESS AFB</u>: (Contractor's attention is directed to Section 00700 paragraph 6.1 for waste determination and classification).

3.1 Non-Hazardous Wastes: Contractor shall transport and dispose of all non-hazardous wastes to and in a State of Texas approved facility or other disposal facility approved by the state in which the disposal facility is located.

3.2 Special Wastes: Special wastes are any wastes that are non-hazardous yet have to be stored, transported, and/or disposed of in a special manner, i.e. petroleum contaminated soil. Contractor shall store, transport and dispose of all Special Wastes in accordance with all Federal, State, and local laws, rules and regulations as applicable. Contractor shall dispose of Special Wastes in a State of Texas approved facility or other disposal facility approved by the state in which the disposal facility is located. Contractor shall make all necessary arrangements with the disposal facility of his choice for disposal of Special Wastes. Contractor shall prepare all necessary paper work, including but not limited to bill of lading, manifests, etc. at no additional cost to the Government.

3.3.1 The Contractor shall be designated the "lead generator". As such, the Contractor is required to notify the State of Texas, specifically the Texas Natural Resource Conservation Commission (TNRCC), of the Contractor's waste generating activities. The Contractor must

have or obtain a Texas Solid Waste Registration (TSWR) number. Depending upon quantity/type of wastes, the TNRCC may also issue an Environmental Protection Agency (US EPA) identification number concurrently with the TSWR number. The Contractor shall submit a copy of his Initial Notification Package for Hazardous Waste Management (Form Number TNRCC-0002) or, if already acquired, a copy of the TSWR number(s) assignment letter from the TNRCC to the Contracting Officer as soon as possible after contract award. The Contractor shall not perform any waste generation activities associated with the performance of work under this contract until he has actually acquired a TSWR number(s) and submitted it to the Contracting Officer. Any ramifications (i.e. fines, penalties, etc) resulting from waste generation activities without prior TNRCC notification/approval shall be born by the Contractor.

3.3.2 The Contractor shall strictly adhere to Title 30, Texas Administrative Code (TAC), Chapter 305 and Chapter 335. The Contractor shall accumulate, manage, store, transport and dispose of all hazardous waste in accordance with Title 30, TAC, Chapter 305 and Chapter 335. The Contractor shall maintain all records, shipping documents, training certificates, plans and other documents required and for the period specified in Title 30, TAC, Chapter 305 and Chapter 335. Upon request by the Government, the Contractor shall provide a copy of any or all of the records, shipping documents, training certificates, plans and other documents required in Title 30, TAC, Chapter 305 and Chapter 335 to the Contracting Officer during the performance of this contract or at any time during the record retention time specified in Title 30, TAC, Chapter 305 and Chapter 335.

3.3.3 The Contractor shall remove all hazardous waste from Dyess AFB on a daily basis unless the accumulation and storage is specifically approved in writing by the Contracting Officer and the 7th Civil Engineering Squadron Environmental Flight. Such approval must be given prior to the generation of any hazardous waste. The Contractor's attention is directed to the fact that approval for accumulation or storage of hazardous wastes in excess of 55 gallons for greater than three (3) calendar days will require a minimum lead time of forty-five (45) calendar days from the date of the receipt of the request and may not be approved at that time. The Contractor shall transport hazardous wastes from Dyess AFB to a Treatment, Storage, or Disposal (TSD) facility permitted by the State of Texas or other TSD facility permitted by the state in which the disposal facility is located. Under no circumstances shall disposal or treatment (as defined in Title 30, TAC, Chapter 335, Subpart A, Section 335.1) of hazardous wastes be allowed on Dyess AFB by the Contractor unless specified else where in this contract.

3.3.4 The Contractor's attention is directed to the fact that violation or alleged violation of Title 30, TAC can and has resulted in the State of Texas issuing fines and penalties, both civil and criminal. As lead generator, the TNRCC and/or the US EPA may at any time and without notice inspect the Contractor's operations and records for compliance with Title 30, TAC. As co-generator, the Government will, as is deemed necessary, inspect the Contractor's operations and records for compliance with Title 30, TAC. The Contractor shall cooperate fully with the TNRCC, US EPA and/or Government representatives during these inspections, if any. The Contractor shall be fully and totally responsible for payment of all fines and/or penalties imposed by the TNRCC or US EPA for violation of Title 30, TAC. The Government will not be responsible for reimbursement to the Contractor for fines and/or penalties, both civil and criminal, incurred for violations of Title 30, TAC.

3.4 Contractor shall submit certification of proper disposal of all wastes to the Contracting Officer prior to the Final Inspection.

4. REQUIRED REPORTS: The contractor shall submit for approval a Final Disposition Report (FDR). The report shall be signed by the owner of the contractor's company or an officer of the company with the authority to act on behalf of the company. As a minimum, this report shall contain the following information:

(1) Report Summary [A summary of facilities completed under this contract, the contents of the FDR, and any special emphasis items such as loss of a manifest, or clean-up of materials spilled during the construction]

(2) Chronology of Events [as occurred during project including placement of stormwater controls, demolition waste generation, waste removal from site, waste disposal, asbestos abatement and disposal, major air upsets conditions, and other notable events which could impact the environment]

(3) Site characterization
- (a) Site conditions before contract start including general site drainage patterns, utility locations, facility site, jobsite trailer location, vehicle parking areas, material staging areas and access roads
- (b) Site conditions after contract completion including general site drainage patterns, facility site, jobsite trailer location, vehicle parking areas, material staging areas and access roads

(4) Closure activities
- (a) Field investigation of site conditions
- (b) Sampling Activities, including the sampler, equipment used, sample locations, packaging, and Chain of Custory documentation as applicable
- (c) Laboratory results, with Laboratory Quality Assurance and Quality Control (QA/QC) data and Method number as applicable

(5) QA/QC procedures
- (a) Confined space entry, as applicable
- (b) Waste Storage Activities including TNRCC waste generator identification number, equipment or methodolgy used for storage, container logs with wastes stored along with dates accepted as removed from storage and methods of control
- (c) Waste management & disposition including rinsates, residues, scrapings, waste piles, Oil/Water Separator contents, etc.
- (d) Equipment decontamination including locations, materials used, disposition and disposal

(6) References
- (a) Site location map with site characterization data
- (b) Site details including, material staging areas, waste storage locations, spill locations, sample locations, storm water controls, and air emission sources as applicable

(7) Documentation
- (a) Air Permitting Exemptions
- (b) Stormwater Notice of Intent and Notice of Termination
- (c) Sample results
- (d) Signed and completed Waste Manifests
- (e) Waste destruction documentation

(f) Container Logs
(g) Chain of Custody documentation, as applicable
(h) Plugging & Abandonment reports
(i) Disposal records including landfill receipts, contractor company owner certification on location of records, certificates of destruction, etc.

(8) Applicable photos, drawings, schematics of activities or processes

(9) Certification statement: with the following wording and signed by the owner of the company or an officer of the company with the authority to act on behalf of the company.

(a) "I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

5. MAINTENANCE OF POLLUTION CONTROL FACILITIES DURING CONSTRUCTION: During the life of this contract the Contractor shall maintain all facilities constructed for pollution control under this contract as long as the operations creating the particular pollutant are being carried out or until the material concerned has become stabilized to the extent that pollution is no longer being created. During the construction period the Contractor shall conduct frequent training courses for his maintenance personnel. The curricula shall include methods of detection of pollution, familiarity with pollution standards, and installation and care of vegetation covers, plants, and other facilities to prevent and correct environmental pollution.

6. PESTICIDES (INSECTICIDES, FUNGICIDES, HERBICIDES, ETC.): Application of all pesticides shall be accomplished by certified pest control personnel in the category of treatment or under the supervision of a certified pest control operator. Delivery and storage of pesticides will be monitored by certified personnel to insure the adequacy of containers and the safe storage of toxic materials. Disposal of containers and chemicals will be monitored to prevent pollution of natural drainage systems or the unintentional release of pesticide particulates into the air. The Contractor shall comply with FIFRA and submit copies of certifications for operator to Contracting Officer for approval prior to application of Insecticide, Fungicides, and Herbicides. Additionally, the Base Entomology Shop at Dyess AFB shall be notified at least three working days in advance by the Contractor of proposed application of any pesticides, insecticides, fungicides, herbicides, etc.

7. SPILLS: Dyess AFB maintains, follows, and enforces the following plans regarding spills of classified substances: (NOTE: A spill is defined to include any spilling, overfilling, releasing, emitting, escaping, venting condition, leaking, air upset, or other discharge of a regulated substance. Regulated substances are listed in 40 CFR Parts 117 and 302.)

A. Hazardous Materials Emergency Response Plan
B. Spill Prevention Control and Counter Measures Plan
C. National Oil and Hazardous Substance Pollution Contingency Plan

D. Community Right-To-Know Plan

These plans are maintained by the Environmental Flight of Civil Engineering at 710 3rd Street, Dyess AFB. Basically, the Contractor shall take preventive measures (Secondary Containment, avoid overfilling of trucks, etc.) to avoid spills and if a spill were to occur, the Contractor shall immediately notify the Base Fire Department at phone number (915) 696-2117. The Base Fire Department is the first responder who will take charge to secure/neutralize the event and to coordinate cleanup/remedial actions. Notification shall be made even if spill is within the cleanup capabilities of the Contractor.

Accordingly, the Contractor shall report all spills immediately, as they occur, to permit proper response by Dyess AFB and Contractor personnel. For example, spillage of asphalt into a field not intended to be asphalted by Contractor's haul truck must be immediately cleaned up as the asphalt becomes a hazardous waste (no longer used for its intended purpose). Contractor may be held liable for all expenses incurred by the Government during and after the spill response including but not necessary limited to spill pads, pillows, booms, vacuum truck and equipment rental, drums, waste transportation, laboratory analysis, and disposal costs.

8. CONTAINERS:

8.1 Aerosol Cans: Aerosol cans, after use must be punctured and drained of product and propellant via approved equipment manufactured for that purpose. The empty cans then can be disposed of as ordinary household garbage. Disposal of the internal can contents shall be accomplished according to its waste classification.

8.2 Other Containers: Refer to 30 Texas Administrative Code 335.41/f for criteria regarding management and disposal of other containers.

9. RELEASE OF FLUIDS TO THE SANITARY SEWER SYSTEM: Dyess AFB's sanitary sewer system discharges into the Publicly Owned Treatment Works (POTW) operated by the City of Abilene, Texas. This POTW has established testing requirements for certain constituents as well as discharge limits of those same constituents. Accordingly, any Contractor performing work at Dyess AFB and contemplating a release of non-hazardous water into the sanitary sewer system shall comply with the testing/release requirements established by the City of Abilene. Contractor is also responsible for any and all testing, monitoring, measuring, documenting, etc. to prove compliance with same. These POTW testing/discharge criteria is included at the end of this section.

10. INSTALLATION OF BACKFLOW PREVENTORS: 30 Texas Administrative Code 290.44(h)(4) requires that all new backflow prevention assemblies be tested upon installation by a recognized backflow prevention assembly tester and certified to be operating within specifications. Recognized testers shall have completed a TNRCC approved course on cross connection and backflow prevention and pass an examination administered by the TNRCC. Gauges used in the testing of backflow prevention assemblies shall be tested for accuracy annually in accordance with the University of Southern California's Foundation of Cross Connection Control and Hydraulic Research and/or the American Water Works Association Manual of Cross Connection Control (Manual M-14). Test gauge serial numbers must be

included on the Test and Maintenance Report form. A Test and Maintenance Report shall be completed by the recognized backflow prevention assembly tester for each assembly tested and be submitted to the Contracting Officer for approval.

CITY OF ABILENE, TEXAS (POTW) TESTING/DISCHARGE CRITERIA

All discharges of non-hazardous water to the sanitary sewer system at Dyess AFB shall be tested for the following constituents and shall comply with the listed discharge limits:

Constituent	Limit
Arsenic	0.80 mg/l
Barium	10.0 mg/l
Beryllium	1.0 mg/l
Cadmium	0.50 mg/l
Chromium	3.00 mg/l
Copper	1.10 mg/l

Cyanide	0.50 mg/l
Lead	1.00 mg/l
Manganese	8.00 mg/l
Mercury	0.02 mg/l
Nickel	3.00 mg/l
Selenium	0.70 mg/l
Silver	0.20 mg/l
Zinc	1.80 mg/l
Benzene	0.040 mg/l
Toluene	14.3 mg/l
Ethyl Benzene	1.4 mg/l
Xylene	10.0 mg/l
Total Petroleum Hydrocarbons	20.0 mg/l or 167 lbs/day
Biochemical Oxygen Demand	2000 lbs/day
Total Suspended Solids	2500 lbs/day
pH	5.5 - 11.0
Fats, Oils, and Greases	834 lbs/day

These constituents shall be analyzed in accordance with the methods set forth in 40 CFR 136 which designates an EPA method number or a method described in the 17th Edition of Standard Methods For the Examination of Water and Wastewater.

As an example and for clarification, non-hazardous water could be placed into a 1,500 gallon capacity tank. If a single, representative sample is extracted and analyzed for the above set of constituents and the results were below the limits annotated above, the entire contents of the tank could be discharged into the sanitary sewer system.

END OF SECTION

SECTION 02230
CLEARING AND GRUBBING
06/97

1 GENERAL

1.1 DEFINITIONS

1.1.1 Clearing

Clearing shall consist of the felling, trimming, and cutting of trees into sections and the satisfactory disposal of the trees and other vegetation designated for removal, including down timber, snags, brush, and rubbish occurring in **all project construction areas – except where trees or other vegetation are specifically noted on the drawings to remain**.

1.1.2 Grubbing

Grubbing shall consist of the removal and disposal of stumps, roots larger than 1 inch in diameter, and matted roots from all contractor cleared areas.

2 PRODUCTS (NOT APPLICABLE)

3 EXECUTION

3.1 CLEARING

Trees, stumps, roots, brush, and other vegetation in areas to be cleared shall be cut off flush with or below the original ground surface, except such trees and vegetation as may be indicated or directed to be left standing. Trees designated to be left standing within the cleared areas shall be trimmed of dead branches 1-1/2 inches or more in diameter and shall be trimmed of all branches the heights indicated or directed. Limbs and branches to be trimmed shall be neatly cut close to the bole of the tree or main branches. Cuts more than 1-1/2 inches in diameter shall be painted with an approved tree-wound paint. Trees and vegetation to be left standing shall be protected from damage incident to clearing, grubbing, and construction operations by the erection of barriers or by such other means as the circumstances require. Clearing shall also include the removal and disposal of structures that obtrude, encroach upon, or otherwise obstruct the work.

3.2 GRUBBING

Material to be grubbed, together with logs and other organic or metallic debris not suitable for foundation purposes, shall be removed to a depth of not less than 18 inches below the original surface level of the ground in areas indicated to be grubbed and in areas indicated as construction areas under this contract, such as areas for buildings, and areas to be paved.

Depressions made by grubbing shall be filled with suitable material and compacted to make the surface conform with the original adjacent surface of the ground.

3.3 TREE REMOVAL

Where indicated or directed, trees and stumps that are designated as trees shall be removed from areas outside those areas designated for clearing and grubbing. This work shall include the felling of such trees and the removal of their stumps and roots as specified in paragraph GRUBBING. Trees shall be disposed of as specified in paragraph DISPOSAL OF MATERIALS.

3.4 DISPOSAL OF MATERIALS

3.4.1 Materials Other Than Salable Timber

Logs, stumps, roots, brush, rotten wood, and other refuse from the clearing and grubbing operations, except for salable timber, shall be disposed of outside the limits of Government-controlled land at the Contractor's responsibility, except when otherwise directed in writing. Such directive will state the conditions covering the disposal of such products and will also state the areas in which they may be placed.

** End of Section **

SECTION 02300
EARTHWORK
12/97

1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 136	(1996a) Sieve Analysis of Fine and Coarse Aggregates
ASTM D 422	(1963; R 1998) Particle-Size Analysis of Soils
ASTM D 1140	(1997) Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve
ASTM D 1556	(1990; R 1996) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(1998) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu. m.))
ASTM D 2167	(1994) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2487	(1998) Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(1996) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 2937	(1994) Density of Soil in Place by the Drive-Cylinder Method
ASTM D 3017	(1988; R 1996el) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 4318	(1998) Liquid Limit, Plastic Limit, and Plasticity Index of Soils

1.2 DEFINITIONS

1.2.1 Satisfactory Materials

Satisfactory materials shall comprise any materials classified by ASTM D 2487 as GW, GP, GM, GP-GM, GW-GM, GC, GP-GC, GM-GC, SW, and SP. Satisfactory materials for grading shall be comprised of stones less than 3 inches in any dimension.

1.2.2 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials are unsatisfactory. Unsatisfactory materials also include man-made fills; trash; refuse; backfills from previous construction; and material classified as satisfactory which contains root and other organic matter or frozen material. The Contracting Officer shall be notified of any contaminated materials.

1.2.3 Cohesionless and Cohesive Materials

Cohesionless materials include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesionless only when the fines are nonplastic. Testing required for classifying materials shall be in accordance with ASTM D 4318, ASTM C 136, ASTM D 422, and ASTM D 1140.

1.2.4 Degree of Compaction

Degree of compaction required is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557 abbreviated as a percent of laboratory maximum density.

1.2.5 Topsoil

Material suitable for topsoils may be obtained from excavations located in the top 3-inches of the existing/undisturbed surface.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 00700 SUBMITTAL PROCEDURES:

SD-08 Statements

Earthwork; FIO.

Procedure and location for disposal of unsatisfactory materials and unused satisfactory material. Proposed source of borrow material.

SD-09 Reports

Testing; GA.

Within 24 hours of conclusion of physical tests, 3 copies of test results, including calibration curves and results of calibration tests.

SD-13 Certificates

Testing; FIO.

Qualifications of the commercial testing laboratory or Contractor's testing facilities.

SD-18 Records

Earthwork; FIO.

Notification of encountering rock in the project. Advance notice on the opening of excavation or borrow areas. Advance notice on shoulder construction for rigid pavements.

1.4 SUBSURFACE DATA

Subsurface soil boring logs **in the immediate vicinity of the project site do not exist**.

1.5 CLASSIFICATION OF EXCAVATION

No consideration will be given to the nature of the materials, and all excavation will be designated as unclassified excavation.

1.5.1 Rock Excavation

Rock excavation shall include excavating, grading, and disposing of material classified as rock and shall include the satisfactory removal and disposal of boulders 1/2 cubic yard or more in volume; solid rock; rock material that is in ledges, bedded deposits, and firmly cemented conglomerate deposits possessing the characteristics of solid rock. The removal of any concrete or masonry structures, except pavements, exceeding 1/2 cubic yard in volume that may be encountered in the work shall be included in this classification. If at any time during excavation, including excavation from borrow areas, the Contractor encounters material that may be classified as rock excavation, such material shall be uncovered and the Contracting Officer notified by the Contractor. The Contractor shall not proceed with the excavation of

this material until the Contracting Officer has classified the materials as common excavation or rock excavation and has taken cross sections as required. Failure on the part of the Contractor to uncover such material, notify the Contracting Officer, and allow ample time for classification and cross sectioning of the undisturbed surface of such material will cause the forfeiture of the Contractor's right of claim to any classification or volume of material to be paid for other than that allowed by the Contracting Officer for the areas of work in which such deposits occur.

1.5.2 Common Excavation

Common excavation shall include the satisfactory removal and disposal of all materials not classified as rock excavation.

1.6 BLASTING

Blasting will not be permitted.

1.7 UTILIZATION OF EXCAVATED MATERIALS

Unsatisfactory materials removed from excavations **and excess satisfactory material shall be disposed of in suitable off base disposal or spoil areas.** Satisfactory material removed from excavations shall be used, insofar as practicable, in the construction of fills, embankments, subgrades, shoulders, bedding (as backfill), and for similar purposes. No excavated material shall be disposed of to obstruct the flow of any stream, endanger a partly finished structure, impair the efficiency or appearance of any structure, or be detrimental to the completed work in any way.

2 PRODUCTS (NOT APPLICABLE)

3 EXECUTION

3.1 STRIPPING OF TOPSOIL

Topsoil shall be stripped to a depth of three- inches. Topsoil shall be spread on areas already graded and prepared for topsoil, or transported and deposited in stockpiles convenient to areas that are to receive application of the topsoil later, or at locations indicated or specified. Topsoil shall be kept separate from other excavated materials, brush, litter, objectionable weeds, roots, stones larger than 2 inches in diameter, and other materials that would interfere with planting and maintenance operations. Any surplus of topsoil from excavations and grading shall be removed from the site.

3.2 GENERAL EXCAVATION

The Contractor shall perform excavation of every type of material encountered within the limits of the project to the lines, grades, and elevations indicated and as specified. Grading shall be in conformity with the typical sections shown and the tolerances specified in

paragraph FINISHING. Satisfactory excavated materials shall be transported to and placed in fill or embankment within the limits of the work. Unsatisfactory materials encountered within the limits of the work shall be excavated below grade and replaced with satisfactory materials as directed. Such excavated material and the satisfactory material ordered as replacement shall be included in excavation. Surplus satisfactory excavated material not required for fill or embankment shall be disposed of in areas approved for surplus material storage or designated waste areas. Unsatisfactory excavated material shall be disposed of in designated waste or spoil areas. During construction, excavation and fill shall be performed in a manner and sequence that will provide proper drainage at all times. Material required for fill or embankment in excess of that produced by excavation within the grading limits shall be excavated from the borrow areas indicated or from other approved areas selected by the Contractor as specified.

3.2.1 Ditches, Gutters, and Channel Changes

Excavation of ditches, gutters, and channel changes shall be accomplished by cutting accurately to the cross sections, grades, and elevations shown. Ditches and gutters shall not be excavated below grades shown. Excessive open ditch or gutter excavation shall be backfilled with satisfactory, thoroughly compacted, material or with suitable stone or cobble to grades shown. Material excavated shall be disposed of as shown or as directed, except that in no case shall material be deposited less than 4 feet from the edge of a ditch. The Contractor shall maintain excavations free from detrimental quantities of leaves, brush, sticks, trash, and other debris until final acceptance of the work.

3.2.2 Drainage Structures

Excavations shall be made to the lines, grades, and elevations shown, or as directed. Trenches and foundation pits shall be of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown. Rock or other hard foundation material shall be cleaned of loose debris and cut to a firm, level, stepped, or serrated surface. Loose disintegrated rock and thin strata shall be removed. When concrete or masonry is to be placed in an excavated area, the bottom of the excavation shall not be disturbed. Excavation to the final grade level shall not be made until just before the concrete or masonry is to be placed.

3.2.3 Deep Excavations

Excavation walls shall not be made vertical for a height exceeding 5-feet without proper bracing/shoring. Excavation walls more than 5-feet high shall be shored, cut back to a stable slope (angle of repose), or provided with equivalent means of protection for employees who may be exposed to moving ground or cave in. Where excavation walls cannot be cut back to a stable slope due to adjacent structures/facilities, shoring is required. All shoring shall be designed by a Registered Professional Engineer provided by Contractor.

3.3 SELECTION OF BORROW MATERIAL

Borrow material shall be selected to meet the requirements and conditions of the particular fill or embankment for which it is to be used. Borrow material shall be obtained from the borrow areas shown or from other approved sources, either private or within the limits of the project site, selected by the Contractor. Unless otherwise provided in the contract, the Contractor shall obtain from the owners the right to procure material, pay royalties and other charges involved, and bear the expense of developing the sources, including rights-of-way for hauling. Borrow material from approved sources on Government-controlled land may be obtained without payment of royalties. Unless specifically provided, no borrow shall be obtained within the limits of the project site without prior written approval. Necessary clearing, grubbing, and satisfactory drainage of borrow pits and the disposal of debris thereon shall be considered related operations to the borrow excavation.

3.4 OPENING AND DRAINAGE OF EXCAVATION AND BORROW PITS

Except as otherwise permitted, borrow pits and other excavation areas shall be excavated providing adequate drainage. Overburden and other spoil material shall be transported to designated spoil areas or otherwise disposed of as directed. Borrow pits shall be neatly trimmed and drained after the excavation is completed. The Contractor shall ensure that excavation of any area, operation of borrow pits, or dumping of spoil material results in minimum detrimental effects on natural environmental conditions.

3.5 GRADING AREAS

Where indicated, work will be divided into grading areas within which satisfactory excavated material shall be placed in embankments, fills, and required backfills. The Contractor shall not haul satisfactory material excavated in one grading area to another grading area except when so directed in writing.

3.6 BACKFILL

Backfill adjacent to any and all types of structures shall be placed and compacted to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials to prevent wedging action or eccentric loading upon or against the structure. Ground surface on which backfill is to be placed shall be prepared as specified in paragraph PREPARATION OF GROUND SURFACE FOR EMBANKMENTS. Compaction requirements for backfill materials shall also conform to the applicable portions of paragraphs PREPARATION OF GROUND SURFACE FOR EMBANKMENTS, EMBANKMENTS, and SUBGRADE PREPARATION, and Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

3.7 PREPARATION OF GROUND SURFACE FOR EMBANKMENTS

3.7.1 General Requirements

Ground surface on which fill is to be placed shall be stripped of live, dead, or decayed vegetation, rubbish, debris, and other unsatisfactory material; plowed, disked, or otherwise broken up to a depth of 6-inches; pulverized; moistened or aerated as necessary; thoroughly mixed; and compacted to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. The prepared ground surface shall be scarified and moistened or aerated as required just prior to placement of embankment materials to assure adequate bond between embankment material and the prepared ground surface.

3.7.2 Frozen Material

Embankment shall not be placed on a foundation which contains frozen material, or which has been subjected to freeze-thaw action. This prohibition encompasses all foundation types, including the natural ground, all prepared subgrades (whether in an excavation or on an embankment) and all layers of previously placed and compacted earth fill which become the foundations for successive layers of earth fill. All material that freezes or has been subjected to freeze-thaw action during the construction work, or during periods of temporary shutdowns, such as, but not limited to, nights, holidays, weekends, winter shutdowns, or earthwork operations, shall be removed to a depth that is acceptable to the Contracting Officer and replaced with new material. Alternatively, the material will be thawed, dried, reworked, and recompacted to the specified criteria before additional material is placed. The Contracting Officer will determine when placement of fill shall cease due to cold weather. The Contracting Officer may elect to use average daily air temperatures, and/or physical observation of the soils for his determination. Embankment material shall not contain frozen clumps of soil, snow, or ice.

3.8 EMBANKMENTS

3.8.1 Earth Embankments

Earth embankments shall be constructed from satisfactory materials free of organic or frozen material and rocks with any dimension greater than 3 inches. The material shall be placed in successive horizontal layers of loose material not more than 9-inches in depth. Each layer shall be spread uniformly on a soil surface that has been moistened or aerated as necessary, and scarified or otherwise broken up so that the fill will bond with the surface on which it is placed. After spreading, each layer shall be plowed, disked, or otherwise broken up; moistened or aerated as necessary; thoroughly mixed; and compacted to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials. Compaction requirements for the upper portion of earth embankments forming subgrade for pavements shall be identical with those requirements

specified in paragraph SUBGRADE PREPARATION. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

3.9 SUBGRADE PREPARATION

3.9.1 Construction

Subgrade shall be shaped to line, grade, and cross section, and compacted as specified. This operation shall include plowing, disking, and any moistening or aerating required to obtain specified compaction. Soft or otherwise unsatisfactory material shall be removed and replaced with satisfactory excavated material or other approved material as directed. Rock encountered in the cut section shall be excavated to a depth of 6 inches below finished grade for the subgrade. Low areas resulting from removal of unsatisfactory material or excavation of rock shall be brought up to required grade with satisfactory materials, and the entire subgrade shall be shaped to line, grade, and cross section and compacted as specified. The elevation of the finish subgrade shall not vary more than 0.05 foot from the established grade and cross section.

3.9.2 Compaction

Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. Except for paved areas and railroads, each layer of the embankment shall be compacted to at least 90 percent of laboratory maximum density.

3.9.2.1 Subgrade for Railroads

Subgrade for railroads shall be compacted to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials.

3.9.2.2 Subgrade for Pavements

Subgrade for pavements shall be compacted to at least 95 percentage laboratory maximum density for the depth below the surface of the pavement shown. When more than one soil classification is present in the subgrade, the top 6 inches of subgrade shall be scarified, windrowed, thoroughly blended, reshaped, and compacted.

3.9.2.3 Subgrade for Shoulders

Subgrade for shoulders shall be compacted to at least 92 percentage laboratory maximum density for full depth of the shoulder.

3.10 SHOULDER CONSTRUCTION

Shoulders shall be constructed of satisfactory excavated or borrow material or as otherwise shown or specified. Shoulders shall be constructed as soon as possible after adjacent paving is complete, but in the case of rigid pavements, shoulders shall not be constructed until permission of the Contracting Officer has been obtained. The entire shoulder area shall be compacted to at least the percentage of maximum density as specified in paragraph SUBGRADE PREPARATION above, for specific ranges of depth below the surface of the shoulder. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. Shoulder construction shall be done in proper sequence in such a manner that adjacent ditches will be drained effectively and that no damage of any kind is done to the adjacent completed pavement. The completed shoulders shall be true to alignment and grade and shaped to drain in conformity with the cross section shown.

3.11 FINISHING

The surface of excavations, embankments, and subgrades shall be finished to a smooth and compact surface in accordance with the lines, grades, and cross sections or elevations shown. The degree of finish for graded areas shall be within 0.1 foot of the grades and elevations indicated except that the degree of finish for subgrades shall be specified in paragraph SUBGRADE PREPARATION. Gutters and ditches shall be finished in a manner that will result in effective drainage. The surface of areas to be turfed shall be finished to a smoothness suitable for the application of turfing materials.

3.12 PLACING TOPSOIL

On areas to receive topsoil, the compacted subgrade soil shall be scarified to a 2 inch depth for bonding of topsoil with subsoil. Topsoil then shall be spread evenly to **the indicated** thickness and graded to the elevations and slopes shown. Topsoil shall not be spread when frozen or excessively wet or dry. Material required for topsoil in excess of that produced by excavation within the grading limits shall be obtained from offsite areas.

3.13 TESTING

Testing shall be performed by an approved commercial testing laboratory or by the Contractor subject to approval. If the Contractor elects to establish testing facilities, no work requiring testing will be permitted until the Contractor's facilities have been inspected and approved by the Contracting Officer. Field in-place density shall be determined in accordance with ASTM D 1556 or ASTM D 2922. When ASTM D 2922 is used, the calibration curves shall be checked and adjusted using only the sand cone method as described in ASTM D 1556. ASTM D 2922 results in a wet unit weight of soil and when using this method ASTM D 3017 shall be

used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall also be checked along with density calibration checks as described in ASTM D 3017; the calibration checks of both the density and moisture gauges shall be made at the beginning of a job on each different type of material encountered and at intervals as directed by the Contracting Officer. ASTM D 2937, Drive Cylinder Method shall be used only for soft, fine-grained, cohesive soils. When test results indicate, as determined by the Contracting Officer, that compaction is not as specified, the material shall be removed, replaced and recompacted to meet specification requirements. Tests on recompacted areas shall be performed to determine conformance with specification requirements. Inspections and test results shall be certified by a registered professional civil engineer. These certifications shall state that the tests and observations were performed by or under the direct supervision of the engineer and that the results are representative of the materials or conditions being certified by the tests. The following number of tests, if performed at the appropriate time, will be the minimum acceptable for each type operation.

3.13.1 Fill and Backfill Material Gradation

One test per 100 cubic yards stockpiled or in-place source material. Gradation of fill and backfill material shall be determined in accordance with ASTM C 136, ASTM D 422, and ASTM D 1140 – as appropriate.

3.13.2 In-Place Densities

a. One test per 100 square yards, or fraction thereof, of each lift of fill or backfill areas compacted by other than hand-operated machines.

b. One test per 10 square yards, or fraction thereof, of each lift of fill or backfill areas compacted by hand-operated machines.

c. One test per 50 linear feet , or fraction thereof, of each lift of embankment or backfill for roads.

3.13.3 Check Tests on In-Place Densities

If ASTM D 2922 is used, in-place densities shall be checked by ASTM D 1556 as follows:

a. One check test per lift for each 1,000 square yards, or fraction thereof, of each lift of fill or backfill compacted by other than hand-operated machines.

b. One check test per lift for each 100 square yards of fill or backfill areas compacted by hand-operated machines.

c. One check test per lift for each 500 linear feet, or fraction thereof, of embankment or backfill for roads.

3.13.4 Moisture Contents

In the stockpile, excavation, or borrow areas, a minimum of two tests per day per type of material or source of material being placed during stable weather conditions shall be performed. During unstable weather, tests shall be made as dictated by local conditions and approved by the Contracting Officer.

3.13.5 Optimum Moisture and Laboratory Maximum Density

Tests shall be made for each type material or source of material including borrow material to determine the optimum moisture and laboratory maximum density values. One representative test per 100 cubic yards of fill and backfill, or when any change in material occurs which may affect the optimum moisture content or laboratory maximum density.

3.13.6 Tolerance Tests for Subgrades

Continuous checks on the degree of finish specified in paragraph SUBGRADE PREPARATION shall be made during construction of the subgrades.

3.14 SUBGRADE AND EMBANKMENT PROTECTION

During construction, embankments and excavations shall be kept shaped and drained. Ditches and drains along subgrade shall be maintained to drain effectively at all times. The finished subgrade shall not be disturbed by traffic or other operation and shall be protected and maintained by the Contractor in a satisfactory condition until ballast, subbase, base, or pavement is placed. The storage or stockpiling of materials on the finished subgrade will not be permitted. No subbase, base course, ballast, or pavement shall be laid until the subgrade has been checked and approved, and in no case shall subbase, base, surfacing, pavement, or ballast be placed on a muddy, spongy, or frozen subgrade.

** End of Section **

SECTION 02316
EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS
11/97

1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 1556	(1990; R 1996) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(1998) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu. m.))
ASTM D 2167	(1994) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2487	(1998) Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(1996) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(1988; R1996el) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)

1.2 DEGREE OF COMPACTION

Degree of compaction shall be expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 00700 SUBMITTAL PROCEDURES:

SD-09 Reports

Field Density Tests; FIO. Testing of Backfill Materials; GA.

Copies of all laboratory and field test reports within 24 hours of the completion of the test.

2 PRODUCTS

2.1 MATERIALS

2.1.1 Satisfactory Materials

Satisfactory materials shall comprise any materials classified by ASTM D 2487 as GW, GP, GM, GP-GM, GW-GM, GC, GP-GC, GM-GC, SW, and SP.

2.1.2 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials are unsatisfactory. Unsatisfactory materials also include man-made fills, trash, refuse, or backfills from previous construction. Unsatisfactory material also includes material classified as satisfactory which contains root and other organic matter, frozen material, and stones larger than 3-inches. The Contracting Officer shall be notified of any contaminated materials.

2.1.3 Cohesionless and Cohesive Materials

Cohesionless materials shall include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials shall include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM shall be identified as cohesionless only when the fines are nonplastic.

2.1.4 Rock

Rock shall consist of boulders measuring 1/2 cubic yard or more and materials that cannot be removed without systematic drilling and blasting such as rock material in ledges, bedded deposits, unstratified masses and conglomerate deposits, and below ground concrete or masonry structures, exceeding 1/2 cubic yard in volume, except that pavements shall not be considered as rock.

2.1.5 Unyielding Material

Unyielding material shall consist of rock and gravelly soils with stones greater than 3-inches in any dimension or as defined by the pipe manufacturer, whichever is smaller.

2.1.6 Unstable Material

Unstable material shall consist of materials too wet to properly support the utility pipe, conduit, or appurtenant structure.

2.1.7 Select Granular Material

Select granular material shall consist of well-graded sand, gravel, crushed gravel, crushed stone or crushed slag composed of hard, tough and durable particles, and shall contain not more than 10 percent by weight of material passing a No. 200 mesh sieve and no less than 95 percent by weight passing the l inch sieve. The maximum allowable aggregate size shall be 3-inches, or the maximum size recommended by the pipe manufacturer, whichever is smaller.

2.1.8 Initial Backfill Material

Initial backfill shall consist of select granular material or satisfactory materials free from rocks 3-inches or larger in any dimension or free from rocks of such size as recommended by the pipe manufacturer, whichever is smaller. When the pipe is coated or wrapped for corrosion protection, the initial backfill material shall be free of stones larger than 2-inches in any dimension or as recommended by the pipe manufacturer, whichever is smaller.

2.2 PLASTIC MARKING TAPE

Plastic marking tape shall be acid and alkali-resistant polyethylene film, 6 inches wide with minimum thickness of 0.004 inch. Tape shall have a minimum strength of 1750 psi lengthwise and 1500 psi crosswise. The tape shall be manufactured with integral wires, foil backing or other means to enable detection by a metal detector when the tape is buried up to 3 feet deep. The tape shall be of a type specifically manufactured for marking and locating underground utilities. The metallic core of the tape shall be encased in a protective jacket or provided with other means to protect it from corrosion. Tape color shall be as specified in TABLE 1 and shall bear a continuous printed inscription describing the specific utility.

TABLE 1. Tape Color

Red:	Electric
Yellow:	Gas, Oil, Dangerous Materials
Orange:	Telephone, Telegraph, Television, Police, and Fire Communications
Blue:	Water Systems
Green:	Sewer Systems

3 EXECUTION

3.1 EXCAVATION

Excavation shall be performed to the lines and grades indicated. Rock excavation shall include removal and disposition of material defined as rock in paragraph MATERIALS. Earth excavation shall include removal and disposal of material not classified as rock excavation. During excavation, material satisfactory for backfilling shall be stockpiled in an orderly manner at a distance from the banks of the trench equal to 1/2 the depth of the excavation, but

in no instance closer than 2 feet. Excavated material not required or not satisfactory for backfill shall be removed from the site and shall be disposed of off base. Grading shall be done as may be necessary to prevent surface water from flowing into the excavation, and any water accumulating shall be removed to maintain the stability of the bottom and sides of the excavation. Unauthorized overexcavation shall be backfilled in accordance with paragraph BACKFILLING AND COMPACTION at no additional cost to the Government.

3.1.1 Trench Excavation Requirements

The trench shall be excavated as recommended by the manufacturer of the pipe to be installed. Trench walls below the top of the pipe shall be sloped, or made vertical, and of such width as recommended in the manufacturer's installation manual. Where no manufacturer's installation manual is available, trench walls shall be made vertical. Trench walls more than 5-feet high shall be shored, cut back to a stable slope, or provided with equivalent means of protection for employees who may be exposed to moving ground or cave in. Vertical trench walls more than 5-feet high shall be shored. Trench walls which are cut back shall be excavated to at least the angle of repose of the soil. Special attention shall be given to slopes which may be adversely affected by weather or moisture content. The trench width below the top of pipe shall not exceed 24 inches plus pipe outside diameter (O.D.) for pipes of less than 24 inches inside diameter and shall not exceed 36 inches plus pipe outside diameter for sizes larger than 24 inches inside diameter. Where recommended trench widths are exceeded, redesign, stronger pipe, or special installation procedures shall be utilized by the Contractor. The cost of redesign, stronger pipe, or special installation procedures shall be borne by the Contractor without any additional cost to the Government.

3.1.1.1 Bottom Preparation

The bottoms of trenches shall be accurately graded to provide uniform bearing and support for the bottom quadrant of each section of the pipe. Bell holes shall be excavated to the necessary size at each joint or coupling to eliminate point bearing. Stones of 3-inches or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, shall be removed to avoid point bearing.

3.1.1.2 Removal of Unyielding Material

Where unyielding material is encountered in the bottom of the trench, such material shall be removed 4-inches below the required grade and replaced with suitable materials as provided in paragraph BACKFILLING AND COMPACTION.

3.1.1.3 Removal of Unstable Material

Where unstable material is encountered in the bottom of the trench, such material shall be removed to the depth directed and replaced to the proper grade with select granular material as provided in paragraph BACKFILLING AND COMPACTION. When removal of unstable material is required due to the Contractor's fault or neglect in performing the work, the

resulting material shall be excavated and replaced by the Contractor without additional cost to the Government.

3.1.1.4 Excavation for Appurtenances

Excavation for manholes, catch-basins, inlets, or similar structures shall be of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown. Rock shall be cleaned of loose debris and cut to a firm surface either level, stepped, or serrated, as shown or as directed. Loose disintegrated rock and thin strata shall be removed. Removal of unstable material shall be as specified above. When concrete or masonry is to be placed in an excavated area, special care shall be taken not to disturb the bottom of the excavation. Excavation to the final grade level shall not be made until just before the concrete or masonry is to be placed.

3.1.1.5 Jacking, Boring, and Tunneling

Where required/indicated (i.e. open trenches are not permitted), install utility lines by a jacking, boring, and/or tunneling procedure which installs a smooth steel pipe casing to receive the utility line. The jacking, boring, and/or tunneling procedure shall be done in a manner that does not damage the above infrastructure in the short term (damage pavement features) or long term (produce ultimate subsidence).

3.1.2 Stockpiles

Stockpiles of satisfactory materials shall be placed and graded as specified. Stockpiles shall be kept in a neat and well drained condition, giving due consideration to drainage at all times. The ground surface at stockpile locations shall be cleared, grubbed, and sealed by rubber-tired equipment, excavated satisfactory and unsatisfactory materials shall be separately stockpiled. Stockpiles of satisfactory materials shall be protected from contamination which may destroy the quality and fitness of the stockpiled material. If the Contractor fails to protect the stockpiles, and any material becomes unsatisfactory, such material shall be removed and replaced with satisfactory material from approved sources at no additional cost to the Government.

3.2 BACKFILLING AND COMPACTION

Backfill material shall consist of satisfactory material, select granular material, or initial backfill material as required. Backfill shall be placed in layers not exceeding 6 inches loose thickness for compaction by hand operated machine compactors, and 8 inches loose thickness for other than hand operated machines, unless otherwise specified. Each layer shall be compacted to at least 95 percent maximum density for cohesionless soils and 90 percent maximum density for cohesive soils, unless otherwise specified.

3.2.1 Trench Backfill

Trenches shall be backfilled to 2-feet above the top of pipe prior to performing the required pressure tests. The joints and couplings shall be left uncovered during the pressure test.

3.2.1.1 Replacement of Unyielding Material

Unyielding material removed from the bottom of the trench shall be replaced with select granular material or initial backfill material.

3.2.1.2 Replacement of Unstable Material

Unstable material removed from the bottom of the trench or excavation shall be replaced with select granular material placed in layers not exceeding 6 inches loose thickness.

3.2.1.3 Bedding and Initial Backfill

Bedding shall be of the type and thickness shown. Initial backfill material shall be placed and compacted with approved tampers to a height of at least one foot above the utility pipe or conduit. The backfill shall be brought up evenly on both sides of the pipe for the full length of the pipe. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe.

3.2.1.4 Final Backfill

The remainder of the trench, except for special materials for roadways, railroads and airfields, shall be filled with satisfactory material. Backfill material shall be placed and compacted as follows:

a. Roadways, Parking Lots, Railroads, and Airfields: Backfill shall be placed up to the elevation at which the requirements in Section 02300 EARTHWORK control. Water flooding or jetting methods of compaction will not be permitted.

b. Sidewalks, Turfed or Seeded Areas and Miscellaneous Areas: Backfill shall be deposited in layers of a maximum of 12 inch loose thickness, and compacted to 85 percent maximum density for cohesive soils and 90 percent maximum density for cohesionless soils. Water flooding or jetting methods of compaction will be permitted for granular noncohesive backfill material. Water jetting shall not be allowed to penetrate the initial backfill. This requirement shall also apply to all other areas not specifically designated above.

3.2.2 Backfill for Appurtenances

After the manhole, catchbasin, inlet, or similar structure has been constructed [and the concrete has been allowed to cure for 7-days, backfill shall be placed in such a manner that the structure will not be damaged by the shock of falling earth. The backfill material shall be deposited and compacted as specified for final backfill, and shall be brought up evenly on all sides of the structure to prevent eccentric loading and excessive stress.

3.3 SPECIAL REQUIREMENTS

Special requirements for both excavation and backfill relating to the specific utilities are as follows:

3.3.1 Gas Distribution

Trenches shall be excavated to a depth that will provide not less than 18 inches of cover in rock excavation and not less than 36-inches of cover in other excavation. Trenches shall be graded as specified for pipe-laying requirements in Section 02556 GAS DISTRIBUTION SYSTEM.

3.3.2 Water Lines

Trenches shall be of a depth to provide a minimum cover of 3-feet from the existing ground surface, or from the indicated finished grade, whichever is lower, to the top of the pipe.

3.3.3 Heat Distribution System

Initial backfill material shall be free of stones larger than 1/4 inch in any dimension.

3.3.4 Electrical Distribution System

Direct burial cable and conduit or duct line shall have a minimum cover of 36-inches from the finished grade, unless otherwise indicated. Special trenching requirements for direct-burial electrical cables and conduits are specified in Section 16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND.

3.3.5 Plastic Marking Tape

Warning tapes shall be installed directly above the pipe, at a depth of 18-inches below finished grade unless otherwise shown.

3.4 TESTING

Testing shall be the responsibility of the Contractor and shall be performed at no additional cost to the Government.

3.4.1 Testing Facilities

Tests shall be performed by an approved commercial testing laboratory or may be tested by facilities furnished by the Contractor. No work requiring testing will be permitted until the facilities have been inspected and approved by the Contracting Officer.

3.4.2 Testing of Backfill Materials

Classification of backfill materials shall be determined in accordance with ASTM D 2487 and the moisture-density relations of soils shall be determined in accordance with ASTM D 1557. A minimum of one soil classification and one moisture-density relation test shall be performed on each different type of material used for bedding and backfill.

3.4.3 Field Density Tests

Tests shall be performed in sufficient numbers to ensure that the specified density is being obtained. A minimum of one field density test per lift of backfill for every 50-feet of installation shall be performed. One moisture density relationship shall be determined for every 1500 cubic yards of material used. Field in-place density shall be determined in accordance with ASTM D 1556 or ASTM D 2922. When ASTM D 2922 is used, the calibration curves shall be checked and adjusted using the sand cone method as described in paragraph Calibration of the ASTM publication. ASTM D 2922 results in a wet unit weight of soil and when using this method, ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall be checked along with density calibration checks as described in ASTM D 3017. The calibration checks of both the density and moisture gauges shall be made at the beginning of a job, on each different type of material encountered, at intervals as directed by the Contracting Officer. Copies of calibration curves, results of calibration tests, and field and laboratory density tests shall be furnished to the Contracting Officer. Trenches improperly compacted shall be reopened to the depth directed, then refilled and compacted to the density specified at no additional cost to the Government.

3.4.4 Displacement of Sewers

After other required tests have been performed and the trench backfill compacted to the finished grade surface, the pipe shall be inspected to determine whether significant displacement has occurred. This inspection shall be conducted in the presence of the Contracting Officer. Pipe sizes larger than 36 inches shall be entered and examined, while smaller diameter pipe shall be inspected by shining a light or laser between manholes or manhole locations, or by the use of television cameras passed through the pipe. If, in the judgment of the Contracting Officer, the interior of the pipe shows poor alignment or any other defects that would cause improper functioning of the system, the defects shall be remedied as directed at no additional cost to the Government.

** End of Section **

SECTION 02466
DRILLED FOUNDATION CAISSONS (PIERS)
13Sep01

1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 615/A 615M	(1996a) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 616/A 616M	(1996) Rail-Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A 617/A 617M	(1996a) Axle-Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM D 1143	(1981; R 1994) Piles Under Static Axial Compressive Load
ASTM D 1586	(1984; R 1992) Penetration Test and Split-Barrel Sampling of Soils

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1	(1996) Structural Welding Code - Steel
AWS D1.4	(1992) Structural Welding Code - Reinforcing Steel

1.2 BASIS OF BID

1.2.1 Bids

The bid shall be based on the number and total length of caissons, established by top and bottom elevations and diameters, as indicated and specified. Adjustment of the contract will be made in accordance with the CONTRACT CLAUSES, should the total length of caissons installed and approved be greater or less than the total length shown. The Contractor will not be allowed payment for rejected caissons or for those not conforming to specifications.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 00700 SUBMITTAL PROCEDURES:

SD-01 Data

Drilled Foundation Caissons; GA

A certified copy of the survey. Lines and levels shall be established and caisson centerline locations staked and maintained by a registered surveyor or engineer provided by the Contractor.

SD-08 Statements

Qualifications; FIO

Qualifications of the foundation system Contractor shall show that he has been engaged in the successful installation of drilled foundation caissons for at least 5 years.

SD-18 Records

Drilled Foundation Caissons; GA

Detailed records in an approved form, for each caisson, showing shaft and bell diameters, depths of test holes, top and bottom elevations, bearing strata description, casing description, water conditions, concrete strength, concrete volume, rock elevations, dates of excavation and concrete placement, and other pertinent information. Upon completion of caisson work, the Contractor shall provide a record of centerline locations based on the survey of the registered surveyor or engineer provided by the Contractor. In addition, corrective measures shall be similarly recorded. A complete tabulation of all records pertaining to approved caissons shall be delivered to the Contracting Officer.

1.4 QUALIFICATIONS

1.4.1 Specialty Subcontractor

The work shall be performed by a specialty subcontractor, specializing in the specified foundation system and having experience installing the specified foundation system under similar subsurface conditions.

1.4.2 Welding

Detail and field welding shall be in accordance with AWS D1.1. Qualification of welding procedures, welders, and welding operators shall be in accordance with AWS D1.1, Section 5.

Records of test results of welding procedures not prequalified and copies of records for each qualified welding operator, containing records on positions of welding and types of electrode qualifications, shall be kept by the Contractor and be available for examination by the Contracting Officer.

1.5 PROJECT/SITE CONDITIONS

1.5.1 Subsurface Data

No subsurface soil data has been obtained for the proposed project site.

1.5.2 Caisson Drilling Equipment

Caisson drilling equipment shall have the minimum torque capacity and downward force capacity for the contract site conditions.

1.6 SEQUENCE OF WORK

1.6.1 Caisson Excavation

Excavation of caissons or groups of caissons shall be performed so that reinforcing steel and concrete placement is a continuous operation performed the same day that the excavation is completed. Excavations shall not be left open overnight.

1.6.2 Acceptance

Concrete shall be placed within 3 hours after approval of the completed excavation.

1.7 SUPERVISION, INSPECTION, AND SAFETY

1.7.1 Contractor Supervision

The Contractor shall provide for the supervision of all phases of drilled pier construction. Supervision shall be the Contractor's responsibility as outlined in Quality Control provisions of the SPECIAL CONTRACT REQUIREMENTS. Each drilled pier excavation shall be checked by the Contractor for its depth, water removal, cleanup, workmanship, and for all tolerance requirements before any concrete is placed.

1.7.2 Government Inspection

The Contracting Officer will inspect each drilled pier excavation. Concrete shall not be placed until the excavation has been approved by the Contracting Officer. The Contractor shall furnish the Contracting Officer all necessary equipment required for proper inspection of drilled pier excavations.

1.7.3 Safety Precautions for Workmen and Inspectors

1.7.3.1 Life Line

Each person entering a drilled pier excavation shall be provided with a life line rigged so that the person can be immediately hoisted out of the excavation in an emergency. The life line shall be suitable for instant rescue, securely fastened to a shoulder harness, and separated from any line used to remove excavated materials. No person shall be lowered into a drilled pier excavation prior to casing the shaft through the overburden.

1.7.3.2 Ventilation

Each drilled pier excavation shall be provided with a ventilating device of sufficient capacity to assure a safe and healthy atmosphere before workmen and inspectors are permitted to enter the drilled pier excavation and during all work periods.

2 PRODUCTS

2.1 CONCRETE WORK

Concrete work shall be in accordance with requirements of Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE, as modified herein:

2.1.1 Coarse Aggregate

Maximum size of coarse aggregate shall be 1-inch.

2.1.2 Reinforcing Steel

Reinforcing steel shall conform to ASTM A 615/A 615M Grade 60. Steel shall be welded into cages in accordance with AWS D1.4 and inserted securely in the caissons, in position and alignment, as shown, prior to concrete placement.

2.1.3 Strength

Concrete strength shall be 4000 psi within 28 days. Slump shall be from 5 to 9 inches.

3 EXECUTION

3.1 PREPARATION

a. Caissons shall be excavated to established depths and dimensions shown. Bottoms of caissons shall be cleaned of loose or soft material and leveled. Excavated material shall be disposed of in accordance with Section 02300 EARTHWORK.

b. In drilling caissons, the surrounding soil and the earth walls shall be adequately and securely protected against cave-ins, displacement of the surrounding earth, and retention of ground water, by means of temporary steel casings. Casings shall have outside diameters not less than indicated shaft sizes, shall be a minimum of 1/4 inch thick, and shall not be removed if the structural integrity of the caisson will be impaired, as determined by the Contracting Officer. Temporary steel casings shall be withdrawn, as the concrete is being placed, maintaining sufficient head of concrete within the casing to prevent extraneous material from falling in from the sides and mixing with the concrete. Casings may be jerked upward a maximum of 4 inches only to break the bottom seal, but thereafter shall be removed with a smooth, continuous motion.

c. The inside of steel casings shall be thoroughly cleaned and oiled before reuse.

d. The temporary casing shall be in place from the caisson top to the ground surface until the concrete has set if the elevation of the top of the caisson is below the adjacent ground surface.

e. The outside diameter of permanent casing shall be the same as the nominal shaft diameter. Wall thickness of permanent casings shall be a minimum of ¼ - inch.

f. Water that flows into the excavations shall be continuously removed and all water shall be removed from the excavation bottom, to the extent possible, prior to concrete placement. The maximum permissible depth of water will be 2 inches. In the event of a severe water condition that makes it impossible or impractical to dewater the excavation, concrete shall be placed using underwater tremie after water movement has stabilized.

g. The bottoms of excavations indicated to be "belled" shall be enlarged to diameters and shapes shown. Bells shall be excavated or drilled in a similar manner to that used for shafts.

h. The excavations for caissons indicated to be shall be of the dimensions and shapes indicated.

i. Each caisson excavation will be inspected and approved by the Contracting Officer prior to placing concrete. A record of all inspections, with related construction changes, shall be kept by the Contractor. The Contractor shall provide support personnel for inspection and testing procedures.

3.2 INSTALLATION

a. Concrete shall be continuously placed by methods that ensure against segregation and dislodging of excavation sidewalls, and shall completely fill the shaft. Concrete shall be placed by pumping or drop chutes in dry holes and by tremie or pumping in wet holes. The discharge shall be kept a minimum of 3 feet below the fresh

concrete surface during placement. Drilling of caissons or driving of casings shall not be within 20 feet of concrete placed within the last 3 days.

b. Concrete shall be brought to a true level surface inside the shaft and a full width cross key formed, or dowels installed, should it become necessary to interrupt placing concrete in any caisson. Prior to placing additional concrete, surfaces shall be cleaned of laitance and slush with one-to-one portland cement grout. The grout shall have a water-cement ratio not exceeding that of the concrete.

c. Concrete in dry batter caissons shall be placed with a drop chute extending within 3 feet of the concrete surface in the excavation.

d. Concrete shall be vibrated for full height.

3.3 TOLERANCES

a. Any caisson out of center or plumb beyond the tolerance specified shall be corrected as necessary to comply with the tolerances and the Contractor shall bear any cost of correction.

b. Cross sections of shafts and bells shall not be less than design dimensions.

c. Caissons shall be installed with top location deviating a maximum of 1 inch from centerline locations.

d. Vertical caissons shall be installed plumb within a maximum of 1-1/2 inches for the first 10 feet and within l/2 inch for each 10 feet of additional depth.

e. Batter caissons shall be installed a maximum of 2 percent of length from specified inclination.

3.4 PROTECTION

Protection shall be provided around top of the excavation to prevent debris from being dislodged into the excavation and concrete.

** End of Section **

SECTION 02510
WATER DISTRIBUTION SYSTEM
04/98

1 GENERAL

1.1 REFERENCES

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

AMERICAN RAILWAY ENGINEERING & MAINTENANCE-OF-WAY ASSOCIATION (AREMA)

AREMA Manual	(1999) 1998-1999 Manual for Railway Engineering (Fixed Properties) 4 Vol.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M	(1997a) Carbon Structural Steel
ASTM A 53	(1998) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded, and Seamless
ASTM B 88	(1996) Seamless Copper Water Tube
ASTM B 88M	(1996) Seamless Copper Water Tube (Metric)
ASTM C 76	(1998) Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C 76M	(1997) Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe (Metric)
ASTM D 1599	(1988; R 1995) Short-Time Hydraulic Failure Pressure of Plastic Pipe, Tubing, and Fittings
ASTM D 1784	(1996) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 1785	(1996b) Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2241	(1996b) Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)

ASTM D 2464	(1996a) Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2466	(1997) Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2467	(1996a) Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2564	(1996a) Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D 2657	(1997) Heat Fusion Joining Polyolefin Pipe and Fittings
ASTM D 2774	(1994) Underground Installation of Thermoplastic Pressure Piping
ASTM D 2855	(1996) Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D 2996	(1995) Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe
ASTM D 2997	(1995) Centrifugally Cast "Fiberglass" (Glass-Fiber-Reinforced-Thermosetting-Resin) Pipe
ASTM D 3139	(1998) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D 3839	(1994a) Underground Installation of "Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Pipe
ASTM F 477	(1996a) Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F 1483	(1998) Oriented Poly(Vinyl Chloride), PVCO, Pressure Pipe

ASME INTERNATIONAL (ASME)

ASME B1.20.1	(1983; R 1992) Pipe Threads, General Purpose (Inch)
ASME B16.1	(1989) Cast Iron Pipe Flanges and Flanged Fittings
ASME B16.3	(1992) Malleable Iron Threaded Fittings

ASME B16.26	(1988) Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B36.10M	(1996) Welded and Seamless Wrought Steel Pipe

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA B300	(1992) Hypochlorites
AWWA B301	(1992) Liquid Chlorine
AWWA C104	(1995) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C105	(1993) Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA C110	(1993) Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (75 mm through 1200 mm), for Water and Other Liquids
AWWA C111	(1995) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115	(1996) Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges
AWWA C151	(1996) Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids
AWWA C153	(1994; Errata Nov 1996) Ductile-Iron Compact Fittings, 3 In. Through 24 In. (76 mm through 610 mm) and 54 In. through 64 In. (1,400 mm through 1,600 mm) for Water Service
AWWA C200	(1997) Steel Water Pipe - 6 In. (150 mm) and Larger
AWWA C203	(1997) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied
AWWA C205	(1995) Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 In. (100 mm) and Larger - Shop Applied

AWWA C207	(1994) Steel Pipe Flanges for Waterworks Service - Sizes 4 In. Through 144 In. (100 mm through 3,600 mm)
AWWA C208	(1996) Dimensions for Fabricated Steel Water Pipe Fittings
AWWA C300	(1997) Reinforced Concrete Pressure Pipe, Steel-Cylinder Type, for Water and Other Liquids
AWWA C301	(1992) Prestressed Concrete Pressure Pipe, Steel-Cylinder Type, for Water and Other Liquids
AWWA C303	(1995) Concrete Pressure Pipe, Bar-Wrapped, Steel Cylinder Type
AWWA C500	(1993; C500a) Metal-Sealed Gate Valves for Water Supply Service
AWWA C502	(1994; C502a) Dry-Barrel Fire Hydrants
AWWA C503	(1997) Wet-Barrel Fire Hydrants
AWWA C504	(1994) Rubber-Seated Butterfly Valves
AWWA C509	(1994) Resilient-Seated Gate Valves for Water Supply Service
AWWA C600	(1993) Installation of Ductile-Iron Water Mains and Their Appurtenances
AWWA C606	(1997) Grooved and Shouldered Joints
AWWA C651	(1992) Disinfecting Water Mains
AWWA C700	(1995) Cold-Water Meters - Displacement Type, Bronze Main Case
AWWA C701	(1988) Cold-Water Meters - Turbine Type, for Customer Service
AWWA C702	(1992) Cold-Water Meters - Compound Type
AWWA C703	(1996) Cold-Water Meters - Fire Service Type
AWWA C704	(1992) Propeller-Type Meters Waterworks Applications

AWWA C706	(1996) Direct-Reading, Remote-Registration Systems for Cold-Water Meters
AWWA C707	(1982; R 1992) Encoder-Type Remote-Registration Systems for Cold-Water Meters
AWWA C800	(1989) Underground Service Line Valves and Fittings
AWWA C900	(1997; C900a Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. Through 12 In., for Water Distribution
AWWA C901	(1996) Polyethylene (PE) Pressure Pipe and Tubing, 1/2 In. Through 3 In., for Water Service
AWWA C905	(1997) Polyvinyl Chloride (PVC) Water Transmission Pipe, Nominal Diameters 14 In. Through 36 In.
AWWA C950	(1995) Fiberglass Pressure Pipe
AWWA M23	(1980) Manual: PVC Pipe - Design and Installation

ASBESTOS CEMENT PIPE PRODUCERS ASSOCIATION (ACPPA)

ACPPA Work Practices	(1988) Recommended Work Practices for A/C Pipe

DUCTILE IRON PIPE RESEARCH ASSOCIATION (DIPRA)

DIPRA-Restraint Design	(1997) Thrust Restraint Design for Ductile Iron Pipe

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

MSS SP-80	(1997) Bronze Gate, Globe, Angle and Check Valves

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 24	(1995) Installation of Private Fire Service Mains and Their Appurtenances
NFPA 49	(1994) Hazardous Chemicals Data
NFPA 325-1	(1994) Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids

NFPA 704	(1996) Identification of the Fire Hazards of Materials for Emergency Response
NFPA 1961	(1997) Fire Hose

NSF INTERNATIONAL (NSF)

NSF 14	(1998) Plastics Piping Components and Related Materials
NSF 61	(1998) Drinking Water System Components - Health Effects (Sections 1-9)

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC Paint 21	(1991) White or Colored Silicone Alkyd Paint
SSPC Paint 25	(1991) Red Iron Oxide, Zinc Oxide, Raw Linseed Oil and Alkyd Primer (Without Lead and Chromate Pigments)

1.2 PIPING

This section covers water distribution and service lines, and connections to building service at a point approximately 5 feet outside buildings and structures to which service is required. The Contractor shall have a copy of the manufacturer's recommendations for each material or procedure to be utilized available at the construction site at all times.

1.2.1 Water Service Lines

Piping for water service lines less than 3 inches in diameter shall be polyvinyl chloride (PVC) plastic, Oriented PVC plastic polyethylene, or copper tubing, unless otherwise shown or specified. Piping for water service lines 3 inches and larger shall be polyvinyl chloride (PVC) plastic, filament-wound or centrifugally cast reinforced thermosetting resin, or reinforced plastic mortar pressure pipe, unless otherwise shown or specified.

1.2.2 Distribution Lines 3 Inches or Larger

Piping for water distribution lines 3 inches or larger shall be polyvinyl chloride (PVC) through 36 inch nominal diameter plastic, Oriented PVC plastic filament-wound or centrifugally cast reinforced thermosetting resin, reinforced plastic mortar pressure pipe, or reinforced concrete, unless otherwise shown or specified.

1.2.3 Potable Water Lines

Piping and components of potable water systems which come in contact with the potable water shall conform to NSF 61.

1.2.4 Plastic Piping System

Plastic piping system components (PVC, polyethylene, thermosetting resin and reinforced plastic mortar pressure) intended for transportation of potable water shall comply with NSF 14 and be legibly marked with their symbol.

1.2.5 Excavation, Trenching, and Backfilling

Excavation, trenching, and backfilling shall be in accordance with the applicable provisions of Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS, except as modified herein.

1.3 MANUFACTURER'S REPRESENTATIVE

The Contractor shall have a manufacturer's field representative present at the jobsite during the installation and testing of PE, RTRP, and/or RPMP pipe to provide technical assistance and to verify that the materials are being installed in accordance with the manufacturer's prescribed procedures. When the representative feels that the Contractor is installing and testing the PE, RTRP, and/or RPMP pipe in a satisfactory manner, certification shall be written to note which individuals employed by the Contractor are capable of properly installing the pipe. The field representative shall advise the Contractor of unsatisfactory conditions immediately when they occur. Such conditions include improper diameter of pipe ends, damaged interior liner, poorly prepared joints, improper curing of joints, moving pipe before joints are cured, bending pipe to follow abrupt changes in trench contours, leaving pipe ends open in trench overnight, not properly drying joints after rain storms, exceeding effective adhesive life, sharp objects in trench bed, backfill that could damage pipe, improper procedure for concrete encasement of pipe, omission of thrust blocks at changes in direction or any other condition which could have an adverse effect on the satisfactory completion and operation of the piping system.

1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 00700 SUBMITTAL PROCEDURES:

SD-06 Instructions

Installation; FIO.

The manufacturer's recommendations for each material or procedure to be utilized.

SD-08 Statements

Waste Water Disposal Method; GA.

The method proposed for disposal of waste water from hydrostatic tests and disinfection, prior to performing hydrostatic tests.

Satisfactory Installation; FIO.

A statement signed by the principal officer of the contracting firm stating that the installation is satisfactory and in accordance with the contract drawings and specifications, and the manufacturer's prescribed procedures and techniques, upon completion of the project and before final acceptance.

SD-09 Reports

Bacteriological Disinfection; GA.

Test results from commercial laboratory verifying disinfection.

SD-13 Certificates

Manufacturer's Representative; FIO.

The name and qualifications of the manufacturer's representative and written certification from the manufacturer that the representative is technically qualified in all phases of PE, RTRP, and/or RPMP pipe laying and jointing and experienced to supervise the work and train the Contractor's field installers, prior to commencing installation.

Installation; FIO.

A statement signed by the manufacturer's field representative certifying that the Contractor's personnel are capable of properly installing the pipe on the project.

Meters; FIO.

Manufacturer's certificate stating that each meter furnished has been tested for accuracy of registration and compliance with the accuracy and capacity requirements of the appropriate AWWA standard.

1.5 HANDLING

Pipe and accessories shall be handled to ensure delivery to the trench in sound, undamaged condition, including no injury to the pipe coating or lining. If the coating or lining of any pipe or fitting is damaged, the repair shall be made by the Contractor in a satisfactory manner, at no additional cost to the Government. No other pipe or material shall be placed inside a pipe or fitting after the coating has been applied. Pipe shall be carried into position and not dragged. Use of pinch bars and tongs for aligning or turning pipe will be permitted only on the bare

ends of the pipe. The interior of pipe and accessories shall be thoroughly cleaned of foreign matter before being lowered into the trench and shall be kept clean during laying operations by plugging or other approved method. Before installation, the pipe shall be inspected for defects. Material found to be defective before or after laying shall be replaced with sound material without additional expense to the Government. Rubber gaskets that are not to be installed immediately shall be stored in a cool and dark place.

1.5.1 Coated and Wrapped Steel Pipe

Coated and wrapped steel pipe shall be handled in conformance with AWWA C203.

1.5.2 Polyethylene (PE) Pipe Fittings and Accessories

PE pipe, fittings, and accessories shall be handled in conformance with AWWA C901.

1.5.3 Miscellaneous Plastic Pipe and Fittings

Polyvinyl Chloride (PVC), Reinforced Thermosetting Resin Pipe (RTRP), and Reinforced Plastic Mortar Pressure (RPMP) pipe and fittings shall be handled and stored in accordance with the manufacturer's recommendations. Storage facilities shall be classified and marked in accordance with NFPA 704, with classification as indicated in NFPA 49 and NFPA 325-1.

2 PRODUCTS

2.1 PIPE

Pipe shall conform to the respective specifications and other requirements specified below.

2.1.1 Reinforced and Prestressed Concrete Pipe

Steel cylinder reinforced concrete pipe shall conform to AWWA C300, AWWA C301, or AWWA C303 and shall be designed to withstand a working pressure of not less than 150 psi unless otherwise shown or specified.

2.1.2 Plastic Pipe

2.1.2.1 PE Plastic Pipe

Pipe, tubing, and heat-fusion fittings shall conform to AWWA C901.

2.1.2.2 PVC Plastic Pipe

Pipe, couplings and fittings shall be manufactured of material conforming to ASTM D 1784, Class 12454B.

a. Pipe Less Than 4 inch Diameter:

(1) Screw-Joint: Pipe shall conform to dimensional requirements of ASTM D 1785 Schedule 80, with joints meeting requirements of 150 psi working pressure, 200 psi hydrostatic test pressure, unless otherwise shown or specified. Pipe couplings when used, shall be tested as required by ASTM D 2464.

(2) Elastomeric-Gasket Joint: Pipe shall conform to dimensional requirements of ASTM D 1785 Schedule 40, with joints meeting the requirements of 150 psi working pressure, 200 psi hydrostatic test pressure, unless otherwise shown or specified, or it may be pipe conforming to requirements of ASTM D 2241, elastomeric joint, with the following applications:

(3) Solvent Cement Joint: Pipe shall conform to dimensional requirements of ASTM D 1785 or ASTM D 2241 with joints meeting the requirements of 150 psi working pressure and 200 psi hydrostatic test pressure.

b. Pipe 4 through 12 inch Diameter: Pipe, couplings and fittings shall conform to AWWA C900, Class 150, CIOD pipe dimensions, elastomeric-gasket joint, unless otherwise shown or specified.

c. Pipe 14 through 36 inch Diameter: Pipe shall conform to AWWA C905 unless otherwise shown or specified.

2.1.2.3 Oriented Polyvinyl Chloride (PVCO) Plastic Pipe

Pipe, couplings, and fittings shall be manufactured of material conforming to ASTM D 1784, Class 1245B. Pipe shall conform to AWWA C900, Class 150, and to ASTM F 1483 and shall have an outside diameter equal to cast iron outside diameter.

2.1.3 Reinforced Plastic Mortar Pressure (RPMP) Pipe

AWWA C950.

2.1.4 Reinforced Thermosetting Resin Pipe (RTRP)

Pipe shall have a quick-burst strength greater than or equal to four times the normal working pressure of the pipe. The quick-burst strength test shall conform to the requirements of ASTM D 1599.

2.1.4.1 RTRP-I

RTRP-I shall conform to ASTM D 2996, except pipe shall have an outside diameter equal to cast iron outside diameter or standard weight steel pipe. The pipe shall be suitable for a normal working pressure of 150 psi at 73 degrees F. The inner surface of the pipe shall have a smooth uniform continuous resin-rich surface liner conforming to ASTM D 2996.

2.1.4.2 RTRP-II

RTRP-II shall conform to ASTM D 2997. Pipe shall have an outside diameter equal to standard weight steel pipe.

2.1.5 Copper Tubing

Copper tubing shall conform to ASTM B 88, Type K, annealed.

2.2 FITTINGS AND SPECIALS

2.2.1 Reinforced Concrete Pipe System

Fittings and specials required for closures, curves, bends, branches and connections to valves, pipe, or structures shall be approved by the Contracting Officer and conform to the details furnished by the manufacturer and to AWWA C300, AWWA C301, or AWWA C303, as applicable.

2.2.2 PVC Pipe System

a. For pipe less than 4 inch diameter, fittings for threaded pipe shall conform to requirements of ASTM D 2464, threaded to conform to the requirements of ASME B1.20.1 for use with Schedule 80 pipe and fittings; fittings for solvent cement jointing shall conform to ASTM D 2466 or ASTM D 2467; and fittings for elastomeric-gasket joint pipe shall be iron conforming to AWWA C110 or AWWA C111. Iron fittings and specials shall be cement-mortar lined (standard thickness) in accordance with AWWA C104.

b. For pipe 4 inch diameter and larger, fittings and specials shall be iron, bell end in accordance with AWWA C110, 150 psi pressure rating unless otherwise shown or specified, except that profile of bell may have special dimensions as required by the pipe manufacturer; or fittings and specials may be of the same material as the pipe with elastomeric gaskets, all in conformance with AWWA C900. Iron fittings and specials shall be cement-mortar lined (standard thickness) in accordance with AWWA C104. Fittings shall be bell and spigot or plain end pipe, or as applicable. Ductile iron compact fittings shall be in accordance with AWWA C153.

2.2.3 RTRP and RPMP Pipe

Fittings and specials shall be compatible with the pipe supplied. Filament wound or molded fittings up to 6 inches shall conform to AWWA C950. Iron fittings shall be cement-mortar lined in accordance with AWWA C104 and shall conform to AWWA C110 and AWWA C111. Fittings shall be suitable for working and testing pressures specified for the pipe.

2.2.4 Copper Tubing System

Fittings and specials shall be flared and conform to ASME B16.26.

2.3 JOINTS

2.3.1 Gaskets for Reinforced Concrete Pipe

Rubber-gasket joints shall be of the type using a bell-and-spigot joint design of steel. The gaskets shall conform to AWWA C300, AWWA C301, or AWWA C303, as applicable.

2.3.2 Plastic Pipe Jointing

2.3.2.1 PE Pipe

Joints for pipe fittings and couplings shall be strong tight joints as specified for PE in Paragraph INSTALLATION. Joints connecting pipe of differing materials shall be made in accordance with the manufacturer's recommendation, and as approved by the Contracting Officer.

2.3.2.2 PVC Pipe

Joints, fittings, and couplings shall be as specified for PVC pipe. Joints connecting pipe of differing materials shall be made in accordance with the manufacturer's recommendations, and as approved by the Contracting Officer.

2.3.2.3 PVCO Pipe

Joints shall conform to ASTM D 3139. Elastomeric gaskets shall conform to ASTM F 477.

2.3.3 RPMP Pipe

Joints shall be mechanical or bell and spigot type with elastomeric gasket.

2.3.4 RTRP Pipe

2.3.4.1 RTRP-I, Grade 1 and 2

Joints shall be bell and spigot with elastomeric gasket, mechanical coupling with elastomeric gasket, threaded and bonded coupling, or tapered bell and spigot with compatible adhesive. All RTRP-I materials shall be products of a single manufacturer.

2.3.4.2 RTRP-II, Grade 1 and 2

Joints shall be the bell and spigot type with elastomeric gasket, bell and spigot with adhesive, butt-jointed with adhesive bonded reinforced overlay, mechanical, flanged, threaded or

commercially available proprietary joints, provided they are capable of conveying water at the pressure and temperature of the pipe.

2.3.5 Isolation Joints

Isolation joints shall be installed between nonthreaded ferrous and nonferrous metallic pipe, fittings and valves. Isolation joints shall consist of a sandwich-type flange isolation gasket of the dielectric type, isolation washers, and isolation sleeves for flange bolts. Isolation gaskets shall be full faced with outside diameter equal to the flange outside diameter. Bolt isolation sleeves shall be full length. Units shall be of a shape to prevent metal-to-metal contact of dissimilar metallic piping elements.

a. Sleeve-type couplings shall be used for joining plain end pipe sections. The two couplings shall consist of one steel middle ring, two steel followers, two gaskets, and the necessary steel bolts and nuts to compress the gaskets.

b. Split-sleeve type couplings may be used in aboveground installations when approved in special situations and shall consist of gaskets and a housing in two or more sections with the necessary bolts and nuts.

2.3.6 Copper Tubing Jointing

Joints shall be compression-pattern flared and shall be made with the specified fittings.

2.4 VALVES

2.4.1 Check Valves

Check valves shall be designed for a minimum working pressure of 150 psi or as indicated. Valves shall have a clear waterway equal to the full nominal diameter of the valve. Valves shall open to permit flow when inlet pressure is greater than the discharge pressure, and shall close tightly to prevent return flow when discharge pressure exceeds inlet pressure. The size of the valve, working pressure, manufacturer's name, initials, or trademark shall be cast on the body of each valve. Valves 2 inches and larger shall be outside lever and spring type.

a. Valves 2 inches and smaller shall be all bronze designed for screwed fittings, and shall conform to MSS SP-80, Class 150, Types 3 and 4 as suitable for the application.

b. Valves larger than 2 inches shall be iron body, bronze mounted, shall have flanged ends, and shall be the non-slam type. Flanges shall be the Class 125 type conforming to ASME B16.1.

2.4.2 Gate Valves

Gate valves shall be designed for a working pressure of not less than 150 psi. Valve connections shall be as required for the piping in which they are installed. Valves shall have a

clear waterway equal to the full nominal diameter of the valve, and shall be opened by turning counterclockwise. The operating nut or wheel shall have an arrow, cast in the metal, indicating the direction of opening.

a. Valves smaller than 3 inches shall be all bronze and shall conform to MSS SP-80, Type 1, Class 150.

b. Valves 3 inches and larger shall be iron body, bronze mounted, and shall conform to AWWA C500. Flanges shall not be buried. An approved pit shall be provided for all flanged connections.

c. Resilient-Seated Gate Valves: For valves 3 to 12 inches in size, resilient-seated gate valves shall conform to AWWA C509.

2.4.3 Rubber-Seated Butterfly Valves

Rubber-seated butterfly valves shall conform to the performance requirements of AWWA C504. Wafer type valves conforming to the performance requirements of AWWA C504 in all respects, but not meeting laying length requirements will be acceptable if supplied and installed with a spacer providing the specified laying length. All tests required by AWWA C504 shall be met. Flanged-end valves shall be installed in an approved pit and provided with a union or sleeve-type coupling in the pit to permit removal. Mechanical-end valves 3 through 10 inches in diameter may be direct burial if provided with a suitable valve box, means for manual operation, and an adjacent pipe joint to facilitate valve removal. Valve operators shall restrict closing to a rate requiring approximately 60 seconds, from fully open to fully closed.

2.4.4 Pressure Reducing Valves

Where indicated, pressure reducing valves shall maintain a constant downstream pressure regardless of fluctuations in demand. Valves shall be suitable for indicated psi operating pressure on the inlet side, with outlet pressure set for Indicated psi. The valves shall be of the hydraulically-operated, pilot controlled, globe or angle type, and may be actuated either by diaphragm or piston. The pilot control shall be the diaphragm-operated, adjustable, spring-loaded type, designed to permit flow when controlling pressure exceeds the spring setting. Ends shall be flanged. Valve bodies shall be bronze, cast iron or cast steel with bronze trim. Valve stem shall be stainless steel. Valve discs and diaphragms shall be synthetic rubber. Valve seats shall be bronze. Pilot controls shall be bronze with stainless steel working parts.

2.4.5 Vacuum and Air Relief Valves

Vacuum and air relief valves shall be of the size shown and shall be of a type that will release air and prevent the formation of a vacuum. The valves shall automatically release air when the lines are being filled with water and shall admit air into the line when water is being withdrawn in excess of the inflow. Valves shall be iron body with bronze trim and stainless steel float.

2.4.6 Indicator Post for Valves

Each valve shown on the drawings with the designation "P.I.V." shall be equipped with indicator post conforming to the requirements of NFPA 24. Operation shall be by a wrench which shall be attached to each post.

2.5 VALVE BOXES

Valve boxes shall be cast iron or concrete, except that concrete boxes may be installed only in locations not subjected to vehicular traffic. Cast-iron boxes shall be extension type with slide-type adjustment and with flared base. The minimum thickness of metal shall be 3/16 inch. Concrete boxes shall be the standard product of a manufacturer of precast concrete equipment. The word "WATER" shall be cast in the cover. The box length shall adapt, without full extension, to the depth of cover required over the pipe at the valve location.

2.6 VALVE PITS

Valve pits shall be constructed at locations indicated or as required above and in accordance with the details shown. Concrete shall have compressive strength of 3000 psi in accordance with Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE.

2.7 FIRE HYDRANTS

Hydrants shall be dry-barrel type conforming to AWWA C502 with valve opening at least 5 inches in diameter and designed so that the flange at the main valve seat can be removed with the main valve seat apparatus remaining intact, closed and reasonably tight against leakage and with a breakable valve rod coupling and breakable flange connections located no more than 8 inches above the ground grade. Hydrants shall have a 6 inch bell connection, two 2-1/2 inch hose connections and one 4-1/2 inch pumper connection. Outlets shall have American National Standard fire-hose coupling threads. Working parts shall be bronze. Design, material, and workmanship shall be equal to the latest stock pattern ordinarily produced by the manufacturer. Hydrants shall be painted with 1 coat of red iron oxide, zinc oxide primer conforming to SSPC Paint 25 and 2 finish coats of silicone alkyd paint conforming to SSPC Paint 21, of the installation's standard colors or as directed by the Contracting Officer. Suitable bronze adapter for the 4-1/2 inch outlet, with caps, shall be furnished.

2.8 FIRE-HYDRANT HOSE HOUSES

Hose houses conforming to the requirements of NFPA 24 shall be furnished at each fire hydrant indicated on the drawings to have a fire-hydrant hose house. The following equipment, in addition to that listed in NFPA 24, paragraph 5-6.1, shall be furnished with each hose house:

a. 200 feet of 2-1/2 inch, woven jacketed, rubber lined hose conforming to NFPA 1961 with a minimum service test pressure of 300 psi.

b. 100 feet of 1-1/2 inch, woven jacketed, rubber lined hose conforming to NFPA 1961 with a minimum service test pressure of 300 psi.

c. One gated 2-1/2 by 1-1/2 by 1-1/2 inch wye.

d. One playpipe for 2-1/2 inch hose with 1 inch shutoff nozzle tip.

e. One playpipe for 1-1/2 inch hose with 1/2 inch shutoff nozzle or combination nozzle.

f. Two adapter fittings, 2-1/2 to 1-1/2 inch.

g. Two spanners for 1-1/2 inch hose.

2.9 MISCELLANEOUS ITEMS

2.9.1 Service Clamps

Service clamps shall have a pressure rating not less than that of the pipe to be connected and shall be either the single or double flattened strap type. Clamps shall have a galvanized malleable-iron body with cadmium plated straps and nuts. Clamps shall have a rubber gasket cemented to the body.

2.9.2 Corporation Stops

Corporation stops shall have standard corporation stop thread conforming to AWWA C800 on the inlet end, with flanged joints, compression pattern flared tube couplings, or wiped joints for connections to goosenecks.

2.9.3 Goosenecks

Copper tubing for gooseneck connections shall conform to the applicable requirements of ASTM B 88, Type K, annealed. Length of cable requirement connections shall be in accordance with standard practice.

2.9.4 Service Stops

Service stops shall be water-works inverted-ground-key type, oval or round flow way, tee handle, without drain. Pipe connections shall be suitable for the type of service pipe used. All parts shall be of bronze with female iron-pipe-size connections or compression-pattern flared tube couplings, and shall be designed for a hydrostatic test pressure not less than 200 psi.

2.9.5 Tapping Sleeves

Tapping sleeves of the sizes indicated for connection to existing main shall be the cast gray, ductile, or malleable iron, split-sleeve type with flanged or grooved outlet, and with bolts,

follower rings and gaskets on each end of the sleeve. Construction shall be suitable for a maximum working pressure of 150 psi. Bolts shall have square heads and hexagonal nuts. Longitudinal gaskets and mechanical joints with gaskets shall be as recommended by the manufacturer of the sleeve. When using grooved mechanical tee, it shall consist of an upper housing with full locating collar for rigid positioning which engages a machine-cut hole in pipe, encasing an elastomeric gasket which conforms to the pipe outside diameter around the hole and a lower housing with positioning lugs, secured together during assembly by nuts and bolts as specified, pretorqued to 50 foot-pound.

2.9.6 Service Boxes

Service boxes shall be cast iron or concrete and shall be extension service boxes of the length required for the depth of the line, with either screw or slide-type adjustment. The boxes shall have housings of sufficient size to completely cover the service stop or valve and shall be complete with identifying covers.

2.9.7 Disinfection

Chlorinating materials shall conform to the following:

Chlorine, Liquid: AWWA B301.

Hypochlorite, Calcium and Sodium: AWWA B300.

2.9.8 Meters

Meters shall be the type and size shown on the drawings or specified. Meters of each of the various types furnished and installed shall be supplied by one manufacturer.

2.9.8.1 Displacement Type

Displacement type meters shall conform to AWWA C700. Registers shall be straight-reading and shall read in U.S. gallons . Meters in sizes 1/2 through 1 inch shall be frost-protection design. Connections shall be suitable to the type of pipe and conditions encountered. Register type shall be a direct reading remote register designed in accordance with AWWA C706. Meters shall comply with the accuracy and capacity requirements of AWWA C700.

2.9.8.2 Turbine Type

Turbine type meters shall conform to AWWA C701 Class II. The main casing shall be bronze with stainless steel external fasteners. Registers shall be straight-reading type, shall be permanently sealed and shall read in U.S. gallons. Connections shall be suitable to the type of pipe and conditions encountered. Register type shall be a direct reading remote register designed in accordance with AWWA C706 or an encoder type remote register designed in accordance with AWWA C707. Meters shall comply with the accuracy and capacity requirements of AWWA C701.

2.9.8.3 Compound Type

Compound type meters shall conform to AWWA C702 and shall be furnished with strainers. The main casing shall be bronze with stainless steel external fasteners. The main casing shall be tapped for field testing purposes. Registers shall be straight-reading type, shall be permanently sealed and shall read in U.S. gallons. The meter shall be equipped with a coordinating register. Connections shall be suitable to the type of pipe and conditions encountered. Register type shall be a direct reading remote register designed in accordance with AWWA C706 or an encoder type remote register designed in accordance with AWWA C707. Meters shall comply with the accuracy and capacity requirements of AWWA C702.

2.9.8.4 Fire Service Type

Fire service type meters shall be proportional type conforming to AWWA C703 and shall-be furnished with strainers. The main casing shall be bronze with stainless steel external fasteners. Registers shall be straight-reading type, shall be permanently sealed and shall read in U.S. gallons. The meter shall be equipped with a coordinating register. Connections shall be suitable to the type of pipe and conditions encountered. Register type shall be a direct reading remote register designed in accordance with AWWA C706 or an encoder type remote register designed in accordance with AWWA C707. Meters shall comply with the accuracy and capacity requirements of AWWA C703. When turbine type main line meters are used, the meter shall be supplied with a separate check valve, as a unit.

2.9.8.5 Propeller Type

Propeller type meters shall conform to AWWA C704. Registers shall be straight-reading type, shall be permanently sealed and shall read in U.S. gallons. Connections shall be suitable to the type of pipe and conditions encountered. Register type shall be a direct-reading remote register designed in accordance with AWWA C706 or an encoder-type remote register designed in accordance with AWWA C707. Meters shall comply with the accuracy and capacity requirements of AWWA C703.

3 EXECUTION

3.1 INSTALLATION

3.1.1 Cutting of Pipe

Cutting of pipe shall be done in a neat and workmanlike manner without damage to the pipe. Unless otherwise recommended by the manufacturer and authorized by the Contracting Officer, cutting shall be done with an approved type mechanical cutter. Wheel cutter shall be used when practicable. Copper tubing shall be cut square and all burrs shall be removed. Squeeze type mechanical cutters shall not be used for ductile iron.

3.1.2 Adjacent Facilities

3.1.2.1 Sewer Lines

Where the location of the water pipe is not clearly defined in dimensions on the drawings, the water pipe shall not be laid closer horizontally than 10 feet from a sewer except where the bottom of the water pipe will be at least 12 inches above the top of the sewer pipe, in which case the water pipe shall not be laid closer horizontally than 6 feet from the sewer. Where water lines cross under gravity-flow sewer lines, the sewer pipe, for a distance of at least 10 feet each side of the crossing, shall be fully encased in concrete or shall be made of pressure pipe with no joint located within 3 feet horizontally of the crossing. Water lines shall in all cases cross above sewage force mains or inverted siphons and shall be not less than 2 feet above the sewer main. Joints in the sewer main, closer horizontally than 3 feet to the crossing, shall be encased in concrete.

3.1.2.2 Water Lines

Water lines shall not be laid in the same trench with sewer lines, gas lines, fuel lines, or electric wiring.

3.1.2.3 Copper Tubing Lines

Copper tubing shall not be installed in the same trench with ferrous piping materials.

3.1.2.4 Nonferrous Metallic Pipe

Where nonferrous metallic pipe, e.g. copper tubing, crosses any ferrous piping material, a minimum vertical separation of 12 inches shall be maintained between pipes.

3.1.2.5 Casing Pipe

Water pipe shall be encased in a sleeve of rigid conduit for the lengths shown. Sleeves under railroads shall be in accordance with the criteria contained in AREMA Manual, Part 5. Where sleeves are required, in all other cases, the pipe sleeve shall be reinforced concrete in accordance with ASTM C 76, Class V . A minimum clearance of at least 2 inches between the inner wall of the sleeve and the maximum outside diameter of the sleeved pipe and joints shall be provided. Sand bedding or suitable pipe support shall be provided for the water pipe through the sleeve.

3.1.2.6 Structures

Where water pipe is required to be installed within 3 feet of existing structures, the water pipe shall be sleeved as required in Paragraph "Casing Pipe". The Contractor shall install the water pipe and sleeve ensuring that there will be no damage to the structures and no settlement or movement of foundations or footings.

3.1.3 Joint Deflection

3.1.3.1 Allowable for Reinforced Concrete Pipe

Maximum allowable deflections from a straight line or grade, as required by vertical curves, horizontal curves, or offsets, shall be 5 degrees for reinforced concrete pipe unless a lesser amount is recommended by the manufacturer. Long radius curves in reinforced concrete pipe shall be formed by straight pipe in which spigot rings are placed on a bevel. Slight deflections may be made by straight pipe, provided that the maximum joint opening caused by such deflection does not exceed the maximum recommended by the pipe manufacturer. Short radius curves and closures shall be formed by shorter lengths of pipe, bevels, or fabricated specials specified.

3.1.3.2 Offset for Flexible Plastic Pipe

Maximum offset in alignment between adjacent pipe joints shall be as recommended by the manufacturer and approved by the Contracting Officer, but shall not exceed 5 degrees.

3.1.4 Placing and Laying

Pipe and accessories shall be carefully lowered into the trench by means of derrick, ropes, belt slings, or other authorized equipment. Water-line materials shall not be dropped or dumped into the trench. Abrasion of the pipe coating shall be avoided. Except where necessary in making connections with other lines or as authorized by the Contracting Officer, pipe shall be laid with the bells facing in the direction of laying. The full length of each section of pipe shall rest solidly upon the pipe bed, with recesses excavated to accommodate bells, couplings, and joints. Pipe that has the grade or joint disturbed after laying shall be taken up and relaid. Pipe shall not be laid in water or when trench conditions are unsuitable for the work. Water shall be kept out of the trench until joints are complete. When work is not in progress, open ends of pipe, fittings, and valves shall be securely closed so that no trench water, earth, or other substance will enter the pipes or fittings. Where any part of the coating or lining is damaged, the repair shall be made by and at the Contractor's expense in a satisfactory manner. Pipe ends left for future connections shall be valved, plugged, or capped, and anchored, as shown.

3.1.4.1 Reinforced Concrete Pipe Installation

Reinforced concrete pipe shall be installed in accordance with recommendations of the pipe manufacturer. Before laying reinforced concrete pipe, the outside surface of the spigot and the inside surface of the bell shall be cleaned and an acceptable vegetable-compound lubricant applied to the inside surface of the bell and to the rubber gasket. Where prescribed by the pipe manufacturer, the gasket shall be placed in the groove on the end of the pipe before the pipe is placed in the trench. After the pipe has been forced together, the position of the rubber gasket shall be checked with a feeler gauge in accordance with the pipe manufacturer's recommendations. Tapping of reinforced concrete cylinder pipe shall be done in accordance with the manufacturer's approved recommendations. Where the manufacturer recommends

that the taps be made by attaching the rubber-gasketed saddle to the outside of the pipe using U-bolts, the saddle shall be grouted in if necessary, the mortar coating shall be chipped away, even with the hole in the saddle plate. The exposed circumferential wires shall be removed and the cylinder and concrete core drilled out, and the steel saddle and U-bolts shall be protected by concrete encasement.

3.1.4.2 Plastic Pipe Installation

RTRP shall be installed in accordance with ASTM D 3839. RPMP shall be installed in accordance with the manufacturer's recommendations. PE Pipe shall be installed in accordance with ASTM D 2774. PVC pipe shall be installed in accordance with AWWA M23.

3.1.4.3 Piping Connections

Where connections are made between new work and existing mains, the connections shall be made by using specials and fittings to suit the actual conditions. When made under pressure, these connections shall be installed using standard methods as approved by the Contracting Officer. Connections to existing asbestos-cement pipe shall be made in accordance with ACPPA Work Practices.

3.1.4.4 Penetrations

Pipe passing through walls of valve pits and structures shall be provided with ductile-iron or Schedule 40 steel wall sleeves. Annular space between walls and sleeves shall be filled with rich cement mortar. Annular space between pipe and sleeves shall be filled with mastic.

3.1.4.5 Flanged Pipe

Flanged pipe shall only be installed above ground or with the flanges in valve pits.

3.1.5 Jointing

3.1.5.1 Reinforced Concrete Pipe Requirements

The inside and outside annular spaces between abutting sections of concrete pipe shall be filled with rich cement mortar in accordance with the pipe manufacturer's recommendations. Excess mortar shall be removed from interior annular spaces, leaving a smooth and continuous surface between pipe sections. Exposed portions of steel joint rings shall be protected from corrosion by a metallic coating or by an approved nonmetallic coating. Rubber gaskets shall be handled, lubricated where necessary, and installed in accordance with the pipe manufacturer's recommendations.

3.1.5.2 PE Pipe Requirements

Jointing shall comply with ASTM D 2657, Technique I-Socket Fusion or Technique II-Butt Fusion.

3.1.5.3 PVC Plastic Pipe Requirements

a. Pipe less than 4 inch diameter: Threaded joints shall be made by wrapping the male threads with approved thread tape or applying an approved lubricant, then threading the joining members together. The joint shall be tightened using strap wrenches to prevent damage to the pipe and/or fitting. To avoid excessive torque, joints shall be tightened no more than one thread past hand-tight. Preformed rubber-ring gaskets for elastomeric-gasket joints shall be made in accordance with ASTM F 477 and as specified. Pipe ends for push-on joints shall be beveled to facilitate assembly and marked to indicate when the pipe is fully seated. The gasket shall be prelubricated to prevent displacement. The gasket and ring groove in the bell or coupling shall match. The manufacturer of the pipe or fitting shall supply the elastomeric gasket. Couplings shall be provided with stops or centering rings to assure that the coupling is centered on the joint. Solvent cement joints shall use sockets conforming to ASTM D 2467. The solvent cement used shall meet the requirements of ASTM D 2564; the joint assembly shall be made in accordance with ASTM D 2855 and the manufacturer's specific recommendations.

b. Pipe 4 through 12 inch diameter: Joints shall be elastomeric gasket as specified in AWWA C900. Jointing procedure shall be as specified for pipe less than 4 inch diameter with configuration using elastomeric ring gasket.

c. Pipe 14 through 36 inch diameter: Joints shall be elastomeric gasket push-on joints made in accordance with AWWA M23.

3.1.5.4 RTRP I, RTRP II and RPMP Pipe

a. RTRP I: Assembly of the pipe shall be done in conformance with the manufacturer's written instruction and installation procedures. Field joints shall be prepared as specified by the pipe manufacturer. Several pipe joints having interference-fit type couplings may be field bonded and cured simultaneously. However, the pipe shall not be moved and additional joints shall not be made until the previously laid joints are completely cured. Joints not having interference-fit type coupling shall be fitted with a clamp which shall hold the joint rigidly in place until the joint cement has completely cured. The clamps shall have a protective material on the inner surface to prevent damage to the plastic pipe when the clamp is tightened in place. The pipe manufacturer shall provide a device or method to determine when the joint is pulled against the pipe stop. Additionally, the pipe manufacturer shall furnish a gauge to measure the diameter of the spigot ends to ensure the diameter conforms to the tolerances specified by the manufacturer. All pipe ends shall be gauged. Factory certified tests shall have been satisfactorily performed to verify that short-term

rupture strength is 1,500 psi or greater when carried out in accordance with ASTM D 1599. At any ambient temperature, field bonded epoxy-cemented joints shall be cured with a self-regulating, thermostatically temperature controlled, electrical heating blanket for the time and temperature recommended by the manufacturer for the applicable size and type of joint, or by an alternate heating method recommended by the manufacturer and approved by the Contracting Officer. The joint sections shall not be moved during heating, or until the joint has cooled to ambient temperature.

b. RTRP II: A reinforced overlay joint shall be used to join sections together through a placement of layers of reinforcement fiberglass roving, mat, tape or fabric thoroughly saturated with compatible catalyzed resin.

c. Fittings and Specials for RTRP and RPMP Pipe: Metal to RTRP and RPMP pipe connections shall be made by bolting steel flanges to RTRP and RPMP pipe flanges. Cast-iron fitting with gasket bell or mechanical joint may be used with RTRP if pipe has cast iron outside diameter. Steel flanges shall be flat-faced type. Where raised-face steel flanges are used, spacer rings shall be used to provide a flat-face seat for RTRP and RPMP pipe flanges. A full-face Buna "N" gasket 3 mm (1/8 inch) 1/8 inch thick with a shore hardness of 50-60 shall be used between all flanged connections. The RTRP and RPMP pipe flange shall have raised sealing rings. Flat washers shall be used under all nuts and bolts on RTRP and RPMP pipe flanges. Bolts and nuts shall be of noncorrosive steel and torqued to not more than 100 foot pounds. Flanges shall not be buried. A concrete pit shall be provided for all flanged connections.

3.1.5.5 Copper Tubing Requirements

Joints shall be made with flared fittings. The flared end tube shall be pulled tightly against the tapered part of the fitting by a nut which is part of the fitting, so there is metal-to-metal contact.

3.1.5.6 Bonded Joints Requirements

Bonded joints shall be installed in accordance with details specified for joints in paragraph JOINTS.

3.1.5.7 Isolation Joints and Dielectric Fittings

Isolation joints and dielectric fittings shall be installed in accordance with details specified in paragraph JOINTS. Dielectric unions shall be encapsulated in a field-poured coal-tar covering, with at least 3 mm 1/8 inch thickness of coal tar over all fitting surfaces.

3.1.5.8 Transition Fittings

Connections between different types of pipe and accessories shall be made with transition fittings approved by the Contracting Officer.

3.1.6 Installation of Service Lines

Service lines shall include the pipeline connecting building piping to water distribution lines to the connections with the building service at a point approximately 5 feet outside the building where such building service exists. Where building services are not installed, the Contractor shall terminate the service lines approximately 5 feet from the site of the proposed building at a point designated by the Contracting Officer. Such service lines shall be closed with plugs or caps. All service stops and valves shall be provided with service boxes. Service lines shall be constructed in accordance with the following requirements:

3.1.6.1 Service Lines 2 Inches and Smaller

Service lines 2 inches and smaller shall be connected to the main by a directly-tapped corporation stop or by a service clamp. A corporation stop and a copper gooseneck shall be provided with either type of connection. Maximum sizes for directly-tapped corporation stops and for outlets with service clamps shall be as in TABLE I. Where 2 or more gooseneck connections to the main are required for an individual service, such connections shall be made with standard branch connections. The total clear area of the branches shall be at least equal to the clear area of the service which they are to supply.

TABLE I. SIZE OF CORPORATION STOPS AND OUTLET

Pipe Size Inches	Corporation Stops, Inches For Ductile-Iron Pipe	Outlets w/Service Clamps, Inches Single & Double Strap
3	--	1
4	1	1
6	1-1/4	1-1/2
8	1-1/2	2
10	1-1/2	2
12 & larger	2	2

NOTE:

a. Service lines 1-1/2 inches and smaller shall have a service stop.

b. Service lines 2 inches in size shall have a gate valve.

3.1.6.2 Service Lines Larger than 2 Inches

Service lines larger than 2 inches shall be connected to the main by a tapped saddle, tapping sleeve and valve, service clamp or reducing tee, depending on the main diameter and the service line diameter, and shall have a gate valve. Lines 3 inches and larger may use rubber-seated butterfly valves as specified above, or gate valves.

3.1.6.3 Service Lines for Sprinkler Supplies

Water service lines used to supply building sprinkler systems for fire protection shall be connected to the water distribution main in accordance with NFPA 24.

3.1.7 Field Coating and Lining of Pipe

3.1.8 Setting of Fire Hydrants, Meters, Valves and Valve Boxes

3.1.8.1 Location of Fire Hydrants

Fire hydrants shall be located and installed as shown. Each hydrant shall be connected to the main with a 6 inch branch line having at least as much cover as the distribution main. Hydrants shall be set plumb with pumper nozzle facing the roadway, with the center of the lowest outlet not less than 18 inches above the finished surrounding grade, and the operating nut not more than 48 inches above the finished surrounding grade. Fire hydrants designated on the drawings as low profile shall have the lowest outlet not less than 18 inches above the finished surrounding grade, the top of the hydrant not more than 24 inches above the finished surrounding grade. Except where approved otherwise, the backfill around hydrants shall be thoroughly compacted to the finished grade immediately after installation to obtain beneficial use of the hydrant as soon as practicable. The hydrant shall be set upon a slab of concrete not less than 4 inches thick and 15 inches square. Not less than 7 cubic feet of free-draining broken stone or gravel shall be placed around and beneath the waste opening of dry barrel hydrants to ensure drainage.

3.1.8.2 Location of Meters

Meters and meter boxes shall be installed at the locations shown on the drawings. The meters shall be centered in the boxes to allow for reading and ease of removal or maintenance.

3.1.8.3 Location of Valves

After delivery, valves, including those in hydrants, shall be drained to prevent freezing and shall have the interiors cleaned of all foreign matter before installation. Stuffing boxes shall

be tightened and hydrants and valves shall be fully opened and fully closed to ensure that all parts are in working condition. Check, pressure reducing, vacuum, and air relief valves shall be installed in valve pits. Valves and valve boxes shall be installed where shown or specified, and shall be set plumb. Valve boxes shall be centered on the valves. Boxes shall be installed over each outside gate valve unless otherwise shown. Where feasible, valves shall be located outside the area of roads and streets. Earth fill shall be tamped around each valve box or pit to a distance of 4 feet on all sides of the box, or the undisturbed trench face if less than 4 feet.

3.1.8.4 Location of Service Boxes

Where water lines are located below paved streets having curbs, the boxes shall be installed directly back of the curbs. Where no curbing exists, service boxes shall be installed in accessible locations, beyond the limits of street surfacing, walks and driveways.

3.1.9 Tapped Tees and Crosses

Tapped tees and crosses for future connections shall be installed where shown.

3.1.10 Thrust Restraint

Plugs, caps, tees and bends deflecting 11.25 degrees or more, either vertically or horizontally, on waterlines 4 inches in diameter or larger, and fire hydrants shall be provided with thrust restraints. Valves shall be securely anchored or shall be provided with thrust restraints to prevent movement. Thrust restraints shall be either thrust blocks or, for ductile-iron pipes, restrained joints.

3.1.10.1 Thrust Blocks

Thrust blocking shall be concrete of a mix not leaner than: 1 cement, 2-1/2 sand, 5 gravel; and having a compressive strength of not less than 2,000 psi after 28 days. Blocking shall be placed between solid ground and the hydrant or fitting to be anchored. Unless otherwise indicated or directed, the base and thrust bearing sides of thrust blocks shall be poured directly against undisturbed earth. The sides of thrust blocks not subject to thrust may be poured against forms. The area of bearing shall be as shown or as directed. Blocking shall be placed so that the fitting joints will be accessible for repair. Steel rods and clamps, protected by galvanizing or by coating with bituminous paint, shall be used to anchor vertical down bends into gravity thrust blocks.

3.1.10.2 Restrained Joints

For ductile-iron pipe, restrained joints shall be designed by the Contractor or the pipe manufacturer in accordance with DIPRA-Restraint Design.

3.2 HYDROSTATIC TESTS

Where any section of a water line is provided with concrete thrust blocking for fittings or hydrants, the hydrostatic tests shall not be made until at least 5 days after installation of the concrete thrust blocking, unless otherwise approved.

3.2.1 Pressure Test

After the pipe is laid, the joints completed, fire hydrants permanently installed, and the trench partially backfilled leaving the joints exposed for examination, the newly laid piping or any valved section of piping shall, unless otherwise specified, be subjected for 1 hour to a hydrostatic pressure test of 200 psi. Water supply lines designated on the drawings shall be subjected for 1 hour to a hydrostatic pressure test of 200 psi. Each valve shall be opened and closed several times during the test. Exposed pipe, joints, fittings, hydrants, and valves shall be carefully examined during the partially open trench test. Joints showing visible leakage shall be replaced or remade as necessary. Cracked or defective pipe, joints, fittings, hydrants and valves discovered in consequence of this pressure test shall be removed and replaced with sound material, and the test shall be repeated until the test results are satisfactory. The requirement for the joints to remain exposed for the hydrostatic tests may be waived by the Contracting Officer when one or more of the following conditions is encountered:

a. Wet or unstable soil conditions in the trench.

b. Compliance would require maintaining barricades and walkways around and across an open trench in a heavily used area that would require continuous surveillance to assure safe conditions.

c. Maintaining the trench in an open condition would delay completion of the project.

The Contractor may request a waiver, setting forth in writing the reasons for the request and stating the alternative procedure proposed to comply with the required hydrostatic tests. Backfill placed prior to the tests shall be placed in accordance with the requirements of Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS.

3.2.2 Leakage Test

Leakage test shall be conducted after the pressure tests have been satisfactorily completed. The duration of each leakage test shall be at least 2 hours, and during the test the water line shall be subjected to not less than 200 psi pressure. Water supply lines designated on the drawings shall be subjected to a pressure equal to 200 psi. Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved or approved section, necessary to maintain pressure within 5 psi of the specified leakage test pressure after the pipe has been filled with water and the air expelled. Piping installation will not be accepted if leakage exceeds the allowable leakage which is determined by the following formula:

L = 0.0001351ND(P raised to 0.5 power)

L = Allowable leakage in gallons per hour
N = Number of joints in the length of pipeline tested
D = Nominal diameter of the pipe in inches
P = Average test pressure during the leakage test, in psi gauge

Should any test of pipe disclose leakage greater than that calculated by the above formula, the defective joints shall be located and repaired until the leakage is within the specified allowance, without additional cost to the Government.

3.2.3 Time for Making Test

Except for joint material setting or where concrete thrust blocks necessitate a 5-day delay, pipelines jointed with rubber gaskets, mechanical or push-on joints, or couplings may be subjected to hydrostatic pressure, inspected, and tested for leakage at any time after partial completion of backfill. Cement-mortar lined pipe may be filled with water as recommended by the manufacturer before being subjected to the pressure test and subsequent leakage test.

3.2.4 Concurrent Hydrostatic Tests

The Contractor may elect to conduct the hydrostatic tests using either or both of the following procedures. Regardless of the sequence of tests employed, the results of pressure tests, leakage tests, and disinfection shall be as specified. Replacement, repair or retesting required shall be accomplished by the Contractor at no additional cost to the Government.

a. Pressure test and leakage test may be conducted concurrently.

b. Hydrostatic tests and disinfection may be conducted concurrently, using the water treated for disinfection to accomplish the hydrostatic tests. If water is lost when treated for disinfection and air is admitted to the unit being tested, or if any repair procedure results in contamination of the unit, disinfection shall be reaccomplished.

3.3 BACTERIAL DISINFECTION

3.3.1 Bacteriological Disinfection

Before acceptance of potable water operation, each unit of completed waterline shall be disinfected as prescribed by AWWA C651. After pressure tests have been made, the unit to be disinfected shall be thoroughly flushed with water until all entrained dirt and mud have been removed before introducing the chlorinating material. The chlorinating material shall be either liquid chlorine, calcium hypochlorite, or sodium hypochlorite, conforming to paragraph MISCELLANEOUS ITEMS. The chlorinating material shall provide a dosage of not less than 50 ppm and shall be introduced into the water lines in an approved manner. Polyvinyl Chloride (PVC) pipe lines shall be chlorinated using only the above specified chlorinating material in solution. The agent shall not be introduced into the line in a dry solid state. The

treated water shall be retained in the pipe long enough to destroy all non-spore forming bacteria. Except where a shorter period is approved, the retention time shall be at least 24 hours and shall produce not less than 25 ppm of free chlorine residual throughout the line at the end of the retention period. Valves on the lines being disinfected shall be opened and closed several times during the contact period. The line shall then be flushed with clean water until the residual chlorine is reduced to less than 1.0 ppm. During the flushing period, each fire hydrant on the line shall be opened and closed several times. From several points in the unit, personnel from the Contractor's commercial laboratory shall take at least 3 water samples from different points, approved by the Contracting Officer, in proper sterilized containers and perform a bacterial examination in accordance with state approved methods. The commercial laboratory shall be certified by the state's approving authority for examination of potable water. The disinfection shall be repeated until tests indicate the absence of pollution for at least 2 full days. The unit will not be accepted until satisfactory bacteriological results have been obtained.

3.4 CLEANUP

Upon completion of the installation of water lines, and appurtenances, all debris and surplus materials resulting from the work shall be removed.

** End of Section **

SECTION 02531
SANITARY SEWERS
12/01

1 GENERAL

1.1 REFERENCES

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

AMERICAN RAILWAY ENGINEERING ASSOCIATION (AREA)

AREA-01	(1996) 1996-1997 Manual for Railway Engineering (Fixed Properties) 4 Vol.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 74	(1996) Cast Iron Soil Pipe and Fittings
ASTM A 123	(1989a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM C 14	(1995) Concrete Sewer, Storm Drain, and Culvert Pipe
ASTM C 14M	(1995) Concrete Sewer, Storm Drain, and Culvert Pipe (Metric)
ASTM C 33	(1993) Concrete Aggregates
ASTM C 76	(1995a) Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C 76M	(1996) Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe (Metric)
ASTM C 94	(1996) Ready-Mixed Concrete
ASTM C 150	(1997) Portland Cement
ASTM C 260	(1995) Air-Entraining Admixtures for Concrete
ASTM C 270	(1997) Mortar for Unit Masonry

ASTM C 425	(1996) Compression Joints for Vitrified Clay Pipe and Fittings
ASTM C 443	(1994) Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
ASTM C 443M	(1994) Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets (Metric)
ASTM C 478	(1996) Precast Reinforced Concrete Manhole Sections
ASTM C 478M	(1996) Precast Reinforced Concrete Manhole Sections (Metric)
ASTM C 564	(1995a) Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM C 700	(1996) Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated
ASTM C 828	(1991, R 1996) Low-Pressure Air Test of Vitrified Clay Pipe Lines
ASTM C 924	(1989) Concrete Pipe Sewer Lines by Low-Pressure Air Test Method
ASTM C 972	(1995) Compression-Recovery of Tape Sealant
ASTM D 412	(1992) Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension
ASTM D 624	(1991; R 1996) Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
ASTM D 1784	(1996) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 2680	(1995a)Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping
ASTM D 2751	(1996) Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings
ASTM D 2996	(1995) Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe

ASTM D 2997	(1995) Centrifugally Cast "Fiberglass" (Glass-Fiber-Reinforced-Thermosetting-Resin) Pipe
ASTM D 3034	(1994) Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D 3212	(1996a) Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D 3262	(1996) "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe
ASTM D 3350	(1996) Polyethylene Plastics Pipe and Fittings Materials
ASTM D 3753	(1981; R 1991) Glass-Fiber-Reinforced Polyester Manholes
ASTM D 3840	(1988) "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Fittings for Nonpressure Applications
ASTM F 402	(1993) Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings
ASTM F 477	(1995) Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F 714	(1994) Polyethylene (PE) Plastic pipe (SDR-PR) Based on Outside Diameter
ASTM F 794	(1995a) Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter
ASTM F 894	(1995) Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe
ASTM F 949	(1994) Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA ANSI/AWWA C105/A21.5	(1993) Polyethylene Encasement for Ductile-Iron Pipe Systems

AWWA ANSI/AWWA C110/A21.10	(1993) Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (75 mm through 1200 mm), for Water and Other Liquids
AWWA ANSI/AWWA C111/A21.11	(1995) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA ANSI/AWWA C115/A21.15	(1994) Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
AWWA ANSI/AWWA C151/A21.51	(1996) Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 49	(1994) Hazardous Chemicals Data
NFPA 325-1	(1994) Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids
NFPA 704	(1996) Identification of the Fire Hazards of Materials for Emergency Response

UNI-BELL PVC PIPE ASSOCIATION (UBPPA)

UBPPA UNI-B-6	(1990) Recommended Practice for the Low-Pressure Air Testing of Installed Sewer Pipe
UBPPA UNI-B-9	(1990; Addenda 1994) Recommended Performance Specification for Polyvinyl Chloride (PVC) Profile Wall Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter (Nominal Pipe Sizes 4-48 inch)

1.2 GENERAL REQUIREMENTS

The construction required herein shall include appurtenant structures and building sewers to points of connection with the building drains 5 feet outside the building to which the sewer system is to be connected. The Contractor shall replace damaged material and redo unacceptable work at no additional cost to the Government. Excavation and backfilling is specified in Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS. Backfilling shall be accomplished after inspection by the Contracting Officer. Before, during, and after installation, plastic pipe and fittings shall be protected from any environment that would result in damage or deterioration to the material. The Contractor shall have a copy of the manufacturer's instructions available at the construction site at all times and shall follow these instructions unless directed otherwise by the Contracting Officer.

Solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials required to install the plastic pipe shall be stored in accordance with the manufacturer's recommendation and shall be discarded if the storage period exceeds the recommended shelf life. Solvents in use shall be discarded when the recommended pot life is exceeded.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 00700 SUBMITTAL PROCEDURES:

SD-13 Certificates

Portland Cement; FIO.

Certificates of compliance stating the type of cement used in manufacture of concrete pipe, fittings and precast manholes.

Joints.

Certificates of compliance stating that the fittings or gaskets used for waste drains are oil resistant.

2 PRODUCTS

2.1 PIPE

Pipe shall conform to the respective specifications and other requirements specified below.

2.1.1 Concrete Pipe

Concrete pipe 24 inches or less in diameter, unless otherwise shown or specified, shall be nonreinforced and conform to ASTM C 14, Class indicated. Concrete pipe greater than 24 inches in diameter shall be reinforced and conform to ASTM C 76, Class indicated. Pipe less than 36 inches in diameter shall be bell and spigot type. Pipe 36 inches or greater in diameter shall be bell and spigot type, tongue and groove type, or modified tongue and groove type.

2.1.2 Plastic Pipe

Acrylonitrile-butadiene-styrene (ABS) and polyvinyl chloride (PVC) composite sewer piping shall conform to ASTM D 2680. Size 8 inch through 15 inch diameter.

2.1.2.1 ABS Pipe

ASTM D 2751.

2.1.2.2 PVC Pipe

ASTM D 3034, Type PSM with a maximum SDR of 35, Size 15 inches or less in diameter. ASTM F 949 for corrugated sewer pipes with a smooth interior. UBPPA UNI-B-9 and ASTM F 794, Series 46, for ribbed sewer pipe with smooth interior, size 8 inch through 48 inch diameters. PVC shall be certified by the compounder as meeting the requirements of ASTM D 1784, cell Class 12454B. The pipe stiffness shall be greater than or equal to 735/D for cohesionless material pipe trench backfills.

2.1.2.3 High Density Polyethylene Pipe

ASTM F 894, Class 63, size 18 inch through 120 inch. ASTM F 714, size 4 inch through 48 inch. The polyethylene shall be certified by the resin producer as meeting the requirements of ASTM D 3350, cell Class 334433C. The pipe stiffness shall be greater than or equal to 1170/D for cohesionless material pipe trench backfills.

2.1.3 Reinforced Plastic Mortar Pipe (RPMP)

ASTM D 3262.

2.1.4 Reinforced Thermosetting Resin Pipe (RTRP)

ASTM D 3262.

2.1.4.1 Filament Wound RTRP-I

RTRP-I shall conform to ASTM D 2996, except pipe shall have an outside diameter equal to cast iron outside diameter or standard weight steel pipe. The pipe shall be suitable for a normal working pressure of 150 psi at 73 degrees F. The inner surface of the pipe shall have a smooth uniform continuous resin-rich surface liner conforming to ASTM D 2996.

2.1.4.2 Centrifugally Cast RTRP-II

RTRP-II shall conform to ASTM D 2997. Pipe shall have an outside diameter equal to standard weight steel pipe.

2.2 REQUIREMENTS FOR FITTINGS

Fittings shall be compatible with the pipe supplied and shall have a strength not less than that of the pipe. Fittings shall conform to the respective specifications and other requirements specified below.

2.2.1 Fittings for Concrete Pipe

ASTM C 14 for pipe 24 inches or less in diameter. ASTM C 76 for pipe greater than 24 inches in diameter.

2.2.2 Fittings for Plastic Pipe

ABS and PVC composite sewer pipe fittings shall conform to ASTM D 2680.

2.2.2.1 Fittings for ABS Pipe

ASTM D 2751.

2.2.2.2 Fittings for PVC Pipe

ASTM D 3034 for type PSM pipe. ASTM F 949 for corrugated sewer pipe with a smooth interior. UBPPA UNI-B-9 and ASTM F 794, Series 46, for ribbed sewer pipe with smooth interior.

2.2.2.3 Fittings for High Density Polyethylene Pipe

ASTM F 894.

2.2.3 Fittings for RPMP

ASTM D 3840.

2.2.4 Fittings for RTRP

ASTM D 3262.

2.3 JOINTS

Joints installation shall comply with the manufacturer's instructions. Fittings and gaskets utilized for waste drains or industrial waste lines shall be certified by the manufacturer as oil-resistant.

2.3.1 Concrete Pipe Jointing

Joints and gaskets shall conform to ASTM C 443.

2.3.2 Plastic Pipe Jointing

Flexible plastic pipe (PVC or high density polyethylene pipe) gasketed joints shall conform to ASTM D 3212.

2.3.2.1 ABS Pipe Jointing

ASTM D 2751, solvent weld or bell and spigot O-ring joint, size 12 inches or less in diameter, dimensions and tolerances in accordance with Table 2 of ASTM D 2751.

2.3.2.2 High Density Polyethylene Pipe Jointing

Rubber gasket joints shall conform to ASTM C 443.

2.3.3 RPMP Jointing

Joints shall be bell and spigot type utilizing an elastomeric gasket in accordance with ASTM F 477.

2.3.4 RTRP Jointing

Joints shall be bell and spigot type utilizing an elastomeric gasket in accordance with ASTM F 477.

2.4 BRANCH CONNECTIONS

Branch connections shall be made by use of regular fittings or solvent cemented saddles as approved. Saddles for ABS and PVC composite pipe shall conform to Figure 2 of ASTM D 2680; saddles for ABS pipe shall comply with Table 3 of ASTM D 2751; and saddles for PVC pipe shall conform to Table 4 of ASTM D 3034.

2.5 FRAMES AND COVERS

Frames and covers shall be cast iron, ductile iron or reinforced concrete. Cast iron frames and covers shall be as indicated or shall be of type suitable for the application, circular, without vent holes. The frames and covers shall have a combined weight of not less than 400 pounds. Reinforced concrete frames and covers shall be as indicated or shall conform to ASTM C 478. The word "Sewer" shall be stamped or cast into covers so that it is plainly visible.

2.6 STEEL LADDER

A steel ladder shall be provided where the depth of a manhole exceeds 12 feet. The ladder shall not be less than 16 inches in width, with 3/4 inch diameter rungs spaced 12 inches apart. The two stringers shall be a minimum 3/8 inch thick and 2 inches wide. Ladders and inserts shall be galvanized after fabrication in conformance with ASTM A 123.

2.7 CEMENT MORTAR

Cement mortar shall conform to ASTM C 270, Type M with Type II cement.

2.7.1 Portland Cement

Portland cement shall conform to ASTM C 150, Type II for concrete used in concrete pipe, concrete pipe fittings, and manholes and type optional with the Contractor for cement used in concrete cradle, concrete encasement, and thrust blocking.

2.7.2 Portland Cement Concrete

Portland cement concrete shall conform to ASTM C 94, compressive strength of 4000 psi at 28 days, except for concrete cradle and encasement or concrete blocks for manholes. Concrete used for cradle and encasement shall have a compressive strength of 2500 psi minimum at 28 days. Concrete in place shall be protected from freezing and moisture loss for 7 days.

2.8 STRUCTURES

2.8.1 Precast Reinforced Concrete Manhole Sections

Precast reinforced concrete manhole sections shall conform to ASTM C 478, except that portland cement shall be as specified herein. Joints shall be cement mortar, an approved mastic, rubber gaskets, a combination of these types; or the use of external preformed rubber joint seals and extruded rolls of rubber with mastic adhesive on one side.

3 EXECUTION

3.1 INSTALLATION

3.1.1 Adjacent Facilities

3.1.1.1 Water Lines

Where the location of the sewer is not clearly defined by dimensions on the drawings, the sewer shall not be closer horizontally than 10 feet to a water-supply main or service line, except that where the bottom of the water pipe will be at least 12 inches above the top of the sewer pipe, the horizontal spacing may be a minimum of 6 feet. Where gravity-flow sewers cross above water lines, the sewer pipe for a distance of 10 feet on each side of the crossing shall be fully encased in concrete or shall be acceptable pressure pipe with no joint closer horizontally than 3 feet to the crossing. The thickness of the concrete encasement including that at the pipe joints shall be not less than 4 inches.

3.1.1.2 Roads, Railroads, and Airfields

Water pipe shall be encased in a sleeve of rigid conduit for the lengths shown. Sleeves under railroads shall be in accordance with the criteria contained in AREA-01, Part 5. Where sleeves are required or indicated, the pipe sleeve shall be reinforced concrete in accordance with ASTM C76, Class V. A minimum clearance of at least 2 inches between the inner wall

of the sleeve and the maximum outside diameter of the sleeved pipe and joints shall be provided. Sand bedding shall be provided for the water pipe through the sleeve.

3.1.1.3 Structural Foundations

Where sewer pipe is to be installed within 3 feet of an existing or proposed building or structural foundation such as a retaining wall, control tower footing, water tank footing, or any similar structure, the sewer pipe shall be sleeved as specified above. Contractor shall ensure there is no damage to these structures, and no settlement or movement of foundations or footing.

3.1.2 Pipe Laying

a. Pipe shall be protected during handling against impact shocks and free fall; the pipe interior shall be free of extraneous material.

b. Pipe laying shall proceed upgrade with the spigot ends of bell-and-spigot pipe and tongue ends of tongue-and-groove pipe pointing in the direction of the flow. Each pipe shall be laid accurately to the line and grade shown on the drawings. Pipe shall be laid and centered so that the sewer has a uniform invert. As the work progresses, the interior of the sewer shall be cleared of all superfluous materials.

c. Before making pipe joints, all surfaces of the portions of the pipe to be joined shall be clean and dry. Lubricants, primers, and adhesives shall be used as recommended by the pipe manufacturer. The joints shall then be placed, fitted, joined, and adjusted to obtain the degree of water tightness required.

d. ABS composite pipe ends with exposed truss and filler material shall be coated with solvent weld material before making the joint to prevent water or air passage at the joint between the inner and outer wall of the pipe.

e. Installations of solvent weld joint pipe, using ABS or PVC pipe and fittings shall be in accordance with ASTM F 402. The Contractor shall ensure adequate trench ventilation and protection for workers installing the pipe.

3.1.2.1 Caulked Joints

The packing material shall be well packed into the annular space to prevent the entrance of lead into the pipe. The remainder of the space shall be filled with molten lead that is hot enough to show a rapid change in color when stirred. Scum shall be removed before pouring. The lead shall be caulked to form a tight joint without overstraining the bell and shall have a minimum depth of 1 inch after caulking.

3.1.2.2 Trenches

Trenches shall be kept free of water and as dry as possible during bedding, laying, and jointing and for as long a period as required. When work is not in progress, open ends of pipe and fittings shall be satisfactorily closed so that no trench water or other material will enter the pipe or fittings.

3.1.2.3 Backfill

As soon as possible after the joint is made, sufficient backfill material shall be placed along the pipe to prevent pipe movement off line or grade. Plastic pipe shall be completely covered to prevent damage from ultraviolet light.

3.1.2.4 Width of Trench

If the maximum width of the trench at the top of the pipe, as specified in Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS, is exceeded for any reason other than by direction, the Contractor shall install, at no additional cost to the Government, concrete cradling, pipe encasement, or other bedding required to support the added load of the backfill.

3.1.2.5 Jointing

Joints between different pipe materials shall be made as specified, using approved jointing materials.

3.1.2.6 Handling and Storage

Pipe, fittings and joint material shall be handled and stored in accordance with the manufacturer's recommendations. Storage facilities for plastic pipe, fittings, joint materials and solvents shall be classified and marked in accordance with NFPA 704, with classification as indicated in NFPA 49 and NFPA 325-1.

3.1.3 Leakage Tests

Lines shall be tested for leakage by low pressure air testing, infiltration tests or exfiltration tests, as appropriate. Low pressure air testing for vitrified clay pipes shall be as prescribed in ASTM C 828. Low pressure air testing for concrete pipes shall be as prescribed in ASTM C 828. Low pressure air testing for PVC pipe shall be as prescribed in UBPPA UNI-B-6. Low pressure air testing procedures for other pipe materials shall use the pressures and testing times prescribed in ASTM C 828 and ASTM C 924, after consultation with the pipe manufacturer. Prior to infiltration or exfiltration tests, the trench shall be backfilled up to at least the lower half of the pipe. If required, sufficient additional backfill shall be placed to prevent pipe movement during testing, leaving the joints uncovered to permit inspection. Visible leaks encountered shall be corrected regardless of leakage test results. When the water table is 600 mm 2 feet or more above the top of the pipe at the upper end of the pipeline section to be

tested, infiltration shall be measured using a suitable weir or other device acceptable to the Contracting Officer. When the Contracting Officer determines that infiltration cannot be properly tested, an exfiltration test shall be made by filling the line to be tested with water so that a head of at least 2 feet is provided above both the water table and the top of the pipe at the upper end of the pipeline to be tested. The filled line shall be allowed to stand until the pipe has reached its maximum absorption, but not less than 4 hours. After absorption, the head shall be re-established. The amount of water required to maintain this water level during a 2-hour test period shall be measured. Leakage as measured by either the infiltration test or exfiltration test shall not exceed 0.2 gal per inch diameter per 100 feet of pipeline per hour. When leakage exceeds the maximum amount specified, satisfactory correction shall be made and retesting accomplished. Testing, correction, and retesting shall be made at no additional cost to the Government.

3.1.4 Test for Deflection

When flexible pipe is used, a deflection test shall be made on the entire length of the installed pipeline not less than 30 days after the completion of all work including the leakage test, backfill, and placement of any fill, grading, paving, concrete, or superimposed loads. Deflection shall be determined by use of a deflection device or by use of a spherical, spheroidal, or elliptical ball, a cylinder, or circular sections fused to a common shaft. The ball, cylinder, or circular sections shall have a diameter, or minor diameter as applicable, of 92.5 percent of the inside diameter of the pipe, but 95 percent for RPMP and RTRP. A tolerance of plus 0.5 percent will be permitted. The ball, cylinder, or circular sections shall be of a homogeneous material throughout, shall have a density greater than 1.0 as related to water at 39.2 degrees F, and shall have a surface brinell hardness of not less than 150. The device shall be center bored and through bolted with a 1/4 inch minimum diameter steel shaft having a yield strength of 70,000 psi or more, with eyes at each end for attaching pulling cables. The eye shall be suitably backed with flange or heavy washer; a pull exerted on the opposite end of the shaft shall produce compression throughout the remote end of the ball, cylinder or circular section. Circular sections shall be spaced so that the distance from the external faces of the front and back sections shall equal or exceed the diameter of the circular section. Failure of the ball, cylinder, or circular section to pass freely through a pipe run, either by being pulled through or by being flushed through with water, shall be cause for rejection of that run. When a deflection device is used for the test in lieu of the ball, cylinder, or circular sections described, such device shall be approved prior to use. The device shall be sensitive to 1.0 percent of the diameter of the pipe being measured and shall be accurate to 1.0 percent of the indicated dimension. Installed pipe showing deflections greater than 7.5 percent of the normal diameter of the pipe, or 5 percent for RTRP and RPMP, shall be retested by a run from the opposite direction. If the retest also fails, the suspect pipe shall be replaced at no cost to the Government.

3.2 CONCRETE CRADLE AND ENCASEMENT

The pipe shall be supported on a concrete cradle, or encased in concrete where indicated or directed.

3.3 INSTALLATION OF WYE BRANCHES

Wye branches shall be installed where sewer connections are indicated or where directed. Cutting into piping for connections shall not be done except in special approved cases. When the connecting pipe cannot be adequately supported on undisturbed earth or tamped backfill, the pipe shall be encased in concrete backfill or supported on a concrete cradle as directed. Concrete required because of conditions resulting from faulty construction methods or negligence by the Contractor shall be installed at no additional cost to the Government. The installation of wye branches in an existing sewer shall be made by a method which does not damage the integrity of the existing sewer. One acceptable method consists of removing one pipe section, breaking off the upper half of the bell of the next lower section and half of the running bell of wye section. After placing the new section, it shall be rotated so that the broken half of the bell will be at the bottom. The two joints shall then be made with joint packing and cement mortar.

3.4 MANHOLE DETAILS

3.4.1 General Requirements

Manholes shall be constructed of cast-in-place concrete or precast concrete manhole sections. The invert channels shall be smooth and semicircular in shape conforming to the inside of the adjacent sewer section. Changes in direction of flow shall be made with a smooth curve of as large a radius as the size of the manhole will permit. Changes in size and grade of the channels shall be made gradually and evenly. The invert channels shall be formed directly in the concrete of the manhole base, or shall be built up with brick and mortar, or shall be half tile laid in concrete, or shall be constructed by laying full section sewer pipe through the manhole and breaking out the top half after the surrounding concrete has hardened. Pipe connections shall be made to manhole using water stops, standard O-ring joints, special manhole coupling, or shall be made in accordance with the manufacturer's recommendation. The Contractor's proposed method of connection, list of materials selected, and specials required, shall be approved prior to installation. The floor of the manhole outside the channels shall be smooth and shall slope toward the channels not less than 1 inch per foot nor more 2 inches per foot. Free drop inside the manholes shall not exceed 18 inches, measured from the invert of the inlet pipe to the top of the floor of the manhole outside the channels; drop manholes shall be constructed whenever the free drop would otherwise be greater than 1 foot 6 inches.

3.4.2 Steel Ladder Anchorage

Ladder shall be adequately anchored to the wall by means of steel inserts spaced not more than 6 feet apart vertically, and shall be installed to provide at least 6 inches of space between the wall and the rungs. The wall along the line of the ladder shall be vertical for its entire length.

3.4.3 Jointing, Plastering and Sealing

Mortar joints shall be completely filled and shall be smooth and free from surplus mortar on the inside of the manhole. Mortar and mastic joints between precast rings shall be full-bedded in jointing compound and shall be smoothed to a uniform surface on both the interior and exterior of the manhole. Installation of rubber gasket joints between precast rings shall be in accordance with the recommendations of the manufacturer. Precast rings may also be sealed by the use of extruded rolls of rubber with mastic adhesive on one side.

3.4.4 Setting of Frames and Covers

Unless otherwise indicated, tops of frames and covers shall be set flush with finished grade in paved areas or 2 inches higher than finished grade in unpaved areas. Frame and cover assemblies shall be sealed to manhole sections using external preformed rubber joint seals that meet the requirements of ASTM D 412 and ASTM D 624, or other methods specified in paragraph Jointing, Plastering and Sealing, unless otherwise specified.

3.4.5 External Preformed Rubber Joint Seals

External preformed rubber joint seals and extruded rolls of rubber with mastic adhesive shall meet the requirements of ASTM D 412 and ASTM C 972 to ensure conformance with paragraph Leakage Tests. The seal shall be multi-section with neoprene rubber top section and all lower sections made of Ethylene Propylene Di Monomer (EPDM) rubber with a minimum thickness of 60 mils. Each unit shall consist of a top and a bottom section and shall have mastic on the bottom of the bottom section and mastic on the top and bottom of the top section. The mastic shall be non-hardening butyl rubber sealant and shall seal to the cone/top slab of the manhole/catch basin and over the lip of the casting. One unit shall seal a casting and up to six, 2 inch adjusting rings. The bottom section shall be 12 inches in height. A 6 inch high top section will cover up to two, 2 inch adjusting rings. A 12 inch high bottom section will cover up to six, 2 inch adjusting rings. Extension sections shall cover up to two more adjusting rings. Each extension shall overlap the bottom section by 2 inches and shall be overlapped by the top section by 2 inches.

3.5 CONNECTING TO EXISTING MANHOLES

Pipe connections to existing manholes shall be made so that finish work will conform as nearly as practicable to the applicable requirements specified for new manholes, including all necessary concrete work, cutting, and shaping. The connection shall be centered on the manhole. Holes for the new pipe shall be of sufficient diameter to allow packing cement mortar around the entire periphery of the pipe but no larger than 1.5 times the diameter of the pipe. Cutting the manhole shall be done in a manner that will cause the least damage to the walls.

3.6 BUILDING CONNECTIONS

Building connections shall include the lines to and connection with the building waste drainage piping at a point approximately 5 feet outside the building, unless otherwise indicated. Where building drain piping is not installed, the Contractor shall terminate the building connections approximately 5 feet from the site of the building at a point and in a manner designated.

3.7 CLEANOUTS AND OTHER APPURTENANCES

Cleanouts and other appurtenances shall be installed where shown on the drawings or as directed by the Contracting Officer, and shall conform to the detail of the drawings.

** End of Section **

SECTION 02556
GAS DISTRIBUTION SYSTEM
12/01

1 GENERAL

1.1 REFERENCES

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

AMERICAN GAS ASSOCIATION (AGA)

AGA Manual	(1994; addenda/correction Jan 1996) A.G.A. Plastic Pipe Manual for Gas Service

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B109.2	(1992) Diaphragm Type Gas Displacement Meters (500 Cubic Feet per Hour Capacity and Over)

AMERICAN PETROLEUM INSTITUTE (API)

API Spec 5L	(1995; Errata Dec 1997) Line Pipe
API Spec 6D	(1994; Supple 1 June 1996; Supple 2 Dec, 1997) Pipeline Valves (Gate, Plug, Ball, and Check Valves)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53	(1997) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 181/A 181M	(1995b) Carbon Steel Forgings, for General-Purpose Piping
ASTM D 2513	(1996a) Thermoplastic Gas Pressure Pipe, Tubing, and Fittings
ASTM D 2517	(1994) Reinforced Epoxy Resin Gas Pressure Pipe and Fittings
ASTM D 2683	(1995) Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing

ASTM D 3261	(1996) Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
ASTM D 3308	(1997) PTFE Resin-Skived Tape
ASTM D 3350	(1996) Polyethylene Plastics Pipe and Fittings Materials

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B1.20.1	(1983; R 1992) Pipe Threads, General Purpose (Inch)
ASME B16.5	(1996) Pipe Flanges and Flanged Fittings NPS 1/2 thru NPS 24
ASME B16.9	(1993) Factory-Made Wrought Steel Buttwelding Fittings
ASME B16.11	(1996) Forged Fittings, Socket-Welding and Threaded
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.34	(1996) Valves - Flanged, Threaded, and Welding End
ASME B16.40	(1985; R 1994) Manually Operated Thermoplastic Gas Shutoffs and Valves in Gas Distribution Systems
ASME B31.8	(1995) Gas Transmission and Distribution Piping Systems
ASME BPV VIII Div 1	(1998) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage

CODE OF FEDERAL REGULATIONS (CFR)

49 CFR 192	Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards

COMMERCIAL ITEM DESCRIPTION (CID)

CID A-A-2962	(Basic) Enamel, Alkyd (Metric)

FEDERAL SPECIFICATIONS (FS)

FS TT-E-2784	(Rev A) Enamel (Acrylic-Emulsion, Exterior Gloss and Semigloss) (Metric)

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

MSS SP-25	(1998) Standard Marking System for Valves, Fittings, Flanges and Unions

NACE INTERNATIONAL (NACE)

NACE RP0185	(1996) Extruded, Polyolefin Resin Coating Systems with Soft Adhesives for Underground or Submerged Pipe
NACE RP0274	(1993) High Voltage Electrical Inspection of Pipeline Coatings Prior to Installation

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC Paint 25	(1991) Red Iron Oxide, Zinc Oxide, Raw Linseed Oil and Alkyd Primer (Without Lead and Chromate Pigments)
SSPC SP 1	(1982) Solvent Cleaning
SSPC SP 3	(1995) Power Tool Cleaning
SSPC SP 6	(1994) Commercial Blast Cleaning
SSPC SP 7	(1994) Brush-Off Blast Cleaning

UNDERWRITERS LABORATORIES (UL)

UL Gas&Oil Dir	(1996; Supple) Gas and Oil Equipment Directory

1.2 GENERAL REQUIREMENTS

1.2.1 Welding Steel Piping

Welding and nondestructive testing procedures for pressure piping are specified in Section 05093 WELDING PRESSURE PIPING. Structural members shall be welded in accordance with Section 05090 WELDING, STRUCTURAL.

1.2.2 Jointing Polyethylene and Fiberglass Piping

Piping shall be joined by performance qualified joiners using qualified procedures in accordance with AGA Manual. Manufacturer's prequalified joining procedures shall be used. Joints shall be inspected by an inspector qualified in the joining procedures being used and in

accordance with AGA Manual. Joiners and inspectors shall be qualified at the jobsite by a person who has been trained and certified by the manufacturer of the pipe, to train and qualify joiners and inspectors in each joining procedure to be used on the job. Training shall include use of equipment, explanation of the procedure, and successfully making joints which pass tests specified in AGA Manual. The Contracting Officer shall be notified at least 24 hours in advance of the date to qualify joiners and inspectors.

1.2.3 Standard Products

Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Asbestos or products containing asbestos shall not be used. Equipment shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site. Valves, flanges, and fittings shall be marked in accordance with MSS SP-25.

1.2.4 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work.

1.2.5 Handling

Pipe and components shall be handled carefully to ensure a sound, undamaged condition. Particular care shall be taken not to damage pipe coating. No pipe or material of any kind shall be placed inside another pipe or fitting after the coating has been applied, except as specified in paragraph INSTALLATION. Plastic pipe shall be handled in conformance with AGA Manual.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 00700 SUBMITTAL PROCEDURES:

SD-04 Drawings

Pipe, Fittings, and Associated Materials; FIO.

Drawings shall contain complete schematic and piping diagrams and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Drawings shall show proposed layout and anchorage of the system and appurtenances, and equipment relationship to other parts of the work including clearances for maintenance and operation.

SD-07 Schedules

Equipment and Materials; GA.

A complete list of equipment and materials, including manufacturer's descriptive and technical literature, performance charts and curves, catalog cuts, and installation instructions, including, but not limited to the following:

a. Dielectric Unions and Flange Kits.

b. Meters.

c. Pressure Reducing Valves.

d. Regulators.

Spare Parts Data; FIO.

Spare parts lists for each different item of material and equipment specified, after approval of the detail drawings and not later than 1 months prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply.

Notification; FIO.

Notification of the Contractor's schedule for making connections to existing gas lines, at least 14 days in advance.

SD-08 Statements

Welding Steel Piping; FIO.

A copy of qualified welding procedures along with a list of names and identification symbols of performance qualified welders and welding operators.

Jointing Polyethylene and Fiberglass Piping; GA.

A copy of qualified jointing procedures, training procedures, qualifications of trainer, and training test results for joiners and inspectors.

Connection and Abandonment Procedures; GA.

A copy of procedures for gas line tie in, hot taps, abandonment/removal or demolition, purging, and plugging as applicable in accordance with ASME B31.8.

SD-13 Certificates

Utility Work; FIO.

Certification from the Operating Agency/Utility Company that work for which the Utility is responsible has been completed.

Training; FIO.

A copy of each inspector's and jointer's training certificate with respective test results.

SD-19 Operation and Maintenance Manuals

Gas Distribution System; FIO.

Six copies, in booklet form and indexed, of site specific natural gas operation and maintenance manual for each gas distribution system including system operation, system maintenance, equipment operation, and equipment maintenance manuals described below. If operation and maintenance manuals are provided in a common volume, they shall be clearly differentiated and separately indexed.

The System Operation Manual shall include but not be limited to the following:

a. Maps showing piping layout and locations of all system valves and gas line markers.

b. Step-by-step procedures required for system startup, operation, and shutdown. System components and equipment shall be indexed to the gas maps.

c. Isolation procedures and valve operations to shut down or isolate each section of the system. Valves and other system components shall be indexed to the gas maps.

d. Descriptions of Site Specific Standard Operation Procedures including permanent and temporary pipe repair procedures, system restart and test procedures for placing repaired lines back in service, and procedures for abandoning gas piping and system components.

e. Descriptions of Emergency Procedures including: isolation procedures including required valve operations with valve locations indexed to gas map, recommended emergency equipment, checklist for major emergencies and procedures for connecting emergency gas supply.

The Equipment Operation Manual shall include, but not be limited to, detail drawings, equipment data, and manufacturer supplied operation manuals for all equipment, valves and system components.

The System Maintenance Manuals shall include, but not be limited to:

a. Maintenance check list for entire gas distribution system.

b. Descriptions of site specific standard maintenance procedures.

c. Maintenance procedures for installed cathodic protection systems.

d. Piping layout, equipment layout, and control diagrams of the systems as installed.

e. Identification of pipe materials and manufacturer by location, pipe repair procedures, and jointing procedures at transitions to other piping materials or piping from different manufacturer.

The Equipment Maintenance Manuals shall include but not be limited to the following:

a. Identification of valves and other equipment by materials, manufacturer, vendor identification and location.

b. Maintenance procedures and recommended maintenance tool kits for all valves and equipment.

c. Recommended repair methods, either field repair, factory repair, or whole-item replacement for each valve component or piece of equipment or component item.

d. Routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guide.

2 PRODUCTS

2.1 PIPE, FITTINGS, AND ASSOCIATED MATERIALS

2.1.1 Steel Pipe

Steel pipe shall conform to ASTM A 53, Grade A or B, Type E or S, Schedule 40; or API Spec 5L seamless or electric resistance welded, Schedule 40, black steel pipe as specified in ASME B31.8. Furnace buttwelded pipe may be used in sizes 1-1/2 inches and smaller.

2.1.2 Small Fittings

Fittings 1-1/2 inches and smaller shall conform to ASME B16.11.

2.1.3 Fittings, 2 Inches and Larger

Pipe flanges and flanged fittings including bolts, nuts, and bolt patterns shall be in accordance with ASME B16.5 Class 150. Buttweld fittings shall be in accordance with ASME B16.9. Weld neck flanges shall be used.

2.1.4 Steel Forged Branch Connections

Connections shall conform to ASTM A 181/A 181M, Class 60, carbon steel.

2.1.5 Flange Gaskets

Gaskets shall be non-asbestos compressed material in accordance with ASME B16.21, 1/16 inch minimum thickness, full face or self-centering flat ring type. The gaskets shall contain aramid fibers bonded with nitrile butadiene rubber (NBR), or glass fibers bonded with polytetrafluoroethylene, suitable for maximum 600 degrees F service and meeting applicable requirements of ASME B31.8.

2.1.6 Pipe Threads

Pipe threads shall conform to ASME B1.20.1.

2.1.7 Polyethylene Pipe, Tubing, Fittings and Joints

Polyethylene pipe, tubing, fittings and joints shall conform to ASTM D 3350 and ASTM D 2513, pipe designations PE 2406 and PE 3408, rated SDR 125 or less, as specified in ASME B31.8. Pipe sections shall be marked as required by ASTM D 2513. Butt fittings shall conform to ASTM D 3261 and socket fittings shall conform to ASTM D 2683. Fittings shall match the service rating of the pipe.

2.1.8 Sealants for Steel Pipe Threaded Joints

2.1.8.1 Sealing Compound

Joint sealing compound shall be as listed in UL Gas&Oil Dir, Class 20 or less.

2.1.8.2 Tape

Polytetrafluoroethylene tape shall conform to ASTM D 3308.

2.1.9 Identification

Pipe flow markings and metal tags for each valve, meter, and regulator shall be provided as required by the Contracting Officer.

2.1.10 Insulating Joint Materials

Insulating joint materials shall be provided between flanged or threaded metallic pipe systems where shown to isolate galvanic or electrolytic action.

2.1.10.1 Threaded Joints

Joints for threaded pipe shall be steel body nut type dielectric type unions with insulating gaskets.

2.1.10.2 Flanged Joints

Joints for flanged pipe shall consist of full face sandwich-type flange insulating gasket of the dielectric type, insulating sleeves for flange bolts and insulating washers for flange nuts.

2.1.11 Gas Transition Fittings

Gas transition fittings shall be manufactured steel fittings approved for jointing steel and polyethylene or fiberglass pipe. Approved transition fittings are those that conform to AGA Manual requirements for transition fittings.

2.2 VALVES

Valves shall be suitable for shutoff or isolation service and shall conform to the following:

2.2.1 Steel Valves

Steel valves 1-1/2 inches and smaller installed underground shall conform to ASME B16.34, carbon steel, socket weld ends, with square wrench operator adaptor. Steel valves 1-1/2 inches and smaller installed aboveground shall conform to ASME B16.34, carbon steel, socket weld or threaded ends with handwheel or wrench operator. Steel valves 2 inches and larger installed underground shall conform to API Spec 6D, carbon steel, buttweld ends, Class 150 with square wrench operator adaptor. Steel valves 2 inches and larger installed aboveground shall conform to API Spec 6D, carbon steel, buttweld or flanged ends, Class 150 with handwheel or wrench operator.

2.2.2 Steel Valve Operators

Valves 8 inches and larger shall be provided with worm or spur gear operators, totally enclosed, grease packed, and sealed. The operators shall have Open and Closed stops and position indicators. Locking feature shall be provided where indicated. Wherever the lubricant connections are not conveniently accessible, suitable extensions for the application of lubricant shall be provided. Valves shall be provided with lubricant compatible with gas service.

2.2.3 Polyethylene Valves

Polyethylene valves shall conform to ASME B16.40. Polyethylene valves, in sizes 1/2 inch to 6 inches, may be used with polyethylene distribution and service lines, in lieu of steel valves, for underground installation only.

2.3 PRESSURE REGULATORS

Regulators shall have ferrous bodies, shall provide backflow and vacuum protection, and shall be designed to meet the pressure, load and other service conditions.

2.3.1 Gas Main Regulators

Pressure regulators for main distribution lines, supplied from a source of gas which is at a higher pressure than the maximum allowable operating pressure for the system, and shall be equipped with pressure regulating devices of adequate capacity. In addition to the pressure regulating devices, a suitable method shall be provided to prevent overpressuring of the system in accordance with ASME B31.8. Suitable protective devices are as follows:

a. Spring-loaded relief valve meeting the provisions of ASME BPV VIII Div 1.

b. Pilot-loaded back pressure regulator used as relief valve, so designed that failure of the pilot system will cause the regulator to open.

c. Weight-loaded relief valves.

d. Monitoring regulator installed in series with the primary pressure regulator.

e. Series regulator installed upstream from the primary regulator, set to limit the pressure on the inlet of the primary regulator continuously to the maximum allowable operating pressure of the system, or less.

f. Automatic shutoff device installed in series with the primary regulator, set to shut off when the pressure on the distribution system reaches the maximum allowable operating pressure of the system, or less. This device shall remain closed until manually reset.

g. Spring-loaded, diaphragm type relief valves.

2.3.2 Service Line Regulators

Pressure regulators for individual service lines shall have ferrous bodies. Regulator shall be capable of reducing distribution line pressure to pressures required for users. Regulators shall be provided where gas will be distributed at pressures in excess of 10 inches of water column. Pressure relief shall be set at a lower pressure than would cause unsafe operation of any connected user. Regulators for liquified petroleum gas shall be adjusted to 10 to 12 inches of water column. Pressure relief for liquified petroleum gas shall be set at 16 inches of water column. Regulator shall have single port with orifice diameter no greater than that recommended by the manufacturer for the maximum gas pressure at the regulator inlet. Regulator valve vent shall be of resilient materials designed to withstand flow conditions when pressed against the valve port. Regulator shall be capable of regulating downstream pressure within limits of accuracy and shall be capable of limiting the buildup of pressure under no-flow conditions to 50 percent or less of the discharge pressure maintained under flow

conditions. Regulator shall have a self contained service regulator. Regulator pipe connections shall not exceed 2 inch size.

2.4 METERS

Meters shall conform to ANSI B109.2. Meters shall be pipe mounted and be provided with a strainer immediately upstream. Meters shall be provided with over-pressure protection as specified in ASME B31.8. Meters shall be suitable for accurately measuring and handling gas at pressures, temperatures, and flow rates indicated. Meters shall have a pulse switch initiator capable of operating up to speeds of 500 pulses per minute with no false pulses and shall require no field adjustments. Initiators shall provide the maximum number of pulses up to 500 per minute that is obtainable from the manufacturer. It shall provide not less than one pulse per 100 cubic feet of gas.

2.5 PROTECTIVE COVERING MATERIALS

Continuously extruded polyethylene and adhesive coating system materials shall conform to NACE RP0185, Type A.

3 EXECUTION

3.1 EXCAVATION AND BACKFILLING

Earthwork shall be as specified in Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS.

3.2 GAS MAINS

Pipe for in ground gas mains shall be polyethylene. Polyethylene mains shall not be installed aboveground.

3.3 SERVICE LINES AND EMERGENCY GAS SUPPLY CONNECTION

Service lines shall be constructed of materials specified for gas mains and shall extend from a gas main to and including the point of delivery within 5 feet of the building. The point of delivery is the service regulator. The service lines shall be connected to the gas mains through service tees, with end of run plugged. Where indicated, service line shall be provided with an isolation valve of the same size as the service line. The service lines shall be as short and as straight as practicable between the point of delivery and the gas main and shall not be bent or curved laterally unless necessary to avoid obstructions or otherwise permitted. Service lines shall be laid with as few joints as practicable using standard lengths of pipe. Shorter lengths shall be used only for closures. Polyethylene or fiberglass service lines shall not be installed aboveground except as permitted in ASME B31.8.

3.4 WORKMANSHIP AND DEFECTS

Pipe, tubing, and fittings shall be clear and free of cutting burrs and defects in structure or threading and shall be thoroughly brushed and blown free of chips and scale. Defective pipe, tubing, or fittings shall be replaced and shall not be repaired.

3.5 PROTECTIVE COVERING

3.5.1 Protective Covering for Aboveground Piping Systems

Finish painting shall conform to the applicable paragraphs of Section 09900 PAINTING, GENERAL and as follows:

3.5.1.1 Ferrous Surfaces

Shop primed surfaces shall be touched up with ferrous metal primer same type paint as the shop primer. Surfaces that have not been shop primed shall be solvent-cleaned in accordance with SSPC SP 1. Surfaces that contain loose rust, loose mill scale, and other foreign substances shall be mechanically cleaned by power wire brushing in accordance with SSPC SP 3 or brush-off blast cleaned in accordance with SSPC SP 7 and primed with ferrous metal primer in accordance with SSPC Paint 25. Primed surfaces shall be finished with two coats of exterior alkyd paint conforming to CID A-A-2962 Type I, Class A, Grade B.

3.6 INSTALLATION

Gas distribution system and equipment shall be installed in conformance with the manufacturer's recommendations and applicable sections of ASME B31.8, AGA Manual and 49 CFR 192. Abandoning existing gas piping shall be done in accordance with ASME B31.8. Pipe shall be cut without damaging the pipe. Unless otherwise authorized, cutting shall be done by an approved type of mechanical cutter. Wheel cutters shall be used where practicable. Cutting of plastic pipe shall be in accordance with AGA Manual. Valve installation in plastic pipe shall be designed to protect the plastic pipe against excessive torsional or shearing loads when the valve is operated and from other stresses which may be exerted through the valve or valve box.

3.6.1 Installing Pipe Underground

Gas mains and service lines shall be graded as indicated. Joints in steel pipe shall be welded except as otherwise permitted for installation of valves. Mains shall have 24 inch minimum cover; service lines shall have 18 inch minimum cover; and both mains and service lines shall be placed on firmly compacted select material for the full length. Where indicated, the main shall be encased, bridged, or designed to withstand any anticipated external loads as specified in ASME B31.8. The encasement material shall be standard weight black steel pipe with a protective coating as specified. The pipe shall be separated from the casing by insulating spacers and sealed at the ends with casing bushings. Trench shall be excavated below pipe grade, bedded with bank sand, and compacted to provide full-length bearing. Laying the pipe

on blocks to produce uniform grade will not be permitted. The pipe shall be clean inside before it is lowered into the trench and shall be kept free of water, soil, and all other foreign matter that might damage or obstruct the operation of the valves, regulators, meters, or other equipment. When work is not in progress, open ends of pipe or fittings shall be securely closed by expandable plugs or other suitable means. Minor changes in line or gradient of pipe that can be accomplished through the natural flexibility of the pipe material without producing permanent deformation and without overstressing joints may be made when approved. Changes in line or gradient that exceed the limitations specified shall be made with fittings. When cathodic protection is furnished, electrically insulated joints or flanges shall be provided. When polyethylene or fiberglass piping is installed underground, foil backed magnetic tape shall be placed above the pipe to permit locating with a magnetic detector. After laying of pipe and testing, trench shall be backfilled in accordance with Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITY SYSTEMS.

3.6.2 Installing Pipe Aboveground

Aboveground piping shall be protected against dirt and other foreign matter as specified for underground piping. Joints in steel pipe shall be welded; however, joints in pipe 1-1/2 inches in diameter and smaller may be threaded; joints may also be threaded to accommodate the installation of valves. Flanges shall be of the weld neck type to match wall thickness of pipe.

3.7 PIPE JOINTS

Pipe joints shall be designed and installed to effectively sustain the longitudinal pullout forces caused by the contraction of piping or superimposed loads.

3.7.1 Threaded Steel Joints

Threaded joints in steel pipe shall have tapered threads evenly cut and shall be made with UL approved graphite joint sealing compound for gas service or polytetrafluoroethylene tape applied to the male threads only. Caulking of threaded joints to stop or prevent leaks will not be permitted.

3.7.2 Welded Steel Joints

Gas pipe weldments shall be as indicated. Changes in direction of piping shall be made with welding fittings only; mitering or notching pipe to form elbows and tees or other similar type construction will not be permitted. Branch connection may be made with either welding tees or forged branch outlet fittings. Branch outlet fittings shall be forged, flared for improvement of flow where attached to the run, and reinforced against external strains. Beveling, alignment, heat treatment, and inspection of weld shall conform to ASME B31.8. Weld defects shall be removed and repairs made to the weld, or the weld joints shall be entirely removed and rewelded. After filler metal has been removed from its original package, it shall be protected or stored so that its characteristics or welding properties are not affected adversely. Electrodes that have been wetted or have lost any of their coating shall not be used.

3.7.3 Polyethylene Pipe Jointing Procedures

Jointing procedures shall conform to AGA Manual. Indiscriminate heat fusion joining of plastic pipe or fittings made from different polyethylene resins by classification or by manufacturer shall be avoided if other alternative joining procedures are available. If heat fusion joining of dissimilar polyethylenes is required, special procedures are required. The method of heat fusion joining dissimilar polyethylene resins shall be tested in accordance with paragraph TESTS, subparagraph Destructive Tests of Plastic Pipe Joints.

3.7.4 Connections Between Metallic and Plastic Piping

Connections shall be made only outside, underground, and with approved transition fittings.

3.8 VALVE BOXES

Valve boxes of cast iron not less than 3/16 inch thick shall be installed at each underground valve except where concrete or other type of housing is indicated. Valve boxes shall be provided with locking covers that require a special wrench for removal. Wrench shall be furnished for each box. The word "gas" shall be cast in the box cover. When the valve is located in a roadway, the valve box shall be protected by a suitable concrete slab at least . 3 square feet. When in a sidewalk, the top of the box shall be in a concrete slab 2 feet square and set flush with the sidewalk. Boxes shall be adjustable extension type with screw or slide-type adjustments. Valve boxes shall be separately supported, not resting on the pipe, so that no traffic loads can be transmitted to the pipe. Valves shall only be located in valve boxes or inside of buildings.

3.9 DRIPS

Drips shall be installed at locations where indicated. Drips shall conform to the details shown or may be commercial units of approved type and capacity. A blow off pipe 1-1/4 inches or larger shall be connected to each drip at its lowest point and shall extend to or near the ground surface at a convenient location away from traffic. Discharge for each drip terminal (outlet) shall be provided with a reducing fitting, a plug valve, and a 1/2 inch nipple turned down. The discharge terminal (outlet) shall be inside a length of 12 inches or larger vitrified clay pipe, concrete sewer pipe or concrete terminal box [set vertically on a bed of coarse gravel 1 foot thick and 3 feet square and closed at the ground surface with a suitable replacement cover.

3.10 PRESSURE REGULATOR INSTALLATION

3.10.1 Service Line Regulators

A shutoff valve, meter set assembly, and service regulator shall be installed on the service line outside the building, 18 inches above the ground on the riser. An insulating joint shall be installed on the inlet side of the meter set assembly and service regulator and shall be constructed to prevent flow of electrical current. A 3/8 inch tapped fitting equipped with a plug shall be provided on both sides of the service regulator for installation of pressure gauges

for adjusting the regulator. All service regulator vents and relief vents shall terminate in the outside air in rain and insect resistant fittings. The open end of the vent shall be located where gas can escape freely into the atmosphere, away from any openings into the building and above areas subject to flooding.

3.11 METER INSTALLATION

Meters shall be installed in accordance with ASME B31.8. Permanent gas meters shall be installed with provisions for isolation and removal for calibration and maintenance, and shall be suitable for operation in conjunction with an energy monitoring and control system.

3.12 CONNECTIONS TO EXISTING LINES

Connections between new work and existing gas lines, where required, shall be made in accordance with ASME B31.8, using proper fittings to suit the actual conditions. When connections are made by tapping into a gas main, the connecting fittings shall be the same size as the pipe being connected.

3.12.1 Connections to Gas Utility Lines

Contractor shall provide materials for the connections to the existing gas lines. The Contractor shall notify the Contracting Officer, in writing, 10 days before final connections and turning on of gas lines. The Contractor shall make necessary arrangements with 7 CES/Operations for tie in and activation of new gas lines. Only the Operating Agency/Utility Company may reactivate the system after tie in. The Contractor shall furnish a certification by the Operating Agency/Utility Company that all Utility work has been satisfactorily completed.

3.13 TESTS

3.13.1 Destructive Tests of Plastic Pipe Joints

Each day, prior to making polyethylene heat fusion joints, a joint of each size and type to be installed that day shall be made by each person performing joining of plastic pipe that day and destructively tested. At least 3 longitudinal straps shall be cut from each joint. Each strap shall be visually examined, shall not contain voids or discontinuities on the cut surfaces of the joint area, and shall be deformed by bending, torque, or impact, and if failure occurs, it must not initiate in the joint area. If a joint fails the visual or deformation test, the qualified joiner who made that joint shall not make further field joints in plastic pipe on this job until that person has been retrained and requalified. The results of the destructive tests shall be recorded to include the date and time of the tests, size and type of the joints, ambient conditions, fusion iron temperature and names of inspectors and joiners.

3.13.2 Pressure and Leak Tests

The system of gas mains and service lines shall be tested after construction and before being placed in service using air as the test medium. Prior to testing the system, the interior shall be

blown out, cleaned and cleared of all foreign materials. All meters, regulators, and controls shall be removed before blowing out and cleaning and reinstalled after clearing of all foreign materials. Testing of gas mains and service lines shall be done with due regard for the safety of employees and the public during the test. Persons not working on the test operations shall be kept out of the testing area while testing is proceeding. The test shall be made on the system as a whole or on sections that can be isolated. Joints in sections shall be tested prior to backfilling when trenches must be backfilled before the completion of other pipeline sections. The test shall continue for at least 24 hours from the time of the initial readings to the final readings of pressure and temperature. The initial test readings of the instrument shall not be made for at least 1 hour after the pipe has been subjected to the full test pressure, and neither the initial nor final readings shall be made at times of rapid changes in atmospheric conditions. The temperatures shall be representative of the actual trench conditions. There shall be no indication of reduction of pressure during the test after corrections have been made for changes in atmospheric conditions in conformity with the relationship T(1)P(2)=T(2)P(1), in which T and P denote absolute temperature and pressure, respectively, and the numbers denote initial and final readings. During the test, the entire system shall be completely isolated from all compressors and other sources of air pressure. Each joint shall be tested by means of soap and water or an equivalent nonflammable solution prior to backfilling or concealing any work. The testing instruments shall be approved by the Contracting Officer. All labor, materials and equipment for conducting the tests shall be furnished by the Contractor and shall be subject to inspection at all times during the tests. The Contractor shall maintain safety precautions for air pressure testing at all times during the tests.

** End of Section **

SECTION 02711
PORTLAND CEMENT STABILIZED MATERIALS
12Sep01

1. **APPLICABLE PUBLICATIONS**: The publications listed below form a part of the specification. The publications are referred to in the text by the basic designation only.

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

C 136	(1996a) Sieve Analysis of Fine and Coarse Aggregates
C 150	(1997) Portland Cement
D 558	(1982) Moisture-Density Relations of Soil-Cement Mixtures
D 1556	(1990; R 1996) Density of Soil in Place by the Sand-Cone Method
D 1557	(1998) Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb (4.54-kg) Rammer and 18-in. (457-mm) Drop

2. **GENERAL**:

2.1 Scope: The work specifed herein consists of the construction of a 6-inch thick layer of portland cement stabilized materials. The work shall be performed in accordance with this specification and shall conform to the lines, grades, notes, and details shown in the plans and as follows:

2.2 Definition: Portland cement stabilized materials, as used herein, is a mixture of portland cement and in-place materials uniformly blended and thoroughly compacted to produce a pavement course which meets all criteria as set forth in the plans and specifications.

3. **PLANT, EQUIPMENT, MACHINES, AND TOOLS**: Plant, equipment, machines, and tools used in the work shall be adequate and shall have the capability of producing the required stabilization, mixing, compaction, meeting grade controls, thickness control, and smoothness requirements as set forth herein.

4. **WEATHER LIMITATIONS:** Cement shall not be applied when the atmospheric temperature is less than 40 degrees F or when freezing weather conditions are predicted to occur prior to the end of the required curing period or placement of overlaying pavement section materials with sufficient thickness to protect the curing cement.

5. **SAMPLING AND TESTING**: All sampling and testing shall be performed by an independent testing laboratory provided by the Contractor at no cost to the Government. Contractor shall provide the following tests:

5.1 Laboratory moisture-density tests: These tests shall be conducted in accordance with the procedures contained in ASTM D 558; however the apparatus and procedures outlined in Methods A or D, depending on gradation of the mix, of ASTM D 1557 shall be used to compact the soil-cement mixture. Since the in-place materials are expected to vary, Contractor shall provide for the obtaining of up to three such laboratory moisture-density relationships for use during the project. The first laboratory moisture-density relationship shall be developed during the first work area requirement and the other two laboratory moisture-density relationships shall be developed later as the work progresses and soil materials encountered change. The government will decide in each case when a new laboratory moisture-density relationship is necessary and which laboratory moisture-density relationship is actually representative of the particular soil materials/portland cement blend in question.

5.2 Field density tests: These tests shall be performed in accordance with ASTM D 1556. Contractor's testing laboratory shall determine the in-place moisture content and density of completed portland cement stabilized materials to verify compaction and moisture content at a rate of at least one test per 500 square yards or each work area. The government will select all test locations. Any unsatisfactory tests shall be repeated after reworking at Contractor's expense.

6. **WAYBILLS AND DELIVERY TICKETS**: Copies of waybills or delivery tickets shall be submitted during the progress of the work for all portland cement used in the work.

7. **MATERIALS**: Areas shall be constructed true to grade, shaped to drain, and shall be maintained free of trash and debris until final inspection has been completed and the work has been accepted.

7.1 Cement: Cement shall conform to ASTM C 150, Type I, IA, II, or IIA.

7.2 Material to be Stabilized: The material to be stabilized shall consist of in-place materials. Stones retained on a 2-inch sieve and deleterious substances such as sticks, debris, and organic matter shall be removed.

7.3 Water: Water shall be clean, fresh, and free from injurious amounts of oil, acid, salt, alkali, organic matter, and other substances deleterious to the proper hardening of the soil-cement, and shall be subject to approval.

8. **MIX**: The mix shall consist of four (plus or minus 0.5) pounds of portland cement per square foot of in-place materials to be stabilized.

9. **GENERAL REQUIREMENTS**: Cement shall not be applied if the soil moisture content exceeds optimum moisture content determined for the cement-treated mixture. After mixing is completed, the proportions of the mixture shall be in accordance with the specified mix. When application of water and mixing are completed, on the basis of dry weight, moisture shall not be below the optimum moisture content of the mixture nor shall it be more than 2 percent above the optimum moisture content. Adequate drainage or dewatering shall be provided during the entire construction period to prevent water from collecting or standing on and in the materials to be stabilized.

10. **PREPARATION OF AREA TO BE STABILIZED**:

10.1 General Requirements: Area shall be cleaned of debris. It shall be inspected for adequate compaction by proof rolling with the compaction equipment proposed for compacting the soil-cement mixture. The area shall be capable of withstanding without displacement the compaction specified for the soil-cement mixture.

10.2 In-Place Material to be Stabilized: The entire area shall be graded and shaped to conform to the lines, grades, and cross sections shown in the plans prior to being processed. Soft, wet, or yielding areas shall be made stable before construction is begun. This shall be accomplished by the installation of drainage/dewatering features and/or by the incorporation of additional dry portland cement into the softer yielding areas below the area to be cement-stabilized.

11. **INSTALLATION**:

11.1 Mixed-In-Place Method: ***Do not remove materials for stabilization***.

11.1.1 Scarifying and Pulverizing of Soil: Prior to the application of cement, the soil shall be scarified and pulverized to a depth of 6-inches. Scarification shall be carefully controlled ***so that the layer beneath the layer to be stabilized is not disturbed***.

11.1.2 Application of Cement: Pulverized material shall be shaped approximately to the cross section indicated. Cement shall be applied so that when uniformly mixed with the soil, the specified cement content is obtained and a sufficient quantity of cement-treated soil is produced to construct a compacted cement-treated course conforming to the lines, grades, and cross section indicated. Place cement only when permitted by existing wind conditions (generally less than 10 miles per hour). Do not allow cement to blow away from the project and create a safety hazard. No equipment except that used in spreading and mixing operations shall pass over the freshly spread cement.

11.1.3 Dry Mixing: Immediately after the cement has been distributed at the proper application rate, it shall be mixed with the soil. ***Do not mix cement with soil that is excessively wet (above optimum).*** Care shall be exercised to prevent the cement from being mixed below the required depth. Mixing shall continue until the cement has been

sufficiently blended with the soil to prevent the formation of cement balls when water is applied.

11.1.4 Water Application and Moist Mixing: Moisture content of the mixture will be determined immediately after completion of mixing of the soil and cement. Water supply and pressure distributing equipment shall be provided that will permit the continuous application within 3-hours of all water required on the section being processed. Water shall be incorporated in the mix in such a manner to avoid concentration of water near the surface. After all the mixing water has been added, mixing shall be continued until the water is uniformly distributed throughout the full depth of the mixture, with no portion of the mixture remaining undisturbed during mixing for more than 30-minutes. Any portion of the mixture remaining undisturbed more than 30-minutes during mixing shall be promptly removed and disposed. Particular care shall be taken to ensure satisfactory moisture distribution along the edges of the section. Contractor's testing laboratory shall be present during mixing/water addition activities to conduct moisture content testing. This same testing laboratory shall also conduct moisture content testing at mixing water addition location selected by government for quality control testing at a rate of at least one test per 500 square yards or each work area.

11.2 Layer Thickness: Compacted thickness of the stabilized course shall be 6-inches.

11.3 Mixing and Compaction: Before compaction operations are started and as a continuation of the mixing operation, the mixture shall be thoroughly loosened to the full depth. At the beginning of compaction, 100 percent of the mixed cement/soil mixture shall pass the 1-inch sieve. If the in place materials is actually base materials, actual pieces of aggregate are excluded from the sieve criteria. Contractor's testing laboratory shall be present during this stage to conduct sieve analysis. This same testing laboratory shall also conduct sieve analysis at any additional location selected by government for quality control testing (minimum of 1 test per 500 square yards). Compaction shall be started immediately after mixing is completed. Density of the compacted soil cement mixture shall be at least 90 percent of the maximum density obtained from the laboratory prepared samples. The mixture shall be uniformly and continuously compacted until the entire depth and width of the area are compacted to the density specified herein. The moisture content at the surface shall be maintained near optimum at times through the rolling but shall be less than that quantity which will cause the soil-cement mixture to become unstable during compaction. Rolling shall begin at the outside edge of the surface and proceed to the center., overlapping on successive trips at least one-half of the width of the roller. Alternate trips of the roller shall be slightly different lengths. Speed of the roller at all times shall be such that displacement of the mixture does not occur. Areas inaccessible to rollers shall be compacted with mechanical tampers.

12. **FINISHING**: The surface shall be moistened, if necessary, and shaped to the required lines, grades, and cross section. If necessary, the surface shall be lightly scarified to eliminate any imprints made by the compacting or shaping equipment. The surface shall then be thoroughly compacted to the specified density with rubber-tired

rollers and smooth-wheel tandem rollers to the extent necessary to provide a smooth dense, uniform surface that is free of surface checking, ridges, or loose material, and that conforms to the crown, grade and lines indicated. These finishing operations shall be completed within 2-hours after completion of mixing operations. In places not accessible to finishing and shaping equipment, the mixtures shall be compacted with mechanical tampers to the density specified and shall be shaped and finished by hand methods. Any portion of the compacted mix that has density less than that specified, that has not properly hardened, or that is improperly finished shall be corrected by removal and replacement with soil-cement that is mixed, moistened, and compacted in accordance with this specification.

13. **CURING AND PROTECTION**: The finished surface shall be protected against rapid drying by installing an asphaltic membrane within 48-hours of mixing. Comply with Section PRIME COAT for asphaltic membrane.

SECTION 02722
FLEXIBLE BASE
12Sep01

1. **APPLICABLE PUBLICATIONS**: The publications listed below form a part of the specification. The publications are referred to in the text by the basic designation only.

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

D 1556-90 Density of Soil in Place by the Sand-Cone Method

D 1557-98 Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb (4.54-kg) Rammer and 18-in. (457-mm) Drop

1.2 "1982 Standard Specifications for Construction of Highways, Streets and Bridges" published by the Texas State Department of Highways and Public Transportation (THD Specs).

2. **GENERAL**: Provide flexible base (crushed stone) consistent with THD Specs, Item 248 for a Type A, Grade 2 material, and as modified as follows:

2.1 Substitute the words "Contracting Officer" for the word "Engineer".

2.2 Paragraphs 248.7 "Measurement" and 248.8 "Payment" shall not apply.

3. **SUBMITTALS**: Contractor shall provide independent testing laboratory test results for the proposed flexible base which establishes compliance with these specifications (THD Specs, Item 248, Type A, Grade 2 material). Submit test results to Contracting Officer for approval. Contractor shall also establish and provide the moisture-density relationship for the proposed flexible base as well as field test reports for the installed flexible base to Contracting Officer for approval.

4. **DENSITY:** The flexible base shall be compacted to a ***minimum density of 100%*** of the maximum density obtained by ASTM D 1557. Field installed densities shall be verified by ASTM D 1556. Nuclear density machines may be substituted for this sand cone method if suitable recent evidence of calibration is available for review by the Contracting Officer.

5. **INSTALLATION:** The flexible base shall be installed in compacted lifts not exceeding 6-inches in depth. Adjust the moisture content of the flexible base such that the moisture content is at or very near the optimum moisture content during compaction. Rolling flexible base wet of optimum and air drying is not an acceptable procedure. Do not overwater! Density and moisture readings shall be taken immediately after rolling (within 8-hours). Moisture readings more than 1.5% above optimum moisture content or density readings below minimum densities shall be cause for rejection of the installed

base. All sampling and testing shall be performed by an independent testing laboratory provided by the Contractor.

6. **TESTING**: Contractor shall provide the services of an independent testing laboratory to determine and establish the moisture-density relationship of the flexible base per ASTM 1557. Contractor shall also provide the services of an independent testing laboratory to determine at least one moisture-density value for each 500 square yards of surface area or individual work area (whichever method produces the greatest number of tests) per lift of contractor installed flexible base. The government shall select the location of such tests to verify installed densities. Any unsatisfactory tests shall be repeated after reworking at contractor's expense. Copies of waybills or delivery tickets shall be submitted during the progress of the work for all flexible base used in the work.

SECTION 02733
PRIME COAT
12Sep01

1. **APPLICABLE PUBLICATIONS**: The Texas State Department of Highways and Public Transportation's "1982 Standard Specifications for Construction of Highways, Streets and Bridges" (THD Specs) form a part of this specification.

2. **GENERAL**: Provide a prime coat consistent with THD Specs, Item 310 over pavement courses where indicated and as modified as follows:

2.1 Substitute the words "Contracting Officer" for the word "Engineer".

2.2 Paragraphs 310.4 "Measurement" and 310.5 "Payment" shall not apply.

3. **SUBMITTALS**: Contractor shall submit independent testing laboratory test results or suitable certification for prime coat materials demonstrating compliance with THD Specs, Item 300 to Contracting Officer for approval prior to application of prime coat.

4. **APPLICATION RATE:** Uniformly apply 0.20 gallons (plus or minus 0.05 gallons) of MC-30 or MC-70 per square yard of surface area per THD Specs, Item 310. Allow to cure prior to application of subsequent pavement section.

5. **WEATHER LIMITATIONS:** Apply only to dry surfaces when the air temperature is at least 50 degrees F.

6. **SURFACE PREPARATION**: Clean pavement course surfaces prior to application of prime coat by removing all loose material by means of a power broom or blower supplemented with hand brooms.

7. **STORAGE/APPLICATION TEMPERATURES**: Maintain application temperature per the following table:

TYPE-GRADE	TEMPERATURE RANGE (degreesF)
MC-30	70-175
MC-70	125-200

SECTION 02734
TACK COAT
12Sep01

1. **APPLICABLE PUBLICATIONS**: The American Society for Testing and Materials (ASTM) Publications form a part of these specifications.

2. **GENERAL**: Provide a tack coat over prime coats, existing asphalt, or other areas as indicated consistent with ASTM D977-86, grade SS-1. ***Place tack coat within one-hour to four-hours preceding placement of hot mix asphaltic concrete.***

3. **SUBMITTALS**: Contractor shall submit independent testing laboratory test results or suitable certification for tack coat materials demonstrating compliance with ASTM D977-86, grade SS-1 to Contracting Officer for approval.

4. **APPLICATION RATE:** Uniformly apply 0.05 gallons (plus or minus 0.02 gallons) per square yard of surface area using a hand spray bar. Vary the exact quantities within the range specified to suit field conditions.

5. **WEATHER LIMITATIONS:** Apply the tack coat only when the surface to be paved is dry and the air temperature is at least 50 degrees F.

6. **SURFACE PREPARATION**: Clean surfaces prior to application of tack coat by removing all loose materials by means of a power broom or blower supplemented with hand brooms.

7. **APPLICATION TEMPERATURES**: Apply materials within the range of 70-160 degrees F.

SECTION 02735
HOT MIX ASPHALTIC CONCRETE PAVEMENT (STREETS)
12Sep01

1. **APPLICABLE PUBLICATIONS**: The publications listed below form a part of this specification. The publications are referred to in the text by the basic designation only.

1.1 Military Standard (Mil. Std.):

MIL-STD-620A & Notice 1	Test Methods for Bituminous Paving Materials

1.2 U.S. Army Corps of Engineers, Handbook for Concrete and Cement:

CRD-C 119-53 Rev Jun 63	Flat and Elongated Particles in Coarse Aggregate

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

C 29-87	Unit Weight and Voids in Aggregate
C 88-83	Soundness of Aggregates by Use of Sodium Sulfate Or Magnesium Sulfate
C 117-87	Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing
C 127-84	Specific Gravity and Absorption of Coarse Aggregate
C 128-84	Specific Gravity and Absorption of Fine Aggregate
C 131-81 (R 1987)	Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
C 136-84a	Sieve Analysis of Fine and Coarse Aggregates
C 183-83a	Sampling and Acceptance of Hydraulic Cement
D 5-86	Penetration of Bituminous Materials
D 75-82	Sampling Aggregates
D 140-70 (R 1981)	Sampling Bituminous Materials

D 242-85	Mineral Filler for Bituminous Paving Mixtures
D 422-63 (R 1972)	Standard Method for Particle-Size Analysis of Soils
D 946-82	Standard Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction
D 1250-84	Petroleum Measurement Tables
D 1559-89	Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
D 1856-79 (R 1984)	Recovery of Asphalt from Solution by Abson Method
D 2041-78	Theoretical Maximum Specific Gravity of Bituminous Paving Mixtures
D 2172-81	Quantitative Extraction of Bitumen from Bituminous Paving Mixtures
D 2216-80	Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures
D 3381-81	Viscosity-Graded Asphalt Cement for Use in Pavement Construction
D 3515-84	Hot-Mixed, Hot-Laid Bituminous Paving Mixtures

2. **STRAIGHTEDGE**: The Contractor shall furnish and maintain at the site, in good condition, one 12-foot straightedge. Straightedge shall be made available for Government use. Straightedge shall be constructed of aluminum or other lightweight metal and shall have blades of box or box-girder cross section with flat bottom reinforced to insure rigidity and accuracy. Straightedges shall have handles to facilitate movement on pavement.

3. **PAVING SEASON/WEATHER LIMITATIONS**: Bituminous courses shall not be constructed during the winter months (December 1 until March 15 of the following year). Also, bituminous courses shall not be constructed when the existing pavement is wet or below 40-degrees F.

4. **PROTECTION OF PAVEMENT**: After asphalt placement and final rolling, no vehicular traffic of any kind shall be permitted on the pavement until the pavement has cooled to 140-degrees F.

5. **GRADE AND SURFACE-SMOOTHNESS REQUIREMENTS**: Finished surface of pavements, when tested as specified below and in paragraph ACCEPTABILITY OF WORK, shall conform to the surface smoothness requirements specified.

5.1 Wearing Course Surface Smoothness: The wearing course upon completion of final rolling shall be smooth and true to profile grade and cross section. When a 12-foot straightedge is laid on the surface and parallel with the centerline (Longitudinal direction), the surface shall not vary in excess of 1/8-inch; and when the same straightedge is laid on the surface and perpendicular with the centerline (Transverse direction), the surface shall not vary in excess of ¼-inch.

6. **GRADE CONTROL/QUALITY ASSURANCE**: The finished surfaces shall match the profile elevations when and as shown on the drawings to within 0.03 foot. When profile elevations are shown on the drawings - to allow verification by the government of the finished profile, Contractor shall provide the services of an independent state-licensed surveyor to survey areas where profile elevations are indicated on the drawings - after the asphalt has been placed. This survey shall take readings every 12.5-feet (Minimum). Submit survey results to Contracting Officer for approval.

7. **SAMPLING AND TESTING**:

7.1 General: Contractor shall provide the services of an independent testing laboratory to perform all sampling and testing required by this specification. Copies of all specified tests shall be submitted to the Contracting Officer within 72 hours after testing has been completed.

7.2 Aggregates:

7.2.1 General: Samples of aggregates shall be taken by the Contractor for testing and approval of aggregate sources and stockpiles prior to the start of production and at times during production of the bituminous mixtures. The Contractor shall take at least one sample of the aggregate per source and shall submit test reports as specified. ASTM D 75 shall be used in sampling coarse aggregate and fine aggregate, and ASTM C 183 shall be used in sampling mineral filler. All tests necessary to determine compliance with requirements specified herein shall be made by the independent testing laboratory provided by Contractor (Refer paragraph BITUMINOUS HOT MIX). Submit test reports to Contracting Officer for approval.

7.2.2 Sources: Sources of aggregates shall be selected well in advance of the time the materials are required in the work. If a previously developed source is selected, samples shall be tested and test results submitted 15 calendar days before starting production, with

evidence that central-plant, hot-mix bituminous pavements constructed with the aggregates have had a satisfactory service record of at least five years under similar climatic and traffic conditions. When new sources are developed, the Contractor shall indicate sources and submit test results and his plan for operation 30 calendar days before starting production. The Contractor shall make such tests and other investigations as necessary to determine whether aggregates meeting the requirements specified herein can be produced from proposed sources. If a sample of material from a new source fails to meet specification requirements, the material represented by the sample shall be replaced, and the cost of testing the replaced sample will be at the expense of the Contractor. Approval of source of aggregate does not relieve the Contractor of the responsibility for delivery at the jobsite of aggregates that meet the requirements specified.

7.3 Bituminous Materials: Samples of bituminous materials shall be obtained by the Contractor; sampling shall be in accordance with ASTM D 140. Tests necessary to determine conformance with requirements specified herein shall be performed by an independent testing laboratory provided by Contractor. Sources where bituminous materials are obtained shall be selected in advance of time when materials will be required in the work and samples of the asphalt cement specified shall be tested and test results submitted for approval not less than 15 calendar days before production of the asphalt mixture. In addition to initial qualification testing of bituminous materials, samples shall be taken before and during construction when shipments of bituminous materials are received or when necessary to assure that handling or storage has not been detrimental to the bituminous material.

7.4 Bituminous Mixtures: Sampling and testing of bituminous mixtures shall be accomplished by an independent testing laboratory provided by Contractor. Submit test reports to Contracting Officer for approval.

8. **DELIVERY, STORAGE, AND HANDLING OF MATERIALS**:

8.1 Mineral Aggregates: Mineral aggregates shall be delivered to the site of the bituminous mixing plant and stockpiled in such a manner as to preclude fracturing of aggregate particles, segregation, contamination, or intermingling of different materials in the stockpiles or cold-feed hoppers. Mineral filler shall be delivered, stored, and introduced into the mixing plant in a manner to preclude exposure to moisture or other detrimental conditions.

8.2 Bituminous Materials: Bituminous materials shall be maintained at appropriate temperature during storage but shall not be heated by application of direct flame to walls of storage tanks or transfer lines. Storage tanks, transfer lines, and weigh bucket shall be thoroughly cleaned before a different type or grade of bitumen is introduced into the system. The asphalt cement shall be heated sufficiently to allow satisfactory pumping of the material; however, the storage temperature shall be maintained below 300 degrees F.

9. **ACCEPTABILITY OF WORK**:

9.1 General: A lot shall be that quantity of construction that will be evaluated for compliance with specification requirements. A lot shall be equal to 1000 tons or 1-day's production - whichever criteria produces the greatest number of tests. All testing for acceptability of work shall be performed by the Contractor provided independent testing laboratory.

9.1.1 In order to evaluate aggregate gradation, asphalt content, and density, each lot shall be divided into four equal sublots. For density determination, one random sample selected by Government personnel shall be taken from the mat of each sublot, and one random sample shall be taken from the joint of each sublot. Each random sample shall weigh at least 1250 grams. After air drying to a constant weight, random samples obtained from the mat will be used for density determination using MIL-STD-620, Method 101. Samples for determining asphalt content and aggregate gradation shall be taken from loaded trucks within each sublot. Asphalt content shall be determined in accordance with ASTM D 2172, Method A or B. Gradation of the aggregate shall be determined from the recovered aggregate according to ASTM C 136 and ASTM C 117.

9.1.2 When any sample fails to meet the specification requirements, that lot of material is considered to have failed and that lot shall be removed and replaced.

9.1.3 The Contracting Officer reserves the right to direct additional sampling and testing (Gradation of aggregate, percent of asphalt, density, and stability are examples) at any area which appears to deviate from the specification requirements (Ravelling, gap-graded aggregate, cracks, etc.). Such additional sampling and testing shall be performed by the independent testing laboratory provided by Contractor. Additional sampling and testing pursuant to this paragraph shall not exceed one test per 1000 tons of asphalt mixture placed.

9.2 Density: Mat densities and joint densities shall be expressed as a percentage of the laboratory density. The laboratory density for each lot shall be determined in accordance with MIL-STD-620, Method 100 from four sets of laboratory samples. One sample shall be obtained from each of the four sublots and will be divided into three specimens to produce one set of laboratory samples. Laboratory samples shall be prepared from asphalt mixture which has not been reheated in the laboratory. Samples will be compacted in accordance with MIL-STD-620 within 2 hours of the time the mixture was loaded into trucks at the asphalt plant.

9.2.1 The <u>mat density</u> shall be equal to or greater than <u>95.0 percent</u> of the laboratory density.

9.2.2 The <u>joint density</u> shall be equal to or greater than <u>93.0 percent</u> of the laboratory density.

9.3 All density, aggregate gradation, asphalt content, etc. results on a lot shall be completed and reported within 48 hours after the construction of that lot.

9.4 All sample holes shall be filled with hot mix and compacted within 48 hours of taking the sample.

9.5 Surface Smoothness: After the completion of final rolling of a lot, the compacted surface will be evaluated by the Contracting Officer's representative with the 12-foot straightedge provided by Contractor. Measurements will be made perpendicular to and across all joints at equal distances along the joint not to exceed 25-feet. Location and deviation from straightedge for all measurements will be recorded. Any joint or mat area surface deviation which exceeds the surface-smoothness tolerances given in paragraph GRADE AND SURFACE-SMOOTHNESS REQUIREMENTS by more than 50 percent shall be corrected to meet the specification requirements. The Contractor shall remove the deficient area and replace with fresh paving mixture at no additional cost to the Government. Sufficient material shall be removed to allow at least 1-inch of asphalt concrete to be placed. Skin patching for correcting low areas is not permitted.

10. **ACCESS TO PLANT AND EQUIPMENT**: The Contracting Officer shall have access at all times to all parts of the paving plant for checking adequacy of equipment in use; inspecting operation of plant; verifying weights, proportions, and character of materials; and checking temperatures maintained in preparation of mixtures. The Contracting Officer shall be notified of the Contractor's proposed asphalt batch plant location at least 10 calendar days in advance of batching operations to allow an inspection by Government to ascertain the asphalt plant's capability/setup for providing the required job mix. Batching of the job mix shall not commence until the Contracting Officer or his designated representative is satisfied as to the asphalt plant's capability/setup for providing the required job mix.

11. **WAYBILLS AND DELIVERY TICKETS**: Waybills and delivery tickets shall be submitted to the Contracting Officer during progress of the work. Before the final statement is allowed, the Contractor shall file with the Contracting Officer certified waybills and certified delivery tickets for all aggregates and bituminous materials actually used in the construction and covered by the contract.

12. **BITUMINOUS HOT MIX**: Bituminous hot mix shall consist of coarse aggregate, fine aggregate, mineral filler, bituminous material, and approved additive, if required, of the qualities and in the proportions specified and shall conform to requirements contained in paragraphs PROPORTIONING OF MIXTURE AND ACCEPTABILITY OF WORK.

12.1 Aggregates: Aggregates shall consist of natural sand, crushed stone, crushed gravel, crushed slag, screenings, sand, and mineral filler, as required. The portion of materials retained on the No. 4 sieve shall be known as coarse aggregate; the portion passing the No. 4 sieve and retained on the No. 200 sieve as fine aggregate; and the portion passing the No. 200 sieve as mineral filler. Aggregate gradation shall conform to gradation

specified in Table I. Table I is based on aggregates of uniform specific gravity. The percentage passing various sieves may be changed by the Contracting Officer when aggregates of varying specific gravities are used. Adjustments of percentages passing various sieves may be directed by the Contracting Officer when aggregates vary more than 0.2 in specific gravity.

TABLE I. AGGREGATE GRADATION

Sieve Size	Percent Passing
½ inch	100
3/8 inch	86 (+/- 7)
No. 4	66 (+/- 7)
No. 8	53 (+/- 7)
No. 16	41 (+/- 7)
No. 30	31 (+/- 7)
No. 50	21 (+/- 6)
No. 100	13 (+/- 5)
No. 200	4.5 (+/- 1.5)

12.1.1 Coarse aggregate shall consist of clean, sound, durable particles meeting the following requirements.

12.1.1.1 Percentage of loss shall not exceed 40 after 500 revolutions, as determined in accordance with ASTM C 131.

12.1.1.2 Percentage of loss shall not exceed 50 after five cycles performed in accordance with
ASTM C 88, using magnesium sulfate.

12.1.1.3 The dry weight of crushed slag shall not be less than 75 pounds per cubic foot, as determined in accordance with ASTM C 29.

12.1.1.4 Crushed gravel retained on the No. 4 sieve and each coarser sieve listed in Table I shall contain at least 75 percent by weight of crushed pieces having two or more fractured faces with the area of each face equal to at least 75 percent of the smallest midsectional area of piece. When two fractures are contiguous, the angle between planes of fractures shall be at least 30 degrees to count as the two fractured faces.

12.1.1.5 Particle shape of crushed aggregates shall be essentially cubical. Quantity of flat and elongated particles in any sieve size shall not exceed 20 percent by weight, when determined in accordance with CRD-C 119.

12.1.2 Fine aggregate shall consist of clean, sound, durable, angular particles produced by crushing stone, slag, or gravel that meets requirements for wear and soundness

specified for coarse aggregate. Fine aggregate produced by crushing gravel shall have at least 90 percent by weight of crushed particles having two or more fractured faces in the portion retained on the No. 30 sieve. This requirement shall apply to material before blending with natural sand, when blending is necessary. Quantity of natural sand to be added to the wearing-course mixtures shall not exceed 15 percent by weight of coarse and fine aggregate and material passing the No. 200 sieve. Natural sand shall be clean and free from clay and organic material. Percentage of loss shall not exceed 50 after five cycles of the soundness test performed in accordance with ASTM C 88, using magnesium sulfate.

12.1.3 Mineral filler shall conform to ASTM D 242. Grain size shall be as follows:

Grain Size in mm	Percent Finer
0.05	70-100
0.02	35-65
0.005	10-22

12.2 Bituminous Materials: Asphalt cement shall conform to ASTM D 946, Penetration Grade 60-70 or AC 20 per ASTM D 3381.

12.3 Additives: The use of additives such as antistripping and antifoaming agents is subject to approval.

13. Proportioning of Mixture:

13.1 Job Mix Formula (JMF): The JMF for the bituminous mixture per these specifications shall be developed/provided by Contractor's independent testing laboratory and submitted to the Contracting Officer for review and approval.

NOTE!!! The bituminous mixture furnished under this contract will be used on streets at Dyess Air Force Base to serve heavily loaded deliverly vehicles and high traffic levels. **A properly prepared and tested, current, and specifically developed for this contract JMF is considered essential to the Government for a successful project**. NO ASPHALT WORK WILL BE ALLOWED TO START WITHOUT THE APPROVED JMF. The JMF and its associated selection of materials/testing shall be developed sufficiently in advance of planned asphalt operations to allow Government review/approval.
The JMF shall be developed per ASTM D 1559 (Marshall Method) and other specific requirements as follows:

Contractor shall develop relationship curves of percent asphalt by weight of mix versus;

1)stability in pounds

2)unit weight in pounds per cubic foot
3)percent air voids
4)percent voids in the mineral aggregate,
5)flow (1/100 inch)

The Government will select the JMF's percent asphalt by averaging the percent asphalt at; 1)highest stability, 2)greatest unit weight, and 3)4% air voids while confirming that all specified criterion and specifically the criterion in Tables II, III, and IV are assured. All test data, curves, % asphalt, etc. required by this specification shall be submitted for review, approval, and percent asphalt selection by the Contracting Officer.

TABLE II. ASPHALT TOLERANCE CRITERIA

Material	Tolerance Plus or Minus
Aggregate passing No. 4 or larger sieves	5 percent
Aggregate passing Nos. 8, 16, 30, and 50 sieves	4 percent
Aggregate passing Nos. 100 and 200 sieves	2 percent
Bitumen (Actual % selected by Government)	0.25 percent
Temperature of mixing	25 degrees F

13.2 Test Properties of Bituminous Mixtures: Finished mixture shall meet requirements described below when tested in accordance with MIL-STD-620, Method 100. All samples shall be compacted with **50 blows** of specified hammer on each side of sample. When bituminous mixture fails to meet the requirements specified below the paving operation shall be stopped until the cause of noncompliance is determined and corrected.

13.2.1 Requirements for stability, flow, and voids are shown in Tables III and IV for nonabsorptive and absorptive aggregates, respectively.

TABLE III. NONABSORPTIVE-AGGREGATE MIXTURE (ACCEPTANCE CRITERIA)

Stability (pounds)	500 (minimum)
Flow (1/100-inch units)	20 (maximum)
Voids total mix (percent)	3-5 (range)
Voids filled with bitumen (percent)	75-85 (range)

TABLE IV. ABSORPTIVE-AGGREGATE MIXTURE (ACCEPTANCE CRITERIA)

Stability (pounds)	500 (minimum)
Flow (1/100-inch units)	20 (maximum)

Voids total mix (percent)	2-4 (range)
Voids filled with bitumen (percent)	80-90 (range)

13.2.1.1 When the water-absorption value of the entire blend of aggregate does not exceed 2.5 percent, as determined in accordance with ASTM C 127 and ASTM C 128, the aggregate is designated as nonabsorptive. The theoretical specific gravity computed from the apparent specific gravity or ASTM D 2041 will be used in computing voids total mix and voids filled with bitumen, and the mixture shall meet the requirements in TABLE III.

13.2.1.2 When the water-absorption value of the entire blend of aggregate exceeds 2.5 percent as determined in accordance with ASTM C 127 and ASTM C 128, the aggregate is designated as absorptive. The theoretical specific gravity computed from the bulk-impregnated specific gravity method contained in MIL-STD-620, Method 105 or ASTM D 2041 shall be used in computing percentages of voids total mix and voids filled with bitumen; the mixture shall meet requirements in Table IV, when MIL-STD-620, Method 105 is used and Table III when ASTM D 2041 is used.

13.2.2 The index of retained stability shall be greater than 75 percent as determined by MIL-STD-620, Method 104. When the index of retained stability is less than 75, the aggregate stripping tendencies may be countered by the use of hydrated lime or by treating the bitumen with an approved antistripping agent. The hydrated lime is considered as mineral filler and should be considered in the gradation requirements. The amount of hydrated lime or antistripping agent added to bitumen shall be sufficient, as approved, to produce an index of retained stability of not less than 75 percent. No additional payment will be made to the Contractor for addition of antistripping agent required.

14. **EXISTING PAVEMENT SURFACE CONDITION**: Surface of the existing pavement shall be inspected by Contractor for adequate preparation as specified. Unsatisfactory areas shall be corrected by Contractor at no cost to the Government.

15. **PREPARATION OF BITUMINOUS MIXTURES**: Rates of feed of aggregates shall be regulated so that moisture content and temperature of aggregates shall be within specified tolerances. Aggregates, mineral filler, and bitumen shall be conveyed into the mixer in proportionate quantities required to meet the JMF. Mixing time shall be as required to obtain a uniform coating of the aggregate with the bituminous material. Temperature of bitumen at the time of mixing shall not exceed 300 degrees F. Temperature of aggregate and mineral filler in the mixer shall not exceed 325 degrees F. when bitumen is added. Overheated and carbonized mixtures or mixtures that foam shall not be used.

16. **WATER CONTENT OF AGGREGATES**: Drying operations are required for wet aggregate and shall reduce the water content of mixture to less than 0.75 percent. Water

content test shall be conducted in accordance with ASTM D 3515; however, in no case shall the mixture be stored for more than 4 hours.

17. **STORAGE OF BITUMINOUS PAVING MIXTURE**: Storage of bituminous paving mixture shall conform to the applicable requirements of ASTM D 3515; however, in no case shall the mixture be stored for more than 4 hours.

18. **TRANSPORTATION OF BITUMINOUS MIXTURE**: Transportation from the paving plant to the site shall be in trucks having tight, clean, smooth beds lightly coated with an approved releasing agent to prevent adhesion of mixture to truck bodies. Excessive releasing agent shall be drained prior to loading. Each load shall be covered with canvas or other approved material of ample size to protect mixture from weather, oxidation, and prevent loss of heat. Loads that have crust of cold, oxidized, unworkable material or have become wet by rain will be rejected. Hauling over freshly placed material will not be permitted.

19. **SURFACE PREPARATION OF UNDERLYING COURSE**: Prior to the placing of subsequent paving course, the underlying course shall be cleaned of all dust and other foreign or objectionable matter with power brooms and hand brooms.

19.1 Prime Coating: Surfaces of previously constructed base course shall be sprayed with bituminous materials conforming to SECTION: PRIME COAT.

20. **TACK COATING**: Contact surfaces of previously constructed or milled pavement, curbs, manholes, and other structures shall be sprayed with a thin coat of bituminous material conforming to SECTION: TACK COAT.

21. **PLACING**: Place in 2.5-inch compacted thickness lifts maximum (A 4-inch thick overlay would have to be placed in at least two lifts.) Bituminous courses shall be constructed only when the base course or existing pavement has no free water on the surface. Bituminous mixtures shall not be placed without ample time to complete spreading and rolling during daylight hours, unless approved satisfactory artificial lighting is provided. Place such that the joints of subsequent courses are offset by at least 2-feet.

21.1 General Requirements for use of Mechanical Spreader: Mixtures having temperatures less than 225 degrees F. when dumped into the mechanical spreader shall not be used. The mechanical spreader shall be adjusted and speed regulated so that the surface of the course being laid will be smooth and continuous without tears and pulls, and of such degree that, when compacted, the surface will conform to the cross section indicated. Each lot of material placed shall conform to requirements specified. Placing of the mixture shall be as nearly continuous as possible, and speed of placing shall be adjusted, as directed, to permit proper rolling. When segregation occurs in the mixture during placing, the spread operation shall be suspended until the cause is determined and corrected.

21.2 Placing Strips Succeeding Initial Strips: In placing each succeeding strip after the initial strip has been spread and compacted as specified below, the screed of the mechanical spreader shall overlap the previously placed strip 2 to 3 inches and be sufficiently high so that compaction produces a smooth dense joint. Mixture placed on the edge of a previously placed strip by the mechanical spreader shall be pushed back to the edge of the strip by the use of a lute. Excess material shall be removed and wasted.

21.3 Handspreading in Lieu of Machine Spreading: In areas where use of machine spreading is impractical and handspreading is authorized by the Contracting Officer, the mixture may be spread by hand. Spreading shall be in a manner to prevent segregation. The mixture shall be spread uniformly with hot rakes in a loose layer of thickness that, when compacted, will conform to the required grade, density, and thickness.

22. **COMPACTION OF MIXTURE**: Rolling shall begin as soon after placing as the mixture will bear a roller without undue displacement. Delays in rolling freshly spread mixture will not be permitted. After initial rolling, preliminary tests of crown, grade, and smoothness shall be made by the Contractor. Deficiencies shall be corrected so that the finished course will conform to requirements for grade and smoothness specified herein and as indicated on the drawings. Crown, grade, and smoothness will be checked for compliance in each lot of completed pavement by the Contractor and will be evaluated as specified in paragraph: ACCEPTABILITY OF WORK. After the crown, grade, and smoothness requirements have been met, rolling shall be continued until the required mat density and joint density are obtained. The density shall be determined and evaluated as specified. Places inaccessible to rollers shall be thoroughly compacted with hot hand tampers to the specified densities.

22.1 Correcting Deficient Areas: Mixtures that become contaminated or are defective shall be removed to the full thickness of the course. Edges of the area to be removed shall be cut so that the sides are perpendicular and parallel to the direction of traffic and so that the edges are vertical. Edges shall be sprayed with bituminous materials conforming to SECTION: TACK COAT. Fresh paving mixture shall be placed in the excavated areas in sufficient quantity so that the finished surface will conform to the grade and smoothness requirements. Paving mixture shall be compacted to the density specified herein. Skin patching of an area that has been rolled shall not be permitted.

23. **JOINTS**:

23.1 General: Joints between old and new pavements, between successive days' work, or joints that have become cold (less than 175 degrees F.) because of any delay, shall be made to insure continuous bond between the old and new sections of the course. All joints shall have the same texture and smoothness as other sections of the course. Contact surfaces of previously constructed pavements coated by dust, sand, or other objectionable materials shall be cleaned by brushing or shall be cut back as directed. The surface against which new material is placed shall be sprayed with a thin, uniform coat of

bituminous material is placed shall be sprayed with a thin, uniform coat of bituminous material conforming to SECTION: TACK COAT. Material shall be applied far enough in advance of the placement of fresh mixture to insure adequate curing. Care shall be taken to prevent damage of contamination of the sprayed surface.

23.2 Transverse Joints: The roller shall pass over the unprotected end of a strip of freshly placed material only when the placing is discontinued or the delivery of the mixture is interrupted to the extent that material in place may become cold. In all cases, prior to continuing placement, the edge of previously placed pavement shall be cut back to expose an even vertical surface for full thickness of the course. In continuing placement of the strip, the mechanical spreader shall be positioned on the transverse joint so that sufficient hot mixture will be spread to obtain a joint after rolling that conforms to the required density and smoothness specified herein.

23.3 Longitudinal Joints: Edges of a previously placed strip shall be prepared such that the pavement in and immediately adjacent to the joint between this strip and the succeeding strip meets the requirements for grade, smoothness, and density.

SECTION 03100
STRUCTURAL CONCRETE FORMWORK
12/01

1 GENERAL

1.1 REFERENCES

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

ACI INTERNATIONAL (ACI)

ACI 347R	(1994) Guide to Formwork for Concrete

AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA ANSI/AHA A135.4	(1995) Basic Hardboard

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 578	(1995) Rigid, Cellular Polystyrene Thermal Insulation

DEPARTMENT OF COMMERCE (DOC)

DOC PS 1	(1996) Voluntary Product Standard - Construction and Industrial Plywood

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 00700 GENERAL:

Drawings

Concrete Formwork; FIO.

Drawings showing details of formwork, including dimensions of fiber voids, joints, supports, studding and shoring, and sequence of form and shoring removal.

Instructions

Form Releasing Agents; FIO.

Manufacturer's recommendation on method and rate of application of form releasing agents.

Certificates

Fiber Voids; FIO.

Certificates attesting that fiber voids conform to the specified requirements.

1.3 DESIGN

Formwork shall be designed in accordance with methodology of ACI 347R for anticipated loads, lateral pressures, and stresses. Forms shall be capable of producing a surface which meets the requirements of the class of finish specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. Forms shall be capable of withstanding the pressures resulting from placement and vibration of concrete.

1.4 STORAGE AND HANDLING

Fiber voids shall be stored above ground level in a dry location. Fiber voids shall be kept dry until installed and overlaid with concrete.

2 PRODUCTS

2.1 FORM MATERIALS

2.1.1 Forms For Class B Finish

Forms for Class B finished surfaces shall be plywood panels conforming to DOC PS 1, Grade B-B concrete form panels, Class I or II. Other form materials or liners may be used provided the smoothness and appearance of concrete produced will be equivalent to that produced by the plywood concrete form panels. Forms for round columns shall be the prefabricated seamless type.

2.1.2 Forms For Class C Finish

Forms for Class C finished surfaces shall be shiplap lumber; plywood conforming to DOC PS 1, Grade B-B concrete form panels, Class I or II; tempered concrete form hardboard conforming to AHA ANSI/AHA A135.4; other approved concrete form material; or steel, except that steel lining on wood sheathing shall not be used. Forms for round columns may have one vertical seam.

2.1.3 Forms For Class D Finish

Forms for Class D finished surfaces, except where concrete is placed against earth, shall be wood or steel or other approved concrete form material.

2.1.4 Form Ties

Form ties shall be factory-fabricated metal ties, shall be of the removable or internal disconnecting or snap-off type, and shall be of a design that will not permit form deflection and will not spall concrete upon removal. Solid backing shall be provided for each tie. Except where removable tie rods are used, ties shall not leave holes in the concrete surface less than 1/4 inch nor more than 1 inch deep and not more than 1 inch in diameter. Removable tie rods shall be not more than 1-1/2 inches in diameter.

2.1.5 Form Releasing Agents

Form releasing agents shall be commercial formulations that will not bond with, stain or adversely affect concrete surfaces. Agents shall not impair subsequent treatment of concrete surfaces depending upon bond or adhesion nor impede the wetting of surfaces to be cured with water or curing compounds.

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2.2 FIBER VOID RETAINERS

2.2.1 Precast Concrete

Precast concrete units shall have a compressive strength of not less than 2500 psi, reinforced with 6 inch by 6 inch by W1.4 WWF wire mesh, and 12 inches (height) by 3 feet (length) by 1-5/8 inches (thickness) in size unless indicated.

3 EXECUTION

3.1 INSTALLATION

3.1.1 Formwork

Forms shall be mortar tight, properly aligned and adequately supported to produce concrete surfaces meeting the surface requirements specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE and conforming to construction tolerance given in TABLE 1. Where concrete surfaces are to have a Class B finish, joints in form panels shall be arranged as approved. Where forms for continuous surfaces are placed in successive units, the forms shall fit over the completed surface to obtain accurate alignment of the surface and to prevent leakage of mortar. Forms shall not be reused if there is any evidence of surface wear and tear or defects which would impair the quality of the surface. Surfaces of forms to be reused shall be cleaned of mortar from previous concreting and of all other foreign material before reuse.

Form ties that are to be completely withdrawn shall be coated with a nonstaining bond breaker.

3.2 CHAMFERING

Except as otherwise shown, external corners that will be exposed shall be chamfered, beveled, or rounded by moldings placed in the forms.

3.3 COATING

Forms for Class B finished surfaces shall be coated with a form releasing agent before the form or reinforcement is placed in final position. The coating shall be used as recommended in the manufacturer's printed or written instructions. Forms for Class C and D finished surfaces may be wet with water in lieu of coating immediately before placing concrete, except that in cold weather with probable freezing temperatures, coating shall be mandatory. Surplus coating on form surfaces and coating on reinforcing steel and construction joints shall be removed before placing concrete.

3.4 REMOVAL OF FORMS

Forms shall be removed preventing injury to the concrete and ensuring the complete safety of the structure. Formwork for columns, walls, side of beams and other parts not supporting the weight of concrete may be removed when the concrete has attained sufficient strength to resist damage from the removal operation but not before at least 24 hours has elapsed since concrete placement. Supporting forms and shores shall not be removed from beams, floors and walls until the structural units are strong enough to carry their own weight and any other construction or natural loads. Supporting forms or shores shall not be removed before the concrete strength has reached 70 percent of design strength, as determined by field cured cylinders or other approved methods. This strength shall be demonstrated by job-cured test specimens, and by a structural analysis considering the proposed loads in relation to these test strengths and the strength of forming and shoring system. The job-cured test specimens for form removal purposes shall be provided in numbers as directed and shall be in addition to those required for concrete quality control. The specimens shall be removed from molds at the age of 24 hours and shall receive, insofar as possible, the same curing and protection as the structures they represent.

TABLE 1

TOLERANCES FOR FORMED SURFACES

1. Variations from the plumb:	In any 10 feet of length ---------- 1/4 inch
a. In the lines and surfaces of columns,	Maximum for entire length ---------- 1 inch

piers, walls and in arises	
b. For exposed corner columns,control-joint grooves, and other conspicuous lines	In any 20 feet of length ---------- 1/4 inch Maximum for entire length---------- 1/2 inch
2. Variation from the level or from the grades indicated on the drawings:	In any 10 feet of length ----------1/4 inch In any bay or in any 20 feet of length---------- 3/8 inch
a. In slab soffits, ceilings, beam soffits, and in arises, measured before removal of supporting shores	Maximum for entire length ---------- 3/4 inch
b. In exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines	In any bay or in any 20 feet of length ---------- ----- 1/4 inch Maximum for entire length---------- 1/2 inch
3. Variation of the linear building lines from established position in plan	In any 20 feet --------- 1/2 inch Maximum ----------1 inch
4. Variation of distance between walls, columns, partitions	1/4 inch per 10 feet of distance, but not more than 1/2 inch in any one bay, and not more than 1 inch total variation
5. Variation in the sizes and locations of sleeves, floor openings, and wall opening	Minus ---------- 1/4 inch Plus ---------- 1/2 inch
6. Variation in cross-sectional dimensions of columns and beams and in the thickness of slabs and walls	Minus ---------- 1/4 inch Plus ---------- 1/2 inch

7. Footings:

a. Variation of dimensions in plan	Minus ---------- 1/2 inch Plus ---------- 2 inches when formed or plus 3 inches when placed against unformed excavation
b. Misplacement of eccentricity	2 percent of the footing width in the direction of misplacement but not more than 2 inches
c. Reduction in thickness of specified thickness	Minus ---------- 5 percent

8. Variation in steps:	Riser ---------- 1/8 inch
a. In a flight of stairs	Tread ---------- 1/4 inch
b. In consecutive steps	Riser ---------- 1/16 inch Tread ---------- 1/8 inch

** End of Section **

SECTION 03200
CONCRETE REINFORCEMENT
12Sep01

1 GENERAL

1.1 REFERENCES

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

ACI INTERNATIONAL (ACI)

ACI 318/318R	(1995) Building Code Requirements for Structural Concrete and Commentary

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53	(1996) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 82	(1995a) Steel Wire, Plain, for Concrete Reinforcement
ASTM A 184/A 184M	(1996) Fabricated Deformed Steel Bar Mats for Concrete Reinforcement
ASTM A 185	(1994) Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM A 496	(1995a) Steel Wire, Deformed, for Concrete Reinforcement
ASTM A 497	(1995) Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement
ASTM A 615/A 615M	(1996a) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 675/A 675M	(1990a; R 1995) Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties
ASTM A 767/A 767M	(1995) Zinc-Coated (Galvanized) Steel Bars in Concrete Reinforcement
ASTM A 775/A 775M	(1996) Epoxy-Coated Reinforcement Steel Bars

ASTM A 884/A 884M	(1996a) Epoxy-Coated Steel Wire and Welded Wire Fabric for Reinforcement
ASTM C 1116	(1995) Fiber-Reinforced Concrete and Shotcrete

AMERICAN WELDING SOCIETY (AWS)

AWS D1.4	(1992) Structural Welding Code - Reinforcing Steel

CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

CRSI MSP-1	(1996) Manual of Standard Practice

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 00700 GENERAL:

Drawings

Concrete Reinforcement System; GA.

Detail drawings showing reinforcing steel placement, schedules, sizes, grades, and splicing and bending details. Drawings shall show support details including types, sizes and spacing.

Certificates

Reinforcing Steel; FIO.

Certified copies of mill reports attesting that the reinforcing steel furnished contains no less than 25 percent recycled scrap steel and meets the requirements specified herein, prior to the installation of reinforcing steel.

1.3 DELIVERY AND STORAGE

Reinforcement and accessories shall be stored off the ground on platforms, skids, or other supports.

2 PRODUCTS

2.1 DOWELS

Dowels shall conform to ASTM A 675/A 675M, Grade 80.

2.2 FABRICATED BAR MATS

Fabricated bar mats shall conform to ASTM A 184/A 184M.

2.3 REINFORCING STEEL

Reinforcing steel shall be deformed bars conforming to ASTM A 615/A 615M or ASTM A 706/A 706M, grade 60 and sizes as indicated. Cold drawn wire used for spiral reinforcement shall conform to ASTM A 82. In highly corrosive environments or when directed by the Contracting Officer, reinforcing steel shall conform to ASTM A 767/A 767M or ASTM A 775/A 775M as appropriate.

2.4 WELDED WIRE FABRIC

Welded wire fabric shall conform to ASTM A 185.

2.5 WIRE TIES

Wire ties shall be 16 gauge or heavier black annealed steel wire.

2.6 SUPPORTS

Bar supports for formed surfaces shall be designed and fabricated in accordance with CRSI MSP-1 and shall be steel or precast concrete blocks. Precast concrete blocks shall have wire ties and shall be not less than 4 inches square when supporting reinforcement on ground. Precast concrete block shall have compressive strength equal to that of the surrounding concrete. Where concrete formed surfaces will be exposed to weather or where surfaces are to be painted, steel supports within 1/2 inch of concrete surface shall be galvanized, plastic protected or of stainless steel. Concrete supports used in concrete exposed to view shall have the same color and texture as the finish surface. For slabs on grade, supports shall be precast concrete blocks, plastic coated steel fabricated with bearing plates, or specifically designed wire-fabric supports fabricated of plastic.

2.7 SYNTHETIC FIBER REINFORCEMENT

Synthetic fiber shall be polypropylene with a denier less than 100 and a nominal fiber length of 2 inches.

3 EXECUTION

3.1 REINFORCEMENT

Reinforcement shall be fabricated to shapes and dimensions shown and shall conform to the requirements of ACI 318/318R. Reinforcement shall be cold bent unless otherwise authorized. Bending may be accomplished in the field or at the mill. Bars shall not be bent after embedment in concrete. Safety caps shall be placed on all exposed ends of vertical

concrete reinforcement bars that pose a danger to life safety. Wire tie ends shall face away from the forms.

3.1.1 Placement

Reinforcement shall be free from loose rust and scale, dirt, oil, or other deleterious coating that could reduce bond with the concrete. Reinforcement shall be placed in accordance with ACI 318/318R at locations shown plus or minus one bar diameter. Reinforcement shall not be continuous through expansion joints and shall be as indicated through construction or contraction joints. Concrete coverage shall be as indicated or as required by ACI 318/318R. If bars are moved more than one bar diameter to avoid interference with other reinforcement, conduits or embedded items, the resulting arrangement of bars, including additional bars required to meet structural requirements, shall be approved before concrete is placed.

3.1.2 Splicing

Splices of reinforcement shall conform to ACI 318/318R and shall be made only as required or indicated. Splicing shall be by lapping or by mechanical or welded butt connection; except that lap splices shall not be used for bars larger than No. 11 unless otherwise indicated. Welding shall conform to AWS D1.4. Welded butt splices shall be full penetration butt welds. Lapped bars shall be placed in contact and securely tied or spaced transversely apart to permit the embedment of the entire surface of each bar in concrete. Lapped bars shall not be spaced farther apart than one-fifth the required length of lap or 6 inches. Mechanical butt splices shall be in accordance with the recommendation of the manufacturer of the mechanical splicing device. Butt splices shall develop 125 percent of the specified minimum yield tensile strength of the spliced bars or of the smaller bar in transition splices. Bars shall be flame dried before butt splicing. Adequate jigs and clamps or other devices shall be provided to support, align, and hold the longitudinal centerline of the bars to be butt spliced in a straight line.

3.2 WELDED-WIRE FABRIC PLACEMENT

Welded-wire fabric shall be placed in slabs as indicated. Fabric placed in slabs on grade shall be continuous between expansion, construction, and contraction joints. Fabric placement at joints shall be as indicated. Lap splices shall be made in such a way that the overlapped area equals the distance between the outermost crosswires plus 2 inches. Laps shall be staggered to avoid continuous laps in either direction. Fabric shall be wired or clipped together at laps at intervals not to exceed 4 feet. Fabric shall be positioned by the use of supports.

3.3 DOWEL INSTALLATION

Dowels shall be installed in slabs on grade at locations indicated and at right angles to joint being doweled. Dowels shall be accurately positioned and aligned parallel to the finished concrete surface before concrete placement. Dowels shall be rigidly supported during concrete placement. One end of dowels shall be coated with a bond breaker.

3.4 SYNTHETIC FIBER REINFORCED CONCRETE

Where indicated, fiber reinforcement shall be added to the concrete mix in accordance with the applicable sections of ASTM C 1116 and the recommendations of the manufacturer, and in an amount of 0.1 percent by volume.

** End of Section **

SECTION O3250
CONCRETE SIDEWALKS AND CURBS AND GUTTERS
12Sep01

1. **CONCRETE:** This specification is applicable to concrete at curbs and gutters as well as to sidewalks. Concrete shall be proportioned and mixed to provide a minimum compressive strength of 3000 pounds per square inch at 28 days.

2. **MATERIALS OTHER THAN CONCRETE:**

2.1 Expansion Joint Materials: Provide commercially prepared and impregnated fiberboard or redwood ½-inch thick.

2.2 Joint Sealant: Provide a joint sealant specifically made for sealing joints in concrete pavement. Comply with manufacturer's recommendations.

2.3 Reinforcement: Provide reinforcement as indicated and comply with Section, CONCRETE REINFORCEMENT.

3. **SUBGRADE PREPARATION**: Construct true to grade and cross section. Construct subgrade of materials equal in bearing quality to the subgrade under adjacent areas. Continue pavement section (base, subbase, etc.) under curbs and gutters.

4. **FORMS**: Construct forms to conform to the dimensions of the sidewalk or curb. Hold forms rigidly in place by the use of stakes placed at intervals not to exceed 4-feet. Remove the forms on the front of the curb not less than 2 hours nor more than 6 hours after the concrete has been placed. Remove remainder of the forms not less than 12 after concrete placement.

5. **CONCRETE PLACEMENT**: The concrete shall be thoroughly consolidated by vibration, rodding, foot tamping, or other methods as approved.

6. **CONCRETE FINISHING AND JOINTING**:

6.1 Finishing: Round the edges of the gutter and top of the curb with a ½-inch edging tool. Float and finish the surface with a smooth wood float until true to grade and section and uniform in texture. Provide a transverse, light broom finish.

6.2 Transverse Expansion Joints: Provide transverse expansion joints at a maximum spacing of 30-feet on centers. Utilize ½-in expansion joint materials for the full cross section at right angles to line of curb or sidewalk.

6.3 Transverse Contraction Joints: Provide transverse contraction joints at a maximum spacing of 5-feet on centers. Utilize a 1/8-inch wide by 1-inch deep slot for contraction joints (not full cross section) installed by utilizing premolded expansion joint filler or

sawcutting. Note, sawcutting shall be performed within 6-hours of placement - if this option is selected.

7. **CURING AND PROTECTION**: Cover the entire surface with a membrane-forming curing compound with a white pigment. Apply curing compound at a coverage of approximately 100 square feet per gallon. Form a uniform, continuous, coherent film free from pinholes. Seal expansion-joint openings by inserting moistened paper or fiber rope or covering with strips of waterproof paper prior to application of the curing compound in a manner to prevent the curing compound from entering the joint.

SECTION 03300
CAST-IN-PLACE STRUCTURAL CONCRETE
13Sep01

1 GENERAL

1.1 REFERENCES

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

ACI INTERNATIONAL (ACI)

ACI 117/117R	(1990; Errata) Standard Tolerances for Concrete Construction and Materials
ACI 211.1	(1991) Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
ACI 214.3R	(1988) Simplified Version of the Recommended Practice for Evaluation of Strength Test Results of Concrete
ACI 301	(1996) Standard Specifications for Structural Concrete
ACI 305R	(1991) Hot Weather Concreting
ACI 318/318R	(1995) Building Code Requirements for Reinforced Concrete and Commentary

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 182	(1991) Burlap Cloth Made From Jute or Kenaf

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 31/C 31M	(1996) Making and Curing Concrete Test Specimens in the Field
ASTM C 33	(1997) Concrete Aggregates
ASTM C 39	(1996) Compressive Strength of Cylindrical Concrete Specimens

ASTM C 42	(1994) Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C 78	(1994) Flexural Strength of Concrete (Using Simple Beam With Third-Point Loading)
ASTM C 94	(1997) Ready-Mixed Concrete
ASTM C 131	(1996) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(1996a) Sieve Analysis of Fine and Coarse Aggregates
ASTM C 143	(1990a) Slump of Hydraulic Cement Concrete
ASTM C 150	(1997) Portland Cement
ASTM C 171	(1997) Sheet Materials for Curing Concrete
ASTM C 172	(1997) Sampling Freshly Mixed Concrete
ASTM C 173	(1996) Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C 192/C 192M	(1995) Making and Curing Concrete Test Specimens in the Laboratory
ASTM C 231	(1997) Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 260	(1995) Air-Entraining Admixtures for Concrete
ASTM C 309	(1997) Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 330	(1989) Lightweight Aggregates for Structural Concrete
ASTM C 494	(1992) Chemical Admixtures for Concrete
ASTM C 496	(1996) Splitting Tensile Strength of Cylindrical Concrete Specimens
ASTM C 552	(1991) Cellular Glass Thermal Insulation
ASTM C 567	(1991) Unit Weight of Structural Lightweight Concrete

ASTM C 578	(1995) Rigid, Cellular Polystyrene Thermal Insulation
ASTM C 591	(1994) Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM C 595	(1995a) Blended Hydraulic Cements
ASTM C 618	(1997) Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
ASTM C 685	(1995a) Concrete Made by Volumetric Batching and Continuous Mixing
ASTM C 881	(1990) Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C 937	(1980; R 1991) Grout Fluidifier for Preplaced-Aggregate Concrete
ASTM C 940	(1989) Expansion and Bleeding of Freshly Mixed Grouts for Preplaced-Aggregate Concrete in the Laboratory
ASTM C 989	(1997) Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
ASTM C 1017	(1992) Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C 1059	(1991) Latex Agents for Bonding Fresh to Hardened Concrete
ASTM C 1064	(1986; R 1993) Temperature of Freshly Mixed Portland Cement Concrete
ASTM C 1077	(1997) Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
ASTM C 1107	(1997) Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C 1116	(1995) Fiber-Reinforced Concrete and Shotcrete

ASTM C 1240	(1997) Silica Fume for Use as a Mineral Admixture in Hydraulic-Cement Concrete, Mortar and Grout
ASTM D 75	(1987; R 1992) Sampling Aggregates
ASTM D 1751	(1983; R 1991) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	(1984; R 1992) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM E 96	(1995) Water Vapor Transmission of Materials
ASTM E 1155	(1996) Determining Floor Flatness and Levelness Using the F-Number System

CORPS OF ENGINEERS (COE)

COE CRD-C 94	(1995) Surface Retarders
COE CRD-C 104	(1980) Method of Calculation of the Fineness Modulus of Aggregate
COE CRD-C 400	(1963) Requirements for Water for Use in Mixing or Curing Concrete
COE CRD-C 521	(1981) Standard Test Method for Frequency and Amplitude of Vibrators for Concrete
COE CRD-C 540	(1971; R 1981) Standard Specification for Nonbituminous Inserts for Contraction Joints in Portland Cement Concrete Airfield Pavements, Sawable Type
COE CRD-C 572	(1974) Corps of Engineers Specifications for Polyvinylchloride Waterstop

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST HB 44	(1997) NIST Handbook 44: Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices

NATIONAL READY-MIXED CONCRETE ASSOCIATION (NRMCA)

NRMCA CPMB 100	(1990) Concrete Plant Standards
NRMCA TMMB 100	(1994) Truck Mixer Agitator and Front Discharge Concrete Carrier Standards
NRMCA QC 3	(1984) Quality Control Manual: Section 3, Plant Certifications Checklist: Certification of Ready Mixed Concrete Production Facilities

1.2 LUMP SUM CONTRACT

Under this type of contract concrete items will be paid for by lump sum and will not be measured. The work covered by these items consists of furnishing all concrete materials, reinforcement, miscellaneous embedded materials, and equipment, and performing all labor for the forming, manufacture, transporting, placing, finishing, curing, and protection of concrete in these structures.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 00700 GENERAL:

Statements

Mixture Proportions; GA.

The results of trial mixture design studies along with a statement giving the maximum nominal coarse aggregate size and the proportions of ingredients that will be used in the manufacture of each strength or class of concrete, at least 14 days prior to commencing concrete placing operations. Aggregate weights shall be based on the saturated surface dry condition. The statement shall be accompanied by test results from an approved independent commercial testing laboratory, showing that mixture design studies have been made with materials proposed for the project and that the proportions selected will produce concrete of the qualities indicated. No substitutions shall be made in the materials used in the mixture design studies without additional tests to show that the quality of the concrete is satisfactory.

Testing and Inspection for Contractor Quality Control; GA.

Certified copies of laboratory test reports, including mill tests and all other test data, for portland cement, blended cement, pozzolan, aggregate, admixtures, and curing compound proposed for use on this project.

Certificates

Qualifications; FIO.

Written documentation for Contractor Quality Control personnel.

1.4 GENERAL REQUIREMENTS

1.4.1 Tolerances

Except as otherwise specified herein, tolerances for concrete batching, mixture properties, and construction as well as definition of terms and application practices shall be in accordance with ACI 117/117R. Level and grade tolerance measurements of slabs shall be made as soon as possible after finishing; when forms or shoring are used, the measurements shall be made prior to removal.

1.4.1.1 Floors

For the purpose of this Section the following terminology correlation between ACI 117/117R and this Section shall apply:

Floor Profile Quality Classification From ACI 117/117R	This Section
Conventional Bullfloated	Same
Conventional Straightedged	Same
Flat	Float Finish or Trowel Finish
Very Flat	Same. Use only with F-system

Levelness tolerance shall not apply where design requires floors to be sloped to drains or sloped for other reasons.

1.4.1.2 Floors by the Straightedge System

The flatness of the floors shall be carefully controlled and the tolerances shall be measured by the straightedge system as specified in paragraph 4.5.7 of ACI 117/117R, using a 10 foot straightedge, within 72 hours after floor slab installation and before shores and/or forms are removed. The listed tolerances shall be met at any and every location at which the straightedge can be placed.

Trowel Finish All areas

1.4.2 Strength Requirements and w/c Ratio

1.4.2.1 Strength Requirements

Specified compressive strength (f'c) shall be as follows:

STRENGTH	STRUCTURE/APPLICATION
3000 - psi (Compressive strength) at 28 days	Sidewalks, curbs and gutters, and equipment pads.
3500 - psi (Compressive strength) at 28 days	Valve boxes, grit chambers, and other applications not specifically listed in this table.
4000 - psi (Compressive strength) at 28 days	Drilled piers
650 – psi (Flexural strength) at 28 days	Slabs on-grade, ribbed mat foundations, and pavement (any concrete subject to vehicular traffic).

Concrete made with high-early strength cement shall have a 7-day strength equal to the specified 28-day strength for concrete made with Type I or II portland cement. Compressive strength shall be determined in accordance with ASTM C 39. Flexural strength shall be determined in accordance with ASTM C 78.

a. Evaluation of Concrete Compressive Strength. Compressive strength specimens (6 by 12 inch cylinders) shall be fabricated by the Contractor and laboratory cured in accordance with ASTM C 31/C 31M and tested in accordance with ASTM C 39. The strength of the concrete will be considered satisfactory so long as the average of all sets of three consecutive test results equals or exceeds the specified compressive strength f'c and no individual test result falls below the specified strength f'c by more than 500 psi. A "test" is defined as the average of two companion cylinders, or if only one cylinder is tested, the results of the single cylinder test. Additional analysis or testing, including taking cores and/or load tests may be required at the Contractor's expense when the strength of the concrete in the structure is considered potentially deficient.

b. Investigation of Low-Strength Compressive Test Results. When any strength test of standard-cured test cylinders falls below the specified strength requirement by more than 500 psi or if tests of field-cured cylinders indicate deficiencies in protection and curing, steps shall be taken to assure that the load-carrying capacity of the structure is not jeopardized. When the strength of concrete in place is considered potentially deficient, cores shall be obtained and tested in accordance with ASTM C 42. At least three representative cores shall be taken from each member or area of concrete in place that is considered potentially deficient. The location of cores will be determined by the Contracting Officer to least impair the strength of the structure. Concrete in the area represented by the core testing will be considered adequate if the average strength of the

cores is equal to at least 85 percent of the specified strength requirement and if no single core is less than 75 percent of the specified strength requirement. Non-destructive tests (tests other than test cylinders or cores) shall not be used as a basis for acceptance or rejection. The Contractor shall perform the coring and repair the holes. Cores will be tested by the Government.

c. Load Tests. If the core tests are inconclusive or impractical to obtain or if structural analysis does not confirm the safety of the structure, load tests may be directed by the Contracting Officer in accordance with the requirements of ACI 318/318R. Concrete work evaluated by structural analysis or by results of a load test as being understrength shall be corrected in a manner satisfactory to the Contracting Officer. All investigations, testing, load tests, and correction of deficiencies shall be performed by and at the expense of the Contractor and must be approved by the Contracting Officer, except that if all concrete is found to be in compliance with the drawings and specifications, the cost of investigations, testing, and load tests will be at the expense of the Government.

d. Evaluation of Concrete Flexural Strength. Flexural strength specimens (beams) shall be fabricated by the Contractor and laboratory cured in accordance with ASTM C 31/C 31M and tested in accordance with ASTM C 78. The strength of the concrete will be considered satisfactory so long as the average of all sets of three consecutive test results equals or exceeds the specified flexural strength and no individual test result falls below the specified flexural strength by more than 50 psi.A "test" is defined as the average of two companion beams. Additional analysis or testing, including taking cores and/or load tests may be required at the Contractor's expense when the strength of the concrete in the slab is considered potentially deficient.

1.4.2.2 Water-Cement Ratio

Maximum water-cement ratio (w/c) for normal weight concrete shall be as follows:

WATER-CEMENT RATIO, BY WEIGHT	STRUCTURE OR PORTION OF STRUCTURE
0.50	All concrete work

This w/c may cause higher strengths than that required above for compressive or flexural strength. The maximum w/c required will be the equivalent w/c as determined by conversion from the weight ratio of water to cement plus pozzolan by the weight equivalency method as described in ACI 211.1.

1.4.3 Air Entrainment

All concrete shall be air entrained to contain between 4 and 7 percent total air, except that when the nominal maximum size coarse aggregate is 3/4 inch or smaller it shall be between 4.5 and 7.5 percent.. Specified air content shall be attained at point of placement into the

forms. Air content for normal weight concrete shall be determined in accordance with ASTM C 231.

1.4.4 Slump

Slump of the concrete, as delivered to the point of placement into the forms, shall be within the following limits. Slump shall be determined in accordance with ASTM C 143.

Structural Element	Slump (Inches) Minimum	Maximum
Walls, columns and beams	2	4
Foundation walls, substructure walls, footings, slabs	1	4
Any structural concrete approved for placement by pumping:		
At pump	2	6
At discharge of line	1	4
Drilled Caissons (Piers)	5	9

When use of a plasticizing admixture conforming to ASTM C 1017 or when a Type F or G high range water reducing admixture conforming to ASTM C 494 is permitted to increase the slump of concrete, concrete shall have a slump of 2 to 4 inches before the admixture is added and a maximum slump of 8 inches at the point of delivery after the admixture is added

1.4.5 Concrete Temperature

The temperature of the concrete as delivered shall not exceed 90 degrees F. When the ambient temperature during placing is 40 degrees F or less, or is expected to be at any time within 6 hours after placing, the temperature of the concrete as delivered shall be between 55 and 75 degrees F.

1.4.6 Size of Coarse Aggregate

The largest feasible nominal maximum size aggregate (NMSA) specified in paragraph AGGREGATES shall be used in each placement. However, nominal maximum size of aggregate shall not exceed any of the following: three-fourths of the minimum cover for reinforcing bars, three-fourths of the minimum clear spacing between reinforcing bars, one-fifth of the narrowest dimension between sides of forms, or one-third of the thickness of slabs or toppings.

1.4.7 Special Properties and Products

Concrete may contain admixtures other than air entraining agents, such as water reducers, superplasticizers, or set retarding agents to provide special properties to the concrete, if specified or approved. Any of these materials to be used on the project shall be used in the mix design studies.

1.5 MIXTURE PROPORTIONS

Concrete shall be composed of portland cement, other cementitious and pozzolanic materials as specified, aggregates, water and admixtures as specified.

1.5.1 Proportioning Studies for Normal Weight Concrete

Trial design batches, mixture proportioning studies, and testing requirements for various classes and types of concrete specified shall be the responsibility of the Contractor. Except as specified for flexural strength concrete, mixture proportions shall be based on compressive strength as determined by test specimens fabricated in accordance with ASTM C 192/C 192M and tested in accordance with ASTM C 39. Samples of all materials used in mixture proportioning studies shall be representative of those proposed for use in the project and shall be accompanied by the manufacturer's or producer's test reports indicating compliance with these specifications. Trial mixtures having proportions, consistencies, and air content suitable for the work shall be made based on methodology described in ACI 211.1, using at least three different water-cement ratios for each type of mixture, which will produce a range of strength encompassing those required for each class and type of concrete required on the project. The maximum water-cement ratios required in the paragraph Maximum Allowable w/c Ratio will be the equivalent water-cement ratio as determined by conversion from the weight ratio of water to cement plus pozzolan by the weight equivalency method as described in ACI 211.1. If pozzolan is used in the concrete mixture, the minimum pozzolan content shall be 15 percent by weight of the total cementitious material, and the maximum shall be 35 percent. Laboratory trial mixtures shall be designed for maximum permitted slump and air content. Separate sets of trial mixture studies shall be made for each combination of cementitious materials and each combination of admixtures proposed for use. No combination of either shall be used until proven by such studies, except that, if approved in writing and otherwise permitted by these specifications, an accelerator or a retarder may be used without separate trial mixture study. Separate trial mixture studies shall also be made for concrete for any conveying or placing method proposed which requires special properties and for concrete to be placed in unusually difficult placing locations. The temperature of concrete in each trial batch shall be reported. For each water-cement ratio, at least three test cylinders for each test age shall be made and cured in accordance with ASTM C 192/C 192M. They shall be tested at 7 and 28 days in accordance with ASTM C 39. From these test results, a curve shall be plotted showing the relationship between water-cement ratio and strength for each set of trial mix studies. In addition, a curve shall be plotted showing the relationship between 7 day and 28 day strengths. Each mixture shall be designed to promote easy and suitable concrete placement, consolidation and finishing, and to prevent segregation and excessive bleeding.

1.5.2 Proportioning Studies for Flexural Strength Concrete

Trial design batches, mixture proportioning studies, and testing requirements shall conform to the requirements specified in paragraph Proportioning Studies for Normal Weight Concrete, except that proportions shall be based on flexural strength as determined by test specimens (beams) fabricated in accordance with ASTM C 192/C 192M and tested in accordance with ASTM C 78. Procedures given in ACI 211.1 shall be modified as necessary to accommodate flexural strength.

1.5.3 Average Compressive Strength Required for Mixtures

The mixture proportions selected during mixture design studies shall produce a required average compressive strength (f'cr) exceeding the specified compressive strength (f'c) by the amount indicated below. This required average compressive strength, f'cr, will not be a required acceptance criteria during concrete production. However, whenever the daily average compressive strength at 28 days drops below f'cr during concrete production, or daily average 7-day strength drops below a strength correlated with the 28-day f'cr, the mixture shall be adjusted, as approved, to bring the daily average back up to f'cr. During production, the required f'cr shall be adjusted, as appropriate, based on the standard deviation being attained on the job.

1.5.3.1 Computations from Test Records

Where a concrete production facility has test records, a standard deviation shall be established in accordance with the applicable provisions of ACI 214.3R. Test records from which a standard deviation is calculated shall represent materials, quality control procedures, and conditions similar to those expected; shall represent concrete produced to meet a specified strength or strengths (f'c) within 500 psi of that specified for proposed work; and shall consist of at least 30 consecutive tests. A strength test shall be the average of the strengths of two cylinders made from the same sample of concrete and tested at 28 days. Required average compressive strength f'cr used as the basis for selection of concrete proportions shall be the larger of the equations that follow using the standard deviation as determined above:

$f'cr = f'c + 1.34S$ where units are in psi

$f'cr = f'c + 2.33S - 500$ where units are in psi

Where S = standard deviation

Where a concrete production facility does not have test records meeting the requirements above but does have a record based on 15 to 29 consecutive tests, a standard deviation shall be established as the product of the calculated standard deviation and a modification factor from the following table:

NUMBER OF TESTS	MODIFICATION FACTOR FOR STANDARD DEVIATION
15	1.16
20	1.08
25	1.03
30 or more	1.00

1.5.3.2 Computations without Previous Test Records

When a concrete production facility does not have sufficient field strength test records for calculation of the standard deviation, the required average strength f'cr shall be determined as follows:

a. If the specified compressive strength f'c is less than 3,000 psi,

f'cr = f'c + 1000 psi

b. If the specified compressive strength f'c is 3,000 to 5,000 psi,

f'cr = f'c + 1,200 psi

c. If the specified compressive strength f'c is over 5,000 psi,

f'cr = f'c + 1,400 psi

1.5.4 Average Flexural Strength Required for Mixtures

The mixture proportions selected during mixture design studies for flexural strength mixtures and the mixture used during concrete production shall be designed and adjusted during concrete production as approved, except that the overdesign for average flexural strength shall simply be 15 percent greater than the specified flexural strength at all times.

1.6 STORAGE OF MATERIALS

Cement and other cementitious materials shall be stored in weathertight buildings, bins, or silos which will exclude moisture and contaminants and keep each material completely separated. Aggregate stockpiles shall be arranged and used in a manner to avoid excessive segregation and to prevent contamination with other materials or with other sizes of aggregates. Aggregate shall not be stored directly on ground unless a sacrificial layer is left undisturbed. Reinforcing bars and accessories shall be stored above the ground on platforms, skids or other supports. Other materials shall be stored in such a manner as to avoid contamination and deterioration. Admixtures which have been in storage at the project site for longer than 6 months or which have been subjected to freezing shall not be used unless

retested and proven to meet the specified requirements. Materials shall be capable of being accurately identified after bundles or containers are opened.

1.7 GOVERNMENT ASSURANCE INSPECTION AND TESTING

Day-to day inspection and testing shall be the responsibility of the Contractor Quality Control (CQC) staff. However, representatives of the Contracting Officer can and will inspect construction as considered appropriate and will monitor operations of the Contractor's CQC staff. Government inspection or testing will not relieve the Contractor of any of his CQC responsibilities.

1.7.1 Materials

The Government will sample and test aggregates, cementitious materials, other materials, and concrete to determine compliance with the specifications as considered appropriate. The Contractor shall provide facilities and labor as may be necessary for procurement of representative test samples. Samples of aggregates will be obtained at the point of batching in accordance with ASTM D 75. Other materials will be sampled from storage at the jobsite or from other locations as considered appropriate. Samples may be placed in storage for later testing when appropriate.

1.7.2 Fresh Concrete

Fresh concrete will be sampled as delivered in accordance with ASTM C 172 and tested in accordance with these specifications, as considered necessary.

1.7.3 Hardened Concrete

Tests on hardened concrete will be performed by the Government when such tests are considered necessary.

1.7.4 Inspection

Concrete operations may be tested and inspected by the Government as the project progresses. Failure to detect defective work or material will not prevent rejection later when a defect is discovered nor will it obligate the Government for final acceptance.

2 PRODUCTS

2.1 CEMENTITIOUS MATERIALS

Cementitious Materials shall be portland cement, portland-pozzolan cement, or portland cement in combination with pozzolan and shall conform to appropriate specifications listed below. Use of cementitious materials in concrete which will have surfaces exposed in the completed structure shall be restricted so there is no change in color, source, or type of cementitious material.

2.1.1 Portland Cement

ASTM C 150, Type I low alkali with a maximum 15 percent amount of tricalcium aluminate, or Type II low alkali. White portland cement shall meet the above requirements except that it may be Type I, Type II or Type III low alkali. White Type III shall be used only in specific areas of the structure, when approved in writing.

2.1.2 Pozzolan (Fly Ash)

ASTM C 618, Class C with the optional requirements for multiple factor, drying shrinkage, and uniformity from Table 2A of ASTM C 618. If pozzolan is used, it shall never be less than 15 percent nor more than 35 percent by weight of the total cementitious material.

2.2 AGGREGATES

Aggregates shall conform to the following.

2.2.1 Fine Aggregate

Fine aggregate shall conform to the quality and gradation requirements of ASTM C 33.

2.2.2 Coarse Aggregate

Coarse aggregate shall conform to ASTM C 33, Class 5S, size designation 1 ½”.

2.3 CHEMICAL ADMIXTURES

Chemical admixtures, when required or permitted, shall conform to the appropriate specification listed. Admixtures shall be furnished in liquid form and of suitable concentration for easy, accurate control of dispensing.

2.3.1 Air-Entraining Admixture

ASTM C 260 and shall consistently entrain the air content in the specified ranges under field conditions.

2.3.2 Accelerating Admixture

ASTM C 494, Type C or E, except that calcium chloride or admixtures containing calcium chloride shall not be used.

2.3.3 Water-Reducing or Retarding Admixture

ASTM C 494, Type A, B, or D, except that the 6-month and 1-year compressive and flexural strength tests are waived.

2.3.4 High-Range Water Reducer

ASTM C 494, Type F or G, except that the 6-month and 1-year strength requirements are waived. The admixture shall be used only when approved in writing, such approval being contingent upon particular mixture control as described in the Contractor's Quality Control Plan and upon performance of separate mixture design studies.

2.3.5 Surface Retarder

COE CRD-C 94.

2.3.6 Expanding Admixture

Aluminum powder type expanding admixture conforming to ASTM C 937.

2.3.7 Other Chemical Admixtures

Chemical admixtures for use in producing flowing concrete shall comply with ASTM C 1017, Type I or II. These admixtures shall be used only when approved in writing, such approval being contingent upon particular mixture control as described in the Contractor's Quality Control Plan and upon performance of separate mixture design studies.

2.4 CURING MATERIALS

2.4.1 Impervious-Sheet

Impervious-sheet materials shall conform to ASTM C 171, type optional, except, that polyethylene sheet shall not be used.

2.4.2 Membrane-Forming Compound

Membrane-Forming curing compound shall conform to ASTM C 309, Type 1-D or 2, except that only a styrene acrylate or chlorinated rubber compound meeting Class B requirements shall be used for surfaces that are to be painted or are to receive bituminous roofing, or waterproofing, or floors that are to receive adhesive applications of resilient flooring. The curing compound selected shall be compatible with any subsequent paint, roofing, waterproofing, or flooring specified. Nonpigmented compound shall contain a fugitive dye, and shall have the reflective requirements in ASTM C 309 waived.

2.4.3 Burlap and Cotton Mat

Burlap and cotton mat used for curing shall conform to AASHTO M 182.

2.5 WATER

Water for mixing and curing shall be fresh, clean, potable, and free of injurious amounts of oil, acid, salt, or alkali, except that non-potable water may be used if it meets the requirements of COE CRD-C 400.

2.6 NONSHRINK GROUT

Nonshrink grout shall conform to ASTM C 1107, Grade A, and shall be a commercial formulation suitable for the proposed application.

2.7 NONSLIP SURFACING MATERIAL

Nonslip surfacing material shall consist of 55 percent, minimum, aluminum oxide or silicon-dioxide abrasive ceramically bonded together to form a homogeneous material sufficiently porous to provide a good bond with portland cement paste; or factory-graded emery aggregate consisting of not less than 45 percent aluminum oxide and 25 percent ferric oxide. The aggregate shall be well graded from particles retained on the No. 30 sieve to particles passing the No. 8 sieve.

2.8 LATEX BONDING AGENT

Latex agents for bonding fresh to hardened concrete shall conform to ASTM C 1059.

2.9 EPOXY RESIN

Epoxy resins for use in repairs shall conform to ASTM C 881, Type V, Grade 2. Class as appropriate to the existing ambient and surface temperatures.

2.10 EMBEDDED ITEMS

Embedded items shall be of the size and type indicated or as needed for the application.

2.11 VAPOR BARRIER

Vapor barrier shall be polyethylene sheeting with a minimum thickness of 6 mils or other equivalent material having a vapor permeance rating not exceeding 0.5 perms as determined in accordance with ASTM E 96.

PART 3 EXECUTION

3.1 PREPARATION FOR PLACING

Before commencing concrete placement, the following shall be performed. Surfaces to receive concrete shall be clean and free from frost, ice, mud, and water. Forms shall be in place, cleaned, coated, and adequately supported. Reinforcing steel shall be in place, cleaned, tied, and adequately supported, in accordance with Section 03200 CONCRETE REINFORCEMENT. Transporting and conveying equipment shall be in-place, ready for use, clean, and free of hardened concrete and foreign material. Equipment for consolidating concrete shall be at the placing site and in proper working order. Equipment and material for curing and for protecting concrete from weather or mechanical damage shall be at the placing site, in proper working condition and in sufficient amount for the entire placement. When hot, windy conditions during concreting appear probable, equipment and material shall be at the placing site to provide windbreaks, shading, fogging, or other action to prevent plastic shrinkage cracking or other damaging drying of the concrete.

3.1.1 Foundations

3.1.1.1 Concrete on Earth Foundations

Earth (subgrade, base, or subbase courses) surfaces upon which concrete is to be placed shall be clean, damp, and free from debris, frost, ice, and standing or running water. Prior to placement of concrete, the foundation shall be well drained and shall be satisfactorily graded and uniformly compacted.

3.1.1.3 Excavated Surfaces in Lieu of Forms

Concrete for footings and walls not exposed to view may be placed directly against the soil provided the earth or rock has been carefully trimmed, is uniform and stable, and meets the compaction requirements of Section 02300 EARTHWORK. The concrete shall be placed without becoming contaminated by loose material, and the outline of the concrete shall be within the specified tolerances.

3.1.2.5 Preparation of Previously Placed Concrete

Concrete surfaces to which other concrete is to be bonded shall be abraded in an approved manner that will expose sound aggregate uniformly without damaging the concrete. Laitance and loose particles shall be removed. Surfaces shall be thoroughly washed and shall be moist but without free water when concrete is placed.

3.1.3 Vapor Barrier

Vapor barrier shall be provided beneath the interior on-grade concrete floor slabs. The greatest widths and lengths practicable shall be used to eliminate joints wherever possible. Joints shall be lapped a minimum of 12 inches. Torn, punctured, or damaged vapor barrier

material shall be removed and new vapor barrier shall be provided prior to placing concrete. For minor repairs, patches may be made using laps of at least 12 inches. Lapped joints shall be sealed and edges patched with pressure-sensitive adhesive or tape not less than 2 inches wide and compatible with the membrane. Vapor barrier shall be placed directly on underlying subgrade, base course, or capillary water barrier, unless it consists of crushed material or large granular material which could puncture the vapor barrier. In this case, the surface shall be choked with a light layer of sand, as approved, before placing the vapor barrier. A 2 inch layer of compacted, clean concrete sand (fine aggregate) shall be placed on top of the vapor barrier before placing concrete. Concrete placement shall be controlled so as to prevent damage to the vapor barrier, or any covering sand.

3.1.5 Embedded Items

Before placement of concrete, care shall be taken to determine that all embedded items are firmly and securely fastened in place as indicated on the drawings, or required. Conduit and other embedded items shall be clean and free of oil and other foreign matter such as loose coatings or rust, paint, and scale. The embedding of wood in concrete will be permitted only when specifically authorized or directed. Voids in sleeves, inserts, and anchor slots shall be filled temporarily with readily removable materials to prevent the entry of concrete into voids. Welding shall not be performed on embedded metals within 1 foot of the surface of the concrete. Tack welding shall not be performed on or to embedded items.

3.2 CONCRETE PRODUCTION

3.2.1 Batching, Mixing, and Transporting Concrete

Concrete shall either be batched and mixed onsite or shall be furnished from a ready-mixed concrete plant. Ready-mixed concrete shall be batched, mixed, and transported in accordance with ASTM C 94, except as otherwise specified. Truck mixers, agitators, and nonagitating transporting units shall comply with NRMCA TMMB 100. Ready-mix plant equipment and facilities shall be certified in accordance with NRMCA QC 3. Approved batch tickets shall be furnished for each load of ready-mixed concrete. Site-mixed concrete shall conform to the following subparagraphs.

3.2.1.1 General

The batching plant shall be located off site close to the project. The batching, mixing and placing system shall have a capacity of at least 60 cubic yards per hour. The batching plant shall conform to the requirements of NRMCA CPMB 100 and as specified; however, rating plates attached to batch plant equipment are not required.

3.2.1.2 Batching Equipment

The batching controls shall be semiautomatic or automatic, as defined in NRMCA CPMB 100. A semiautomatic batching system shall be provided with interlocks such that the discharge

device cannot be actuated until the indicated material is within the applicable tolerance. The batching system shall be equipped with accurate recorder or recorders that meet the requirements of NRMCA CPMB 100. The weight of water and admixtures shall be recorded if batched by weight. Separate bins or compartments shall be provided for each size group of aggregate and type of cementitious material, to prevent intermingling at any time. Aggregates shall be weighed either in separate weigh batchers with individual scales or, provided the smallest size is batched first, cumulatively in one weigh batcher on one scale. Aggregate shall not be weighed in the same batcher with cementitious material. If both portland cement and other cementitious material are used, they may be batched cumulatively, provided that the portland cement is batched first. Water may be measured by weight or volume. Water shall not be weighed or measured cumulatively with another ingredient. Filling and discharging valves for the water metering or batching system shall be so interlocked that the discharge valve cannot be opened before the filling valve is fully closed. Piping for water and for admixtures shall be free from leaks and shall be properly valved to prevent backflow or siphoning. Admixtures shall be furnished as a liquid of suitable concentration for easy control of dispensing. An adjustable, accurate, mechanical device for measuring and dispensing each admixture shall be provided. Each admixture dispenser shall be interlocked with the batching and discharging operation of the water so that each admixture is separately batched and individually discharged automatically in a manner to obtain uniform distribution throughout the water as it is added to the batch in the specified mixing period. When use of truck mixers makes this requirement impractical, the admixture dispensers shall be interlocked with the sand batchers. Different admixtures shall not be combined prior to introduction in water and shall not be allowed to intermingle until in contact with the cement. Admixture dispensers shall have suitable devices to detect and indicate flow during dispensing or have a means for visual observation. The plant shall be arranged so as to facilitate the inspection of all operations at all times. Suitable facilities shall be provided for obtaining representative samples of aggregates from each bin or compartment, and for sampling and calibrating the dispensing of cementitious material, water, and admixtures. Filling ports for cementitious materials bins or silos shall be clearly marked with a permanent sign stating the contents.

3.2.1.3 Scales

The weighing equipment shall conform to the applicable requirements of CPMB Concrete Plant Standard, and of NIST HB 44, except that the accuracy shall be plus or minus 0.2 percent of scale capacity. The Contractor shall provide standard test weights and any other auxiliary equipment required for checking the operating performance of each scale or other measuring devices. The tests shall be made at the specified frequency in the presence of a Government inspector. The weighing equipment shall be arranged so that the plant operator can conveniently observe all dials or indicators.

3.2.1.4 Batching Tolerances

(A) Tolerances with Weighing Equipment

MATERIAL	PERCENT OF REQUIRED WEIGHT

Cementitious materials	0 to plus 2
Aggregate	plus or minus 2
Water	plus or minus 1
Chemical admixture	0 to plus 6

(B) Tolerances with Volumetric Equipment

For volumetric batching equipment used for water and admixtures, the following tolerances shall apply to the required volume of material being batched:

MATERIAL	PERCENT OF REQUIRED MATERIAL
Water:	plus or minus 1 percent
Chemical admixtures:	0 to plus 6 percent

3.2.1.5 Moisture Control

The plant shall be capable of ready adjustment to compensate for the varying moisture content of the aggregates and to change the weights of the materials being batched.

3.2.1.6 Concrete Mixers

Mixers shall be stationary mixers or truck mixers. Mixers shall be capable of combining the materials into a uniform mixture and of discharging this mixture without segregation. The mixers shall not be charged in excess of the capacity recommended by the manufacturer. The mixers shall be operated at the drum or mixing blade speed designated by the manufacturer. The mixers shall be maintained in satisfactory operating condition, and the mixer drums shall be kept free of hardened concrete. Should any mixer at any time produce unsatisfactory results, its use shall be promptly discontinued until it is repaired.

3.2.1.7 Stationary Mixers

Concrete plant mixers shall be drum-type mixers of tilting, nontilting, horizontal-shaft, or vertical-shaft type, or shall be pug mill type and shall be provided with an acceptable device to lock the discharge mechanism until the required mixing time has elapsed. The mixing time and uniformity shall conform to all the requirements in ASTM C 94 applicable to central-mixed concrete.

3.2.1.8 Truck Mixers

Truck mixers, the mixing of concrete therein, and concrete uniformity shall conform to the requirements of ASTM C 94. A truck mixer may be used either for complete mixing (transit-mixed) or to finish the partial mixing done in a stationary mixer (shrink-mixed). Each truck shall be equipped with two counters from which it is possible to determine the number of revolutions at mixing speed and the number of revolutions at agitating speed. Or, if approved

in lieu of this, the number of revolutions shall be marked on the batch tickets. Water shall not be added at the placing site unless specifically approved; and in no case shall it exceed the specified w/c. Any such water shall be injected at the base of the mixer, not at the discharge end.

3.6 TRANSPORTING CONCRETE TO PROJECT SITE

Concrete shall be transported to the placing site in truck mixers conforming to NRMCA TMMB 100 or by approved pumping equipment.

3.7 CONVEYING CONCRETE ON SITE

Concrete shall be conveyed from mixer or transporting unit to forms as rapidly as possible and within the time interval specified by methods which will prevent segregation or loss of ingredients using following equipment. Conveying equipment shall be cleaned before each placement.

3.7.1 Buckets

The interior hopper slope shall be not less than 58 degrees from the horizontal, the minimum dimension of the clear gate opening shall be at least 5 times the nominal maximum-size aggregate, and the area of the gate opening shall not be less than 2 square feet. The maximum dimension of the gate opening shall not be greater than twice the minimum dimension. The bucket gates shall be essentially grout tight when closed and may be manually, pneumatically, or hydraulically operated except that buckets larger than 2 cubic yards shall not be manually operated. The design of the bucket shall provide means for positive regulation of the amount and rate of deposit of concrete in each dumping position.

3.7.2 Transfer Hoppers

Concrete may be charged into nonagitating hoppers for transfer to other conveying devices. Transfer hoppers shall be capable of receiving concrete directly from delivery vehicles and shall have conical-shaped discharge features. The transfer hopper shall be equipped with a hydraulically operated gate and with a means of external vibration to effect complete discharge. Concrete shall not be held in nonagitating transfer hoppers more than 30 minutes.

3.7.3 Trucks

Truck mixers operating at agitating speed or truck agitators used for transporting plant-mixed concrete shall conform to the requirements of ASTM C 94. Nonagitating equipment shall be used only for transporting plant-mixed concrete over a smooth road and when the hauling time is less than 15 minutes. Bodies of nonagitating equipment shall be smooth, watertight, metal containers specifically designed to transport concrete, shaped with rounded corners to minimize segregation, and equipped with gates that will permit positive control of the discharge of the concrete.

3.7.4 Chutes

When concrete can be placed directly from a truck mixer, agitator, or nonagitating equipment, the chutes normally attached to this equipment by the manufacturer may be used. A discharge deflector shall be used when required by the Contracting Officer. Separate chutes and other similar equipment will not be permitted for conveying concrete.

3.7.5 Belt Conveyors

Belt conveyors shall be designed and operated to assure a uniform flow of concrete from mixer to final place of deposit without segregation of ingredients or loss of mortar and shall be provided with positive means, such as discharge baffle or hopper , for preventing segregation of the concrete at the transfer points and the point of placing. Belt conveyors shall be constructed such that the idler spacing shall not exceed 36 inches. The belt speed shall be a minimum of 300 feet per minute and a maximum of 750 feet per minute. If concrete is to be placed through installed horizontal or sloping reinforcing bars, the conveyor shall discharge concrete into a pipe or elephant truck that is long enough to extend through the reinforcing bars.

3.7.6 Concrete Pumps

Concrete may be conveyed by positive displacement pump when approved. The pumping equipment shall be piston or squeeze pressure type; pneumatic placing equipment shall not be used. The pipeline shall be rigid steel pipe or heavy-duty flexible hose. The inside diameter of the pipe shall be at least 3 times the nominal maximum-size coarse aggregate in the concrete mixture to be pumped but not less than 4 inches. Aluminum pipe shall not be used.

3.8 PLACING CONCRETE

Mixed concrete shall be discharged within 1-1/2 hours or before the mixer drum has revolved 300 revolutions, whichever comes first after the introduction of the mixing water to the cement and aggregates. When the concrete temperature exceeds 85 degrees F, the time shall be reduced to 45 minutes. Concrete shall be placed within 15 minutes after it has been discharged from the transporting unit. Concrete shall be handled from mixer or transporting unit to forms in a continuous manner until the approved unit of operation is completed. Adequate scaffolding, ramps and walkways shall be provided so that personnel and equipment are not supported by in-place reinforcement. Placing will not be permitted when the sun, heat, wind, or limitations of facilities furnished by the Contractor prevent proper consolidation, finishing and curing. Sufficient placing capacity shall be provided so that concrete can be kept free of cold joints.

3.8.1 Depositing Concrete

Concrete shall be deposited as close as possible to its final position in the forms, and there shall be no vertical drop greater than 5 feet except where suitable equipment is provided to prevent segregation and where specifically authorized. Depositing of the concrete shall be so

regulated that it will be effectively consolidated in horizontal layers not more than 12 inches thick, except that all slabs shall be placed in a single layer. Concrete to receive other construction shall be screeded to the proper level. Concrete shall be deposited continuously in one layer or in layers so that fresh concrete is deposited on in-place concrete that is still plastic. Fresh concrete shall not be deposited on concrete that has hardened sufficiently to cause formation of seams or planes of weakness within the section. Concrete that has surface dried, partially hardened, or contains foreign material shall not be used. When temporary spreaders are used in the forms, the spreaders shall be removed as their service becomes unnecessary. Concrete shall not be placed in slabs over columns and walls until concrete in columns and walls has been in-place at least two hours or until the concrete begins to lose its plasticity. Concrete for beams, girders, brackets, column capitals, haunches, and drop panels shall be placed at the same time as concrete for adjoining slabs.

3.8.2 Consolidation

Immediately after placing, each layer of concrete shall be consolidated by internal vibrators, except for slabs 4 inches thick or less. The vibrators shall at all times be adequate in effectiveness and number to properly consolidate the concrete; a spare vibrator shall be kept at the jobsite during all concrete placing operations. The vibrators shall have a frequency of not less than 10,000 vibrations per minute, an amplitude of at least 0.025 inch, and the head diameter shall be appropriate for the structural member and the concrete mixture being placed. Vibrators shall be inserted vertically at uniform spacing over the area of placement. The distance between insertions shall be approximately 1-1/2 times the radius of action of the vibrator so that the area being vibrated will overlap the adjacent just-vibrated area by a reasonable amount. The vibrator shall penetrate rapidly to the bottom of the layer and at least 6 inches into the preceding layer if there is such. Vibrator shall be held stationary until the concrete is consolidated and then vertically withdrawn slowly while operating. Form vibrators shall not be used unless specifically approved and unless forms are constructed to withstand their use. Vibrators shall not be used to move concrete within the forms. Slabs 4 inches and less in thickness shall be consolidated by properly designed vibrating screeds or other approved technique. Excessive vibration of lightweight concrete resulting in segregation or flotation of coarse aggregate shall be prevented. Frequency and amplitude of vibrators shall be determined in accordance with COE CRD-C 521. Grate tampers ("jitterbugs") shall not be used.

3.8.3 Cold Weather Requirements

Special protection measures, approved by the Contracting Officer, shall be used if freezing temperatures are anticipated before the expiration of the specified curing period. The ambient temperature of the air where concrete is to be placed and the temperature of surfaces to receive concrete shall be not less than 40 degrees F. The temperature of the concrete when placed shall be not less than 50 degrees F nor more than 75 degrees F. Heating of the mixing water or aggregates will be required to regulate the concrete placing temperature. Materials entering the mixer shall be free from ice, snow, or frozen lumps. Salt, chemicals or other materials shall not be incorporated in the concrete to prevent freezing. Upon written approval, an

accelerating admixture conforming to ASTM C 494, Type C or E may be used, provided it contains no calcium chloride. Calcium chloride shall not be used.

3.8.4 Hot Weather Requirements

When the ambient temperature during concrete placing is expected to exceed 85 degrees F, the concrete shall be placed and finished with procedures previously submitted and as specified herein. The concrete temperature at time of delivery to the forms shall not exceed the temperature shown in the table below when measured in accordance with ASTM C 1064. Cooling of the mixing water or aggregates or placing concrete in the cooler part of the day may be required to obtain an adequate placing temperature. A retarder may be used, as approved, to facilitate placing and finishing. Steel forms and reinforcements shall be cooled as approved prior to concrete placement when steel temperatures are greater than 120 degrees F. Conveying and placing equipment shall be cooled if necessary to maintain proper concrete-placing temperature.

Maximum Allowable Concrete Placing Temperature

Relative Humidity, Percent, During Time of Concrete Placement	Maximum Allowable Concrete Temperature Degrees
Greater than 60	90 F
40-60	85 F
Less than 40	80 F

3.8.5 Prevention of Plastic Shrinkage Cracking

During hot weather with low humidity, and particularly with appreciable wind, as well as interior placements when space heaters produce low humidity, the Contractor shall be alert to the tendency for plastic shrinkage cracks to develop and shall institute measures to prevent this. Particular care shall be taken if plastic shrinkage cracking is potentially imminent and especially if it has developed during a previous placement. Periods of high potential for plastic shrinkage cracking can be anticipated by use of Fig. 2.1.5 of ACI 305R. In addition the concrete placement shall be further protected by erecting shades and windbreaks and by applying fog sprays of water, sprinkling, ponding or wet covering. Plastic shrinkage cracks that occur shall be filled by injection of epoxy resin as directed, after the concrete hardens. Plastic shrinkage cracks shall never be troweled over or filled with slurry.

3.8.6 Placing Concrete Underwater

Concrete shall be deposited in water by a tremie or concrete pump. The methods and equipment used shall be subject to approval. Concrete buckets shall not be used for underwater placement of concrete except to deliver concrete to the tremie. The tremie shall be

watertight and sufficiently large to permit a free flow of concrete. The concrete shall be deposited so that it enters the mass of the previously placed concrete from within, displacing water with a minimum disturbance to the surface of the concrete. The discharge end of the pump line or tremie shaft shall be kept continuously submerged in the concrete. The underwater seal at start of placing shall not produce undue turbulence in the water. The tremie shaft shall be kept full of concrete to a point well above the water surface. Placement shall proceed without interruption until the concrete has been brought to the required height. The tremie shall not be moved horizontally during a placing operation, and a sufficient number of tremies shall be provided so that the maximum horizontal flow of concrete will be limited to 5 m. 15 feet. Concrete shall not be deposited in running water or in water with a temperature below 35 degrees F.

3.8.7 Placing Concrete in Congested Areas

Special care shall be used to ensure complete filling of the forms, elimination of all voids, and complete consolidation of the concrete when placing concrete in areas congested with reinforcing bars, embedded items, waterstops and other tight spacing. An appropriate concrete mixture shall be used, and the nominal maximum size of aggregate (NMSA) shall meet the specified criteria when evaluated for the congested area. Vibrators with heads of a size appropriate for the clearances available shall be used, and the consolidation operation shall be closely supervised to ensure complete and thorough consolidation at all points. Where necessary, splices of reinforcing bars shall be alternated to reduce congestion. Where two mats of closely spaced reinforcing are required, the bars in each mat shall be placed in matching alignment to reduce congestion. Reinforcing bars may be temporarily crowded to one side during concrete placement provided they are returned to exact required location before concrete placement and consolidation are completed.

3.8.8 Placing Flowable Concrete

If a plasticizing admixture conforming to ASTM C 1017 is used or if a Type F or G high range water reducing admixture is permitted to increase the slump, the concrete shall meet all requirements of paragraph GENERAL REQUIREMENTS in PART 1. Extreme care shall be used in conveying and placing the concrete to avoid segregation. Consolidation and finishing shall meet all requirements of paragraphs Placing Concrete, Finishing Formed Surfaces, and Finishing Unformed Surfaces. No relaxation of requirements to accommodate flowable concrete will be permitted.

3.9 JOINTS

Joints shall be located and constructed as indicated or approved. Joints not indicated on the drawings shall be located and constructed to minimize the impact on the strength of the structure. In general, such joints shall be located near the middle of the spans of supported slabs, beams, and girders unless a beam intersects a girder at this point, in which case the joint in the girder shall be offset a distance equal to twice the width of the beam. Joints in walls and columns shall be at the underside of floors, slabs, beams, or girders and at the tops of footings or floor slabs, unless otherwise approved. Joints shall be perpendicular to the main

reinforcement. All reinforcement shall be continued across joints; except that reinforcement or other fixed metal items shall not be continuous through expansion joints, or through construction or contraction joints in slabs on grade. Reinforcement shall be 2 inches clear from each joint. Except where otherwise indicated, construction joints between interior slabs on grade and vertical surfaces shall consist of 30 pound asphalt-saturated felt, extending for the full depth of the slab. The perimeters of the slabs shall be free of fins, rough edges, spalling, or other unsightly appearance. Reservoir for sealant for construction and contraction joints in slabs shall be formed to the dimensions shown on the drawings by removing snap-out joint-forming inserts, by sawing sawable inserts, or by sawing to widen the top portion of sawed joints. Joints to be sealed shall be cleaned and sealed as indicated and in accordance with Section 07900 JOINT SEALING.

3.9.1 Construction Joints

For concrete other than slabs on grade, construction joints shall be located so that the unit of operation does not exceed 25 feet. Concrete shall be placed continuously so that each unit is monolithic in construction. Fresh concrete shall not be placed against adjacent hardened concrete until it is at least 24 hours old. Construction joints shall be located as indicated or approved. Where concrete work is interrupted by weather, end of work shift or other similar type of delay, location and type of construction joint shall be subject to approval of the Contracting Officer. Unless otherwise indicated and except for slabs on grade, reinforcing steel shall extend through construction joints. Construction joints in slabs on grade shall be keyed or doweled as shown. Concrete columns, walls, or piers shall be in place at least 2 hours, or until the concrete begins to lose its plasticity, before placing concrete for beams, girders, or slabs thereon. In walls having door or window openings, lifts shall terminate at the top and bottom of the opening. Other lifts shall terminate at such levels as to conform to structural requirements or architectural details. Where horizontal construction joints in walls or columns are required, a strip of 1 inch square-edge lumber, bevelled and oiled to facilitate removal, shall be tacked to the inside of the forms at the construction joint. Concrete shall be placed to a point 1 inch above the underside of the strip. The strip shall be removed 1 hour after the concrete has been placed, and any irregularities in the joint line shall be leveled off with a wood float, and all laitance shall be removed. Prior to placing additional concrete, horizontal construction joints shall be prepared as specified in paragraph Previously Placed Concrete.

3.9.2 Contraction Joints in Slabs on Grade

Contraction joints shall be located and detailed as specified or shown on the drawings. Contraction Joints shall be produced by forming a weakened plane in the concrete slab by use of rigid inserts impressed in the concrete during placing operations, use of snap-out plastic joint forming inserts, or sawing a continuous slot with a concrete saw. Regardless of method used to produce the weakened plane, it shall be 1/4 the depth of the slab thickness and between 1/8 and 3/16 inch wide. For saw-cut joints, cutting shall be timed properly with the set of the concrete. Cutting shall be started as soon as the concrete has hardened sufficiently to prevent ravelling of the edges of the saw cut. Cutting shall be completed before shrinkage stresses

become sufficient to produce cracking. Reservoir for joint sealant shall be formed as previously specified.

3.9.5 Dowels and Tie Bars

Dowels and tie bars shall be installed at the locations shown on the drawings and to the details shown, using materials and procedures specified in Section 03200 CONCRETE REINFORCEMENT and herein. Conventional smooth "paving" dowels shall be installed in slabs using approved methods to hold the dowel in place during concreting within a maximum alignment tolerance of 1/8 inch in 12 inches. "Structural" type deformed bar dowels, or tie bars, shall be installed to meet the specified tolerances. Care shall be taken during placing adjacent to and around dowels and tie bars to ensure there is no displacement of the dowel or tie bar and that the concrete completely embeds the dowel or tie bar and is thoroughly consolidated.

3.10 FINISHING FORMED SURFACES

Unless another type of architectural or special finish is specified, surfaces shall be left with the texture imparted by the forms except that defective surfaces shall be repaired. Unless painting of surfaces is required, uniform color of the concrete shall be maintained by use of only one mixture without changes in materials or proportions for any structure or portion of structure that requires a Class A or B finish. Except for major defects, as defined hereinafter, surface defects shall be repaired as specified herein within 24 hours after forms are removed. Repairs of the so-called "plaster-type" will not be permitted in any location. Tolerances of formed surfaces shall conform to the requirements of ACI 117/117R. These tolerances apply to the finished concrete surface, not to the forms themselves; forms shall be set true to line and grade. Form tie holes requiring repair and other defects whose depth is at least as great as their surface diameter shall be repaired as specified in paragraph Damp-Pack Mortar Repair. Defects whose surface diameter is greater than their depth shall be repaired as specified in paragraph Repair of Major Defects. Repairs shall be finished flush with adjacent surfaces and with the same surface texture. The cement used for all repairs shall be a blend of job cement with white cement proportioned so that the final color after curing and aging will be the same as the adjacent concrete. Concrete with excessive honeycomb, or other defects which affect the strength of the member, will be rejected. Repairs shall be demonstrated to be acceptable and free from cracks or loose or drummy areas at the completion of the contract and, for Class A and B Finishes, shall be inconspicuous. Repairs not meeting these requirements will be rejected and shall be replaced.

3.10.1 Class B Finish

Class B finish is required at surfaces exposed to view. Fins, ravelings, and loose material shall be removed, all surface defects over 1/2 inch in diameter or more than 1/2 inch deep, shall be repaired and holes left by removal of form ties shall be reamed and filled. Defects more than 1/2 inch in diameter shall be cut back to sound concrete, but in all cases at least 1 inch deep.

3.10.2 Class C and Class D Finish

Class C finish is permitted on surfaces not exposed to view. Class D finish is also permitted on surfaces not exposed to view. Fins, ravelings, and loose material shall be removed, and holes left by removal of form ties shall be reamed and filled. Honeycomb and other defects more than 1/2 inch deep or more than 2 inches in diameter shall be repaired. Defects more than 2 inches in diameter shall be cut back to sound concrete, but in all cases at least 1 inch deep.

3.11 REPAIRS

3.11.1 Damp-Pack Mortar Repair

Form tie holes requiring repair and other defects whose depth is at least as great as their surface diameter but not over 4 inches shall be repaired by the damp-pack mortar method. Form tie holes shall be reamed and other similar defects shall be cut out to sound concrete. The void shall then be thoroughly cleaned, thoroughly wetted, brush-coated with a thin coat of neat cement grout and filled with mortar. Mortar shall be a stiff mix of 1 part portland cement to 2 parts fine aggregate passing the No. 16 mesh sieve, and minimum amount of water. Only sufficient water shall be used to produce a mortar which, when used, will stick together on being molded into a ball by a slight pressure of the hands and will not exude water but will leave the hands damp. Mortar shall be mixed and allowed to stand for 30 to 45 minutes before use with remixing performed immediately prior to use. Mortar shall be thoroughly tamped in place in thin layers using a hammer and hardwood block. Holes passing entirely through walls shall be completely filled from the inside face by forcing mortar through to the outside face. All holes shall be packed full. Damp-pack repairs shall be moist cured for at least 48 hours.

3.11.2 Repair of Major Defects

Major defects will be considered to be those more than 1/2 inch deep or, for Class A and B finishes, more than 1/2 inch in diameter and, for Class C and D finishes, more than 2 inches in diameter. Also included are any defects of any kind whose depth is over 4 inches or whose surface diameter is greater than their depth. Major defects shall be repaired as specified below.

3.11.2.1 Surface Application of Mortar Repair

Defective concrete shall be removed, and removal shall extend into completely sound concrete. Approved equipment and procedures which will not cause cracking or microcracking of the sound concrete shall be used. If reinforcement is encountered, concrete shall be removed so as to expose the reinforcement for at least 2 inches on all sides. All such defective areas greater than 12 square inches shall be outlined by saw cuts at least 1 inch deep. Defective areas less than 12 square inches shall be outlined by a 1 inch deep cut with a core drill in lieu of sawing. All saw cuts shall be straight lines in a rectangular pattern in line with the formwork panels. After concrete removal, the surface shall be thoroughly cleaned by high

pressure washing to remove all loose material. Surfaces shall be kept continually saturated for the first 12 of the 24 hours immediately before placing mortar and shall be damp but not wet at the time of commencing mortar placement. The Contractor, at his option, may use either hand-placed mortar or mortar placed with a mortar gun. If hand-placed mortar is used, the edges of the cut shall be perpendicular to the surface of the concrete. The prepared area shall be brush-coated with a thin coat of neat cement grout. The repair shall then be made using a stiff mortar, preshrunk by allowing the mixed mortar to stand for 30 to 45 minutes and then remixed, thoroughly tamped into place in thin layers. If hand-placed mortar is used, the Contractor shall test each repair area for drumminess by firm tapping with a hammer and shall inspect for cracks, both in the presence of the Contracting Officer's representative, immediately before completion of the contract, and shall replace any showing drumminess or cracking. If mortar placed with a mortar gun is used, the gun shall be a small compressed air-operated gun to which the mortar is slowly hand fed and which applies the mortar to the surface as a high-pressure stream, as approved. Repairs made using shotcrete equipment will not be accepted. The mortar used shall be the same mortar as specified for damp-pack mortar repair. If gun-placed mortar is used, the edges of the cut shall be beveled toward the center at a slope of 1:1. All surface applied mortar repairs shall be continuously moist cured for at least 7 days. Moist curing shall consist of several layers of saturated burlap applied to the surface immediately after placement is complete and covered with polyethylene sheeting, all held closely in place by a sheet of plywood or similar material rigidly braced against it. Burlap shall be kept continually wet.

3.11.2.2 Repair of Deep and Large Defects

Deep and large defects will be those that are more than 6 inches deep and also have an average diameter at the surface more than 18 inches or that are otherwise so identified by the Project Office. Such defects shall be repaired as specified herein or directed, except that defects which affect the strength of the structure shall not be repaired and that portion of the structure shall be completely removed and replaced. Deep and large defects shall be repaired by procedures approved in advance including forming and placing special concrete using applied pressure during hardening. Preparation of the repair area shall be as specified for surface application of mortar. In addition, the top edge (surface) of the repair area shall be sloped at approximately 20 degrees from the horizontal, upward toward the side from which concrete will be placed. The special concrete shall be a concrete mixture with low water content and low slump, and shall be allowed to age 30 to 60 minutes before use. Concrete containing a specified expanding admixture may be used in lieu of the above mixture; the paste portion of such concrete mixture shall be designed to have an expansion between 2.0 and 4.0 percent when tested in accordance with ASTM C 940. A full width “chimney” shall be provided at the top of the form on the placing side to ensure filling to the top of the opening. A pressure cap shall be used on the concrete in the chimney with simultaneous tightening and revibrating the form during hardening to ensure a tight fit for the repair. The form shall be removed after 24 hours and immediately the chimney shall be carefully chipped away to avoid breaking concrete out of the repair; the surface of the repair concrete shall be dressed as required.

3.11.2.3 Resinous and Latex Material Repair

In lieu of the portland cement bonding coats specified above, an epoxy resin or a latex bonding agent may be used.

3.12 FINISHING UNFORMED SURFACES

The finish of all unformed surfaces shall meet the requirements of paragraph Tolerances in PART 1, when tested as specified herein.

3.12.1 General

The ambient temperature of spaces adjacent to unformed surfaces being finished and of the base on which concrete will be placed shall be not less than 50 degrees F. In hot weather all requirements of paragraphs Hot Weather Requirements and Prevention of Plastic Shrinkage Cracking shall be met. Unformed surfaces that are not to be covered by additional concrete or backfill shall have a float finish, with additional finishing as specified below, and shall be true to the elevation shown on the drawings. Surfaces to receive additional concrete or backfill shall be brought to the elevation shown on the drawings, properly consolidated, and left true and regular. Unless otherwise shown on the drawings, exterior surfaces shall be sloped for drainage, as directed. Where drains are provided, interior floors shall be evenly sloped to the drains. Joints shall be carefully made with a jointing or edging tool. The finished surfaces shall be protected from stains or abrasions. Grate tampers or “jitterbugs” shall not be used for any surfaces. The dusting of surfaces with dry cement or other materials or the addition of any water during finishing shall not be permitted. If bleed water is present prior to finishing, the excess water shall be carefully dragged off or removed by absorption with porous materials such as burlap. During finishing operations, extreme care shall be taken to prevent over finishing or working water into the surface; this can cause “crazing” (surface shrinkage cracks which appear after hardening) of the surface. Any slabs with surfaces which exhibit significant crazing shall be removed and replaced. During finishing operations, surfaces shall be checked with a 10 foot straightedge, applied in both directions at regular intervals while the concrete is still plastic, to detect high or low areas.

3.12.3 Floated Finish

Slabs on grade shall be given float finish. The screeding shall be followed immediately by darbying or bull floating before bleeding water is present, to bring the surface to a true, even plane. Then, after the concrete has stiffened so that it will withstand a man's weight without imprint of more than 1/4 inch and the water sheen has disappeared, it shall be floated to a true and even plane free of ridges. Floating shall be performed by use of suitable hand floats or power driven equipment. Sufficient pressure shall be used on the floats to bring a film of moisture to the surface. Hand floats shall be made of wood, magnesium, or aluminum. Concrete that exhibits stickiness shall be floated with a magnesium float. Care shall be taken to prevent over-finishing or incorporating water into the surface.

3.12.4 Troweled Finish

Slabs on grade shall be given a trowel finish. After floating is complete and after the surface moisture has disappeared, unformed surfaces shall be steel-troweled to a smooth, even, dense finish, free from blemishes including trowel marks. In lieu of hand finishing, an approved power finishing machine may be used in accordance with the directions of the machine manufacturer. Additional trowelings shall be performed, either by hand or machine until the surface has been troweled 2 times, with waiting period between each. Care shall be taken to prevent blistering and if such occurs, troweling shall immediately be stopped and operations and surfaces corrected. A final hard steel troweling shall be done by hand, with the trowel tipped, and using hard pressure, when the surface is at a point that the trowel will produce a ringing sound. The finished surface shall be thoroughly consolidated and shall be essentially free of trowel marks and be uniform in texture and appearance. The concrete mixture used for troweled finished areas shall be adjusted, if necessary, in order to provide sufficient fines (cementitious material and fine sand) to finish properly.

3.12.6 Non-Slip Finish

All slabs on grade shall receive a non-slip finish in accordance with the following subparagraphs.

3.12.6.1 Broomed

All slabs on grade shall receive a light, transverse broom finish. After floating, the surface shall be lightly steel troweled, and then carefully scored by pulling a fiber push-type broom across the surface. Brooming shall be transverse to traffic or at right angles to the slope of the slab. Resulting texture shall be neat, parallel (non-wavy) lines. After the end of the curing period, the surface shall be vigorously broomed with a coarse fiber broom to remove all loose or semi-detached particles.

3.14.5 CURING AND PROTECTION

3.14.5.1 General

Concrete with Type III cement	3 days
All other concrete	7 days

Immediately after placement, concrete shall be protected from premature drying, extremes in temperatures, rapid temperature change, mechanical injury and damage from rain and flowing water for the duration of the curing period. Air and forms in contact with concrete shall be maintained at a temperature above 50 degrees F for the first 3 days and at a temperature above 32 degrees F for the remainder of the specified curing period. Exhaust fumes from combustion heating units shall be vented to the outside of the enclosure, and heaters and ducts shall be placed and directed so as not to cause areas of overheating and drying of concrete

surfaces or to create fire hazards. Materials and equipment needed for adequate curing and protection shall be available and at the site prior to placing concrete. No fire or excessive heat, including welding, shall be permitted near or in direct contact with the concrete at any time. Except as otherwise permitted by paragraph Membrane Forming Curing Compounds, moist curing shall be provided for any areas to receive floor hardener, any paint or other applied coating, or to which other concrete is to be bonded. Except for plastic coated burlap, impervious sheeting alone shall not be used for curing.

3.16.6 Moist Curing

Concrete to be moist-cured shall be maintained continuously wet for the entire curing period, commencing immediately after finishing. If water or curing materials used stain or discolor concrete surfaces which are to be permanently exposed, the concrete surfaces shall be cleaned as approved. When wooden forms are left in place during curing, they shall be kept wet at all times. If steel forms are used in hot weather, nonsupporting vertical forms shall be broken loose from the concrete soon after the concrete hardens and curing water continually applied in this void. If the forms are removed before the end of the curing period, curing shall be carried out as on unformed surfaces, using suitable materials. Surfaces shall be cured by ponding, by continuous sprinkling, by continuously saturated burlap or cotton mats, or by continuously saturated plastic coated burlap. Burlap and mats shall be clean and free from any contamination and shall be completely saturated before being placed on the concrete. The Contractor shall have an approved work system to ensure that moist curing is continuous 24 hours per day.

3.16.7 Membrane Forming Curing Compounds

Membrane forming curing compounds shall be used only on slabs on grade. Membrane curing shall not be used on surfaces that are to receive any subsequent treatment depending on adhesion or bonding to the concrete, including surfaces to which a smooth finish is to be applied or other concrete to be bonded. However, a styrene acrylate or chlorinated rubber compound meeting ASTM C 309, Class B requirements, may be used for surfaces which are to be painted or are to receive bituminous roofing or waterproofing, or floors that are to receive adhesive applications of resilient flooring. The curing compound selected shall be compatible with any subsequent paint, roofing, waterproofing or flooring specified. Membrane curing compound shall not be used on surfaces that are maintained at curing temperatures with free steam. Curing compound shall be applied to formed surfaces immediately after the forms are removed and prior to any patching or other surface treatment except the cleaning of loose sand, mortar, and debris from the surface. All surfaces shall be thoroughly moistened with water. Curing compound shall be applied to slab surfaces as soon as the bleeding water has disappeared, with the tops of joints being temporarily sealed to prevent entry of the compound and to prevent moisture loss during the curing period. The curing compound shall be applied in a two-coat continuous operation by approved motorized power-spraying equipment operating at a minimum pressure of 75 psi, at a uniform coverage of not more than 400 square feet per gallon for each coat, and the second coat shall be applied perpendicular to the first coat. Concrete surfaces which have been subjected to rainfall within 3 hours after curing compound has been applied shall be resprayed by the method and at the

coverage specified. Surfaces on which clear compound is used shall be shaded from direct rays of the sun for the first 3 days. Surfaces coated with curing compound shall be kept free of foot and vehicular traffic, and from other sources of abrasion and contamination during the curing period.

3.16.8 Impervious Sheeting

Slabs on grade may be cured using impervious sheets. However, except for plastic coated burlap, impervious sheeting alone shall not be used for curing. Impervious-sheet curing shall only be used on horizontal or nearly horizontal surfaces. Surfaces shall be thoroughly wetted and be completely covered with the sheeting. Sheeting shall be at least 18 inches wider than the concrete surface to be covered. Covering shall be laid with light-colored side up. Covering shall be lapped not less than 12 inches and securely weighted down or shall be lapped not less than 4 inches and taped to form a continuous cover with completely closed joints. The sheet shall be weighted to prevent displacement so that it remains in contact with the concrete during the specified length of curing. Coverings shall be folded down over exposed edges of slabs and secured by approved means. Sheets shall be immediately repaired or replaced if tears or holes appear during the curing period.

3.16.9 Ponding or Immersion

Concrete shall be continually immersed throughout the curing period. Water shall not be more than 20 degrees F less than the temperature of the concrete.

3.16.10 Cold Weather Curing and Protection

When the daily ambient low temperature is less than 32 degrees F the temperature of the concrete shall be maintained above 40 degrees F for the first seven days after placing. During the period of protection removal, the air temperature adjacent to the concrete surfaces shall be controlled so that concrete near the surface will not be subjected to a temperature differential of more than 25 degrees F as determined by suitable temperature measuring devices furnished by the Government, as required, and installed adjacent to the concrete surface and 2 inches inside the surface of the concrete. The installation of the thermometers shall be made by the Contractor as directed.

3.17 SETTING BASE PLATES AND BEARING PLATES

After being properly positioned, column base plates, bearing plates for beams and similar structural members, and machinery and equipment base plates shall be set to the proper line and elevation with damp-pack bedding mortar, except where nonshrink grout is indicated. The thickness of the mortar or grout shall be approximately 1/24 the width of the plate, but not less than 3/4 inch. Concrete and metal surfaces in contact with grout shall be clean and free of oil and grease, and concrete surfaces in contact with grout shall be damp and free of laitance when grout is placed. Nonshrink grout shall be used for column base plates.

3.17.1 Damp-Pack Bedding Mortar

Damp-pack bedding mortar shall consist of 1 part cement and 2-1/2 parts fine aggregate having water content such that a mass of mortar tightly squeezed in the hand will retain its shape but will crumble when disturbed. The space between the top of the concrete and bottom of the bearing plate or base shall be packed with the bedding mortar by tamping or ramming with a bar or rod until it is completely filled.

3.17.2 Nonshrink Grout

Nonshrink grout shall be a ready-mixed material requiring only the addition of water. Water content shall be the minimum that will provide a flowable mixture and completely fill the space to be grouted without segregation, bleeding, or reduction of strength.

3.17.2.1 Mixing and Placing of Nonshrink Grout

Mixing and placing shall be in conformance with the material manufacturer's instructions and as specified therein. Ingredients shall be thoroughly dry-mixed before adding water. After adding water, the batch shall be mixed for 3 minutes. Batches shall be of size to allow continuous placement of freshly mixed grout. Grout not used within 30 minutes after mixing shall be discarded. The space between the top of the concrete or machinery-bearing surface and the plate shall be filled solid with the grout. Forms shall be of wood or other equally suitable material for completely retaining the grout on all sides and on top and shall be removed after the grout has set. The placed grout shall be carefully worked by rodding or other means to eliminate voids; however, overworking and breakdown of the initial set shall be avoided. Grout shall not be retempered or subjected to vibration from any source. Where clearances are unusually small, placement shall be under pressure with a grout pump. Temperature of the grout, and of surfaces receiving the grout, shall be maintained at 65 to 85 degrees F until after setting.

3.17.2.2 Treatment of Exposed Surfaces

For metal-oxidizing nonshrink grout, exposed surfaces shall be cut back 25 mm 1 inch and immediately covered with a parge coat of mortar consisting of 1 part portland cement and 2-1/2 parts fine aggregate by weight, with sufficient water to make a plastic mixture. The parge coat shall have a smooth finish. For other mortars or grouts, exposed surfaces shall have a smooth-dense finish and be left untreated. Curing shall comply with paragraph CURING AND PROTECTION.

3.18 TESTING AND INSPECTION FOR CONTRACTOR QUALITY CONTROL

The Contractor shall perform the inspection and tests described below and, based upon the results of these inspections and tests, shall take the action required and shall submit specified reports. When, in the opinion of the Contracting Officer, the concreting operation is out of control, concrete placement shall cease and the operation shall be corrected. The laboratory performing the tests shall be onsite and shall conform with ASTM C 1077. Materials may be

subjected to check testing by the Government from samples obtained at the manufacturer, at transfer points, or at the project site. The Government will inspect the laboratory, equipment, and test procedures prior to start of concreting operations.

3.18.1 Grading and Corrective Action

3.18.1.1 Fine Aggregate

At least once during each shift when the concrete plant is operating, there shall be one sieve analysis and fineness modulus determination in accordance with ASTM C 136 and COE CRD-C 104 for the fine aggregate or for each fine aggregate if it is batched in more than one size or classification. The location at which samples are taken may be selected by the Contractor as the most advantageous for control. However, the Contractor is responsible for delivering fine aggregate to the mixer within specification limits. When the amount passing on any sieve is outside the specification limits, the fine aggregate shall be immediately resampled and retested. If there is another failure on any sieve, the fact shall immediately reported to the Contracting Officer, concreting shall be stopped, and immediate steps taken to correct the grading.

3.18.1.2 Coarse Aggregate

At least once during each shift in which the concrete plant is operating, there shall be a sieve analysis in accordance with ASTM C 136 for each size of coarse aggregate. The location at which samples are taken may be selected by the Contractor as the most advantageous for production control. However, the Contractor shall be responsible for delivering the aggregate to the mixer within specification limits. A test record of samples of aggregate taken at the same locations shall show the results of the current test as well as the average results of the five most recent tests including the current test. The Contractor may adopt limits for control coarser than the specification limits for samples taken other than as delivered to the mixer to allow for degradation during handling. When the amount passing any sieve is outside the specification limits, the coarse aggregate shall be immediately resampled and retested. If the second sample fails on any sieve, that fact shall be reported to the Contracting Officer. Where two consecutive averages of 5 tests are outside specification limits, the operation shall be considered out of control and shall be reported to the Contracting Officer. Concreting shall be stopped and immediate steps shall be taken to correct the grading.

3.18.1.3 Quality of Aggregates

Thirty days prior to the start of concrete placement, the Contractor shall perform all tests for aggregate quality required by ASTM C 33. In addition, after the start of concrete placement, the Contractor shall perform tests for aggregate quality at least every three months, and when the source of aggregate or aggregate quality changes. Samples tested after the start of concrete placement shall be taken immediately prior to entering the concrete mixer.

3.18.2 Scales, Batching and Recording

The accuracy of the scales shall be checked by test weights prior to start of concrete operations and at least once every three months. Such tests shall also be made as directed whenever there are variations in properties of the fresh concrete that could result from batching errors. Once a week the accuracy of each batching and recording device shall be checked during a weighing operation by noting and recording the required weight, recorded weight, and the actual weight batched. At the same time, the Contractor shall test and ensure that the devices for dispensing admixtures are operating properly and accurately. When either the weighing accuracy or batching accuracy does not comply with specification requirements, the plant shall not be operated until necessary adjustments or repairs have been made. Discrepancies in recording accuracies shall be corrected immediately.

3.18.3 Batch-Plant Control

The measurement of concrete materials including cementitious materials, each size of aggregate, water, and admixtures shall be continuously controlled. The aggregate weights and amount of added water shall be adjusted as necessary to compensate for free moisture in the aggregates. The amount of air-entraining agent shall be adjusted to control air content within specified limits. A report shall be prepared indicating type and source of cement used, type and source of pozzolan or slag used, amount and source of admixtures used, aggregate source, the required aggregate and water weights per cubic yard, amount of water as free moisture in each size of aggregate, and the batch aggregate and water weights per cubic yard for each class of concrete batched during each day's plant operation.

3.18.4 Concrete Mixture

a. Air Content Testing. Air content tests shall be made when test specimens are fabricated. In addition, at least two tests for air content shall be made on randomly selected batches of each separate concrete mixture produced during each 8-hour period of concrete production. Additional tests shall be made when excessive variation in workability is reported by the placing foreman or Government inspector. Tests shall be made in accordance with ASTM C 231 for normal weight concrete and ASTM C 173 for lightweight concrete. Test results shall be plotted on control charts which shall at all times be readily available to the Government and shall be submitted weekly. Copies of the current control charts shall be kept in the field by testing crews and results plotted as tests are made. When a single test result reaches either the upper or lower action limit, a second test shall immediately be made. The results of the two tests shall be averaged and this average used as the air content of the batch to plot on both the air content and the control chart for range, and for determining need for any remedial action. The result of each test, or average as noted in the previous sentence, shall be plotted on a separate control chart for each mixture on which an "average line" is set at the midpoint of the specified air content range from paragraph Air Entrainment. An upper warning limit and a lower warning limit line shall be set 1.0 percentage point above and below the average line, respectively. An upper action limit and a lower action limit line shall be set 1.5 percentage points above and below the average line, respectively. The range between

each two consecutive tests shall be plotted on a secondary control chart for range where an upper warning limit is set at 2.0 percentage points and an upper action limit is set at 3.0 percentage points. Samples for air content may be taken at the mixer, however, the Contractor is responsible for delivering the concrete to the placement site at the stipulated air content. If the Contractor's materials or transportation methods cause air content loss between the mixer and the placement, correlation samples shall be taken at the placement site as required by the Contracting Officer, and the air content at the mixer controlled as directed.

b. Air Content Corrective Action. Whenever points on the control chart for percent air reach either warning limit, an adjustment shall immediately be made in the amount of air-entraining admixture batched. As soon as practical after each adjustment, another test shall be made to verify the result of the adjustment. Whenever a point on the secondary control chart for range reaches the warning limit, the admixture dispenser shall be recalibrated to ensure that it is operating accurately and with good reproducibility. Whenever a point on either control chart reaches an action limit line, the air content shall be considered out of control and the concreting operation shall immediately be halted until the air content is under control. Additional air content tests shall be made when concreting is restarted.

c. Slump Testing. In addition to slump tests which shall be made when test specimens are fabricated, at least four slump tests shall be made on randomly selected batches in accordance with ASTM C 143 for each separate concrete mixture produced during each 8-hour or less period of concrete production each day. Also, additional tests shall be made when excessive variation in workability is reported by the placing foreman or Government inspector. Test results shall be plotted on control charts which shall at all times be readily available to the Government and shall be submitted weekly. Copies of the current control charts shall be kept in the field by testing crews and results plotted as tests are made. When a single slump test reaches or goes beyond either the upper or lower action limit, a second test shall immediately be made. The results of the two tests shall be averaged and this average used as the slump of the batch to plot on both the control charts for slump and the chart for range, and for determining need for any remedial action. Limits shall be set on separate control charts for slump for each type of mixture. The upper warning limit shall be set at 1/2 inch below the maximum allowable slump specified in paragraph Slump in PART 1 for each type of concrete and an upper action limit line and lower action limit line shall be set at the maximum and minimum allowable slumps, respectively, as specified in the same paragraph. The range between each consecutive slump test for each type of mixture shall be plotted on a single control chart for range on which an upper action limit is set at 2 inches. Samples for slump shall be taken at the mixer. However, the Contractor is responsible for delivering the concrete to the placement site at the stipulated slump. If the Contractor's materials or transportation methods cause slump loss between the mixer and the placement, correlation samples shall be taken at the placement site as required by the Contracting Officer, and the slump at the mixer controlled as directed.

d. Slump Corrective Action. Whenever points on the control charts for slump reach the upper warning limit, an adjustment shall immediately be made in the batch weights of water and fine aggregate. The adjustments are to be made so that the total water content does not exceed that amount allowed by the maximum w/c ratio specified, based on aggregates which are in a saturated surface dry condition. When a single slump reaches the upper or lower action limit, no further concrete shall be delivered to the placing site until proper adjustments have been made. Immediately after each adjustment, another test shall be made to verify the correctness of the adjustment. Whenever two consecutive individual slump tests, made during a period when there was no adjustment of batch weights, produce a point on the control chart for range at or above the upper action limit, the concreting operation shall immediately be halted, and the Contractor shall take appropriate steps to bring the slump under control. Additional slump tests shall be made as directed.

e. Temperature. The temperature of the concrete shall be measured when compressive strength specimens are fabricated. Measurement shall be in accordance with ASTM C 1064. The temperature shall be reported along with the compressive strength data.

f. Strength Specimens. At least one set of test specimens shall be made, for compressive or flexural strength as appropriate, on each different concrete mixture placed during the day for each 500 cubic yards or portion thereof of that concrete mixture placed each day. Additional sets of test specimens shall be made, as directed by the Contracting Officer, when the mixture proportions are changed or when low strengths have been detected. A truly random (not haphazard) sampling plan shall be developed by the Contractor and approved by the Contracting Officer prior to the start of construction. The plan shall assure that sampling is done in a completely random and unbiased manner. A set of test specimens for concrete with a 28-day specified strength per paragraph Strength Requirements in PART 1 shall consist of four specimens, two to be tested at 7 days and two at 28 days. Test specimens shall be molded and cured in accordance with ASTM C 31/C 31M and tested in accordance with ASTM C 39 for test cylinders and ASTM C 78 for test beams. Results of all strength tests shall be reported immediately to the Contracting Officer. Quality control charts shall be kept for individual strength "tests", ("test" as defined in paragraph Strength Requirements in PART 1) moving average of last 3 "tests" for strength, and moving average for range for the last 3 "tests" for each mixture. The charts shall be similar to those found in ACI 214.3R.

3.18.5 Inspection Before Placing

Foundations, construction joints, forms, and embedded items shall be inspected by the Contractor in sufficient time prior to each concrete placement in order to certify to the Contracting Officer that they are ready to receive concrete. The results of each inspection shall be reported in writing.

3.18.6 Placing

The placing foreman shall supervise placing operations, shall determine that the correct quality of concrete or grout is placed in each location as specified and as directed by the Contracting Officer, and shall be responsible for measuring and recording concrete temperatures and ambient temperature hourly during placing operations, weather conditions, time of placement, volume placed, and method of placement. The placing foreman shall not permit batching and placing to begin until it has been verified that an adequate number of vibrators in working order and with competent operators are available. Placing shall not be continued if any pile of concrete is inadequately consolidated. If any batch of concrete fails to meet the temperature requirements, immediate steps shall be taken to improve temperature controls.

3.18.7 Vibrators

The frequency and amplitude of each vibrator shall be determined in accordance with COE CRD-C 521 prior to initial use and at least once a month when concrete is being placed. Additional tests shall be made as directed when a vibrator does not appear to be adequately consolidating the concrete. The frequency shall be determined while the vibrator is operating in concrete with the tachometer being held against the upper end of the vibrator head while almost submerged and just before the vibrator is withdrawn from the concrete. The amplitude shall be determined with the head vibrating in air. Two measurements shall be taken, one near the tip and another near the upper end of the vibrator head, and these results averaged. The make, model, type, and size of the vibrator and frequency and amplitude results shall be reported in writing. Any vibrator not meeting the requirements of paragraph Consolidation, shall be immediately removed from service and repaired or replaced.

3.18.8 Curing Inspection

a. Moist Curing Inspections. At least once each shift, and not less than twice per day on both work and non-work days, an inspection shall be made of all areas subject to moist curing. The surface moisture condition shall be noted and recorded.

b. Moist Curing Corrective Action. When a daily inspection report lists an area of inadequate curing, immediate corrective action shall be taken, and the required curing period for those areas shall be extended by 1 day.

c. Membrane Curing Inspection. No curing compound shall be applied until the Contractor has verified that the compound is properly mixed and ready for spraying. At the end of each operation, the Contractor shall estimate the quantity of compound used by measurement of the container and the area of concrete surface covered, shall compute the rate of coverage in square feet per gallon, and shall note whether or not coverage is uniform.

d. Membrane Curing Corrective Action. When the coverage rate of the curing compound is less than that specified or when the coverage is not uniform, the entire surface shall be sprayed again.

e. Sheet Curing Inspection. At least once each shift and once per day on non-work days, an inspection shall be made of all areas being cured using impervious sheets. The condition of the covering and the tightness of the laps and tapes shall be noted and recorded.

f. Sheet Curing Corrective Action. When a daily inspection report lists any tears, holes, or laps or joints that are not completely closed, the tears and holes shall promptly be repaired or the sheets replaced, the joints closed, and the required curing period for those areas shall be extended by 1 day.

3.18.9 Cold-Weather Protection

At least once each shift and once per day on non-work days, an inspection shall be made of all areas subject to cold-weather protection. Any deficiencies shall be noted, corrected, and reported.

3.18.10 Mixer Uniformity

a. Stationary Mixers. Prior to the start of concrete placing and once every 6 months when concrete is being placed, or once for every 75,000 cubic yards of concrete placed, whichever results in the shortest time interval, uniformity of concrete mixing shall be determined in accordance with ASTM C 94.

b. Truck Mixers. Prior to the start of concrete placing and at least once every 6 months when concrete is being placed, uniformity of concrete mixing shall be determined in accordance with ASTM C 94. The truck mixers shall be selected randomly for testing. When satisfactory performance is found in one truck mixer, the performance of mixers of substantially the same design and condition of the blades may be regarded as satisfactory.

c. Mixer Uniformity Corrective Action. When a mixer fails to meet mixer uniformity requirements, either the mixing time shall be increased, batching sequence changed, batch size reduced, or adjustments shall be made to the mixer until compliance is achieved.

3.18.11 Reports

All results of tests or inspections conducted shall be reported informally as they are completed and in writing daily. A weekly report shall be prepared for the updating of control charts covering the entire period from the start of the construction season through the current week. During periods of cold-weather protection, reports of pertinent temperatures shall be made daily. These requirements do not relieve the Contractor of the obligation to report certain failures immediately as required in preceding paragraphs. Such reports of failures and the action taken shall be confirmed in writing in the routine reports. The Contracting Officer has the right to examine all contractor quality control records.

** End of Section **

SECTION 04200
MASONRY
07/92

1 GENERAL

1.1 REFERENCES

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

ACI INTERNATIONAL (ACI)

ACI SP-66	(1994) ACI Detailing Manual

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 82	(1997a) Steel Wire, Plain, for Concrete Reinforcement
ASTM A 153	(1998) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 615	(1996a) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM C 90	(1998) Loadbearing Concrete Masonry Units
ASTM C 91	(1998) Masonry Cement
ASTM C 140	(1998b) Sampling and Testing Concrete Masonry Units
ASTM C 270	(1997ae1) Mortar for Unit Masonry
ASTM C 476	(1998) Grout for Masonry
ASTM C 494	(1998) Chemical Admixtures for Concrete
ASTM C 578	(1995) Rigid, Cellular Polystyrene Thermal Insulation
ASTM C 1019	(1989a; R 1998) Sampling and Testing Grout
ASTM C 1072	(1998) Measurement of Masonry Flexural Bond Strength
ASTM C 1289	(1998) Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board

ASTM D 2000	(1998c) Rubber Products in Automotive Applications
ASTM D 2240	(1997el) Rubber Property - Durometer Hardness
ASTM D 2287	(1996) Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 00700 GENERAL:

Data

Clay or Shale Brick; GA. Concrete Masonry Units; GA. Insulation; GA.

Manufacturer's descriptive data.

Drawings

Masonry Work; GA.

Drawings including plans, elevations, and details of wall reinforcement; details of reinforcing bars at corners and wall intersections; offsets; tops, bottoms, and ends of walls; control and expansion joints; and wall openings. Bar splice locations shall be shown. Bent bars shall be identified on a bending diagram and shall be referenced and located on the drawings. Wall dimensions, bar clearances, and wall openings greater than one masonry unit in area shall be shown. No approval will be given to the shop drawings until the Contractor certifies that all openings, including those for mechanical and electrical service, are shown. If, during construction, additional masonry openings are required, the approved shop drawings shall be resubmitted with the additional openings shown along with the proposed changes. Location of these additional openings shall be clearly highlighted. The minimum scale for wall elevations shall be 1/4 inch per foot. Reinforcement bending details shall conform to the requirements of ACI SP-66.

Statements

Cold Weather Installation; GA.

Cold weather construction procedures/instructions.

Reports

Efflorescence Test; FIO. Field Testing of Mortar; FIO. Field Testing of Grout; FIO. Masonry Cement; FIO.

Test reports from an approved independent laboratory. Test reports on a previously tested material shall be certified as the same as that proposed for use in this project.

Certificates

Clay or Shale Brick; FI0. Concrete Masonry Units (CMU); FIO. Anchors, Ties, and Bar Positioners; FIO. Joint Reinforcement; FIO. Reinforcing Steel Bars and Rods; FIO. Masonry Cement; FIO. Insulation; FIO.

Certificates of compliance stating that the materials meet the specified requirements.

Insulation; FIO.

Certificate attesting that the polyurethane or polyisocyanurate insulation furnished for the project contains recovered material, and showing an estimated percent of such recovered material.

Samples

Anchors, Ties, and Bar Positioners; GA.

Two of each type used.

Joint Reinforcement; GA.

One piece of each type used, including corner and wall intersection pieces, showing at least two cross wires.

Portable Panel; GA.

One panel of clay or shale brick, 2 feet by 2 feet, containing approximately 24 brick facings to establish range of color and texture.

1.3 SAMPLE MASONRY PANELS

After material samples are approved and prior to starting masonry work, sample masonry panel shall be constructed. At least 48 hours prior to constructing the sample panel, the Contractor shall submit written notification to the Contracting Officer's Representative. Sample panel shall be built in, or as part of the structure, as directed.

1.3.1 Configuration

Panel shall be L-shaped or otherwise configured to represent all of the wall elements. Panel shall be of the size necessary to demonstrate the acceptable level of workmanship for each

type of masonry represented on the project. The minimum size of a straight panel or a leg of an L-shaped panel shall be 8 feet long by 4 feet high.

1.3.2 Composition

Panel shall show full color range, texture, and bond pattern of the masonry work. The Contractor's method for mortar joint tooling; grouting of reinforced vertical cores, and bond beams; positioning, securing, and lapping of reinforcing steel; positioning and lapping of joint reinforcement; and cleaning of masonry work shall be demonstrated during the construction of the panel. Installation or application procedures for anchors, wall ties, insulation, flashing, and weep holes shall be shown in the sample panel. The panel shall contain a masonry bonded corner that includes a bond beam corner. Required reinforcing shall be provided at wall corners.

1.3.3 Construction Method

Where anchored veneer walls are required, the Contractor shall demonstrate and receive approval for the method of construction; i.e., either bring up the two wythes together or separately, with the insulation and appropriate ties placed within the specified tolerances across the cavity. Temporary provisions shall be demonstrated to preclude mortar or grout droppings in the cavity and to provide a clear open air space of the dimensions shown on the drawings. Where masonry is to be grouted, the Contractor shall demonstrate and receive approval on the method that will be used to bring up the masonry wythes; support the reinforcing bars; and grout cells and bond beams using the requirements specified herein.

1.3.4 Usage

The completed panel shall be used as the standard of workmanship for the type of masonry represented. Masonry work shall not commence until the sample panel has been completed and approved. Panels shall be protected from the weather until the masonry work has been completed and approved.

1.4 DELIVERY, HANDLING, AND STORAGE

Materials shall be delivered, handled, stored, and protected to avoid chipping, breakage, and contact with soil or contaminating material.

1.4.1 Masonry Units

Concrete masonry units shall be covered or protected from inclement weather and shall conform to the moisture content as specified in ASTM C 90 when delivered to the job site.

1.4.2 Reinforcement, Anchors, and Ties

Steel reinforcing bars, coated anchors, ties, and joint reinforcement shall be stored above the ground. Steel reinforcing bars and uncoated ties shall be free of loose mill scale and rust.

1.4.3 Cementitious Materials, Sand and Aggregates

Cementitious and other packaged materials shall be delivered in unopened containers, plainly marked and labeled with manufacturers' names and brands. Cementitious material shall be stored in dry, weathertight enclosures or be completely covered. Cement shall be handled in a manner that will prevent the inclusion of foreign materials and damage by water or dampness. Sand and aggregates shall be stored in a manner to prevent contamination or segregation.

2 PRODUCTS

2.1 GENERAL REQUIREMENTS

The source of materials which will affect the appearance of the finished work shall not be changed after the work has started except with Contracting Officer's approval.

2.2 CLAY OR SHALE BRICK

Color range and texture of clay or shale brick shall conform to the approved sample. Grade SW shall be used for all exterior work. Clay or shale brick units shall be delivered factory-blended to provide a uniform appearance and color range in the completed wall. Brick shall be Acme “Dyess Blended Velour Modular Mingle” or approved equal. Brick shall conform to ASTM C 216, Type FBS. Brick size shall be modular and the nominal size of the brick used shall be 2-1/4 inches by 3-5/8 inches by 7-5/8 inches.

2.3 CONCRETE MASONRY UNITS (CMU)

Hollow and solid concrete masonry units shall conform to ASTM C 90, Type I, lightweight. Cement shall have a low alkali content and be of one brand.

2.3.1 Kinds and Shapes

Units shall be modular in size and shall include closer, jamb, header, lintel, and bond beam units and special shapes and sizes to complete the work as indicated. Units used in exposed masonry surfaces in any one building shall have a uniform fine to medium texture and a uniform color.

2.4 MORTAR

Mortar shall be Type S in accordance with the proportion specification of ASTM C 270 except Type S cement-lime mortar proportions shall be 1 part cement, 1/2 part lime and 4-1/2 parts aggregate; when masonry cement ASTM C 91 is used the maximum air content shall be limited to 12 percent and performance equal to cement-lime mortar shall be verified. Verification of masonry cement performance shall be based on ASTM C 780 and ASTM C

1072. Cement shall have a low alkali content and be of one brand. Aggregates shall be from one source.

2.4.1 Admixtures

In cold weather, a non-chloride based accelerating admixture may be used subject to approval. Accelerating admixture shall be non-corrosive, shall contain less than 0.2 percent chlorides, and shall conform to ASTM C 494, Type C.

2.5 GROUT

Grout shall conform to ASTM C 476. Cement used in grout shall have a low alkali content. Grout slump shall be between 8 and 10 inches. Grout shall be used subject to the limitations of Table III. Proportions shall not be changed and materials with different physical or chemical characteristics shall not be used in grout for the work unless additional evidence is furnished that the grout meets the specified requirements.

2.5.1 Admixtures

In cold weather, a non-chloride based accelerating admixture may be used subject to approval. Accelerating admixture shall be non-corrosive, shall contain less than 0.2 percent chlorides, and shall conform to ASTM C 494, Type C.

2.5.2 Grout Barriers

Grout barriers for vertical cores shall consist of fine mesh wire, fiberglass, or expanded metal.

2.6 ANCHORS, TIES, AND BAR POSITIONERS

Anchors and ties shall be fabricated without drips or crimps and shall be zinc-coated in accordance with ASTM A 153/A 153M, Class B-2. Steel wire used for anchors and ties shall be fabricated from steel wire conforming to ASTM A 82. Anchors and ties shall be sized to provide a minimum of 5/8 inch mortar cover from either face.

2.6.1 Wall Ties

Wall ties shall be rectangular-shaped or Z-shaped fabricated of 3/16 inch diameter zinc-coated steel wire. Rectangular wall ties shall be no less than 4 inches wide. Wall ties may also be of a continuous type conforming to paragraph JOINT REINFORCEMENT. Adjustable type wall ties, if approved for use, shall consist of two essentially U-shaped elements fabricated of 3/16 inch diameter zinc-coated steel wire. Adjustable ties shall be of the double pintle to eye type and shall allow a maximum of 1/2 inch eccentricity between each element of the tie. Play between pintle and eye opening shall be not more than 1/16 inch. The pintle and eye elements shall be formed so that both can be in the same plane.

2.6.2 Bar Positioners

Bar positioners, used to prevent displacement of reinforcing bars during the course of construction, shall be factory fabricated from 9 gauge steel wire or equivalent, and coated with a hot-dip galvanized finish. Not more than one wire shall cross the cell.

2.7 JOINT REINFORCEMENT

Joint reinforcement shall be factory fabricated from steel wire conforming to ASTM A 82, welded construction. Tack welding will not be acceptable in reinforcement used for wall ties. Wire shall have zinc coating conforming to ASTM A 153/A 153M, Class B-2. All wires shall be a minimum of 9 gauge. Reinforcement shall be ladder type design, having one longitudinal wire in the mortar bed of each face shell for hollow units. Joint reinforcement shall be placed a minimum of 5/8 inch cover from either face. The distance between crosswires shall not exceed 16 inches. Joint reinforcement for straight runs shall be furnished in flat sections not less than 10 feet long. Joint reinforcement shall be provided with factory formed corners and intersections. If approved for use, joint reinforcement may be furnished with adjustable wall tie features.

2.8 REINFORCING STEEL BARS AND RODS

Reinforcing steel bars and rods shall conform to ASTM A 615/A 615M, Grade 60.

2.9 EXPANSION-JOINT MATERIALS

Backer rod and sealant shall be adequate to accommodate joint compression equal to 50 percent of the width of the joint. The backer rod shall be compressible rod stock of polyethylene foam, polyurethane foam, butyl rubber foam, or other flexible, nonabsorptive material as recommended by the sealant manufacturer. Sealant shall conform to Section 07900 JOINT SEALING.

2.10 INSULATION

2.10.1 Rigid Board-Type Insulation

Rigid board-type insulation shall be extruded polystyrene, polyurethane, or polyisocyanurate. Polystyrene shall conform to ASTM C 578. Polyurethane or polyisocyanurate shall conform to ASTM C 1289, Type I, Class 2, faced with aluminum foil on both sides of the foam. The insulation shall be a standard product and shall be marked with not less than the manufacturer's trademark or name, the specification number, the permeance and R-values.

2.10.1.1 Insulation Thickness and Air Space

The cavity space shall allow for a maximum insulation thickness of 2 inches, and a minimum air space of 3/4 inch.

2.10.1.2 Aged R-Value

The insulation shall provide a minimum aged R-value of 11 for the overall thickness. The aged R-value shall be determined at 75 degrees F in accordance with the appropriate referenced specification. The stated R-value of the insulation shall be certified by an independent testing laboratory or certified by an independent Registered Professional Engineer if tests are conducted in the manufacturer's laboratory.

2.10.1.3 Recovered Material

Insulation shall contain the highest practicable percentage of recovered material derived from solid waste (but material reused in the manufacturing process cannot be counted toward the percentage of recovered material). Where two materials have the same price and performance, the one containing the higher recovered material content shall be provided. The polyurethane or polyisocyanurate foam shall have a minimum recovered material content of 9 percent by weight of the core material.

2.10.2 Insulation Adhesive

Insulation adhesive shall be specifically prepared to adhere the insulation to the masonry and, where applicable, to the thru-wall flashing. The adhesive shall not deleteriously affect the insulation, and shall have a record of satisfactory and proven performance for the conditions under which to be used.

2.11 FLASHING

Through-wall flashing shall be minimum 0.040 inch thick synthetic rubber membrane. Width shall be as indicated. Acceptable product is Carlisle Pre-kleened EPDM Thru-Wall flashing.

2.12 WEEP HOLE VENTILATORS

Weephole ventilators shall be prefabricated aluminum grill type vents designed to prevent insect entry with maximum air entry. Ventilators shall be sized to match modular construction with a standard 3/8 inch mortar joint.

3 EXECUTION

3.1 ENVIRONMENTAL REQUIREMENTS

3.1.1 Hot Weather Installation

The following precautions shall be taken if masonry is erected when the ambient air temperature is more than 99 degrees F in the shade and the relative humidity is less than 50 percent. All masonry materials shall be shaded from direct sunlight; mortar beds shall be spread no more than 4 feet ahead of masonry. Masonry units shall be set within one minute of

spreading mortar. After erection, masonry shall be protected from direct exposure to wind and sun for 48 hours.

3.1.2 Cold Weather Installation

Before erecting masonry when ambient temperature or mean daily air temperature falls below 40 degrees F, a written statement of proposed cold weather construction procedures shall be submitted for approval. The following precautions shall be taken during all cold weather erection.

3.1.2.1 Preparation

Ice or snow formed on the masonry bed shall be thawed by the application of heat. Heat shall be applied carefully until the top surface of the masonry is dry to the touch. Sections of masonry deemed frozen and damaged shall be removed before continuing construction of those sections.

a. Air Temperature 40 to 32 Degrees F. Sand or mixing water shall be heated to produce mortar temperatures between 40 degrees F and 120 degrees F.

b. Air Temperature 32 to 25 Degrees F. Sand and mixing water shall be heated to produce mortar temperatures between 40 degrees F and 120 degrees F. Temperature of mortar on boards shall be maintained above freezing.

c. Air Temperature 25 to 20 Degrees F. Sand and mixing water shall be heated to provide mortar temperatures between 40 degrees F and 120 degrees F. Temperature of mortar on boards shall be maintained above freezing. Sources of heat shall be used on both sides of walls under construction. Windbreaks shall be employed when wind is in excess of 15 mph.

d. Air Temperature 20 Degrees F and below. Sand and mixing water shall be heated to provide mortar temperatures between 40 degrees F and 120 degrees F. Enclosure and auxiliary heat shall be provided to maintain air temperature above 32 degrees F. Temperature of units when laid shall not be less than 20 degrees F.

3.1.2.2 Completed Masonry and Masonry Not Being Worked On

a. Mean daily air temperature 40 degrees F to 32 degrees F. Masonry shall be protected from rain or snow for 24 hours by covering with weather-resistive membrane.

b. Mean daily air temperature 32 degrees F to 25 degrees F. Masonry shall be completely covered with weather-resistant membrane for 24 hours.

c. Mean Daily Air Temperature 25 Degrees F to 20 Degrees F. Masonry shall be completely covered with insulating blankets or equally protected for 24 hours.

d. Mean Daily Temperature 20 Degrees F and below. Masonry temperature shall be maintained above 32 degrees F for 24 hours by enclosure and supplementary heat, by electric heating blankets, infrared heat lamps, or other approved methods.

3.2 LAYING MASONRY UNITS

Masonry units shall be laid in running bond pattern. Facing courses shall be level with back-up courses, unless the use of adjustable ties has been approved in which case the tolerances shall be plus or minus 1/2 inch. Each unit shall be adjusted to its final position while mortar is still soft and plastic. Units that have been disturbed after the mortar has stiffened shall be removed, cleaned, and relaid with fresh mortar. Air spaces, cavities, chases, expansion joints, and spaces to be grouted shall be kept free from mortar and other debris. Units used in exposed masonry surfaces shall be selected from those having the least amount of chipped edges or other imperfections detracting from the appearance of the finished work. Vertical joints shall be kept plumb. Units being laid and surfaces to receive units shall be free of water film and frost. Mortar for veneer wythes shall be beveled and sloped toward the center of the wythe from the cavity side. Units shall be shoved into place so that the vertical joints are tight. Vertical joints of brick and the vertical face shells of concrete masonry units, except where indicated at control, expansion, and isolation joints, shall be completely filled with mortar. Mortar will be permitted to protrude up to 1/2 inch into the space or cells to be grouted. Means shall be provided to prevent mortar from dropping into the space below. In double wythe construction, the inner wythe may be brought up not more than 16 inches ahead of the outer wythe. Collar joints shall be filled with mortar or grout during the laying of the facing wythe, and filling shall not lag the laying of the facing wythe by more than 8 inches.

3.2.1 Surface Preparation

Surfaces upon which masonry is placed shall be cleaned of laitance, dust, dirt, oil, organic matter, or other foreign materials and shall be slightly roughened to provide a surface texture with a depth of at least 1/8 inch. Sandblasting shall be used, if necessary, to remove laitance from pores and to expose the aggregate.

3.2.2 Forms and Shores

Forms and shores shall be sufficiently rigid to prevent deflections which may result in cracking or other damage to supported masonry and sufficiently tight to prevent leakage of mortar and grout. Supporting forms and shores shall not be removed in less than 10 days.

3.2.3 Concrete Masonry Units

Units in starting courses on footings, lintels, bond beams, and where cells are to be filled with grout shall be full bedded in mortar under both face shells and webs. Other units shall be full bedded under both face shells. Head joints shall be filled solidly with mortar for a distance in from the face of the unit not less than the thickness of the face shell. Jamb units shall be of the shapes and sizes to conform with wall units. Solid units may be incorporated in the masonry work where necessary to fill out at corners and elsewhere as approved. Double walls shall be

stiffened at wall-mounted fixtures by use of strap anchors, two above each fixture and two below each fixture, located to avoid pipe runs, and extending from center to center of the double wall. Walls and partitions shall be adequately reinforced for support of wall-hung equipment when carriers are not specified.

3.2.4 Clay or Shale Brick Units

Brick facing shall be laid with the better face exposed. Brick shall be laid in running bond with each course bonded at corners, unless otherwise indicated.

3.2.4.1 Wetting of Units

Wetting of clay, shale brick, or hollow brick units having an initial rate of absorption of more than 1 gram per minute per square inch of bed surface shall be in conformance with ASTM C 67. The method of wetting shall ensure that each unit is nearly saturated but surface dry when laid.

3.2.4.2 Hollow Units

Hollow units shall be laid as specified for concrete masonry units.

3.2.5 Tolerances

Masonry shall be laid plumb, true to line, with courses level. Bond pattern shall be kept plumb throughout. Corners shall be square unless noted otherwise. Masonry shall be laid within the following tolerances (plus or minus unless otherwise noted):

TABLE II
TOLERANCES

Variation from the plumb in the lines and surfaces of walls	
In adjacent masonry units	1/8 inch
In 10 feet	1/4 inch
In 20 feet	3/8 inch
In 40 feet or more	1/2 inch

Variations from the plumb for external corners, expansion joints, and other conspicuous lines	
In 20 feet	1/4 inch
In 40 feet or more	1/2 inch

Variations from the level for exposed lintels, and other conspicuous lines	
In 20 feet	1/4 inch
In 40 feet or more	1/2 inch

Variation from level for bed joints and top surfaces of bearing walls	
In 10 feet	1/4 inch
In 40 feet or more	1/2 inch

Variations from horizontal lines	
In 10 feet	1/4 inch
In 20 feet	3/8 inch
In 40 feet or more	1/2 inch

Variations in cross sectional dimensions in thickness of walls	
Minus	1/4 inch
Plus	1/2 inch

3.2.6 Cutting and Fitting

Full units of the proper size shall be used wherever possible, in lieu of cut units. Cutting and fitting, including that required to accommodate the work of others, shall be done by masonry mechanics using power masonry saws. Concrete masonry units may be wet or dry cut. Wet cut units, before being placed in the work, shall be dried to the same surface-dry appearance as uncut units being laid in the wall. Cut edges shall be clean, true and sharp. Openings in the masonry shall be made carefully so that wall plates, cover plates or escutcheons required by the installation will completely conceal the openings and will have bottoms parallel with the masonry bed joints. Reinforced masonry lintels shall be provided above openings over 12 inches wide for pipes, ducts, cable trays, and other wall penetrations, unless steel sleeves are used.

3.2.7 Jointing

Joints shall be tooled when the mortar is thumbprint hard. Horizontal joints shall be tooled last. Joints shall be brushed to remove all loose and excess mortar. Mortar joints shall be finished as follows:

3.2.7.1 Flush Joints

Joints in concealed masonry surfaces and joints at electrical outlet boxes in wet areas shall be flush cut. Flush cut joints shall be made by cutting off the mortar flush with the face of the wall.

3.2.7.2 Tooled Joints

Joints in exposed exterior and interior masonry surfaces shall be tooled slightly concave. Joints shall be tooled with a jointer slightly larger than the joint width so that complete contact is made along the edges of the unit. Tooling shall be performed so that the mortar is compressed and the joint surface is sealed. Jointer of sufficient length shall be used to obtain a straight and true mortar joint.

3.2.7.3 Door Frame Joints

On the exposed interior side of exterior frames, joints between frames and abutting masonry walls shall be raked to a depth of 3/8 inch. On the exterior side of exterior frames, joints between frames and abutting masonry walls shall be raked to a depth of 3/8 inch.

3.2.8 Joint Widths

Joint widths shall be as follows:

3.2.8.1 Concrete Masonry Units

Concrete masonry units shall have 3/8 inch joints.

3.2.8.2 Brick

Brick joint widths shall be the difference between the actual and nominal dimensions of the brick in either height or length.

3.2.9 Embedded Items

Spaces around built-in items shall be filled with mortar. Openings around flush-mount electrical outlet boxes in wet locations shall be pointed with mortar. Anchors, ties, wall plugs, accessories, flashing, pipe sleeves and other items required to be built-in shall be embedded as the masonry work progresses. Anchors, ties and joint reinforcement shall be fully embedded in the mortar. Cells receiving anchor bolts and cells of the first course below bearing plates shall be filled with grout.

3.2.10 Unfinished Work

Unfinished work shall be stepped back for joining with new work. Toothing may be resorted to only when specifically approved. Loose mortar shall be removed and the exposed joints shall be thoroughly cleaned before laying new work.

3.2.11 Masonry Wall Intersections

Each course shall be masonry bonded at corners and elsewhere as shown. Masonry walls shall be anchored or tied together at corners and intersections with bond beam reinforcement and prefabricated corner or tee pieces of joint reinforcement as shown.

3.3 ANCHORED VENEER CONSTRUCTION

The inner and outer wythes shall be completely separated by a continuous airspace as shown on the drawings. Both the inner and the outer wythes shall be laid up together except when adjustable joint reinforcement assemblies are approved for use. When both wythes are not brought up together, through-wall flashings shall be protected from damage until they are fully enclosed in the wall. The airspace between the wythes shall be kept clear and free of mortar droppings by temporary wood strips laid on the wall ties and carefully lifted out before placing the next row of ties. A coarse gravel or drainage material shall be placed behind the weep holes in the cavity to a minimum depth of 4 inches of coarse aggregate or 10 inches of drainage material to keep mortar droppings from plugging the weep holes.

3.4 WEEP HOLES

Weep holes shall be provided not more than 24 inches on centers in mortar joints of the exterior wythe above wall flashing, over foundations, bond beams, and any other horizontal interruptions of the cavity. Weep holes shall be constructed using weep hole ventilators. Other approved methods may be used for providing weep holes. Weep holes shall be kept free of mortar and other obstructions.

3.5 COMPOSITE WALLS

Masonry wythes shall be tied together with joint reinforcement or with unit wall ties. The facing wythe shall be anchored or tied to the backup at a maximum spacing of 16 inches on center vertically and 24 inches on center horizontally. Unit ties shall be spaced not over 24 inches on centers horizontally, in courses not over 16 inches apart vertically, staggered in alternate courses. Ties shall be laid not closer than 5/8 inch to either masonry face.

3.6 MORTAR

Mortar shall be mixed in a mechanically operated mortar mixer for at least 3 minutes, but not more than 5 minutes. Measurement of ingredients for mortar shall be by volume. Ingredients not in containers, such as sand, shall be accurately measured by the use of measuring boxes. Water shall be mixed with the dry ingredients in sufficient amount to provide a workable

mixture that will adhere to the vertical surfaces of masonry units. Mortar that has stiffened because of loss of water through evaporation shall be retempered by adding water to restore the proper consistency and workability. Mortar that has reached its initial set or that has not been used within 2-1/2 hours after mixing shall be discarded.

3.7 REINFORCING STEEL

Reinforcement shall be cleaned of loose, flaky rust, scale, grease, mortar, grout, or other coating which might destroy or reduce its bond prior to placing grout. Bars with kinks or bends not shown on the drawings shall not be used. Reinforcement shall be placed prior to grouting. Unless otherwise indicated, vertical wall reinforcement shall extend to within 2 inches of tops of walls.

3.7.1 Positioning Bars

Vertical bars shall be accurately placed within the cells at the positions indicated on the drawings. A minimum clearance of 1/2 inch shall be maintained between the bars and masonry units. Minimum clearance between parallel bars shall be one diameter of the reinforcement. Vertical reinforcing may be held in place using bar positioners located near the ends of each bar and at intermediate intervals of not more than 192 diameters of the reinforcement.

3.7.2 Splices

Bars shall be lapped a minimum of 48 diameters of the reinforcement. Welded or mechanical connections shall develop at least 125 percent of the specified yield strength of the reinforcement.

3.8 JOINT REINFORCEMENT

Joint reinforcement shall be installed at 16 inches on center or as indicated. Reinforcement shall be lapped not less than 6 inches. Prefabricated sections shall be installed at corners and wall intersections. The longitudinal wires of joint reinforcement shall be placed to provide not less than 5/8 inch cover to either face of the unit.

3.9 PLACING GROUT

Cells containing reinforcing bars shall be filled with grout. Hollow masonry units in walls or partitions supporting plumbing, heating, or other mechanical fixtures, voids at door and window jambs, and other indicated spaces shall be filled solid with grout. Cells under lintel bearings on each side of openings shall be filled solid with grout for full height of openings. Walls below grade, lintels, and bond beams shall be filled solid with grout. Units other than open end units may require grouting each course to preclude voids in the units. Grout not in place within 1-1/2 hours after water is first added to the batch shall be discarded. Sufficient time shall be allowed between grout lifts to preclude displacement or cracking of face shells of

masonry units. If blowouts, flowouts, misalignment, or cracking of face shells should occur during construction, the wall shall be torn down and rebuilt.

3.9.1 Vertical Grout Barriers for Fully Grouted Walls

Grout barriers shall be provided as required to limit the horizontal flow of grout for each pour.

3.9.2 Horizontal Grout Barriers

Grout barriers shall be embedded in mortar below cells of hollow units receiving grout.

3.9.3 Grout Holes and Cleanouts

3.9.3.1 Grout Holes

Grouting holes shall be provided in in-place overhead construction. Holes shall be located over vertical reinforcing bars or as required to facilitate grout fill in bond beams. Additional openings spaced not more than 16 inches on centers shall be provided where grouting of all hollow unit masonry is indicated. Openings shall not be less than 4 inches in diameter or 3 by 4 inches in horizontal dimensions. Upon completion of grouting operations, grouting holes shall be plugged and finished to match surrounding surfaces.

3.9.3.2 Cleanouts for Hollow Unit Masonry Construction

Cleanout holes shall be provided at the bottom of every pour in cores containing vertical reinforcement when the height of the grout pour exceeds 5 feet. Where all cells are to be grouted, cleanout courses shall be constructed using bond beam units in an inverted position to permit cleaning of all cells. Cleanout holes shall be provided at a maximum spacing of 32 inches where all cells are to be filled with grout. A new series of cleanouts shall be established if grouting operations are stopped for more than 4 hours. Cleanouts shall not be less than 3 by 4 inch openings cut from one face shell. Manufacturer's standard cutout units may be used at the Contractor's option. Cleanout holes shall not be closed until masonry work, reinforcement, and final cleaning of the grout spaces have been completed and inspected. For walls that will be exposed to view, cleanout holes shall be closed in an approved manner to match surrounding masonry.

3.9.4 Grouting Equipment

3.9.4.1 Grout Pumps

Pumping through aluminum tubes will not be permitted. Pumps shall be operated to produce a continuous stream of grout without air pockets, segregation, or contamination. Upon completion of each day's pumping, waste materials and debris shall be removed from the equipment, and disposed of outside the masonry.

3.9.4.2 Vibrators

Internal vibrators shall maintain a speed of not less than 5,000 impulses per minute when submerged in the grout. At least one spare vibrator shall be maintained at the site at all times. Vibrators shall be applied at uniformly spaced points not further apart than the visible effectiveness of the machine. Duration of vibration shall be limited to time necessary to produce satisfactory consolidation without causing segregation.

3.9.5 Grout Placement

Masonry shall be laid to the top of a pour before placing grout. Grout shall not be placed in two-wythe solid unit masonry cavity until mortar joints have set for at least 3 days during hot weather and 5 days during cold damp weather. Grout shall not be placed in hollow unit masonry until mortar joints have set for at least 24 hours. Grout shall be placed using a hand bucket, concrete hopper, or grout pump to completely fill the grout spaces without segregation of the aggregates. Vibrators shall not be inserted into lower pours that are in a semi-solidified state. The height of grout pours and type of grout used shall be limited by the dimensions of grout spaces as indicated in Table III. Low-lift grout methods may be used on pours up to and including 5 feet in height. High-lift grout methods shall be used on pours exceeding 5 feet in height.

3.9.5.1 Low-Lift Method

Grout shall be placed at a rate that will not cause displacement of the masonry due to hydrostatic pressure of the grout. Mortar protruding more than 1/2 inch into the grout space shall be removed before beginning the grouting operation. Grout pours 12 inches or less in height shall be consolidated by mechanical vibration or by puddling. Grout pours over 12 inches in height shall be consolidated by mechanical vibration and reconsolidated by mechanical vibration after initial water loss and settlement has occurred. Vibrators shall not be inserted into lower pours that are in a semi-solidified state. Low-lift grout shall be used subject to the limitations of Table III.

3.9.5.2 High-Lift Method

Mortar droppings shall be cleaned from the bottom of the grout space and from reinforcing steel. Mortar protruding more than 1/4 inch into the grout space shall be removed by dislodging the projections with a rod or stick as the work progresses. Reinforcing, bolts, and embedded connections shall be rigidly held in position before grouting is started. CMU units shall not be pre-wetted. Grout, from the mixer to the point of deposit in the grout space, shall be placed as rapidly as practical by pumping and placing methods which will prevent segregation of the mix and cause a minimum of grout splatter on reinforcing and masonry surfaces not being immediately encased in the grout lift. The individual lifts of grout shall be limited to 4 feet in height. The first lift of grout shall be placed to a uniform height within the pour section and vibrated thoroughly to fill all voids. This first vibration shall follow immediately behind the pouring of the grout using an approved mechanical vibrator. After a waiting period sufficient to permit the grout to become plastic, but before it has taken any set,

the succeeding lift shall be poured and vibrated 12 to 18 inches into the preceding lift. If the placing of the succeeding lift is going to be delayed beyond the period of workability of the preceding, each lift shall be reconsolidated by reworking with a second vibrator as soon as the grout has taken its settlement shrinkage. The waiting, pouring, and reconsolidation steps shall be repeated until the top of the pour is reached. The top lift shall be reconsolidated after the required waiting period. The high-lift grouting of any section of wall between vertical grout barriers shall be completed to the top of a pour in one working day unless a new series of cleanout holes is established and the resulting horizontal construction joint cleaned. High-lift grout shall be used subject to the limitations in Table III.

TABLE III

POUR HEIGHT AND TYPE OF GROUT FOR VARIOUS GROUT SPACE DIMENSIONS

Maximum Grout Pour Height (feet) (4)	Grout Type	Grouting Procedure	Minimum Dimensions of the Total Clear Areas Within Grout Spaces and Cells (in.) (1,2)	
			Multiwythe Masonry (3)	Hollow-unit Masonry
1	Fine	Low Lift	3/4	1-1/2 x 2
5	Fine	Low Lift	2	2 x 3
8	Fine	High Lift	2	2 x 3
12	Fine	High Lift	2-1/2	2-1/2 x 3
24	Fine	High Lift	3	3 x 3
1	Coarse	Low Lift	1-1/2	1-1/2 x 3
5	Coarse	Low Lift	2	2-1/2 x 3
8	Coarse	High Lift	2	3 x 3
12	Coarse	High Lift	2-1/2	3 x 3
24	Coarse	High Lift	3	3 x 4

Notes:

(1) The actual grout space or cell dimension must be larger than the sum of the following items:

a) The required minimum dimensions of total clear areas given in the table above;
b) The width of any mortar projections within the space;
c) The horizontal projections of the diameters of the horizontal reinforcing bars within a cross section of the grout space or cell.

(2) The minimum dimensions of the total clear areas shall be made up of one or more open areas, with at least one area being 3/4 inch or greater in width.

(3) For grouting spaces between masonry wythes.

(4) Where only cells of hollow masonry units containing reinforcement are grouted, the maximum height of the pour shall not exceed the distance between horizontal bond beams.

3.10 BOND BEAMS

Bond beams shall be filled with grout and reinforced as indicated on the drawings. Grout barriers shall be installed under bond beam units to retain the grout as required. Reinforcement shall be continuous, including around corners, except through control joints or expansion joints, unless otherwise indicated on the drawings. Where splices are required for continuity, reinforcement shall be lapped 48 bar diameters. A minimum clearance of 1/2 inch shall be maintained between reinforcement and interior faces of units.

3.11 LINTELS

3.11.1 Masonry Lintels

Masonry lintels shall be constructed with lintel units filled solid with grout in all courses and reinforced with a minimum of two No. 4 bars in the bottom course unless otherwise indicated on the drawings. Lintel reinforcement shall extend beyond each side of masonry opening 40 bar diameters or 24 inches, whichever is greater. Reinforcing bars shall be supported in place prior to grouting and shall be located 1/2 inch above the bottom inside surface of the lintel unit.

3.12 INSULATION

Anchored veneer walls shall be insulated, where shown, by installing board-type insulation on the cavity side of the inner wythe. Board type insulation shall be applied directly to the masonry or thru-wall flashing with adhesive. Insulation shall be neatly fitted between obstructions without impaling of insulation on ties or anchors. The insulation shall be applied in parallel courses with vertical joints breaking midway over the course below and shall be applied in moderate contact with adjoining units without forcing, and shall be cut to fit neatly against adjoining surfaces.

3.13 POINTING AND CLEANING

After mortar joints have attained their initial set, but prior to hardening, mortar and grout daubs or splashings shall be completely removed from masonry-unit surfaces that will be exposed or painted. Before completion of the work, defects in joints of masonry to be exposed or painted shall be raked out as necessary, filled with mortar, and tooled to match existing joints. Immediately after grout work is completed, scum and stains which have percolated through the masonry work shall be removed using a high pressure stream of water and a stiff bristled brush. Masonry surfaces shall not be cleaned, other than removing excess surface mortar, until mortar in joints has hardened. Masonry surfaces shall be left clean, free of mortar daubs, dirt, stain, and discoloration, including scum from cleaning operations, and with tight mortar joints throughout. Metal tools and metal brushes shall not be used for cleaning.

3.13.1 Concrete Masonry Unit Surfaces

Exposed concrete masonry unit surfaces shall be dry-brushed at the end of each day's work and after any required pointing, using stiff-fiber bristled brushes.

3.13.2 Clay or Shale Brick Surfaces

Exposed clay or shale brick masonry surfaces shall be cleaned as necessary to obtain surfaces free of stain, dirt, mortar and grout daubs, efflorescence, and discoloration or scum from cleaning operations. After cleaning, the sample panel of similar material shall be examined for discoloration or stain as a result of cleaning. If the sample panel is discolored or stained, the method of cleaning shall be changed to assure that the masonry surfaces in the structure will not be adversely affected. The exposed masonry surfaces shall be water-soaked and then cleaned with a solution proportioned 1/2 cup trisodium phosphate and 1/2 cup laundry detergent to one gallon of water or cleaned with a proprietary masonry cleaning agent specifically recommended for the color and texture by the clay products manufacturer. The solution shall be applied with stiff fiber brushes, followed immediately by thorough rinsing with clean water. Proprietary cleaning agents shall be used in conformance with the cleaning product manufacturer's printed recommendations. Efflorescence shall be removed in conformance with the brick manufacturer's recommendations.

3.14 BEARING PLATES

Bearing plates for beams and other structural members shall be set to the proper line and elevation with damp-pack bedding mortar, except where non-shrink grout is indicated. Bedding mortar and non-shrink grout shall be as specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE.

3.15 PROTECTION

Facing materials shall be protected against staining. Top of walls shall be covered with nonstaining waterproof covering or membrane when work is not in progress. Covering of the top of the unfinished walls shall continue until the wall is waterproofed with a complete roof or parapet system. Covering shall extend a minimum of 2 feet down on each side of the wall and shall be held securely in place. Before starting or resuming, top surface of masonry in place shall be cleaned of loose mortar and foreign material.

3.16 TEST REPORTS

3.16.1 Field Testing of Mortar

At least three specimens of mortar shall be taken each day. A layer of mortar 1/2 to 5/8 inch thick shall be spread on the masonry units and allowed to stand for one minute. The specimens shall then be prepared and tested for compressive strength in accordance with ASTM C 780.

3.16.2 Field Testing of Grout

Field sampling and testing of grout shall be in accordance with the applicable provisions of ASTM C 1019. A minimum of three specimens of grout per day shall be sampled and tested. Each specimen shall have a minimum ultimate compressive strength of 2000 psi at 28 days.

** End of Section **

SECTION 05090
WELDING, STRUCTURAL
09/98

1 GENERAL

1.1 REFERENCES

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

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC-04	(1989) Specification for Structural Steel Buildings - Allowable Stress Design, Plastic Design

AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

ASNT-01	(1996) Recommended Practice SNT-TC-1A

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4	(1993) Standard Symbols for Welding, Brazing and Nondestructive Examination
AWS A3.0	(1994) Standard Welding Terms and Definitions
AWS D1.1	(1996) Structural Welding Code - Steel
AWS Z49.1	(1994) Safety in Welding and Cutting and Allied Processes

1.2 DEFINITIONS

Definitions of welding terms shall be in accordance with AWS A3.0.

1.3 GENERAL REQUIREMENTS

The design of welded connections shall conform to AISC-04 unless otherwise indicated or specified. Material with welds will not be accepted unless the welding is specified or indicated on the drawings or otherwise approved. Welding shall be as specified in this section, except where additional requirements are shown on the drawings or are specified in other sections. Welding shall not be started until welding procedures, welders, welding operators, and tackers have been qualified and the submittals approved by the Contracting Officer. Qualification testing shall be performed at or near the work site. Each Contractor performing

welding shall maintain records of the test results obtained in welding procedure, welder, welding operator, and tacker performance qualifications.

1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 00700 GENERAL:

Statements

Welding Procedure Qualifications; GA.

Welder, Welding Operator, and Tacker Qualification; FIO.

Inspector Qualification; FIO.

Copies of the welding procedure specifications; the procedure qualification test records; and the welder, welding operator, or tacker qualification test records.

Records

Quality Control; FIO.

A quality assurance plan and records of tests and inspections.

1.5 WELDING PROCEDURE QUALIFICATIONS

Except for prequalified (per AWS D1.1) and previously qualified procedures, each Contractor performing welding shall record in detail and shall qualify the welding procedure specification for any welding procedure followed in the fabrication of weldments. Qualification of welding procedures shall conform to AWS D1.1 and to the specifications in this section. Copies of the welding procedure specification and the results of the procedure qualification test for each type of welding which requires procedure qualification shall be submitted for approval. Approval of any procedure, however, will not relieve the Contractor of the sole responsibility for producing a finished structure meeting all the requirements of these specifications. This information shall be submitted on the forms in Appendix E of AWS D1.1. Welding procedure specifications shall be individually identified and shall be referenced on the detail drawings and erection drawings, or shall be suitably keyed to the contract drawings. In case of conflict between this specification and AWS D1.1, this specification governs.

1.5.1 Previous Qualifications

Welding procedures previously qualified by test may be accepted for this contract without requalification if the following conditions are met:

a. Testing was performed by an approved testing laboratory, technical consultant, or the Contractor's approved quality control organization.

b. The qualified welding procedure conforms to the requirements of this specification and is applicable to welding conditions encountered under this contract.

c. The welder, welding operator, and tacker qualification tests conform to the requirements of this specification and are applicable to welding conditions encountered under this contract.

1.5.2 Prequalified Procedures

Welding procedures which are considered prequalified as specified in AWS D1.1 will be accepted without further qualification. The Contractor shall submit for approval a listing or an annotated drawing to indicate the joints not prequalified. Procedure qualification shall be required for these joints.

1.5.3 Retests

If welding procedure fails to meet the requirements of AWS D1.1, the procedure specification shall be revised and requalified, or at the Contractor's option, welding procedure may be retested in accordance with AWS D1.1. If the welding procedure is qualified through retesting, all test results, including those of test welds that failed to meet the requirements, shall be submitted with the welding procedure.

1.6 WELDER, WELDING OPERATOR, AND TACKER QUALIFICATION

Each welder, welding operator, and tacker assigned to work on this contract shall be qualified in accordance with the applicable requirements of AWS D1.1 and as specified in this section. Welders, welding operators, and tackers who make acceptable procedure qualification test welds will be considered qualified for the welding procedure used.

1.6.1 Previous Qualifications

At the discretion of the Contracting Officer, welders, welding operators, and tackers qualified by test within the previous 6 months may be accepted for this contract without requalification if all the following conditions are met:

a. Copies of the welding procedure specifications, the procedure qualification test records, and the welder, welding operator, and tacker qualification test records are submitted and approved in accordance with the specified requirements for detail drawings.

b. Testing was performed by an approved testing laboratory, technical consultant, or the Contractor's approved quality control organization.

c. The previously qualified welding procedure conforms to the requirements of this specification and is applicable to welding conditions encountered under this contract.

d. The welder, welding operator, and tacker qualification tests conform to the requirements of this specification and are applicable to welding conditions encountered under this contract.

1.6.2 Certificates

Before assigning any welder, welding operator, or tacker to work under this contract, the Contractor shall submit the names of the welders, welding operators, and tackers to be employed, and certification that each individual is qualified as specified. The certification shall state the type of welding and positions for which the welder, welding operator, or tacker is qualified, the code and procedure under which the individual is qualified, the date qualified, and the name of the firm and person certifying the qualification tests. The certification shall be kept on file, and 3 copies shall be furnished. The certification shall be kept current for the duration of the contract.

1.6.3 Renewal of Qualification

Requalification of a welder or welding operator shall be required under any of the following conditions:

a. It has been more than 6 months since the welder or welding operator has used the specific welding process for which he is qualified.

b. There is specific reason to question the welder or welding operator's ability to make welds that meet the requirements of these specifications.

c. The welder or welding operator was qualified by an employer other than those firms performing work under this contract, and a qualification test has not been taken within the past 12 months. Records showing periods of employment, name of employer where welder, or welding operator, was last employed, and the process for which qualified shall be submitted as evidence of conformance.

d. A tacker who passes the qualification test shall be considered eligible to perform tack welding indefinitely in the positions and with the processes for which he is qualified, unless there is some specific reason to question the tacker's ability. In such a case, the tacker shall be required to pass the prescribed tack welding test.

1.7 INSPECTOR QUALIFICATION

Inspection qualifications shall be in accordance with AWS D1.1. Nondestructive testing personnel shall be qualified in accordance with the requirements of ASNT-01 for Levels I or II in the applicable nondestructive testing method. The inspector may be supported by assistant welding inspectors who are not qualified to ASNT-01, and assistant inspectors may perform specific inspection functions under the supervision of the qualified inspector.

1.8 SYMBOLS

Symbols shall be in accordance with AWS A2.4, unless otherwise indicated.

1.9 SAFETY

Safety precautions during welding shall conform to AWS Z49.1.

2 PRODUCTS

2.1 WELDING EQUIPMENT AND MATERIALS

All welding equipment, electrodes, welding wire, and fluxes shall be capable of producing satisfactory welds when used by a qualified welder or welding operator performing qualified welding procedures. All welding equipment and materials shall comply with the applicable requirements of AWS D1.1.

3 EXECUTION

3.1 WELDING OPERATIONS

3.1.1 Requirements

Workmanship and techniques for welded construction shall conform to the requirements of AWS D1.1 and AISC-04. When AWS D1.1 and the AISC-04 specification conflict, the requirements of AWS D1.1 shall govern.

3.1.2 Identification

Welds shall be identified in one of the following ways:

a. Written records shall be submitted to indicate the location of welds made by each welder, welding operator, or tacker.

b. Each welder, welding operator, or tacker shall be assigned a number, letter, or symbol to identify welds made by that individual. The Contracting Officer may require welders, welding operators, and tackers to apply their symbol next to the weld by means of rubber stamp, felt-tipped marker with waterproof ink, or other methods that do not cause an indentation in the metal. For seam welds, the identification mark shall be adjacent to the weld at 3 foot intervals. Identification with die stamps or electric etchers shall not be allowed.

3.2 QUALITY CONTROL

Testing shall be done by an approved inspection or testing laboratory or technical consultant; or if approved, the Contractor's inspection and testing personnel may be used instead of the

commercial inspection or testing laboratory or technical consultant. The Contractor shall perform visual and radiographic, ultrasonic, magnetic particle, and dye penetrant inspection to determine conformance with paragraph STANDARDS OF ACCEPTANCE. Procedures and techniques for inspection shall be in accordance with applicable requirements of AWS D1.1, except that in radiographic inspection only film types designated as "fine grain," or "extra fine," shall be employed.

3.3 STANDARDS OF ACCEPTANCE

Dimensional tolerances for welded construction, details of welds, and quality of welds shall be in accordance with the applicable requirements of AWS D1.1 and the contract drawings. Nondestructive testing shall be by visual inspection and radiographic, ultrasonic, magnetic particle, or dye penetrant methods. The minimum extent of nondestructive testing shall be random ten percent of welds or joints, at locations selected by the Contracting Officer.

3.3.1 Nondestructive Examination

The welding shall be subject to inspection and tests in the mill, shop, and field. Inspection and tests in the mill or shop will not relieve the Contractor of the responsibility to furnish weldments of satisfactory quality. When materials or workmanship do not conform to the specification requirements, the Government reserves the right to reject material or workmanship or both at any time before final acceptance of the structure containing the weldment.

3.3.2 Destructive Tests

When metallographic specimens are removed from any part of a structure, the Contractor shall make repairs. The Contractor shall employ qualified welders or welding operators, and shall use the proper joints and welding procedures, including peening or heat treatment if required, to develop the full strength of the members and joints cut and to relieve residual stress.

3.4 GOVERNMENT INSPECTION AND TESTING

In addition to the inspection and tests performed by the Contractor for quality control, the Government may perform inspection and testing for acceptance to the extent determined by the Contracting Officer. The costs of such inspection and testing will be borne by the Contractor if unsatisfactory welds are discovered, or by the Government if the welds are satisfactory. The work may be performed by the Government's own forces or under a separate contract for inspection and testing. The Government reserves the right to perform supplemental nondestructive and destructive tests to determine compliance with paragraph STANDARDS OF ACCEPTANCE.

3.5 CORRECTIONS AND REPAIRS

When inspection or testing indicates defects in the weld joints, the welds shall be repaired using a qualified welder or welding operator as applicable. Corrections shall be in accordance

with the requirements of AWS D1.1 and the specifications. Defects shall be repaired in accordance with the approved procedures. Defects discovered between passes shall be repaired before additional weld material is deposited. Wherever a defect is removed and repair by welding is not required, the affected area shall be blended into the surrounding surface to eliminate sharp notches, crevices, or corners. After a defect is thought to have been removed, and before rewelding, the area shall be examined by suitable methods to ensure that the defect has been eliminated. Repair welds shall meet the inspection requirements for the original welds. Any indication of a defect shall be regarded as a defect, unless reevaluation by nondestructive methods or by surface conditioning shows that no unacceptable defect is present.

** End of Section **

SECTION 05120
STRUCTURAL STEEL
09/97

1 GENERAL

1.1 REFERENCES

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

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC ASD Mnl	(1989) Manual of Steel Construction Allowable Stress Design
AISC ASD/LRFD Vol II	(1992) Manual of Steel Construction Vol II: Connections
AISC Design Guide #10	(1989) Erection Bracing of Low-Rise Structural Steel Frames
AISC Pub No. S303	(1992) Code of Standard Practice for Steel Buildings and Bridges

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 6	(1997) General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
ASTM A 36	(1996) Carbon Structural Steel
ASTM A 307	(1994) Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 325	(1997) Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A 500	(1996) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 501	(1996) Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM A 563	(1996) Carbon and Alloy Steel Nuts

ASTM F 844	(1990) Washers, Steel, Plain (Flat), Unhardened for General Use

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B46.1	(1995) Surface Texture (Surface Roughness, Waviness, and Lay)

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4	(1993) Standard Symbols for Welding, Brazing and Nondestructive Examination
AWS D1.1	(1996) Structural Welding Code - Steel

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC Paint 25	(1991) Red Iron Oxide, Zinc Oxide, Raw Linseed Oil and Alkyd Primer (without Lead and Chromate Pigments)

1.2 GENERAL REQUIREMENTS

Structural steel fabrication and erection shall be performed by an organization experienced in structural steel work of equivalent magnitude. The Contractor shall be responsible for correctness of detailing, fabrication, and for the correct fitting of structural members. Connections, for any part of the structure not shown on the contract drawings, shall be considered simple shear connections and shall be designed and detailed in accordance with pertinent provisions of AISC ASD Mnl and AISC LRFD Vol II. Substitution of sections or modification of connection details will not be accepted unless approved by the Contracting Officer. AISC ASD Mnl and AISC ASD/LRFD Vol II shall govern the work. Welding shall be in accordance with AWS D1.1. High-strength bolting shall be in accordance with AISC ASD Mnl.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 00700 GENERAL:

Drawings

Structural Steel System; GA. Structural Connections; GA.

Shop and erection details including members (with their connections) not shown on the contract drawings. Welds shall be indicated by standard welding symbols in accordance with AWS A2.4.

Statements

Erection; GA.

Prior to erection, erection plan of the structural steel framing describing all necessary temporary supports, including the sequence of installation and removal.

Certificates

Mill Test Reports; FIO.

Certified copies of mill test reports for structural steel, structural bolts, nuts, washers and other related structural steel items, including attesting that the structural steel furnished contains no less than 25 percent recycled scrap steel and meets the requirements specified, prior to the installation.

Fabrication; FIO.

A copy of the AISC certificate indicating that the fabrication plant meets the specified structural steel work category.

1.4 STORAGE

Material shall be stored out of contact with the ground in such manner and location as will minimize deterioration.

2 PRODUCTS

2.1 STRUCTURAL STEEL

2.1.1 Carbon Grade Steel

Carbon grade steel shall conform to ASTM A 36.

2.2 STRUCTURAL TUBING

Structural tubing shall conform to ASTM A 500, Grade B.

2.3 HIGH STRENGTH BOLTS AND NUTS

High strength bolts shall conform to ASTM A 325, Type 1 with carbon steel nuts conforming to ASTM A 563, Grade C.

2.4 CARBON STEEL BOLTS AND NUTS

Carbon steel bolts shall conform to ASTM A 307, Grade A with carbon steel nuts conforming to ASTM A 563, Grade A.

2.5 NUTS DIMENSIONAL STYLE

Carbon steel nuts shall be Hex style when used with ASTM A 307 bolts or Heavy Hex style when used with ASTM A 325 bolts.

2.6 WASHERS

Plain washers shall conform to ASTM F 844.

2.7 PAINT

Paint shall conform to SSPC Paint 25.

3 EXECUTION

3.1 FABRICATION

Fabrication shall be in accordance with the applicable provisions of AISC ASD Mnl. Fabrication and assembly shall be done in the shop to the greatest extent possible. Compression joints depending on contact bearing shall have a surface roughness not in excess of 500 micro inches as determined by ASME B46.1, and ends shall be square within the tolerances for milled ends specified in ASTM A 6. Structural steel work, except surfaces to be field welded, shall be prepared for painting in accordance with SSPC 25 and primed with the specified paint.

3.2 ERECTION

a: Erection of structural steel, except as indicated in item b. below, shall be in accordance with the applicable provisions of AISC ASD Mnl.

b. For low-rise structural steel buildings 60 feet tall or less and a maximum of 2 stories, the erection plan shall conform to AISC Pub No. S303 and the structure shall be erected in accordance with AISC Design Guide #10.

3.2.1 Structural Connections

Anchor bolts and other connections between the structural steel and foundations shall be provided and shall be properly located and built into connecting work. Field welded structural connections shall be completed before load is applied.

3.2.2 Base Plates and Bearing Plates

Column base plates for columns and bearing plates for beams, girders, and similar members shall be provided. Base plates and bearing plates shall be provided with full bearing after the supported members have been plumbed and properly positioned, but prior to placing superimposed loads. Separate setting plates under column base plates will not be permitted. The area under the plate shall be damp-packed solidly with bedding mortar, except where nonshrink grout is indicated on the drawings. Bedding mortar and grout shall be as specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE.

3.2.3 Field Priming

After erection, the field bolt heads and nuts, field welds, and any abrasions in the shop coat shall be cleaned and primed with paint of the same quality as that used for the shop coat.

** End of Section **

SECTION 05500
MISCELLANEOUS METAL
07/97

1 GENERAL

1.1 REFERENCES

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

ALUMINUM ASSOCIATION (AA)

AA DAF-45	(1980; R 1993) Designation System for Aluminum Finishes

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36	(1996) Carbon Structural Steel
ASTM A 53	(1996) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 123	(1989a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 283	(1993a) Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A 500	(1993) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 653	(1996) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 924	(1996a) Steel Sheet, Metallic-Coated by the Hot-Dip Process

AMERICAN WELDING SOCIETY (AWS)

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

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 00700 GENERAL:

Drawings

Miscellaneous Metal Items; GA.

Detail drawings indicating material thickness, type, grade, and class; dimensions; and construction details. Drawings shall include catalog cuts, erection details, manufacturer's descriptive data and installation instructions, and templates. Detail drawings for the following items: louvers, dampers, recesses for wand boom, and access doors.

1.3 GENERAL REQUIREMENTS

The Contractor shall verify all measurements and shall take all field measurements necessary before fabrication. Welding to or on structural steel shall be in accordance with AWS D1.1. Items specified to be galvanized, when practicable and not indicated otherwise, shall be hot-dip galvanized after fabrication. Galvanizing shall be in accordance with ASTM A 123, ASTM A 653, or ASTM A 924, as applicable. Exposed fastenings shall be compatible materials, shall generally match in color and finish, and shall harmonize with the material to which fastenings are applied. Materials and parts necessary to complete each item, even though such work is not definitely shown or specified, shall be included. Poor matching of holes for fasteners shall be cause for rejection. Fastenings shall be concealed where practicable. Thickness of metal and details of assembly and supports shall provide strength and stiffness. Joints exposed to the weather shall be formed to exclude water.

1.4 DISSIMILAR MATERIALS

Where dissimilar metals are in contact, or where aluminum is in contact with concrete, mortar, masonry, wet or pressure-treated wood, or absorptive materials subject to wetting, the surfaces shall be protected with a coat of bituminous paint or asphalt varnish.

1.5 WORKMANSHIP

Miscellaneous metalwork shall be well formed to shape and size, with sharp lines and angles and true curves. Drilling and punching shall produce clean true lines and surfaces. Welding shall be continuous along the entire area of contact except where tack welding is permitted. Exposed connections of work in place shall not be tack welded. Exposed welds shall be ground smooth. Exposed surfaces of work in place shall have a smooth finish, and unless otherwise approved, exposed riveting shall be flush. Where tight fits are required, joints shall be milled. Corner joints shall be coped or mitered, well formed, and in true alignment. Work shall be accurately set to established lines and elevations and securely fastened in place.

Installation shall be in accordance with manufacturer's installation instructions and approved drawings, cuts, and details.

1.6 ANCHORAGE

Anchorage shall be provided where necessary for fastening miscellaneous metal items securely in place. Anchorage not otherwise specified or indicated shall include slotted inserts made to engage with the anchors, expansion shields, and power-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine and carriage bolts for steel; and lag bolts and screws for wood.

1.7 ALUMINUM FINISHES

Unless otherwise specified, aluminum items shall have anodized finish. The thickness of the coating shall be not less than that specified for protective and decorative type finishes for items used in interior locations or architectural Class I type finish for items used in exterior locations in AA DAF-45. Items to be anodized shall receive a polished satin finish.

1.8 SHOP PAINTING

Surfaces of ferrous metal except galvanized surfaces shall be cleaned and shop coated with the manufacturer's standard protective coating unless otherwise specified. Surfaces of items to be embedded in concrete shall not be painted. Items to be finish painted shall be prepared according to manufacturer's recommendations or as specified.

2 PRODUCTS

2.1 ACCESS DOOR

Door shall be flush type unless otherwise indicated. Frames for access doors shall be fabricated of not lighter than 16 gauge steel with welded joints and finished with anchorage for securing into construction. Access doors shall be 24 by 24 inches and of not lighter than 14 gauge steel, with stiffened edges, complete with attachments. Access doors shall be hinged to frame and provided with a flush face, screw driver operated latch. Exposed metal surfaces shall have a baked enamel finish. Acceptable product is Karp DSB-214SM or approved equal.

2.2 BOLLARDS

Bollards shall be heavy duty steel pipe conforming to ASTM A 53, Type E or S, weight STD. Paint as indicated on the drawings.

2.3 MISCELLANEOUS

Miscellaneous plates and shapes for items that do not form a part of the structural steel framework, such as lintels, miscellaneous mountings, walkways, and frames, shall be provided to complete the work.

3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

All items shall be installed at the locations shown and according to the manufacturer's recommendations. Items listed below require additional procedures as specified.

3.2 INSTALLATION OF BOLLARDS

Bollards shall be set vertically in concrete piers. Piers shall be constructed of, and the hollow cores of the pipe filled with, concrete specified in SECTION 03300 CAST-IN-PLACE STRUCTURAL CONCRETE.

3.3 INSTALLATION OF ACCESS DOOR

Access door shall be installed in accordance with the manufacturer’s instructions.

** End of Section **

SECTION 07413
METAL SOFFIT, CEILING, AND FASCIA

1 GENERAL

1.1 REFERENCES

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

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI Cold-Formed Mnl	(1996) Cold-Formed Steel Design Manual

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 463	(1997) Steel Sheet, Aluminum-Coated, by the Hot-Dip Process
ASTM A 653	(1998) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 792	(1997) Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
ASTM B117	(1994) Operating Salt Spray (Fog) Testing Apparatus
ASTM C 518	(1998) Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
ASTM D 522	(1993a) Mandrel Bend Test of Attached Organic Coatings
ASTM D 714	(1987; R 1994) Evaluating Degree of Blistering of Paints
ASTM D 968	(1993) Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM D 1654	(1992) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments

ASTM D 2244	(1995) Calculation of Color Differences from Instrumentally Measured Color Coordinates
ASTM D 2247	(1997) Testing Water Resistance of Coatings in 100% Relative Humidity
ASTM D 2794	(1993) Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
ASTM D 3359	(1997) Measuring Adhesion by Tape Test
ASTM D 4214	(1998) Evaluating Degree of Chalking of Exterior Paint Films
ASTM D 4587	(1991) Conducting Tests on Paint and Related Coatings and Materials Using a Fluorescent UV-Condensation Light- and Water- Exposure Apparatus
ASTM E 84	(1998) Surface Burning Characteristics of Building Materials
ASTM E 96	(1995) Water Vapor Transmission of Materials

1.2 GENERAL REQUIREMENTS

1.2.1 Design

Contract drawings show the design wind loads and the extent and general assembly details of the metal panels. Members and connections not shown on the drawings shall be designed by the Contractor. Panels and accessories shall be the products of the same manufacturer. Design shall be in accordance with AISI-01.

1.2.2 Architectural Considerations

Profiles for fascias shall be as shown on the drawings. Soffit and ceiling panels shall be MBCI “U” panel Signature 200 or approved equal.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 00700 GENERAL:

Drawings

Soffit, Ceiling, and Fascia; GA.

Drawings consisting of catalog cuts, design and erection drawings, shop coating and finishing specifications, and other data as necessary to clearly describe design, materials, sizes, layouts, construction details, fasteners, and erection.

Certificates

Soffit, Ceiling, and Fascia; FIO. Installation; FIO. Accessories; FIO.

Certificates attesting that the panels and accessories conform to the requirements specified. Certified laboratory test reports showing that the sheets to be furnished are produced under a continuing quality control program and has met the quality standards specified for factory color finish. Mill certification for fascia, ceiling, and soffit.

Samples

Accessories; FIO.

One sample of each type of flashing, trim, closure, cap and similar items. Size shall be sufficient to show construction and configuration.

Soffit, Ceiling, and Fascia; GA.

One piece of each type and finish to be used, 9 inches long, full width.

Descriptive data.

Fasteners; FIO.

Each type of bolt, nut, and washer to be used with statement regarding intended use.

Gaskets and Insulating Compounds; FIO.

Each type of gasket and insulating compound to be used with statement regarding intended use.

1.4 DELIVERY AND STORAGE

Materials shall be delivered to the site in a dry and undamaged condition and stored out of contact with the ground. Materials shall be covered with weathertight coverings and kept dry. Storage accommodations for metal soffit, ceiling, and fascia shall provide good air circulation and protection from surface staining.

1.5 WARRANTIES

The Contractor shall provide a weather tight warranty for the metal panels for a period of 20 years to include panel assembly, 10 years against the wear of color finish, and 10 years against the corrosion of fasteners caused by ordinary wear and tear by the elements. The warranties

shall start upon final acceptance of the work or the date the Government takes possession, whichever is earlier.

2 PRODUCTS

2.1 SOFFIT, CEILING, AND FASCIA

Panels shall be steel and shall have a factory color finish. Length of sheets shall be sufficient to cover the entire span without jointing, up to 20 feet. Short pieces, i. e. pieces less than one foot long, shall not be used. Design provisions shall be made for thermal expansion and contraction.

2.1.1 Soffit, Ceiling, and Fascia Panels

Soffit and ceiling panels shall have overlapping ribs for securing adjacent sheets. Fascia, soffit, and ceiling panels shall be fastened to framework using exposed fasteners.

2.1.2 Steel Panels

Zinc-coated steel conforming to ASTM A 653; aluminum-zinc alloy coated steel conforming to ASTM A 792, AZ 55 coating; or aluminum-coated steel conforming to ASTM A 463, Type 2, coating designation T2 65.

2.2 FACTORY COLOR FINISH

Panels shall have a factory applied finish on the exposed side. The thermoset coating system shall be composed of polyester resin modified by copolymerization with a functional silicone resin intermediate. The exterior finish shall consist of a baked-on topcoat with an appropriate prime coat. Color shall match the color indicated on the drawings. The exterior coating shall be a nominal 1 mil thickness consisting of a topcoat of not less than 0.7 mil dry film thickness and the paint manufacturer's recommended primer of not less than 0.2 mil thickness. MBCI Signature 200 paint system is an acceptable system. The exterior color finish shall meet the test requirements specified below.

2.2.1 Salt Spray Test

A sample of the sheets shall withstand a cyclic corrosion test for a minimum of 1000 hours in accordance with ASTM B 117, including the scribe requirement in the test. Immediately upon removal of the panel from the test, the coating shall receive a rating of not less than 8F, few no. 8 blisters, as determined by ASTM D 714; and a rating of 6, 1/8 inch failure at scribe, as determined by ASTM D 1654.

2.2.2 Formability Test

When subjected to testing in accordance with ASTM D 522 Method B, 1/8 inch diameter mandrel, the coating film shall show no evidence of fracturing to the naked eye.

2.2.3 Accelerated Weathering, Chalking Resistance and Color Change

A sample of the sheets shall be tested in accordance with ASTM D 4587, test condition B for 1000 total hours. The coating shall withstand the weathering test without cracking, peeling, blistering, loss of adhesion of the protective coating, or corrosion of the base metal. Protective coating that can be readily removed from the base metal with tape in accordance with ASTM D 3359, Test Method B, shall be considered as an area indicating loss of adhesion. Following the accelerated weathering test, the coating shall have a chalk rating not less than No. 8 in accordance with ASTM D 4214 test procedures, and the color change shall not exceed 5 CIE or Hunter Lab color difference (delta E) units in accordance with ASTM D 2244.

2.2.4 Humidity Test

When subjected to a humidity cabinet test in accordance with ASTM D 2247 for 1000 hours, a scored panel shall show no signs of blistering, cracking, creepage or corrosion.

2.2.5 Impact Resistance

Factory-painted sheet shall withstand direct and reverse impact in accordance with ASTM D 2794 0.500 inch diameter hemispherical head indenter, 1.5 times the metal thickness in mils, expressed in inch-pounds, with no loss of adhesion.

2.2.6 Abrasion Resistance Test

When subjected to the falling sand test in accordance with ASTM D 968, Method A, the coating system shall withstand a minimum of 50 liters of sand before the appearance of the base metal. The term "appearance of base metal" refers to the metallic coating on steel base metal.

2.3 ACCESSORIES

Flashing, trim, metal closure strips, caps, and similar metal accessories shall be the manufacturer's standard products. Exposed metal accessories shall be finished to match the panels furnished. Metal accessories shall not be less than the minimum thickness specified for panels. Molded closure strips shall be bituminous-saturated fiber, closed-cell or solid-cell synthetic rubber or neoprene, or polyvinyl chlorided premolded to match configuration of the panels and shall not absorb or retain water.

2.4 FASTENERS

Fasteners for steel panels shall be zinc-coated steel, aluminum, corrosion resisting steel, or nylon capped steel, type and size specified below or as otherwise approved for the applicable requirements. Fasteners for attaching panels to supports shall provide both tensile and shear strength of not less than 750 pounds per fastener. Fasteners for accessories shall be the

manufacturer's standard. Exposed fasteners shall be same color as panels. Exposed fasteners in ceilings of wash bays shall have rubber gasket washer.

2.4.1 Screws

Screws shall be as recommended by the manufacturer.

2.4.2 Blind Rivets

Blind rivets shall be aluminum with 3/16 inch nominal diameter shank or stainless steel with 1/8 inch nominal diameter shank. Rivets shall be threaded stem type if used for other than the fastening of trim. Rivets with hollow stems shall have closed ends.

2.4.3 Bolts

Bolts shall be not less than 1/4 inch diameter, shouldered or plain shank as required, with proper nuts.

2.5 INSULATION

Thermal resistance of insulation shall be not less than the R-values shown on the contract drawings. R-values shall be determined at a mean temperature of 75 degrees F in accordance with ASTM C 518. Insulation shall be a standard product with the insulation manufacturer, factory-marked or identified with insulation manufacturer's name or trademark and R-value. Identification shall be on individual pieces or individual packages. Blanket insulation shall have a facing as specified in paragraph VAPOR RETARDER. Insulation, including facings, shall have a flame spread not in excess of 25 and a smoke developed rating not in excess of 50 when tested in accordance with ASTM E 84. The stated R-value of the insulation shall be certified by an independent Registered Professional Engineer if tests are conducted in the insulation manufacturer's laboratory.

2.6 VAPOR RETARDER

2.6.1 Vapor Retarders as Integral Facing

Insulation facing shall have a permeability of 0.1 perm or less when tested in accordance with ASTM E 96. Facing shall be white polypropylene scrim kraft finish. Facings and finishes shall be factory applied.

2.7 SEALANT

Sealant shall be an elastomeric type containing no oil or asphalt. Exposed sealant shall be colored to match the applicable building color and shall cure to a rubberlike consistency.

2.8 GASKETS AND INSULATING COMPOUNDS

Gaskets and insulating compounds shall be nonabsorptive and suitable for insulating contact points of incompatible materials. Insulating compounds shall be nonrunning after drying.

3 EXECUTION

3.1 INSTALLATION

Installation shall be in accordance with the manufacturer's erection instructions and drawings. Dissimilar materials which are not compatible when contacting each other shall be insulated from each other by means of gaskets or insulating compounds. Improper or mislocated drill holes shall be plugged with an oversize screw fastener and gasketed washer; however, panels with an excess of such holes or with such holes in critical locations shall not be used. Exposed surfaces and edges shall be kept clean and free from sealant, metal cuttings, hazardous burrs, and other foreign material. Stained, discolored, or damaged sheets shall be removed from the site.

3.1.1 Panels and Accessories

Soffit, ceiling, and fascia shall be applied in configurations as shown on the drawings. Accessories shall be fastened into framing members, except as otherwise approved. Closure strips shall be provided where necessary to provide weathertight construction, i. e. a continuous seal against water used in the car wash operation.

3.1.1.1 Lap Type Fascia with Exposed Fasteners

End laps shall be made over framing members or substrate with fasteners into framing members approximately 2 inches from the end of the overlapping sheet. Side laps shall be laid away from the prevailing winds. Spacing of fasteners shall present an orderly appearance and shall attach the fascias securely to the framing members or substrate. Fasteners shall be driven normal to the surface and to a uniform depth to seat the gasketed washers properly.

3.1.1.2 Exposed Fastener Soffit and Ceiling Panels

Panels shall be fastened to framing members with exposed fasteners clips standard with the manufacturer. Spacing of fasteners shall be in accordance with the manufacturer's written instructions. Spacing of fasteners and along the panel overlapping ribs shall not exceed 12 inches on center except when otherwise approved. Fasteners shall not puncture metal sheets except as approved for flashing, closures, and trim; exposed fasteners shall be installed in straight lines. Overlapping ribs shall be sealed with factory-applied sealant. Joints at accessories shall be sealed.

** End of Section **

SECTION 07416
STRUCTURAL STANDING SEAM METAL ROOF (SSSMR) SYSTEM
10/98

1 GENERAL

1.1 REFERENCES

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

ALUMINUM ASSOCIATION (AA)

AA Design Manual	(1994) Aluminum Design Manual: Specification & Guidelines for Aluminum Structures

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC ASD Spec	(1989) Specification for Structural Steel Buildings - Allowable Stress Design, Plastic Design

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI Cold-Formed Mnl	(1996) Cold-Formed Steel Design Manual

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 463	(1997) Steel Sheet, Aluminum-Coated, by the Hot-Dip Process
ASTM A 653	(1998) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 792	(1997) Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
ASTM B 117	(1994) Operating Salt Spray (Fog) Testing Apparatus
ASTM C 518	(1998) Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
ASTM D 522	(1993a) Mandrel Bend Test of Attached Organic Coatings

ASTM D 523	(1989; R 1994) Specular Gloss
ASTM D 714	(1987; R 1994) Evaluating Degree of Blistering of Paints
ASTM D 968	(1993) Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM D 1308	(1987; R 1998) Effect of Household Chemicals on Clear and Pigmented Organic Finishes
ASTM D 1654	(1992) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D 2244	(1995) Calculation of Color Differences from Instrumentally Measured Color Coordinates
ASTM D 2247	(1997) Testing Water Resistance of Coatings in 100% Relative Humidity
ASTM D 2794	(1993) Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
ASTM D 3359	(1997) Measuring Adhesion by Tape Test
ASTM D 4214	(1998) Evaluating Degree of Chalking of Exterior Paint Films
ASTM D 4587	(1991) Conducting Tests on Paint and Related Coatings and Materials Using a Fluorescent UV-Condensation Light- and Water-Exposure Apparatus
ASTM E 84	(1998e1) Surface Burning Characteristics of Building Materials
ASTM E 96	(1995) Water Vapor Transmission of Materials
ASTM E 1592	(1995) Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7	(1995) Minimum Design Loads for Buildings and Other Structures

1.2 GENERAL REQUIREMENTS

The Contractor shall furnish a commercially available roofing system which satisfies all requirements contained herein and has been verified by load testing and independent design analyses to meet the specified design requirements.

1.2.1 Structural Standing Seam Metal Roof (SSSMR) System

The SSSMR system covered under this specification shall include the entire roofing system; the standing seam metal roof panels, fasteners, connectors, roof securement components, and assemblies tested and approved in accordance with ASTM E 1592. In addition, the system shall consist of panel finishes, all accessories, components, and trim and all connections with roof panels. This includes roof penetration items such as vents, eaves, ridge, hip, valley, rake, or other roof system flashings installed and any other components specified within this contract to provide a weathertight roof system. Seaming system shall be a “double lock” configuration.

1.2.2 Manufacturer

The SSSMR system shall be the product of a manufacturer who has been in the practice of manufacturing and designing SSSMR systems for a period of not less than 3 years and has been involved in at least five projects similar in size and complexity to this project.

1.2.3 Installer

The installer shall be certified by the SSSMR system manufacturer to have experience in installing at least three projects that are of comparable size, scope and complexity as this project for the particular roof system furnished. The installer may be either employed by the manufacturer or be an independent installer.

1.3 DESIGN REQUIREMENTS

The design of the SSSMR system shall be provided by the Contractor as a complete system. Members and connections not indicated on the drawings shall be designed by the Contractor. Roof panels, components, transitions, accessories, and assemblies shall be supplied by the same roofing system manufacturer.

1.3.1 Design Criteria

Design criteria shall be in accordance with ASCE 7.

1.3.2 Dead Loads

The dead load shall be the weight of the SSSMR system. Collateral loads such as mechanical and electrical systems and ceilings shall not be attached to the panels.

1.3.3 Live Loads

1.3.3.1 Concentrated Loads

The panels and anchor clips shall be capable of supporting a 300 pound concentrated load. The concentrated load shall be applied at the panel midspan and will be resisted by a single standing seam metal roof panel assumed to be acting as a beam. The undeformed shape of the panel shall be used to determine the section properties.

1.3.3.2 Uniform Loads

The panels and concealed anchor clips shall be capable of supporting a minimum uniform live load of 20 psf.

1.3.4 Wind Loads

The design wind uplift pressure for the roof system shall meet UL 90 wind uplift criteria. The design uplift force for each connection assembly shall be that pressure given for the area under consideration, multiplied by the tributary load area of the connection assembly. The safety factor listed below shall be applied to the design force and compared against the ultimate capacity. Prying shall be considered when figuring fastener design loads.

a. Single fastener in each connection.....……3.0

b. Two or more fasteners in each connection...2.25

1.3.5 Thermal Loads

Roof panels shall be free to move in response to the expansion and contraction forces resulting from a total temperature range of 100 degrees F during the life of the structure.

1.3.6 Framing Members Supporting the SSSMR System

Any additions/revisions to framing members supporting the SSSMR system to accommodate the manufacturer/fabricator's design shall be the Contractor's responsibility and shall be submitted for review and approval. New or revised framing members and their connections shall be designed in accordance with AISC-04. Maximum deflection under applied live load, snow, or wind load shall not exceed 1/180 of the span length.

1.3.7 Roof Panels Design

Steel panels shall be designed in accordance with AISI-01. The structural section properties used in the design of the panels shall be determined using the unloaded shape of the roof panels. The calculated panel deflection from concentrated loads shall not exceed 1/180 of the span length. The calculated panel deflection under applied live load, snow, or wind load shall

not exceed 1/180 times the span length. Deflections shall be based on panels being continuous across three or more supports. Deflection shall be calculated and measured along the major ribs of the panels.

1.3.8 Accessories and Their Fasteners

Accessories and their fasteners shall be capable of resisting the specified design wind uplift forces and shall allow for thermal movement of the roof panel system. Exposed fasteners shall not restrict free movement of the roof panel system resulting from thermal forces. There shall be a minimum of two fasteners per clip. Single fasteners with a minimum diameter of 3/8 inch will be allowed when the supporting structural members are prepunched or predrilled.

1.4 PERFORMANCE REQUIREMENTS

The SSSMR shall be tested for wind uplift resistance in accordance with ASTM E 1592; SSSMR systems previously tested and approved by the Corps of Engineers' STANDARD TEST METHOD FOR STRUCTURAL PERFORMANCE OF SSMRS BY UNIFORM STATIC AIR PRESSURE DIFFERENCE may be acceptable. Two tests shall be performed. Test 1 shall simulate the edge condition with one end having crosswise restraint and other end free of crosswise restraint. The maximum span length for the edge condition shall be 30 inches. Test 2 shall simulate the interior condition with both ends free of crosswise restraint. The maximum span length for the interior condition shall be 5.0 feet. External reinforcement, such as clamps on the ribs, shall not be installed to improve uplift resistance. Bolts through seams shall not be installed.

1.5 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 00700 GENERAL:

Data

Design Analysis; GA.

Design analysis signed by a Registered Professional Engineer employed by the SSSMR manufacturer. The design analysis shall include a list of the design loads, and complete calculations for the support system (when provided by the Contractor), roofing system and its components, screw pullout test results, and shall indicate how expected thermal movements are accommodated.

Drawings

Structural Standing Seam Metal Roof System; GA.

Metal roofing drawings and specifications and erection drawings; shop coating and finishing specifications; and other data as necessary to clearly describe design, materials, sizes, layouts, standing seam configuration, construction details, provisions for thermal movement, line of panel fixity, fastener sizes and spacings, sealants, and erection procedures. Drawings shall reflect the intent of the architectural detailing using the manufacturer's proprietary products and fabricated items as required. The SSSMR system shop drawings shall be provided by the metal roofing manufacturer.

Statements

Qualifications; GA.

Qualifications of the manufacturer and installer.

Reports

Test Report for Uplift Resistance of the SSSMR; GA.

The report shall include the following information:

a. Details of the SSSMR system showing the roof panel cross-section with dimensions and thickness.

b. Details of the anchor clip, dimensions, and thickness.

c. Type of fasteners, size, and the number required for each connection.

d. Purlins' size and spacing used in the test.

e. Description of the seaming operation including equipment used.

f. Maximum allowable uplift pressures. These pressures are determined from the ultimate load divided by a factor of safety equal to 1.65.

g. Any additional information required to identify the SSSMR system tested.

h. Signature and seal of an independent registered engineer who witnessed the test.

Certificates

Structural Standing Seam Metal Roof System; GA.

a. Certification that the actual thickness of uncoated sheets used in SSSMRS components including roofing panels, purlins, and concealed anchor clips complies with specified requirements.

b. Certification that materials used in the installation are mill certified.

c. Previous certification of SSSMR system tested under the Corps of Engineers' Standard Test Method in lieu of ASTM E 1592 testing.

d. Certification that the sheets to be furnished are produced under a continuing quality control program and that a representative sample consisting of not less than three pieces has been tested and has met the quality standards specified for factory color finish.

e. Certification of installer. Installer certification shall be furnished.

f. Warranty certificate. At the completion of the project the Contractor shall furnish signed copies of the 5-year Warranty for Structural Standing Seam Metal Roof (SSSMR) System, a sample copy of which is attached to this section, and the 20-year Manufacturer's Material Warranties.

Samples

Factory Color Finish; GA.

One 3 by 5 inches sample of type and color.

Descriptive Data

Accessories; FIO.

Each type of flashing, trim, closure, thermal spacer block, cap and similar items.

Roof Panel; GA.

One piece of type and finish to be used, 9 inches long, full width.

Fasteners; FIO.

Each type of bolt, nut, and washer to be used, with statement regarding intended use.

Gaskets and Insulating Compounds; FIO.

Each type of gasket and insulating compound to be used, with statement regarding intended use.

Concealed Anchor Clips; FIO.

Each type of concealed anchor clip to be used, with statement regarding intended use.

1.6 DELIVERY AND STORAGE

Materials shall be delivered to the site in a dry and undamaged condition and stored out of contact with the ground. Materials shall be covered with weathertight coverings and kept dry. Storage conditions shall provide good air circulation and protection from surface staining.

1.7 WARRANTIES

The SSSMR system shall be warranted as outlined below. Any emergency temporary repairs conducted by the owner shall not negate the warranties.

1.7.1 Contractor's Weathertightness Warranty

The SSSMR system shall be warranted by the Contractor on a no penal sum basis for a period of five years against material and workmanship deficiencies; system deterioration caused by exposure to the elements and/or inadequate resistance to specified service design loads, water leaks, and wind uplift damage. The SSSMR system covered under this warranty shall include the entire roofing system including, but not limited to, the standing seam metal roof panels, fasteners, connectors, roof securement components, and assemblies tested and approved in accordance with ASTM E 1592. In addition, the system shall consist of panel finishes, all accessories, components, and trim and all connections with roof panels. This includes roof penetration items such as vents, eaves, ridge, hip, valley, rake, or other roof system flashings installed and any other components specified within this contract to provide a weathertight roof system; and items specified in other sections of these specifications that are part of the SSSMR system. All material and workmanship deficiencies, system deterioration caused by exposure to the elements and/or inadequate resistance to specified design loads, water leaks and wind uplift damage shall be repaired as approved by the Contracting Officer. This warranty shall warrant and cover the entire cost of repair or replacement, including all material, labor, and related markups. The Contractor shall supplement this warranty with written warranties from the installer and system manufacturer, which shall be submitted along with Contractor's warranty; however, the Contractor shall be ultimately responsible for this warranty. The Contractor's written warranty shall be as outlined in attached WARRANTY FOR STRUCTURAL STANDING SEAM METAL ROOF (SSSMR) SYSTEM, and shall start upon final acceptance of the facility or the date the Government takes possession, whichever is earlier. It shall be understood that the Contractor’s Performance Bond will remain effective throughout the five year Contractor’s warranty period for the entire SSSMR system as outlined above.

1.7.2 Manufacturer's Material Warranties.

The Contractor shall furnish, in writing, the following manufacturer's material warranties which cover all SSSMR system components such as roof panels, anchor clips and fasteners, flashing, accessories, and trim, fabricated from coil material:

a. A manufacturer's 20 year material warranty warranting that the zinc-coated steel, aluminum-zinc alloy coated steel or aluminum-coated steel as specified herein will not

rupture, structurally fail, fracture, deteriorate, or become perforated under normal design atmospheric conditions and service design loads. Liability under this warranty shall be limited exclusively to the cost of either repairing or replacing nonconforming, ruptured, perforated, or structurally failed coil material.

b. A manufacturer's 20 year exterior material finish warranty on the factory colored finish warranting that the finish, under normal atmospheric conditions at the site, will not crack, peel, or delaminate; chalk in excess of a numerical rating of eight, as determined by ASTM D 4214 test procedures; or change color in excess of five CIE or Hunter Lab color difference (delta E) units in accordance with ASTM D 2244. Liability under this warranty is exclusively limited to refinishing with an air-drying version of the specified finish or replacing the defective coated material.

2 PRODUCTS

2.1 ROOF PANELS

Panels shall be steel and shall have a factory color finish. Length of sheets shall be sufficient to cover the entire length of any unbroken roof slope for slope lengths that do not exceed 30 feet. When length of run exceeds 30 feet and panel laps are provided, each sheet in the run shall extend over three or more supports. Width of sheets shall provide not more than 24 inches of coverage in place. SSSMR system with roofing panels greater than 12 inches in width shall have standing seams rolled during installation by an electrically driven seaming machine. Height of standing seams shall be not less than 2 inches.

2.1.1 Steel Panels

Steel panels shall be zinc-coated steel conforming to ASTM A 653; aluminum-zinc alloy coated steel conforming to ASTM A 792, AZ 55 coating; or aluminum-coated steel conforming to ASTM A 463, Type 2, coating designation T2 65. Uncoated panels shall be 0.0239 inch thick minimum. Panels shall be within 95 percent of nominal thickness.

2.2 CONCEALED ANCHOR CLIPS

Concealed anchor clips shall be the same as the tested roofing system. Clip bases shall have factory punched or drilled holes for attachment. Clips shall be made from multiple pieces with the allowance for the total thermal movement required to take place within the clip. Single piece clips may be acceptable when the manufacturer can substantiate that the system can accommodate the thermal cyclic movement under sustained live or snow loads.

2.3 ACCESSORIES

Flashing, trim, metal closure strips, caps and similar metal accessories shall be the manufacturer's standard products. Exposed metal accessories shall be finished to match the panels furnished. Molded closure strips shall be bituminous-saturated fiber, closed-cell or

solid-cell synthetic rubber or neoprene, or polyvinyl chloride premolded to match configuration of the panels and shall not absorb or retain water. The use of a continuous angle butted to the panel ends to form a closure will not be allowed.

2.4 FASTENERS

Fasteners for steel roof panels shall be zinc-coated steel, corrosion resisting steel, or nylon capped steel, type and size specified below or as otherwise approved for the applicable requirements. Fasteners for structural connections shall provide both tensile and shear ultimate strengths of not less than 750 pounds per fastener. Fasteners for accessories shall be the manufacturer's standard. Exposed roof fasteners shall be sealed or have sealed washers on the exterior side of the roof to waterproof the fastener penetration. Washer material shall be compatible with the roofing; have a minimum diameter of 3/8 inch for structural connections; and gasketed portion of fasteners or washers shall be neoprene or other equally durable elastomeric material approximately 1/8 inch thick. Exposed fasteners for factory color finished panels shall be factory finished to match the color of the panels.

2.4.1 Screws

Screws for attaching anchor devices shall be not less than No. 14. Other screws shall be as recommended by the manufacturer to meet the strength design requirements of the panels.

2.4.2 Bolts

Bolts shall be not less than 1/4 inch diameter, shouldered or plain shank as required, with locking washers and nuts.

2.4.3 Structural Blind Fasteners

Blind screw-type expandable fasteners shall be not less than 1/4 inch diameter. Blind (pop) rivets shall be not less than 9/32 inch minimum diameter.

2.5 PURLINS

Cold formed supporting structural members/purlins shall have a minimum thickness of 0.059 inches and a minimum tensile yield strength of 50000 psi. Hot rolled structural members shall have a minimum thickness of 0.25 inches and a minimum tensile yield strength of 36000 psi. Purlins shall be shop painted.

2.6 FACTORY COLOR FINISH

Panels shall have a factory applied silicone modified polyester finish on the exposed side. The exterior finish shall consist of a baked-on topcoat with an appropriate prime coat. Color shall match the color indicated on the drawings. The exterior coating shall be a nominal 1 mil thickness consisting of a topcoat of not less than 0.7 mil dry film thickness and the paint manufacturer's recommended primer of not less than 0.2 mil thickness. The interior color

finish shall consist of a backer coat with a dry film thickness of 0.5 mil. The exterior color finish shall meet the test requirements specified below.

2.6.1 Salt Spray Test

A sample of the sheets shall withstand a cyclic corrosion test for a minimum of 1000 hours in accordance with ASTM B 117, including the scribe requirement in the test. Immediately upon removal of the panel from the test, the coating shall receive a rating of not less than 8F, few No. 8 blistering, as determined by ASTM D 714; 10; and a rating of 6, 1/8 inch failure at scribe, as determined by ASTM D 1654.

2.6.2 Formability Test

When subjected to testing in accordance with ASTM D 522 Method B, 1/8 inch diameter mandrel, the coating film shall show no evidence of cracking to the naked eye.

2.6.3 Accelerated Weathering, Chalking Resistance and Color Change

A sample of the sheets shall be tested in accordance with ASTM D 4587, test condition B for 1000 total hours. The coating shall withstand the weathering test without cracking, peeling, blistering, loss of adhesion of the protective coating, or corrosion of the base metal. Protective coating that can be readily removed from the base metal with tape in accordance with ASTM D 3359, Test Method B, shall be considered as an area indicating loss of adhesion. Following the accelerated weathering test, the coating shall have a chalk rating not less than No. 8 in accordance with ASTM D 4214 test procedures, and the color change shall not exceed 5 CIE or Hunter Lab color difference (delta E) units in accordance with ASTM D 2244.

2.6.4 Humidity Test

When subjected to a humidity cabinet test in accordance with ASTM D 2247 for 1000 hours, a scored panel shall show no signs of blistering, cracking, creepage or corrosion.

2.6.5 Impact Resistance

Factory-painted sheet shall withstand direct and reverse impact in accordance with ASTM D 2794 0.500 inch diameter hemispherical head indenter, equal to 1.5 times the metal thickness in mils, expressed in inch-pounds, with no cracking.

2.6.6 Abrasion Resistance Test

When subjected to the falling sand test in accordance with ASTM D 968, Method A, the coating system shall withstand a minimum of 50 liters of sand before the appearance of the base metal. The term "appearance of base metal" refers to the metallic coating on steel or the aluminum base metal.

2.6.7 Specular Gloss

Finished roof surfaces shall have a specular gloss value of 10 or less when measured in accordance with ASTM D 523.

2.6.8 Pollution Resistance

Coating shall show no visual effects when covered spot tested in a 10 percent hydrochloric acid solution for 24 hours in accordance with ASTM D 1308.

2.7 SEALANT

Sealants shall be elastomeric type containing no oil or asphalt. Exposed sealant shall be colored to match the applicable building color and shall cure to a rubberlike consistency. Sealant placed in the roof panel standing seam ribs shall be provided in accordance with the manufacturer's recommendations.

2.8 GASKETS AND INSULATING COMPOUNDS

Gaskets and insulating compounds shall be nonabsorptive and suitable for insulating contact points of incompatible materials. Insulating compounds shall be nonrunning after drying.

2.9 EPDM RUBBER BOOTS

Flashing devices around pipe penetrations shall be flexible, one-piece devices molded from weather-resistant EPDM rubber. Rubber boot material shall be as recommended by the manufacturer. The boots shall have base rings made of aluminum or corrosion resisting steel that conform to the contours of the roof panel to form a weather-tight seal.

3 EXECUTION

3.1 INSTALLATION

Installation shall be in accordance with the manufacturer's erection instructions and drawings. Dissimilar materials which are not compatible when contacting each other shall be insulated by means of gaskets or insulating compounds. Molded closure strips shall be installed wherever roofing sheets terminate in open-end configurations, exclusive of flashings. The closure strip installation shall be weather-tight and sealed. Screws shall be installed with a clutching screw gun, to assure screws are not stripped. Field test shall be conducted on each gun prior to starting installation and periodically thereafter to assure it is adjusted properly to install particular type and size of screw as recommended by manufacturer's literature. Improper or mislocated drill holes shall be plugged with an oversize screw fastener and gasketed washer; however, sheets with an excess of such holes or with such holes in critical locations shall not be used. Exposed surfaces and edges shall be kept clean and free from

sealant, metal cuttings, hazardous burrs, and other foreign material. Stained, discolored, or damaged sheets shall be removed from the site.

3.1.1 Field Forming of Panels

Field forming of panels is prohibited.

3.1.2 Purlins

Unless otherwise shown, purlins shall be anchored to the structural framing members with bolts or screws. Attachment to the substrate (when provided) or to the panels is not permitted. The purlin spacing shall not exceed 30 inches on centers at the corner, edge and ridge zones, and 5 foot maximum on centers for the remainder of the roof. Corner, edge, and ridge zones are as defined in ASCE 7.

3.1.3 Roof Panel Installation

Roof panels shall be installed with the standing seams in the direction of the roof slope. The side seam connections for installed panels shall be completed at the end of each day's work. Method of applying joint sealant shall conform to the manufacturer's recommendation to achieve a complete weather-tight installation. End laps of panels shall be provided in accordance with the manufacturer's instructions. Closures, flashings, EPDM rubber boots, and related accessories shall be installed according to the manufacturer's drawings. Fasteners shall not puncture roofing sheets except as provided for in the manufacturer's instructions for erection and installation.

3.1.4 Concealed Anchor Clips

Concealed anchor clips shall be fastened directly to the structural framing members. The maximum distance, parallel to the seams, between clips shall be 30 inches on center at the corner, edge, and ridge zones, and 5 feet maximum on centers for the remainder of the roof.

3.2 CLEANING AND TOUCH-UP

Exposed SSSMR systems shall be cleaned at completion of installation. Debris that could cause discoloration and harm to the panels, flashings, closures and other accessories shall be removed. Grease and oil films, excess sealants, and handling marks shall be removed and the work shall be scrubbed clean. Exposed metal surfaces shall be free of dents, creases, waves, scratch marks, and solder or weld marks. Immediately upon detection, abraded or corroded spots on shop-painted surfaces shall be wire brushed and touched up with the same material used for the shop coat. Factory color finished surfaces shall be touched up with the manufacturer's recommended touch up paint.

CONTRACTOR'S FIVE (5) YEAR NO PENAL SUM WARRANTY FOR STRUCTURAL STANDING SEAM METAL ROOF (SSSMR) SYSTEM

FACILITY DESCRIPTION_____

BUILDING NUMBER:_____

CORPS OF ENGINEERS CONTRACT NUMBER:_____

CONTRACTOR

CONTRACTOR:_____

ADDRESS:_____

POINT OF CONTACT:_____

TELEPHONE NUMBER:_____

OWNER

OWNER:_____

ADDRESS:_____

POINT OF CONTACT:_____

TELEPHONE NUMBER:_____

CONSTRUCTION AGENT

CONSTRUCTION AGENT:_____

ADDRESS:_____

POINT OF CONTACT:_____

TELEPHONE NUMBER:_____

CONTRACTOR'S FIVE (5) YEAR NO PENAL SUM WARRANTY
FOR
STRUCTURAL STANDING SEAM METAL ROOF (SSSMR) SYSTEM
(continued)

THE SSSMR SYSTEM INSTALLED ON THE ABOVE NAMED BUILDING IS WARRANTED BY _____ FOR A PERIOD OF FIVE (5) YEARS AGAINST WORKMANSHIP AND MATERIAL DEFICIENCES, WIND DAMAGE, STRUCTURAL FAILURE, AND LEAKAGE. THE SSSMR SYSTEM COVERED UNDER THIS WARRANTY SHALL INCLUDE, BUT SHALL NOT BE LIMITED TO, THE FOLLOWING: THE ENTIRE ROOFING SYSTEM, MANUFACTURER SUPPLIED FRAMING AND STRUCTURAL MEMBERS, METAL ROOF PANELS, FASTENERS, CONNECTORS, ROOF SECUREMENT COMPONENTS, AND ASSEMBLIES TESTED AND APPROVED IN ACCORDANCE WITH ASTM E 1592. IN ADDITION, THE SYSTEM PANEL FINISHES, SLIP SHEET, INSULATION, VAPOR RETARDER, ALL ACCESSORIES, COMPONENTS, AND TRIM AND ALL CONNECTIONS ARE INCLUDED. THIS INCLUDES ROOF PENETRATION ITEMS SUCH AS VENTS, CURBS, SKYLIGHTS; INTERIOR OR EXTERIOR GUTTERS AND DOWNSPOUTS; EAVES, RIDGE, HIP, VALLEY, RAKE, GABLE, WALL, OR OTHER ROOF SYSTEM FLASHINGS INSTALLED AND ANY OTHER COMPONENTS SPECIFIED WITHIN THIS CONTRACT TO PROVIDE A WEATHERTIGHT ROOF SYSTEM; AND ITEMS SPECIFIED IN OTHER SECTIONS OF THE SPECIFICATIONS THAT ARE PART OF THE SSSMR SYSTEM.

ALL MATERIAL DEFICIENCIES, WIND DAMAGE, STRUCTURAL FAILURE, AND LEAKAGE ASSOCIATED WITH THE SSSMR SYSTEM COVERED UNDER THIS WARRANTY SHALL BE REPAIRED AS APPROVED BY THE CONTRACTING OFFICER. THIS WARRANTY SHALL COVER THE ENTIRE COST OF REPAIR OR REPLACEMENT, INCLUDING ALL MATERIAL, LABOR, AND RELATED MARKUPS. THE ABOVE REFERENCED WARRANTY COMMENCED ON THE DATE OF FINAL ACCEPTANCE ON _____ AND WILL REMAIN IN EFFECT FOR STATED DURATION FROM THIS DATE.

SIGNED, DATED, AND NOTARIZED (BY COMPANY PRESIDENT)

_____

(Company President) (Date)

CONTRACTOR'S FIVE (5) YEAR NO PENAL SUM WARRANTY
FOR
STRUCTURAL STANDING SEAM METAL ROOF (SSSMR) SYSTEM
(continued)

THE CONTRACTOR SHALL SUPPLEMENT THIS WARRANTY WITH WRITTEN WARRANTIES FROM THE MANUFACTURER AND/OR INSTALLER OF THE SSSMR SYSTEM, WHICH SHALL BE SUBMITTED ALONG WITH THE CONTRACTOR'S WARRANTY. HOWEVER, THE CONTRACTOR WILL BE ULTIMATELY RESPONSIBLE FOR THIS WARRANTY AS OUTLINED IN THE SPECIFICATIONS AND AS INDICATED IN THIS WARRANTY EXAMPLE.

EXCLUSIONS FROM COVERAGE

1. NATURAL DISASTERS, ACTS OF GOD (LIGHTNING, FIRE, EXPLOSIONS, SUSTAINED WIND FORCES IN EXCESS OF THE DESIGN CRITERIA, EARTHQUAKES, AND HAIL).

2. ACTS OF NEGLIGENCE OR ABUSE OR MISUSE BY GOVERNMENT OR OTHER PERSONNEL, INCLUDING ACCIDENTS, VANDALISM, CIVIL DISOBEDIENCE, WAR, OR DAMAGE CAUSED BY FALLING OBJECTS.

3. DAMAGE BY STRUCTURAL FAILURE, SETTLEMENT, MOVEMENT, DISTORTION, WARPAGE, OR DISPLACEMENT OF THE BUILDING STRUCTURE OR ALTERATIONS MADE TO THE BUILDING.

4. CORROSION CAUSED BY EXPOSURE TO CORROSIVE CHEMICALS, ASH OR FUMES GENERATED OR RELEASED INSIDE OR OUTSIDE THE BUILDING FROM CHEMICAL PLANTS, FOUNDRIES, PLATING WORKS, KILNS, FERTILIZER FACTORIES, PAPER PLANTS, AND THE LIKE.

5. FAILURE OF ANY PART OF THE SSSMR SYSTEM DUE TO ACTIONS BY THE OWNER TO INHIBIT FREE DRAINAGE OF WATER FROM THE ROOF AND GUTTERS AND DOWNSPOUTS OR ALLOW PONDING WATER TO COLLECT ON THE ROOF SURFACE. CONTRACTOR'S DESIGN SHALL INSURE FREE DRAINAGE FROM THE ROOF AND NOT ALLOW PONDING WATER.

6. THIS WARRANTY APPLIES TO THE SSSMR SYSTEM. IT DOES NOT INCLUDE ANY CONSEQUENTIAL DAMAGE TO THE BUILDING INTERIOR OR CONTENTS WHICH IS COVERED BY THE WARRANTY OF CONSTRUCTION CLAUSE INCLUDED IN THIS CONTRACT.

7. THIS WARRANTY CANNOT BE TRANSFERRED TO ANOTHER OWNER WITHOUT WRITTEN CONSENT OF THE CONTRACTOR; AND THIS WARRANTY AND THE CONTRACT PROVISIONS WILL TAKE PRECEDENCE OVER ANY CONFLICTS WITH STATE STATUTES.

**REPORTS OF LEAKS AND SSSMR SYSTEM DEFICIENCIES SHALL BE RESPONDED TO WITHIN 48 HOURS OF RECEIPT OF NOTICE, BY TELEPHONE OR IN WRITING, FROM EITHER THE OWNER OR CONTRACTING OFFICER. EMERGENCY REPAIRS TO PREVENT FURTHER ROOF LEAKS SHALL BE INITIATED IMMEDIATELY; A WRITTEN PLAN SHALL BE SUBMITTED FOR APPROVAL TO REPAIR OR REPLACE THIS SSSMR SYSTEM WITHIN SEVEN (7) CALENDAR DAYS. ACTUAL WORK FOR PERMANENT REPAIRS OR REPLACEMENT SHALL BE STARTED WITHIN 30 DAYS AFTER RECEIPT OF NOTICE, AND COMPLETED WITHIN A REASONABLE TIME FRAME. IF THE CONTRACTOR FAILS TO ADEQUATELY RESPOND TO THE WARRANTY PROVISIONS, AS STATED IN THE CONTRACT AND AS CONTAINED HEREIN, THE CONTRACTING OFFICER MAY HAVE THE SSSMR SYSTEM REPAIRED OR REPLACED BY OTHERS AND CHARGE THE COST TO THE CONTRACTOR.

IN THE EVENT THE CONTRACTOR DISPUTES THE EXISTENCE OF A WARRANTABLE DEFECT, THE CONTRACTOR MAY CHALLENGE THE OWNER'S DEMAND FOR REPAIRS AND/OR REPLACEMENT DIRECTED BY THE OWNER OR CONTRACTING OFFICER EITHER BY REQUESTING A CONTRACTING OFFICER'S DECISION UNDER THE CONTRACT DISPUTES ACT, OR BY REQUESTING THAT AN ARBITRATOR RESOLVE THE ISSUE. THE REQUEST FOR AN ARBITRATOR MUST BE MADE WITHIN 48 HOURS OF BEING NOTIFIED OF THE DISPUTED DEFECTS. UPON BEING INVOKED, THE PARTIES SHALL, WITHIN TEN (10) DAYS, JOINTLY REQUEST A LIST OF FIVE (5) ARBITRATORS FROM THE FEDERAL MEDIATION AND CONCILIATION SERVICE. THE PARTIES SHALL CONFER WITHIN TEN (10) DAYS AFTER RECEIPT OF THE LIST TO SEEK AGREEMENT ON AN ARBITRATOR. IF THE PARTIES CANNOT AGREE ON AN ARBITRATOR, THE CONTRACTING OFFICER AND THE PRESIDENT OF THE CONTRACTOR'S COMPANY WILL STRIKE ONE (1) NAME FROM THE LIST ALTERNATIVELY UNTIL ONE (1) NAME REMAINS. THE REMAINING PERSON SHALL BE THE DULY SELECTED ARBITRATOR. THE COSTS OF THE ARBITRATION, INCLUDING THE ARBITRATOR'S FEE AND EXPENSES, COURT REPORTER, COURTROOM OR SITE SELECTED, ETC., SHALL BE BORNE EQUALLY BETWEEN THE PARTIES. EITHER PARTY DESIRING A COPY OF THE TRANSCRIPT SHALL PAY FOR THE TRANSCRIPT. A HEARING WILL BE HELD AS SOON AS THE PARTIES CAN MUTUALLY AGREE. A WRITTEN ARBITRATOR'S DECISION WILL BE REQUESTED NOT LATER THAN 30 DAYS FOLLOWING THE HEARING. THE DECISION OF THE ARBITRATOR WILL NOT BE BINDING; HOWEVER, IT WILL BE ADMISSIBLE IN ANY SUBSEQUENT APPEAL UNDER THE CONTRACT DISPUTES ACT.

A FRAMED COPY OF THIS WARRANTY SHALL BE POSTED IN THE MECHANICAL ROOM OR OTHER APPROVED LOCATION DURING THE ENTIRE WARRANTY PERIOD.

** End of Section **

SECTION 07900
JOINT SEALING

1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 509	(1994) Elastomeric Cellular Preformed Gasket and Sealing Material
ASTM C 834	(1995) Latex Sealants
ASTM C 920	(1995) Elastomeric Joint Sealants
ASTM C 1085	(1991) Butyl Rubber-Based Solvent-Release Sealants
ASTM C 1184	(1995) Structural Silicone-Sealants
ASTM D 1056	(1991) Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D 1565	(1981; R 1990) Flexible Cellular Materials - Vinyl Chloride Polymers and Copolymers (Open-Cell Foam)

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 00700 GENERAL:

Data

Backing; FIO.

Bond-Breaker; FIO.

Sealant; FIO.

Manufacturer's descriptive data including storage requirements, shelf life, curing time, instructions for mixing and application, and primer data (if required). A copy of the Material Safety Data Sheet shall be provided for each solvent, primer or sealant material.

Certificates

Sealant; FIO.

Certificates of compliance stating that the materials conform to the specified requirements.

1.3 ENVIRONMENTAL REQUIREMENTS

The ambient temperature shall be within the limits of 40 to 90 degrees F when the sealants are applied.

1.4 DELIVERY AND STORAGE

Materials shall be delivered to the job in the manufacturer's original unopened containers. The container label or accompanying data sheet shall include the following information as applicable: manufacturer, name of material, formula or specification number, lot number, color, date of manufacture, mixing instructions, shelf life, and curing time at the standard conditions for laboratory tests. Materials shall be handled and stored to prevent inclusion of foreign materials. Materials shall be stored at temperatures between 40 and 90 degrees F unless otherwise specified by the manufacturer.

2 PRODUCTS

2.1 BACKING

Backing shall be 25 to 33 percent oversize for closed cell and 40 to 50 percent oversize for open cell material, unless otherwise indicated.

2.1.1 Rubber

Cellular rubber sponge backing shall be ASTM D 1056, Type 1, open cell, or Type 2, closed cell, Class A round cross section.

2.1.2 Synthetic Rubber

Synthetic rubber backing shall be ASTM C 509, Option I, Type I tubes.

2.2 BOND-BREAKER

Bond-breaker shall be as recommended by the sealant manufacturer to prevent adhesion of the sealant to backing or to bottom of the joint.

2.3 PRIMER

Primer shall be non-staining type as recommended by sealant manufacturer for the application.

2.4 SEALANT

2.4.1 LATEX

S4: Latex Sealant shall be ASTM C 834.

2.4.2 ELASTOMERIC

Elastomeric sealants shall conform to ASTM C 920 and the following:

2.4.2.1 Polysulfide Sealant

a. S1: Type S or M, Grade NS, Class 12.5, Use NT, M, A, or O.

2.4.2.2 Polyurethane Sealant

a. S2: Grade NS, Class 12.5, Use T.

b. S3: S3: Grade P, Class 12.5, Use T.

2.4.3 BUTYL

Butyl sealant shall be ASTM C 1085.

2.5 SOLVENTS AND CLEANING AGENTS

Solvents, cleaning agents, and accessory materials shall be provided as recommended by the manufacturer.

3 EXECUTION

3.1 GENERAL

3.1.1 Surface Preparation

The surfaces of joints to receive sealant or caulk shall be free of all frost, condensation and moisture. Oil, grease, dirt, chalk, particles of mortar, dust, loose rust, loose mill scale, and other foreign substances shall be removed from surfaces of joints to be in contact with the sealant. Oil and grease shall be removed with solvent and surfaces shall be wiped dry with clean cloths. For surface types not listed below, the sealant manufacturer shall be contacted for specific recommendations.

3.1.2 Concrete and Masonry Surfaces

Where surfaces have been treated with curing compounds, oil, or other such materials, the materials shall be removed by sandblasting or wire brushing. Laitance, efflorescence and loose mortar shall be removed from the joint cavity.

3.1.3 Steel Surfaces

Steel surfaces to be in contact with sealant shall be sandblasted or, if sandblasting would not be practical or would damage adjacent finish work, the metal shall be scraped and wire brushed to remove loose mill scale. Protective coatings on steel surfaces shall be removed by sandblasting or by a solvent that leaves no residue.

3.1.4 Aluminum Surfaces

Aluminum surfaces to be in contact with sealants shall be cleaned of temporary protective coatings. When masking tape is used for a protective cover, the tape and any residual adhesive shall be removed just prior to applying the sealant. Solvents used to remove protective coating shall be as recommended by the manufacturer of the aluminum work and shall be non-staining.

3.2 APPLICATION

3.2.1 Masking Tape

Masking tape shall be placed on the finish surface on one or both sides of a joint cavity to protect adjacent finish surfaces from primer or sealant smears. Masking tape shall be removed within 10 minutes after joint has been filled and tooled.

3.2.2 Backing

Backing shall be installed to provide the indicated sealant depth. The installation tool shall be shaped to avoid puncturing the backing.

3.2.3 Bond-Breaker

Bond-breaker shall be applied to fully cover the bottom of the joint without contaminating the sides where sealant adhesion is required.

3.2.4 Primer

Primer shall be used on concrete masonry units, wood, or other porous surfaces in accordance with instructions furnished with the sealant. Primer shall be applied to the joint surfaces to be sealed. Surfaces adjacent to joints shall not be primed.

3.2.5 Sealant

Sealant shall be used before expiration of shelf life. Multi-component sealants shall be mixed according to manufacturer's printed instructions. Sealant in guns shall be applied with a nozzle of proper size to fit the width of joint. Joints shall be sealed as detailed in the drawings. Sealant shall be forced into joints with sufficient pressure to expel air and fill the groove solidly. Sealant shall be installed to the indicated depth without displacing the backing. Unless otherwise indicated, specified, or recommended by the manufacturer, the installed sealant shall be dry tooled to produce a uniformly smooth surface free of wrinkles and to ensure full adhesion to the sides of the joint; the use of solvents, soapy water, etc., will not be allowed. Sealants shall be installed free of air pockets, foreign embedded matter, ridges and sags. Sealer shall be applied over the sealant when and as specified by the sealant manufacturer.

3.3 CLEANING

The surfaces adjoining the sealed joints shall be cleaned of smears and other soiling resulting from the sealant application as work progresses.

3.5 SCHEDULE

Exterior Joints:

1. Vertical or inclined joints such as panel, control, and perimeters of doors and other wall penetrations: Sealant types S1 or S2.

2. Threshold bedding: Sealant type S3 or butyl.

3. Joints in sheet metal flashing: Sealant type S1.

Interior Joints:

1. Vertical or inclined joints such as panel, control, and perimeters of doors and other wall penetrations: Sealant types S1 or S2.

2. Non-structural hollow metal doors: Sealant type S1 or S2.

** End of Section **

SECTION 08110
STEEL DOORS AND FRAMES

1 GENERAL

1.1 REFERENCES

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A250.8	(1998) Steel Doors and Frames

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 236	(1993) Steady State Thermal Performance of Building Assemblies by Means of a Guarded Hot Box
ASTM C 976	(1996) Thermal Performance of Building Assemblies by Means of a Calibrated Hot Box
ASTM D 2863	(1997) Measuring the Minimum Oxygen Concentration to Support Candle Like Combustion of Plastics (Oxygen Index)
ASTM E 283	(1991) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen

DOOR AND HARDWARE INSTITUTE (DHI)

DHI A115.1G	(1994) Installation Guide for Doors and Hardware

STEEL DOOR INSTITUTE (SDOI)

SDOI SDI-106	(1996) Standard Door Type Nomenclature
SDOI SDI-107	(1997) Hardware on Steel Doors (Reinforcement - Application)

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 00700 GENERAL:

Drawings

Steel Doors and Frames; GA.

Drawings using standard door type nomenclature in accordance with SDOI SDI-106 indicating the location of each door and frame, elevation of each model of door and frame, details of construction, method of assembling sections, location and extent of hardware reinforcement, hardware locations, type and location of anchors for frames, and thicknesses of metal. Drawings shall include catalog cuts or descriptive data for the doors and frames including air infiltration data and manufacturers printed instructions.

Certificates

Thermal Insulated Doors; FIO.

a. Certification of Thermal Insulating Rating: Certification or test report for thermal insulated doors shall show compliance with the specified requirements. The certification, or test report, shall list the parameters and the type of hardware and perimeter seals used to achieve the rating.

1.3 DELIVERY AND STORAGE

During shipment, welded unit type frames shall be strapped together in pairs with heads at opposite ends or shall be provided with temporary steel spreaders at the bottom of each frame. Materials shall be delivered to the site in undamaged condition, and stored out of contact with the ground and under a weathertight covering permitting air circulation. Doors and assembled frames shall be stored in an upright position in accordance with DHI A115.1G. Abraded, scarred, or rusty areas shall be cleaned and touched up with matching finishes.

1.4 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one year period shall be provided.

2 PRODUCTS

2.1 DOORS AND FRAMES

Doors and frames shall be factory fabricated in accordance with ANSI A250.8 and the additional requirements specified herein. Door grade shall be heavy duty (Grade II) unless

otherwise indicated on the door and door frame schedules. Exterior doors and frames shall be designation G60 galvanized. Doors and frames shall be prepared to receive hardware conforming to the templates and information provided under Section 08700 BUILDERS' HARDWARE. Doors and frames shall be reinforced, drilled, and tapped to receive mortised hinges and locks as required. Doors and frames shall be reinforced for surface applied hardware. Frames shall be welded type. Door frames shall be furnished with a minimum of three jamb anchors and one floor anchor per jamb. Anchors shall be not less than 18 gauge steel or 7 gauge diameter wire. For wall conditions that do not allow the use of a floor anchor, an additional jamb anchor shall be provided. Rubber silencers shall be furnished for installation into factory predrilled holes in door frames; adhesively applied silencers are not acceptable. Where frames are installed in masonry walls, plaster guards shall be provided on door frames at hinges and strikes. Reinforcing of door assemblies for required hardware shall be in accordance with ANSI A250.8. Exterior doors shall have top edges closed flush and sealed against water penetration.

2.2 THERMAL INSULATED DOORS

The interior of thermal insulated doors shall be completely filled with rigid plastic foam permanently bonded to each face panel. The thermal conductance (U-value) through the door shall not exceed 0.41 btu/hr times sq f times f when tested as an operational assembly in accordance with ASTM C 236 or ASTM C 976. Doors with cellular plastic cores shall have a minimum oxygen index rating of 22 percent when tested in accordance with ASTM D 2863.

2.3 FACTORY FINISH

Doors and frames shall be phosphatized and primed with standard factory primer system.

2.4 LOUVERS

Where indicated, door shall be provided with louver section. Louvers shall be sightproof type inserted into the door. Inserted louvers shall be adjustable. Louvers shall be nonremovable from the outside of exterior door. Insect screen shall be a removable type with 18 by 16 mesh aluminum or bronze cloth.

3 EXECUTION

3.1 INSTALLATION

Installation shall be in accordance with DHI A115.1G. Preparation for surface applied hardware shall be in accordance with SDOI SDI-107. Rubber silencers shall be installed in door frames after finish painting has been completed; adhesively applied silencers are not acceptable. Weatherstripping shall be installed at exterior door openings to provide a weathertight installation. Hollow metal door frames shall be solid grouted in masonry walls.

3.1.1 Thermal Insulated Doors

Hardware and perimeter seals shall be adjusted for proper operation. Doors shall be sealed weathertight after installation of hardware and shall be in accordance with Section 07900 JOINT SEALING.

3.2 FIELD PAINTED FINISH

Steel doors and frames shall be field painted in accordance with Section 09900 PAINTING, GENERAL. Weatherstrips shall be protected from paint. Finish shall be free of scratches or other blemishes. Color shall be as indicated on the drawings.

** End of Section **

SECTION 08700
BUILDERS' HARDWARE

1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 283	(1991) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors Under Specified Pressure Differences Across the Specimen

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

BHMA L & R Directory	(Effective thru Jun 1999) Directory of Certified Locks & Latches
BHMA A156.1	(1997) Butts and Hinges
BHMA A156.2	(1996) Bored and Preassembled Locks and Latches
BHMA A156.5	(1992) Auxiliary Locks and Associated Products
BHMA A156.6	(1994) Architectural Door Trim
BHMA A156.7	(1997) Template Hinge Dimensions
BHMA A156.16	(1989) Auxiliary Hardware
BHMA A156.18	(1993) Materials and Finishes
BHMA A156.21	(1996) Thresholds

DOOR AND HARDWARE INSTITUTE (DHI)

DHI Keying Systems	(1989) Keying Systems and Nomenclature
DHI Locations for CSD	(1997) Recommended Locations for Builders' Hardware for Custom Steel Doors and Frames
DHI Locations for SSD	(1990) Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames

DHI ANSI/DHI A115.1G (1994) Installation Guide for Doors and Hardware

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 00700 GENERAL:

Data

Hardware and Accessories; FIO.

Manufacturer's descriptive data, technical literature, catalog cuts, and installation instructions. Spare parts data for locksets, after approval of the detail drawings, and not later than one month prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply.

Schedules

Hardware Schedule; FIO.

Hardware schedule listing all items to be furnished. The schedule shall include for each item: the quantities; manufacturer's name and catalog numbers; the ANSI number specified, sizes; detail information or catalog cuts; finishes; door and frame size and materials; location and hardware set identification cross-references to drawings; corresponding reference standard type number or function number from manufacturer's catalog if not covered by ANSI or BHMA; and list of abbreviations and template numbers.

Certificates

Hardware and Accessories; FIO.

The hardware manufacturer's certificates of compliance stating that the supplied material or hardware item meets specified requirements. Each certificate shall be signed by an official authorized to certify in behalf of the product manufacturer and shall identify quantity and date or dates of shipment or delivery to which the certificates apply. A statement that the proposed hardware items appear in BHMA L & R Directory of certified products may be submitted in lieu of certificates.

1.3 PREDELIVERY CONFERENCE

Upon approval of the Hardware Schedule, the construction Contractor shall arrange a conference with the hardware supplier, Contracting Officer and the using agency to determine keying system requirements. Location of the key control storage system, set-up and key identification labeling will also be determined.

1.4 DELIVERY, STORAGE, AND HANDLING

Hardware shall be delivered to the project site in the manufacturer's original packages. Each article of hardware shall be individually packaged in the manufacturer's standard commercial carton or container, and shall be properly marked or labeled to be readily identifiable with the approved hardware schedule. Each change key shall be tagged or otherwise identified with the door for which its cylinder is intended. Where double cylinder functions are used or where it is not obvious which is the key side of a door, appropriate instructions shall be included with the lock and on the hardware schedule. Manufacturer's printed installation instructions, fasteners, and special tools shall be included in each package.

1.5 SPECIAL TOOLS

Special tools, such as those supplied by the manufacturer, unique wrenches, and dogging keys, shall be provided as required to adjust hardware items.

1.6 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one year period shall be provided.

2 PRODUCTS

2.1 GENERAL HARDWARE REQUIREMENTS

Hardware shall conform to the requirements specified herein and the HARDWARE SET listing at the end of this section.

2.2 TEMPLATES

Requirements for hardware to be mounted on metal doors or metal frames shall be coordinated between hardware manufacturer and door or frame manufacturer by use of templates and other information to establish location, reinforcement required, size of holes, and similar details. Templates of hinges shall conform to BHMA A156.7.

2.3 HINGES

Hinges shall conform to BHMA A156.1. Hinges used on metal doors and frames shall also conform to BHMA A156.7. Except as otherwise specified, hinge sizes shall conform to the hinge manufacturer's printed recommendations. Contractor shall size hinges to accommodate door size.

2.3.1 Hinges for Reverse Bevel Doors with Locks

Hinges for reverse bevel doors with locks shall have pins that are made nonremovable by means such as a set screw in the barrel, or safety stud, when the door is in the closed position.

2.3.2 Contractor's Option

Hinges with antifriction bearings may be furnished in lieu of ball bearing hinges

2.4 LOCKS

To the maximum extent possible, locksets and all components thereof, including cylinders and removable cores, shall be the products of a single manufacturer.

2.3.3 Bored Locks

Bored locks and strikes shall be series 4000 and shall conform to BHMA A156.2, Grade 1. Bored type locks for doors 1-3/8 inches thick and over shall have adjustable bevel fronts or otherwise conform to the shape of the door.

2.3.4 Lock Cylinders (Bored)

Lock cylinders shall comply with BHMA A156.5. Lock cylinder shall have seven pins. Cylinder shall have key removable type cores. Core shall be pinned for an A-3 (.018 differential) type system. A blank core shall be provided to base locksmith to key. A construction interchangeable core shall be provided. Disassembly of lockset shall not be required to remove core from lockset.

Dyess' existing master key system is by "BEST." Lock shall be furnished with the manufacturer's standard construction core and key system.

2.3.5 Lock Trim

Lock trim shall be cast, forged, or heavy wrought construction of commercial plain design with brushed stainless steel finish. In addition to meeting the test requirement of BHMA A156.2, lever handles, roses, and escutcheons shall be 0.050 inch thick, if unreinforced. If reinforced, the outer shell shall be 0.035 inch thick and the combined thickness shall be 0.070 inch except that knob shanks shall be 0.060 inch thick. Lever handle shall be of plain design with ends returned to no more than 1/2 inch from the door face.

2.4 KEYING

Lock shall be keyed by base locksmith. Locks shall be furnished with the manufacturer's standard construction key system.

2.5 ARCHITECTURAL DOOR TRIM

Architectural door trim shall conform to BHMA A156.6.

2.5.1.1 Kick Plates

Kickplate shall be J102 aluminum. Width of plates shall be 2 inches less than door width for single door. Height shall be 12 inches. Edges of metal plates shall be square.

2.6 AUXILIARY HARDWARE

Auxiliary hardware, consisting of combination stop and holder shall conform to BHMA A156.16.

2.7 MISCELLANEOUS

2.7.1 Metal Thresholds

Thresholds shall conform to BHMA A156.21. Thresholds for exterior doors shall be extruded aluminum of the type indicated and shall provide proper clearance and an effective seal with specified weather stripping. Air leakage rate of weatherstripping shall not exceed 0.5 cubic feet per minute per lineal foot of crack when tested in accordance with ASTM E 283 at standard test conditions.

2.7.2 Aluminum Housed Type Weatherseals

Weatherseals of the type indicated shall consist of extruded aluminum retainers not less than 0.07 inch wall thickness with vinyl, neoprene, silicone rubber, polyurethane or vinyl brush inserts. Aluminum shall be bronze anodized. Weatherseal material shall be of an industrial/commercial grade. Seals shall remain functional through all weather and temperature conditions. Air leakage rate of weatherstripping shall not exceed 0.5 cubic feet per minute per lineal foot of crack when tested in accordance with ASTM E 283 at standard test conditions.

2.7.3 Combination Stop and Holder

Combination stop and holder shall conform to BHMA A156.16.

2.8 FASTENINGS

Fastenings of proper type, size, quantity, and finish shall be supplied with each article of hardware. Machine screws and expansion shields shall be used for attaching hardware to concrete or masonry. Fastenings exposed to the weather in the finished work shall be of brass, bronze, or stainless steel.

2.9 FINISHES

Unless otherwise specified, finishes shall conform to those identified in BHMA A156.18. Where painting of primed surfaces is required, painting is specified in Section 09900 PAINTING, GENERAL.

3 EXECUTION

3.1 APPLICATION

Hardware shall be located in accordance with DHI Locations for CSD and DHI Locations for SSD. When approved, slight variations in locations or dimensions will be permitted. Application shall be in accordance with DHI ANSI/DHI A115.1G. Alternate fastening methods may be approved by the Contracting Officer when manufacturers' documentation is submitted to verify that the fastening devices and door reinforcements are adequate to resist wind induced stresses.

3.1.1 Kick Plates

Kick plates shall be installed on the push side of single-acting door.

3.1.2 Thresholds

Thresholds shall be secured with a minimum of four fasteners per single door with a maximum spacing of 12 inches. Exterior thresholds shall be installed in a bed of sealant with expansion anchors and stainless steel screws, except that bronze or anodized bronze thresholds shall be installed with expansion anchors with brass screws. Minimum screw size shall be No. 10 length, dependent on job conditions, with a minimum of 3/4 inch thread engagement into the floor or anchoring device used.

3.1.3 Weatherseals

Weatherseals shall be located as indicated, snug to door face and fastened in place with color matched metal screws after door and frames have been finish painted. Screw spacing shall be as recommended by manufacturer.

3.2 HARDWARE SET

Hardware for Equipment Room Door:

2 pr	Hinges
1 ea	Lockset, F86 Grade 1
1 ea	Kickplate
1 set	Weatherstripping
1 ea	Combination stop and holder, L01371
1 ea	Threshold, Pemko 171A or approved equal
1 ea	Bottom sweep, Pemko 57AV or approved equal

** End of Section **

SECTION 09900
PAINTING, GENERAL

1 GENERAL

1.1 REFERENCES

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

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)

ACGIH Limit Values	(1996) Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 4214	(1998) Evaluating Degree of Chalking of Exterior Paint Films

COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-2246	(Rev B) Paint, Latex
CID A-A-2247	(Basic) Paint, Latex (Semigloss, Interior)
CID A-A-2962	(Rev A) Enamel, Alkyd (Metric)
CID A-A-2994	(Basic) Primer Coating, Interior, for Walls and Wood

FEDERAL SPECIFICATIONS (FS)

FS TT-E-2784	(Rev A) Enamel (Acrylic-Emulsion, Exterior Gloss and Semigloss) (Metric)

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC Paint 20	(1991) Zinc-Rich Primers (Type I - Inorganic and Type II - Organic)
SSPC Paint 23	(1982) Latex Primer for Steel surfaces

SSPC Paint 25	(1991) Red Iron Oxide, Zinc Oxide, Raw Linseed Oil and Alkyd Primer (Without Lead and Chromate Pigments)
SSPC SP 1	(1982) Solvent Cleaning
SSPC SP 2	(1995) Hand Tool Cleaning
SSPC SP 3	(1995) Power Tool Cleaning
SSPC SP 7/NACE 4	(1994) Brush-Off Blast Cleaning

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 00700 GENERAL:

Data

Paint; GA.

The names, quantity represented, and intended use for the proprietary brands of materials proposed to be substituted for the specified materialsregardless of quantities in states where VOC content limitations apply.

Instructions

Mixing and Thinning; FIO. Application; FIO.

Manufacturer's current printed product description, material safety data sheets (MSDS) and technical data sheets for each coating system. Detailed mixing, thinning and application instructions, minimum and maximum application temperature, and curing and drying times between coats for epoxy, moisture-curing polyurethane, and liquid glaze coatings. Detailed application instructions for textured coatings shall be provided.

Reports

Paint; FIO.

A statement as to the quantity represented and the intended use.

Certificates

Lead; FIO. Mildewcide and Insecticide; FIO. Volatile Organic Compound (VOC) Content; FIO.

Certificate stating that paints for interior use contain no mercurial mildewcide or insecticide. Certificate stating that paints proposed for use contain not more than 0.06 percent lead by weight of the total nonvolatile. Certificate stating that paints proposed for use meet Federal VOC regulations and those of the of the local Air Pollution Control Districts having jurisdiction over the geographical area in which the project is located.

Samples

Paint; FIO.

While the material is at the site or source of supply, and at a time agreeable to the Contractor and the Contracting Officer, a one quart sample of each color and batch, except for quantities of 50 gallons or less, shall be taken by random selection from the sealed containers by the Contractor in the presence of a representative of the Contracting Officer. The contents of the containers to be sampled shall be thoroughly mixed to ensure that the sample is representative. Samples shall be identified by designated name, specification number, manufacturer name and address, batch number, project contract number, intended use, and quantity involved.

1.3 PACKAGING, LABELING, AND STORING

Paints shall be in sealed containers that legibly show the designated name, formula or specification number, batch number, color, quantity, date of manufacture, manufacturer's formulation number, manufacturer's directions including any warnings and special precautions, and name of manufacturer. Pigmented paints shall be furnished in containers not larger than 5 gallons. Paints and thinner shall be stored in accordance with the manufacturer's written directions and as a minimum stored off the ground, under cover, with sufficient ventilation to prevent the buildup of flammable vapors and at temperatures between 40 and 95 degrees F. Paints shall be stored on the project site or segregated at the source of supply sufficiently in advance of need to allow 30 days for testing.

1.4 APPROVAL OF MATERIALS

When samples are tested, approval of materials will be based on test reports furnished with them.

1.5 ENVIRONMENTAL CONDITIONS

Unless otherwise recommended by the paint manufacturer, the ambient temperature shall be between 45 and 95 degrees F when applying coatings other than water-thinned and epoxy coatings. Water-thinned coatings shall be applied only when ambient temperature is between 50 and 90 degrees F. Epoxy coatings shall be applied only within the minimum and maximum temperatures recommended by the coating manufacturer.

1.6 SAFETY AND HEALTH

Work shall comply with applicable Federal, State, and local laws and regulations, and with the ACCIDENT PREVENTION PLAN, including the Activity Hazard Analysis as specified in the CONTRACT CLAUSES. The Activity Hazard Analysis shall include analyses of the potential impact of painting operations on painting personnel and on others involved in and adjacent to the work zone.

1.6.1 Worker Exposures

Exposure of workers to hazardous chemical substances shall not exceed limits established by ACGIH Limit Values, or as required by a more stringent applicable regulation.

1.6.2 Toxic Compounds

Toxic products having ineffective physiological warning properties, such as no or low odor or irritation levels, shall not be used unless approved by the Contracting Officer.

1.6.3 Training

Workers having access to an affected work area shall be informed of the contents of the applicable material data safety sheets (MDSS) and shall be informed of potential health and safety hazard and protective controls associated with materials used on the project. An affected work area is one which may receive mists and odors from the painting operations. Workers involved in preparation, painting and clean-up shall be trained in the safe handling and application, and the exposure limit, for each material which the worker will use in the project. Personnel having a need to use respirators and masks shall be instructed in the use and maintenance of such equipment.

1.6.4 Coordination

Work shall be coordinated to minimize exposure of building occupants, other Contractor personnel, and visitors to mists and odors from preparation, painting and clean-up operations.

2 PRODUCTS

2.1 PAINT

The term "paint" as used herein includes emulsions, enamels, paints, stains, varnishes, sealers, cement-emulsion filler, and other coatings, whether used as prime, intermediate, or finish coat. Paint shall conform to the requirements listed in the painting schedules at the end of this section, except when the required amount of a material of a particular batch is 50 gallons or less, an approved first-line proprietary paint material with similar intended formulation, usage and color to that specified may be used. Additional requirements are as follows:

2.1.1 Colors and Tints

Colors shall be as selected from manufacturer's standard colors, as indicated. Manufacturer's standard color is for identification of color only. Tinting of epoxy and urethane paints shall be done by the manufacturer. Stains shall conform in shade to manufacturer's standard color. The color of the undercoats shall vary slightly from the color of the next coat.

2.1.2 Mildewcide and Insecticide

Paint specified for all coats applied to structure surfaces in wash bays shall contain a mildewcide that will not adversely affect the color, texture, or durability of the coating. The mildewcide shall be incorporated into the paint by the manufacturer and shall attain a surface disfigurement rating of 8 or greater when tested in accordance with ASTM D 3273 and evaluated in accordance with ASTM D 3274. Mercurial mildewcide shall not be used in interior paint. Insecticides shall not be used in paint.

2.1.3 Lead

Paints containing lead in excess of 0.06 percent by weight of the total nonvolatile content (calculated as lead metal) shall not be used.

2.1.4 Chromium

Paints containing zinc chromate or strontium chromate pigments shall not be used.

2.1.5 Volatile Organic Compound (VOC) Content

Paints shall comply with applicable federal, state and local laws enacted to insure compliance with Federal Clean Air Standards and shall conform to the restrictions of the local air pollution control authority.

3 EXECUTION

3.1 PROTECTION OF AREAS NOT TO BE PAINTED

Items not to be painted which are in contact with or adjacent to painted surfaces shall be removed or protected prior to surface preparation and painting operations. Items removed prior to painting shall be replaced when painting is completed. Following completion of painting, workmen skilled in the trades involved shall reinstall removed items. Surfaces contaminated by coating materials shall be restored to original condition.

3.2 SURFACE PREPARATION

Surfaces to be painted shall be clean and free of foreign matter before application of paint or surface treatments. Oil and grease shall be removed prior to mechanical cleaning. Cleaning shall be programmed so that dust and other contaminants will not fall on wet, newly painted

surfaces. Exposed ferrous metals such as nail heads on or in contact with surfaces to be painted with water-thinned paints, shall be spot-primed with a suitable corrosion-inhibitive primer capable of preventing flash rusting and compatible with the coating specified for the adjacent areas.

3.2.1 Masonry Surfaces

Masonry surfaces shall be allowed to dry at least 30 days before painting. Surfaces shall be cleaned in accordance with ASTM D 4258. Glaze, efflorescence, laitance, dirt, grease, oil, asphalt, surface deposits of free iron and other foreign matter shall be removed prior to painting. Surfaces to receive epoxy coatings shall be acid-etched or mechanically abraded as specified by the coating manufacturer, rinsed with water, allowed to dry, and treated with the manufacturer's recommended conditioner prior to application of the first coat. Any chemical washing shall be only performed using cleaning agents which leave no residues or excess acid or alkali following final rinsing.

3.2.2 Ferrous Surfaces

Ferrous surfaces including those that have been shop-coated, shall be solvent-cleaned or detergent-washed in accordance with SSPC SP 1. Surfaces that contain loose rust, loose mill scale, and other foreign substances shall be cleaned mechanically with hand tools according to SSPC SP 2, power tools according to SSPC SP 3 or by sandblasting according to SSPC SP 7/NACE 4. Shop-coated ferrous surfaces shall be protected from corrosion by treating and touching up corroded areas immediately upon detection.

3.2.3 Nonferrous Metallic Surfaces

Galvanized, aluminum and aluminum-alloy, and other nonferrous metal surfaces shall be solvent-cleaned or detergent-washed in accordance with SSPC SP 1.

3.3 MIXING AND THINNING

When thinning is approved as necessary to suit surface, temperature, weather conditions, or application methods, paints may be thinned in accordance with the manufacturer's directions. When thinning is allowed, paints shall be thinned immediately prior to application with not more than 1 pint of suitable thinner per gallon. The use of thinner shall not relieve the Contractor from obtaining complete hiding, full film thickness, or required gloss. Thinning shall not cause the paint to exceed limits on volatile organic compounds. Paints of different manufacturers shall not be mixed.

3.3.1 Two-Component Systems

Two-component systems shall be mixed in accordance with manufacturer's instructions. Any thinning of the first coat to ensure proper penetration and sealing shall be as recommended by the manufacturer for each type of substrate.

3.4 APPLICATION

Painting practices shall comply with applicable federal, state and local laws enacted to insure compliance with Federal Clean Air Standards. Unless otherwise specified or recommended by the paint manufacturer, paint may be applied by brush, roller, or spray. At the time of application, paint shall show no signs of deterioration. Uniform suspension of pigments shall be maintained during application. Each coat of paint shall be applied so dry film shall be of uniform thickness and free from runs, drops, ridges, waves, pinholes or other voids, laps, brush marks, and variations in color, texture, and finish. Hiding shall be complete. Rollers for applying paints and enamels shall be of a type designed for the coating to be applied and the surface to be coated. Special attention shall be given to insure that all edges, corners, crevices, welds, and rivets receive a film thickness equal to that of adjacent painted surfaces. Paints, except water-thinned types, shall be applied only to surfaces that are completely free of moisture as determined by sight or touch.

3.4.1 Ventilation

Affected areas shall be ventilated during paint application so that workers exposure to chemical substances shall not exceed limits as established by ACGIH Limit Values, or as required by a more stringent applicable regulation. Interior work zones having a volume of 10,000 cubic feet or less shall be ventilated at a minimum of 2 air exchanges per hour. Solvent vapors shall be exhausted outdoors, away from air intakes and workers.

3.4.2 Respirators

Operators and personnel in the vicinity of operating paint sprayers shall wear respirators.

3.4.3 First Coat

The first coat on surfaces shall include repeated touching up of suction spots or overall application of primer or sealer to produce uniform color and gloss.

3.4.4 Timing

Surfaces that have been cleaned, pretreated, and otherwise prepared for painting shall be given a coat of the specified first coat as soon as practical after such pretreatment has been completed, but prior to any deterioration of the prepared surface. Sufficient time shall elapse between successive coats to permit proper drying. This period shall be modified as necessary to suit weather conditions. Oil-based or oleoresinous solvent-type paints shall be considered dry for recoating when the paint feels firm, does not deform or feel sticky under moderate pressure of the thumb, and the application of another coat of paint does not cause the undercoat to lift or lose adhesion. Manufacturer's instructions for application, curing and drying time between coats of two-component systems shall be followed.

3.4.5 Ferrous-Metal Primer

Primer for ferrous-metal shall be applied to ferrous surfaces to receive paint other than asphalt varnish prior to deterioration of the prepared surface. The semitransparent film applied to some pipes and tubing at the mill is not to be considered a shop coat, but shall be overcoated with the specified ferrous-metal primer prior to application of finish coats.

3.5 PIPE COLOR CODE MARKING

Pipes in exposed areas and in accessible pipe spaces shall be provided with color band and titles adjacent to all valves, at not more than 40 foot spacing on straight pipe runs, adjacent to change in direction, and on both sides where pipes pass through walls or floors. Color code marking shall be of the color listed in TABLE I and the size listed in TABLE II. The arrows shall be installed adjacent to each band to indicate the direction of flow in the pipe. The legends shall be printed in upper-case black letters as listed in TABLE I. Letter sizes shall be as listed in TABLE II. Marking shall be painted or applied using colored, pressure-sensitive adhesive markers of standard manufacture. Paint shall be as specified for insulated and uninsulated piping.

TABLE I. COLOR CODES FOR MARKING PIPE

Material	Band	Letters and Arrow*	Legend
Cold water (potable)	Green	White	POTABLE WATER
Hot water (domestic)	Green	White	H.W.
Compressed air	Blue	White	COMP. AIR
Natural gas	Yellow	Black	NAT. GAS

TABLE II. COLOR CODE MARKING SIZES

Outside Diameter of Pipe Covering (Inches)	Length of Color Band (Inches)	Arrow Length x Width (Inches)	Size of Legend Letters and Numerals (Inches)
Less than 1-1/2	8	8 x 2-1/4	1/2
1-1/2 to 2-3/8	8	8 x 2-1/4	3/4
2-1/2 to 7-7/8	12	8 x 2-1/4	1-1/4
8 to 10	24	12 x 4-1/2	2-1/2
Over 10	32	12 x 4-1/2	3-1/2

3.6 MISCELLANEOUS PAINTING

3.6.1 Lettering

Lettering shall be provided as scheduled on the drawings. Sample shall be approved before application.

3.7 SURFACES TO BE PAINTED

Surfaces listed in the painting schedules at the end of this section, other than those listed in paragraph SURFACES NOT TO BE PAINTED, shall be painted as scheduled.

3.8 SURFACES NOT TO BE PAINTED

Surfaces in the following areas shall not to be painted: surfaces of hardware, fittings, and other factory finished items.

3.9 CLEANING

Cloths, cotton waste and other debris that might constitute a fire hazard shall be placed in closed metal containers and removed at the end of each day. Upon completion of the work, staging, scaffolding, and containers shall be removed from the site or destroyed in an approved manner. Paint and other deposits on adjacent surfaces shall be removed and the entire job left clean and acceptable.

3.10 PAINTING SCHEDULES

The following painting schedules identify the surfaces to be painted and prescribe the paint to be used and the number of coats of paint to be applied. Contractor options are indicated by ------or------ between optional systems or coats.

EXTERIOR PAINTING SCHEDULE

Surface	First Coat	Second Coat	Third Coat
Concrete masonry units	FS TT-E-2784 Type III	FS TT-E-2784 Type III	
Ferrous metal unless otherwise specified	SSPC Paint 23 Type I	FS TT-E-2784 Type I	FS TT-E-2784
Galvanized metal	FS TT-E-2784 Type III	FS TT-E-2784 Type III	FS TT-E-2784 Type III
Aluminum aluminum-alloy, and other non-ferrous metal (non-galvanized)	FS TT-E-2784 Type III	FS TT-E-2784 Type III	FS TT-E-2784 Type III
Face brick In wash bays	Waterborne Epoxy Coating (Edison Coatings Aquepoxy 250-HD (clear) or approved equal)	Waterborne Epoxy Coating (Edison Coatings Aquepoxy 250-HD (clear) or approved equal)	None
Concrete masonry Units in wash bays	Waterborne Epoxy Coating (Edison Coatings Aquepoxy 250-HD (pigmented) or approved equal)	Waterborne Epoxy Coating (Edison Coatings Aquepoxy 250-HD (pigmented) or approved equal)	None

INTERIOR PAINTING SCHEDULE

Surface	First Coat	Second Coat	Third Coat
Concrete masonry Units not requiring smooth finish	CID A-A-2247	CID A-A-2247	None
Ferrous Metal Unless otherwise specified	SSPC Paint 25	CID A-A-2962	CID A-A-2962
		-- or --	
	SSPC Paint 23	FS TT-E-2784	FS TT-E-2784
Ferrous metal factory-primed mechanical and electrical equipment.	Two coats of paint as recommended by the equipment manufacturer		None

** End of Section **

SECTION 11000
CAR WASH EQUIPMENT

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification. The publications are referred to in the text by the basic designation only. The latest published version of each shall be used.

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 1	Industrial Control and Systems
NEMA ICS 2	Controllers, Contactors and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC
NEMA ICS 6	Industrial Control and Systems Enclosures

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	National Electrical Code (NEC)

1.2 GENERAL

Furnish and install the car wash equipment as specified herein and all other components required for a complete usable system.

The equipment selection, general layout, piping, and wiring arrangement specified herein and shown on the drawings indicate the minimum requirements for the car wash system. The system proposed by the bidders shall adhere as closely as possible to the layout on the drawings. Any and all variances recommended by the equipment manufacturer to meet the performance criteria shall be denoted by written exceptions in his bid; and costs for proposed variances shall be included in the contract price. The contractor shall secure the services of a registered Professional Engineer to certify that all equipment, electrical power and control wiring, conduit, compressed air, water, and gas piping sizes and materials specified herein or indicated on the drawings, or otherwise recommended by the equipment manufacturer, shall meet all codes and performance criteria specified herein; and shall operate as a complete usable system. All documents submittals required herein shall be affixed with the Engineer’s seal, signed, and dated.

All equipment, with exception to the fluid module and the pumping units, shall be products of the manufacturers specified herein, or approved equals. The fluid module and the pumping units shall be as manufactured by Mark VII Equipment, Inc. Arvada, CO or GinSan Industries, Inc. or Oasis Car Wash Systems, Galena, KS or equal.

Equipment shall include:

1) Hot water heater, storage tank, water circulating pump, and temperature controls
2) Water softener and automatic controls
3) High pressure pumping units, hour meters, LED indicators, and automatic controls
4) Fluid module with medium pressure pumps, metering and solution mixing tanks, flow meters, and automatic controls
5) Rigid and flexible tubing fluid delivery system
6) Overhead mounted 360 degree stainless steel spray wand booms with insulated hoses, swivels, foam generators and spray wands
7) 180 degree stainless steel bubble brush booms with insulated hoses, swivels, foam generators, spray wands, and brush stainless steel holders
8) Freeze protection to include overhead hot water circulation tubing and automatic boiler controls, automatic fail-safe brush and wand weep systems
9) Multi-color Lexan signage
10) Stainless steel floor mat holders
11) Stainless steel in-the-wall 12 position rotary switch coin operated control, collection, and rejection boxes with 1” high digit LED count-down display timer
12) Stainless steel in-the-wall $5 and $1 bill changer
13) Pre-wired electrical power and control harnesses for the pumping units and coin control boxes
14) Air compressor, storage tank, and automatic controls
15) Reverse osmosis water filtering system, spot free storage tank, re-pressurization pump and storage tank.
16) Stainless steel floor mounted, single compartment sink, faucets, drain trap, and wringer.
17) Dual vacuum systems with coin operators

All equipment shall be suitable for operation on 120/208 VAC, single or three-phase power.

1.3 PERFORMANCE

1.3.1 The system shall deliver multiple washing solutions to a spray wand and a bubble brush provided in each of 3 Bays at the pressure and temperature specified herein, with an ambient outdoor air temperature of 45 Deg F, and with all twelve (12) washing/cleaning solutions selected for each car sequentially entering the Bays continuously for two hours and within 3 minutes of completion of cleaning of the previous car in the same Bay.

1.3.2 System shall be capable of delivering high pressure cleaning and washing solutions at 3.5 GPM in each of the 3 Bays simultaneously through an insulated safety trigger wand at 1200 PSI residual pressure and 100 Deg. F. discharge temperature with 50 Deg. F domestic cold water supplied to the hot water heating system.

1.3.3 System shall be capable of delivering medium pressure cleaning and washing solution bubbles at atmospheric pressure through a Bubble Brush at 1 GPM and 100 Deg. F. discharge temperature with 50 Deg. F domestic cold water supplied to the hot water heater.

1.3.4. The automatic hot water circulating freeze protection system and the timed/automatic weep freeze protection systems shall be simulated to operate as specified under cold weather conditions by manually triggering the automatic control devices. Conditional acceptance of the freeze protection system shall be granted until the system is demonstrated to perform satisfactorily by automatic operation under the ambient conditions specified.

1.4 SUBMITTALS

1.4.1 Shop Drawings: Shop drawings shall be submitted in accordance with the Section 00700, GENERAL and shall consist of illustrations, schedules, performance charts, instructions, brochures, diagrams and complete shop drawings of the car wash system and any other information required to illustrate the system has been coordinated and will function as a unit. Six each copies of the submittal information shall be provided to include drawings showing physical dimensions of the equipment; all interconnecting piping, pipe sizes, pipe materials, and type of connections; all internal, external, and interconnecting power, control wiring, and design calculations.

Control wiring shall show all printed circuit boards, equipment, devices, power and control wiring external to the circuit boards. Everything shall be clearly labeled with device description, device ratings, part numbers, wire color, wire number, cable type and connector type. Provide a written sequence of operation for each system. Include all equipment and devices in the description.

1.4.2 Test Procedures: The Contractor shall furnish to the Contracting Officer detailed test procedures for the car wash system prior to performing system tests. The test procedures must be signed by a registered Professional Engineer who has had at least 2 years experience in car wash systems design. Qualifications shall be submitted to and approved by the Contracting Officer.

1.4.3 Spare Parts Data: After approval of the shop drawings, the Contractor shall furnish spare parts data for each different item of materials and equipment specified. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of the parts recommended by the manufacturer to be replaced after 1 year of service.

1.4.4 Operating and Maintenance Instructions:

1.4.4.1 The Contractor shall furnish to the Contracting Officer copies of operating instructions outlining the step-by-step procedures required for system start-up, operation and shutdown. The instructions shall include the manufacturer's name, model number, catalog cuts, diagrams, drawings, parts list, and descriptive data covering the proper operatoion and testing.

1.4.4.2 The Contractor shall furnish to the Contracting Officer copies of maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. The instructions shall include simplified diagrams for the system as installed.

1.4.4.3 Three each neatly labeled, indexed, tabbed copies of instruction manuals in 3 ring binders shall be provided at the completion of the facility construction which will contain a copy of all of the required and approved submittal material. In addition, the instruction manuals shall contain a listing of all components by part number; a written sequence of operations describing the function of all components; data showing operating pressures, temperature, concentration of all fluid solutions in the system, trouble-shooting, and a description of how to make adjustments to the system to maximize the efficient use of chemicals.

1.4.5 Performance Test Reports: Upon completion and testing of the installed system, test reports shall be submitted in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria. Each test report shall indicate the final position of the controls.

1.5 QUALITY ASSURANCE

1.5.1 Manufacturer’s Qualifications

The car wash equipment manufacturer shall be regularly engaged in the manufacturer of type of equipment required for this project; and shall have minimum five years of experience. Proof of experience shall be submitted upon request of the Contracting Officer.

1.5.2 Installer's Qualifications

Contractor shall provide an installation supervisor who has a minimum of five years of experience in installation of the manufacturer’s car wash equipment provided under this contract. Installation personnel shall be skilled and experienced in the assembly, operation, and testing of the type and size equipment required for this project.

1.6 DELIVERY, STORAGE, AND HANDLING

Deliver materials in original rolls, packages, containers, boxes, or crates bearing the manufacturer's name, brand, and model number. Store materials and equipment in dry locations with adequate ventilation, free from dust and water, and so as to permit access for inspection and handling. Handle materials carefully to prevent damage. Remove damaged items that cannot be restored to like-new condition and provide new items.

PART 2 PRODUCTS

2.1 High Pressure Pumping Units

Provide three (3) high pressure pumping units, each with a 5HP, 208V, 3P, 1725RPM electric TEFC motor and a belt driven positive displacement pump, factory assembled, pre-piped and pre-wired, with rigid copper/brass piping manifolds, valves, instrumentation, glycerin-filled pressure gages, 24V wash/wax/spot free rinse controls, and color coded power and control wiring all mounted as a package on a minimum 12 gage all stainless steel frame with adjustable leveling leg posts and vibration damper pads.

Pumps shall be CAT Pump Model 310 or equal, 4GPM, 1200PSI, 950RPM triplex plunger type, with oil bath cast aluminum crankcase, chrome-moly crankshaft, high tensile stainless steel plunger rods, solid ceramic graphite impregnated plungers, high tensile strength forged brass manifold, stainless steel inlet and discharge valves, high pressure mechanical seals, belt guard, motor starter, and safety switch.

Back-pressure regulator, unloader valve, relief valve, solenoid valves, and manual control valves shall be provided for each pump unit and shall be U.S. Para Plate Corporation or equal, all stainless steel construction, and rated for 0-4GPM, 1000-1500PSI.

High pressure hoses connecting the fluid module and pumping unit shall be 3/8 inch inside diameter polybraid flexible 3000PSI wire reinforced rubber hoses with zinc fittings. High pressure hoses from the pumping unit to the bays shall be 1/2 inch inside diameter polybraid flexible 3000PSI wire reinforced rubber hoses with zinc fittings. No splices shall be made in the tubing between the pumping unit and the brush or spray wand booms. Provide stainless steel escutcheons and rubber grommets where each hose or tubing passes through the sheet metal building structure.

Prefabricated multi-conductor cables with DB-25 serial cable connectors shall be provided to interconnect the fluid module to each of the three pumping units. A color coded 19-conductor cable shall be provided in the correct length to connect the pumping units to each of the three coin boxes. Power to the coin boxes shall be provided through this 19-conductor cable as distributed from the pumping unit. Plug connectors shall be provided and installed by the car wash equipment manufacturer.

A single pre-wired fused disconnect switch in a stainless steel enclosure shall be provided and mounted on each pumping unit. A stainless steel enclosed control panel shall be provided for each pump pre-wired and with pre-plumbed fluid lines, all mounted on the stainless steel frame. The control panel shall bear the UL listing label for industrial control panels and shall be in a NEMA 250, Type 1 enclosure.

The control panel shall include the following: No-flow shutdown; audio-visual alarm; external resets; magnetic motor controllers; time delays; transformer; switches for each pump; minimum run timers; low suction pressure cutout; and indicating lights for power on, individual motor overload, and low suction pressure shall be provided. All components of the High Pressure Pumping Unit to include electrical enclosures with hinged doors shall be constructed of stainless steel. Individual regulators and flow gauges for fluid functions shall be provided for each Bay. The pumps shall be protected from thermal buildup, when running at no-flow, by a thermal relief valve. A total hour meter shall be provided for each pump.

System shall be protected from freezing weather to 10 Deg. F as follows:

1) A timed/automatic weep system for the bubble brushes and spray wands shall operate automatically when the ambient temperature drops below 40 Deg. F to protect the exposed equipment in the wash bays.

2) A timed/automatic antifreeze fluid injection system shall be provided to keep the brush and wand hoses from freezing. System shall automatically inject an approved non-toxic, bio-degradable antifreeze when the ambient temperature drops below 40 Deg. F to protect the exposed equipment in the wash bays.

3) Fluid lines above the ceiling shall be protected by circulating hot water lines in the tubing support trays. Hot water circulating system shall operate automatically when the ambient temperature drops below 40 Deg. F by energizing the hot water boiler, circulating pump, and automatic control valve. All hoses above the bay ceilings shall be insulated individually with 3/4 inch thick cellular foam insulation. Hoses shall also be bundled and strapped together with the hot water circulating copper tube freeze protection system piping; and neatly wrapped and bound together with minimum 2 inch thick aluminum foil-backed fiberglass insulation around the entire support tray.

2.2 Compressed Air Operated Medium Pressure Fluid Pumping Unit

Provide one (1) medium pressure fluid pumping unit with eight (8) each air operated diaphragm type positive displacement pumps as manufactured by ARO with cast aluminum housing, Buna-N diaphragm, stroke control, pulsation damper. Each unit shall be factory assembled, pre-piped and pre-wired, with rigid copper/brass piping manifolds, valves, instrumentation, 24V controls, and power wiring all mounted as a package on a minimum 12 gage all stainless steel frame with

adjustable leveling legs posts. Individual metering and shutoff valve shall be provided for each fluid concentrate. Twelve (12) each 14 gage stainless steel fluid tanks with Cleveland Co. float/metering and automatic mixing/refill controls shall be provided for the following solutions:

1) Medium pressure presoak soap solution
2) Tire cleaner foam solution
3) Wheel cleaner foam solution
4) High pressure soap solution
5) Bubble brush foam solution
6) Painted surfaces foaming conditioner
7) Bug cleaner solution
8) Glass cleaner solution
9) High pressure rinse water
10) High pressure clear coat protectant (hot wax)
11) Spot free low pressure ultra-pure rinse water
12) Antifreeze injection system

Space shall be provided on the floor adjacent to the pumping unit for mounting twelve (12) each 30 gallon plastic drums containing the above listed concentrated fluids. An ejector on each stainless steel solution tank shall remove the concentrate from the drum; meter and mix the concentrate with water in the correct proportion. All equipment shall be mounted on the stainless steel unit frame with pre-plumbed air and fluid lines. All components of the Medium Pressure Fluid Pumping Unit to include electrical enclosures with hinged doors shall be constructed of stainless steel. Individual air and fluid regulators, fluid flow and pressure gauges shall be provided for each solution. Each pump shall be equipped with an air pressure regulator and an air dump valve assembly.

2.3 Spare Parts Kit for Pumping Unit and Fluid Module

1) One (1) 24 volt transformer with fuse and fuse block
2) One (1) rotary switch
3) One (1) 3/8 x 14 foot high pressure hose with fittings
4) One (1) 17 foot bubble brush hose
5) One (1) bubble brush assembly
6) One (1) 3/8 x 12 inch high pressure hose assembly
7) One (1) 3/8 inch hose swivel
8) Two (2) boom swivels
9) Two (2) trigger gun assemblies
10) Two (2) gun barrels
11) Two (2) nozzles
12) Two (2) switch knobs
13) Two (2) 24 volt lamps

14) One (1) infrared coin switch
15) Two (2) Accutime timers
16) One (1) coin box door lock with key
17) One (1) 15 foot x 2 inch vacuum hose
18) Two (2) vacuum hose nozzles
19) Five (5) 1/4 inch poly-flow ferrules
20) Five (5) 3/8 inch poly-flow ferrules

2.4 Rotary Timer and Coin Safe

Provide three (3) stainless steel coin boxes each with an IDX MH 800 twelve (12) position rotary timer, coin acceptor ($.25 coin & $1.00 bill) / rejector and steel enclosure with hinged, key operated locking steel door for flush mounting in a masonry wall. Boxes shall be 15.5 x 15.5 x 7.25 inches. Stainless steel coin safes shall be 10.75 x 11.5 x 7.25 inch steel enclosures with a hinged, key lock stainless steel door and key lock suitable for mounting in a masonry wall. Coin tray shall be provided capable of storing $1000 in change or cash. Provisions shall be made for a 2 inch threaded steel conduit nipple connection between the coin box and the respective coin safe. Coin boxes shall operate on 120VAC power.

2.5 Large Display Units

Provide three (3) each Dixmore Model DX2000 wall mounted LED display units with GIANT 3 x 12 inch dot matrix alpha/numerical displays, stainless steel wall mounted enclosure 19 x 8.5 x 1 1/2 inch , programmable moving sign board type display, “Last Minute Warning” display & “More Coins Needed” horn output interfaced with coin operator, 24 hour real time clock controlled secondary output, remote turn-on of timer output, and built-in “sun switch” light control feature. Provide IBM compatible software and communications cables to telephone connectors in flush mounted wall box in mechanical equipment room for connection to GFE laptop computer for programming the displays.

2.6 Bill Changer

Provide Rowe BC 1400 Bill Changer which accepts 5 denominations ($1, $2, $5, $10, $20), dual (2000 bill) stacker, and with 2 each ($.25) coin hoppers. Enclosure shall be 38 5/8 x 12 1/16x 18 1/4 inch 10 gage stainless steel with a hinged, key lock <u>high security</u> stainless steel front door, hinged rear service door, heater, and suitable for mounting in a masonry wall. Coin tray shall be provided capable of storing $1300 in change or cash.

2.7 Drop Down Shelf Vendor

Provide stainless steel drop down shelf vendor. Vendor shall be all stainless steel, weatherproof 20 gage cabinet and 18 gage door with 12 gage stainless steel finished frame, 42 x 5 1/4 x 12 1/4.

Vendor shall have twenty-four drop shelves with turned up edges, high security coin box with $110 capacity, adjustable from $.25 to $3.5 (1-14 coins). Products shall be provided to fill and divided equally on all shelves; and shall include Amour All, Wet Towell, Sara Dry, Mr. Towel, Hugh & Hefty, PWC Cleaner, and Mr White Wall. Provide Pedistal #1004. Mount on wall at same height, and adjacent to the bill changer.

2.8 360-Degree High Pressure Single Boom and Spray Wand

Provide three (3) each 360-degree high pressure booms, J.E. Adams, or equal, Model 6050. Booms shall be constructed of all stainless steel with 75 inches long spring loaded arm and 1/2 inch mounting holes on 23 3/8 inch centers, 3/8 inch high pressure in-line hose swivel, 8 feet long 3/8 inch wire-braided polybraid high-pressure hose from boom to wand. Provide a compressed air actuated all copper/brass foam generator assembly with associated copper/brass valves and fittings for each boom. Provide J.E. Adams, or equal, Model 6048 3/8 inch wire braided hose assembly, Model 7445 swivel, Model 5800D2, 90 Deg fitting, and Model 6318 pulse hose assembly.

2.9 180-Degree Low Pressure Single Boom and Bubble Brush

Provide three (3) each 180-degree low pressure booms, J.E. Adams, or equal, Model 6090. Booms shall be constructed of stainless steel with 72 inches long rigid foam brush arm, 3/8 inch mounting holes on 7 inch centers, and rubber boom stops. Provide a compressed air actuated all copper/brass foam generator assembly with associated copper/brass valves and fittings for each boom. Provide J.E. Adams, or equal, Model 6098 17 feet long 3/8 inch wire braided hose assembly, Model 7445 swivel, Model 5800D2, 90 Deg fitting, and Model 6318 pulse hose assembly. Provide hog-hair weep bubble brush with 48 inch long insulated high temperature plastic handle, 12 x 4 heavy duty bristled brush, 3/8 inch NPT inlet and rated for 125 PSI at 1 GPM as manufactured by J.E. Adams.

2.10 Bay Activation Manual Override Switch

Provide a manual override red heavy-duty oil tight mushroom pushbutton switch flush mounted in wall box near the Mechanical Room door and wired to shut down all pumping units in an emergency.

2.11 Wand Holders, Bubble Brush Holders, and Hose Hooks

Provide three (3) each all stainless steel floor mounted wand holders and all stainless steel hose hooks with 1 1/2 inch NPT threaded weep attachment to sanitary sewer and six (6) each plastic coated stainless steel bubble brush wall mounted brush and hose hooks.

2.12 Application Gun

Provide three (3) each J.E. Adams, or equal, Model 4830W Liberty weep gun with pistol grip five finger safety trigger, 18 inch long stainless steel discharge wand with insulated barrel, spray tip with 3.5GPM, 1100 PSI rated orifice, 3/8 inch NPT inlet, 1/8 inch NPT outlet and rated for maximum 3000 PSI at 8 GPM.

2.13 Signage

Provide the following Lexan signage for each of the three (3) each bays:

1) “Instructions” sheet with backing plate
2) “High Pressure” warning
3) “Need More Time”
4) “Hang Hose on Hook”
5) “Clean Mats Here”
6) “Spot Free Rinse”
7) “Squeeze Trigger”
8) “Tire”
9) “Arrow”
10) “Presoak”
11) “Brush Instructions”
12) “Change” Sign for Bill Changer
13) “Oil Dumping is Strictly Prohibited in Bay Drain”
14) “Washing of Engines is Prohibited – ACCMAN 32-7051”

2.14 Mat Hangers

Provide three (12) each J.E. Adams, or equal, Model 6002 aluminum clamp mat hangers with urethane mat gripper and Lexan white on red decal.

2.15 Initial Fill of Supplies

Provide initial fill of supplies to include one (1) 30 gallon drum of the concentrate for each of the twelve(12) listed medium pressure pumping unit solution tanks. Concentrate drum shall be labeled by the original product manufacturer with the recommended concentration of the mixed solution for the application intended. Product labels and OSHA Material Safety Data Sheet shall be submitted and provided with each concentrate indicating concentrations of all hazardous and non-hazardous materials.

2.16 Warranty

Provide 1 year warranty on parts and labor should any part fails under normal use.

2.17 Vacuum Cleaning Units

Provide two (2) each J.E. Adams, or equal, Model 8960 Dual Vacuum (Double Sided) commercial heavy-duty automobile vacuum systems, each system with four vacuum motors (one high vacuum and one low vacuum for each half of both systems) and two coin ($.25) operated controls. The larger vacuum motor shall be minimum 1.6 HP, 20 A, 1P, 120 VAC capable of providing 200 CFM at 90 inches of water lift. The smaller vacuum shall be approximately 1 / 2 the rating of the larger pump.

Provide two stage selector control for high and low vacuum to permit manual selection of either the larger or the smaller of the two motors. An 18-gauge stainless steel, brushed finished, large capacity coin box shall hold minimum $500 in quarters. A clamping latch and key operated locks on the system faceplate shall be provided for quick access to the coin box and controls.

The dirt canisters shall be constructed of 16-gauge steel with 0.60 cubic feet capacity in a large central service and control compartment. A 15 feet by 2 inch diameter heavy duty vacuum hose on each side shall be provided with swivel cuff, nozzle, and hose bracket. Provide filtration media for 30 day operation for each unit.

Complete system casing shall be factory primed and factory painted to match the color of the vacuum island structure. Provided with white translucent lighted dome internally pre-wired to the vacuum motor electrical service.

2.18 Stainless Steel Sink

Provide one (1) each stainless steel ASME A112.19.3M 24 x 24 inch compartments, 12 inch deep, 7.5 inch splash back. Type 304 stainless steel bowl, adjustable leveling legs, and backsplash, minimum 12 gage construction. Drain shall have quick opening valve. Support on stainless steel legs.

Faucet and Spout - Cast or wrought copper alloy, with backflow preventer. Chrome plated faucets shall have replaceable seat and the washer shall rotate onto the seat. Chrome plated strainers shall have internal threads. Combination faucets with two valves and spouts shall be provided.

Handles - Cast copper alloy, wrought copper alloy, or stainless steel, four arm type.

Drain Assembly - Plug, cup strainer, crossbars, jam nuts, washers, couplings, stopper, etc., shall be copper alloy or stainless steel.

2.19 Chamois Wringer

Provide one (1) each J.E. Adams, or equal, Model 6031 chamois wringer to mount on stainless steel sink with rustproof, all steel frame, forged steel handle, and gray baked-enamel finish, hard maple bearings, and clamps which open to 1.75 inch, 12 inch wide by 1.875 inch diameter rolls.

2.20 Air Compressor

Air compressor unit shall be a factory-packaged assembly, including motor controls, switches, wiring, air dryer, accessories, and motor controllers, in a NEMA 250, Type 1 enclosure, Ingersoll Rand Type 30 Model 2475N5 (17ACFM, 175PSI maximum) or equal. Tank-mounted belt driven 2 cylinder air compressors with 5HP TEFC motor and belt guard shall be manufactured to comply with UL listing requirements. Air compressor shall have removable cylinders, one-piece connecting rods, splash lubrication, ductile iron crankshaft, fined copper intercooler, two-stage design, centrifugal unloader, low oil level switch, aftercooler, automatic drain valve and magnetic starter. Air compressor~~s~~ shall have manufacturer's name and address, together with trade name, and catalog number on a nameplate securely attached to the equipment. Compressor shall start and stop automatically at upper and lower pressure limits of the system. Guards shall shield exposed moving parts. Compressor motor shall be provided with an across-the-line-type magnetic controller, complete with low-voltage release. An intake air filter and silencer shall be provided with each compressor. Aftercooler and moisture separator shall be installed between compressors and air receiver to remove moisture and oil condensates before the air enters the receiver. The air shall pass through a sufficient number of tubes to affect cooling. Tubes shall be sized to give maximum heat transfer. Cooling capacity of the aftercooler shall be sized for the total capacity of the compressors. Provide an automatic float trap or pneumatic operated drain valve for condensed moisture drain from the receiver.

Receiver shall be 80GAL vertical tank with support legs and designed for 200 psi working pressure. Receivers shall be factory air tested to 1-1/2 times the working pressure. Receivers shall be equipped with safety relief valves and accessories, including pressure gauges, automatic and manual drains, adjustable leveling legs, and vibration damper pads. The outside of air receivers may be galvanized or supplied with commercial enamel finish. Receivers shall be designed and constructed in accordance with ASME BPV VIII Div 1 and shall have the design working pressures specified herein. A display of the ASME seal on the receiver or a certified test report from an approved independent testing laboratory indicating conformance to the ASME Code shall be provided.

Dry type air filter shall be provided having a collection efficiency of 99 percent of particles larger than 10 microns. Filter body and media shall withstand a maximum 125 psi, capacity as indicated.

The air system shall be provided with the necessary adjustable regulator valve(s) to maintain the desired pressure for the installed equipment. Regulator(s) shall be designed for a maximum inlet pressure of 175 psi and a maximum temperature of 200 degrees F. Regulators shall be single-

seated, pilot-operated with valve plug, bronze body and trim or equal, and threaded connections. The regulator valve shall include a pressure gauge and shall be provided with an adjustment screw for adjusting the pressure differential from 0 to 125 psi.

2.21 Water Softening System

Provide a Culligan HI-FLO 2, Model PV-45A or equal commercial heavy-duty water system with solid state controls capable of reducing the hardness from 300 mg/L to less than 1 mg/L. The system shall be designed to handle a flow rate of 26GPM continuous flow at a pressure loss of not exceeding 15 PSI. The system shall have a minimum softening capacity of not less than 30,000 grains of softening capacity per regeneration with a salt dosage of 9 pounds per tank.

Softener resin tank shall be minimum 12 inches in diameter. The side-shell height shall be minimum 38 inches, sufficient to allow proper freeboard space above the resin bed depth for adequate expansion of the resin during backwashing. Tanks shall be designed for a working pressure of 100 PSI. Each will be equipped with a removable opening in the top head for media filling purposes. All tanks shall consist of a minimum 20 mil thick vinyl liner hermetically sealed within the steel tank to protect against internal corrosion. The tank constructed of molded high-density polyethylene for corrosion resistance. It shall also act as an insulator to minimize condensation on the surface of the tank.

Softener tank shall be equipped with a soft water collector and back-wash water distributor consisting of a plastic riser pipe with a fine-slotted plastic strainer attached to the bottom of the pipe, covered with a minimum of 3 inches of under-bed sand to ensure even distribution of water. Softener tank shall be equipped with an upper distributor that distributes water laterally to ensure maximum water softening capacity.

Softener tank shall be provided with minimum 1.5 cubic feet of resin. The media shall be solid and shall contain no agglomerates, shell, plates, or other shapes that might interfere with the normal function of the water softener. All resin will be manufactured to comply with food additive regulation, Paragraph 121-1148 of the Food and Drug Administration.

A combination salt storage and brine tank, measuring minimum 18 inches in diameter by 38 inches tall with cover will be provided. The tank shall be molded of corrosion-proof, high-density polyethylene. The brine tank shall be equipped with an elevated salt plate for brine collection, and a chamber to house a brine valve assembly. The brine valve shall automatically open to admit brine to the resin tank during eduction and close automatically to prevent introduction of air into the resin tank. During refill, the brine valve shall regulate the flow of soft water into the brine, tank, working with the timed refill feature of the softener control valve; together these components shall admit the correct volume of water to the brine tank in accordance with the salt dosage settings on the control valve. The brine valve shall include a

float-operated safety shut-off valve, as a back-up to the time refill valve on the control to prevent brine tank overflow.

The main control valve shall be of the 4-position motor-driven piston type to positively locate the internal valve piston to route the flow of water through the softener during service, back-wash, brine draw/brine rinse, and fast rinse/brine refill. The valve body shall be molded of phenylene oxide thermoplastic to resist attack by substances found in natural water supplies

The valve shall contain fixed and self-adjusting flow controls to control water flow through the valve during back-wash, brine and slow rinse, and fast rinse, when water pressure is between 30 and 100 PSIG. The internal piston and seal assembly shall be of modular cartridge design for ease of replacement and service. The control shall be fully tested before shipment and shall be made by the same manufacturer as the tank.

Units shall be fitted with 1 1/2-inch NPT inlet and outlet water pipe connections and diaphragm type valves to control water flow through the softener during the service cycle to permit high flow rates during regeneration with minimum pressure drop.

Regeneration frequency shall be controlled by a solid state system which permits regeneration at any time of day or night, on any day or every day of the week. The timer shall permit adjustment of back-wash time and fast rinse/refill time. An extra recharge control shall be provided to permit manual regeneration at any time. An automatic reset water meter shall also be provided and override the 7-day calendar clock to initiate regeneration after a pre-set maximum number of gallons has flowed through the meter.

If two resin tanks are required to meet the specified continuous capacity, a duplex alternator shall be provided. It shall control the units such that only one unit to be in the service cycle at any given time, while keeping the other unit in regeneration, or on standby after regeneration. It shall be equipped with lights to indicate which unit is in the service cycle.

2.22 Water Heater

Provide one (1) hot water heater to supply water for hot rinse. Unit shall be Lochinvar Model RWN 500PM-F9, or equal copper fin tube hot water boiler capable of delivering 8 GPM at 100 Deg F rise with 500,000 BTUH natural gas input. Gas-fired water heater shall have controls with an adjustable range that includes 90 to 150 Deg F. discharge water temperature. Gas-fired water boiler shall conform to AGA, ANSI Z21.10 and certified to 160 PSI working pressure. Provide the following:

1) Electronic ignition and 100% flame safety safeguard.
2) Entering and discharge pressure and temperature gages
3) Draft hood of size recommended by unit manufacturer (min 10 inch diameter)

4) Provide a 150PSI ASME pressure and temperature relief valve
5) Dielectric unions for connections to metallic pipe
6) Gas pressure regulator and gas shutoff valve
7) Electronic temperature controls to include outdoor air thermostat and wiring for boiler water temperature and freeze protection with high limit control, immersion thermostat.
8) Ceramic tile combustion chamber
9) Stainless steel burners
10) Galvanized steel jacket and high gloss acrylic paint finish

Provide an inline centrifugal hot water boiler circulating pump with 120 Volt, 1 Phase, 1/4 HP motor, controlled by Honeywell thermostat with 0-100 Deg F range, SPDT 8A, 120VAC rated contact, remote outdoor air bulb sensor and sun guard and motor starter. Provide all necessary power and control wiring.

Equipment shall be installed as indicated and in accordance with the recommendations of the equipment manufacturer and the listing agency, except as otherwise specified.

Heater shall be installed at height indicated with clearance to combustibles complying with minimum distances as determined by the AGAL Directory of Certified Appliances and Accessories, the UL Gas and Oil Equipment Directory, and as indicated on each heater approval and listing plate. Heater shall be independently supported from the building structure as indicated and shall not rely on support from suspended ceiling systems.

Vent piping and structural penetrations shall be located as indicated. Vent piping shall be type B, conforming to the requirements of ANSI Z223.1. Vent pipes shall extend through the roof and shall terminate in compliance with ANSI Z223.1. Vent passing through waterproof membranes shall be provided with the necessary flashings to obtain waterproof installations.

Provide a 120 GAL vertical steel, galvanized, 160 PSI ASME certified, hot water storage tank with 150 PSI ASME pressure relief valve. Tank shall be thermally insulated with minimum 1 1/2 inch thick fiberglass insulation and aluminum lagging in accordance with section 15250 Thermal Insulation for Mechanical Systems.

Gas piping shall be connected as indicated and shall comply with the applicable requirements at SECTION: GAS PIPING SYSTEMS.

2.23 Reverse Osmosis System, 3600 Gallon Per Day

Provide one (1) Culligan Model C-2 reverse osmosis unit which shall remove 98% of dissolved minerals, and 100% of colloidal and suspended matter.

Unit membrane shall be physically strong to stand up to high osmotic pressure, 400 PSI.
Thin film composite membranes shall be made of cellulose acetate or polyamide

composites cast into a thin film, either as a sheet or fine hollow fibers. The membranes shall be constructed into each of two cartridge reverse osmosis modules. Controls shall be provided to switch between modules and to back-flush the system automatically; and be connected to operate on demand from the high-pressure fluid pumping units and fluid module control system. The unit shall operate on a single 120VAC, 20A, single-phase circuit.

Domestic water shall be pre-filtered to remove suspended particles and pressurized to 200 - 400 PSI to reach the water's osmotic pressure. A minimum of 3600 gallons per day shall (permeate) diffuse through the membrane leaving dissolved salts and other contaminants behind with the remaining water where they shall be piped to the sanitary sewer drain as waste (concentrate).

The domestic cold water shall be pretreated with the water softener to enhance quality and quantity of the RO unit; and to reduce water-borne contaminant deposits on the membrane.

Unit shall consist of stainless steel membrane modules, stainless steel module housings, all stainless steel high pressure pump with 3 HP, 3 Phase, 208V, TEFC motor, cartridge pre-filter, pressure gages, flow meters, NEMA rated solid state control panel with motor starter and status indicator lights, stainless steel concentrate valve to set system recovery, low pressure shutdown, and total dissolved solids monitor.

Provide a 300 GAL UV-Stabilized, FDA-listed resin atmospheric vertical storage tank with float switch to control the RO unit pump and with overflow piped to the floor drain.

Provide a re-pressurization system consisting of a 1HP, 208V, 3 phase, TEFC motor driven centrifugal bronze bodied pump with stainless steel impeller that comes on automatically to fill and pressurize a 175 PSI ASME certified 20 GAL galvanized bladder tank to maintain pressure to provide an even 35 GPM supply of water at 60 PSI when the demand arises as sensed by an automatic pressure controller. Re-pressurization pump and bladder tank shall be mounted on a 12 gage stainless steel frame with motor starter and discharge pressure gage.

Provide one spare pre-filter and one spare set of membranes for the RO unit.

2.24 Water and Compressed Air Hose Reel

Provide one (1) J.E. Adams, or equal, Industries Model 6026 retractable stainless steel hose reel base and 8670-1WB combination air/water cabinet. Base and cabinet shall be constructed of 12 gage stainless steel with 25 foot steel braided hose which automatically retracts into the cabinet. Hoses shall be complete with pressure gages, valves and nozzles.

2.3 ELECTRICAL WORK

The Contractor shall provide new electrical equipment and controls constructed in accordance with the latest NEMA standards. Installation of equipment, control circuits, and circuits shall conform to NFPA 70. Manual and automatic control devices necessary for operation of the system shall be provided by car wash equipment manufacturer to include heavy duty push button stations, indicating lights, magnetic starters, control circuit transformers, relays, timing devices, warning devices, solenoids, prefabricated cables and connectors and electronic solid state controls.

PART 3 EXECUTION

3.1 CLEANING:

All metal surfaces shall be factory primed and painted. Field fabricated components shall be painted in accordance with Section 9A - Painting, General.

3.2 INSTALLATION:

3.2.1 Car Wash Equipment to be installed by the manufacturer's representative:

1) Fluid hoses and compressed air tubing between all car wash equipment to include the high pressure pumping unit, low pressure fluid module, foam generators, spray wands, bubble brushes.

   High pressure hoses shall be minimum 3/8 inch diameter flexible 3000 PSI rated steel reinforced rubber hose with factory stainless steel compression connectors insulated with minimum 3/4 inch thick cellular foam insulation.

   Medium pressure hoses shall be 150 PSI rated polyethylene tubing with stainless steel screw hose clamps with minimum 3/4 inch thick cellular foam insulation.

   Compressed air piping shall be minimum 1/4 inch ANSI B88 copper tubing with threaded joints rated for 125 PSI working pressure.

2) Electrical control ribbon cables and wiring harnesses between all car wash equipment to include the high pressure pumping unit, medium pressure fluid module, spray wands, bubble brushes, and coin boxes.

3) Power and control wiring and connections within the car wash equipment units from junction boxes or receptacles provided by the prime contractor on or near the boiler, hot water circulating pump, water softener, pumping units, air compressor, reverse osmosis unit, re-pressurization unit, coin boxes, and bill changer. Wiring shall be in accordance with the NEC.

4) Coin box electronics, bill changer electronics and make power and control terminations.

5) Automatic timed weep freeze protection system for each Spray Wand and each Bubble Brush.

3.2.2 Car Wash Equipment to be received, unloaded, provided with temporary storage, uncrated, unpacked, set in place, and anchored by the prime contractor. Installation shall include leveling and providing vibration isolation pads for all equipment. Prime contractor shall mount all control and indicating devices and equipment enclosures; provide miscellaneous control and power wiring; make plumbing connections, and assist in startup for the following:

1) High pressure pump units
2) Fluid module
3) Coin box enclosures, coin safe enclosures, and large LED unit
4) Bill changer enclosure
5) Wand boom
6) Brush boom
7) Wand holder with sanitary sewer connection
8) Brush holder
9) Mat hangers
10) Wand and brush hose hooks
11) Signage
12) Stainless steel sink
13) Water softening unit
14) Reverse osmosis
15) Spot free storage tank
16) Re-pressurization pump/tank unit
13) Hot water heater
14) Vacuum systems

3.2.3 Support utilities to be provided by the prime contractor:

1) Domestic cold water service, natural gas service, sanitary sewer service, and electrical from the main to the building.

2) Interior building domestic cold water, waste and drain piping, natural gas piping, sanitary sewer piping, flue vent piping, drain piping from all equipment, and 120/208VAC power to all equipment.

3) Soft water piping from the softener to the reverse osmosis unit, boiler, service sink, and hose reel.

4) Filtered water piping from the reverse osmosis unit to the storage tank, between the storage tank and re-pressurization pump/tank, and from the re-pressurization pump/tank to the fluid module.

5) An aluminum tray hose support system between the Mechanical Room and the Wash Bays in which the fluid hoses and compressed air tubing.

6) Circulating hot water freeze protection system for the solution hoses in the hose support system to include installation and connection of the circulating hot water copper tubing to the hot water boiler. Provide a hot water circulating pump and associated controls with an outdoor air thermostat to automatically ignite the boiler and turn on the hot water pump when the ambient air temperature drops below 40 Deg F.

3.3 PERFORMANCE TESTS

Contractor shall test all system components to meet specified performance criteria in the presence of the Contracting Officer. Correct defects disclosed by the test. Retest and adjust system until the entire installation is fully operational and acceptable to the Contracting Officer.

Tests shall be conducted at 30 minute intervals over a period of not less than 4 hours; and shall include the following information in a written report:

1) Time and date of test.

2) Fluid pressure, air pressure, and flow rate for water and solutions at the inlet and discharge of each piece of equipment, at each pump suction and discharge, and directly ahead of each wand and brush.

3) Operational test of each bay coin box, spray wand, and bubble brush for each solution to be dispensed.

4) Temperature of each hot water and fluid delivered at each bay.

5) Demonstrate simulated operation of freeze protection system and automatic weep system.

6) Demonstrate simulated operation of emergency stop condition.

-- End of Section –

SECTION 15190
GAS PIPING SYSTEMS

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.45	(1995) Flexible Connectors of Other Than All-Metal Construction for Gas Appliances

AMERICAN PETROLEUM INSTITUTE (API)

API Spec 6D	(1994; Supple 1 Jun 1996; Supple 2 Dec 1997) Pipeline Valves (Gate, Plug, Ball, and Check Valves)

ASME INTERNATIONAL (ASME)

ASME B1.20.1	(1983; R 1992) Pipe Threads, General Purpose (Inch)
ASME B16.3	(1998) Malleable Iron Threaded Fittings
ASME B16.5	(1996; B16.5a) Pipe Flanges and Flanged Fittings NPS 1/2 thru NPS 24
ASME B16.9	(1993) Factory-Made Wrought Steel Buttwelding Fittings
ASME B16.11	(1996) Forged Fittings, Socket-Welding and Threaded
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.33	(1990) Manually Operated Metallic Gas Valves for Use in Gas Piping Systems Up to 125 psig (Sizes 1/2 through 2)
ASME B31.1	(1998) Power Piping
ASME B31.2	(1968) Fuel Gas Piping
ASME B36.10M	(1996) Welded and Seamless Wrought Steel Pipe

ASME BPV IX	(1998) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications

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

MSS SP-25	(1998) Standard Marking System for Valves, Fittings, Flanges and Unions
MSS SP-58	(1993) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	(1996) Pipe Hangers and Supports - Selection and Application

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 54	(1999) National Fuel Gas Code
NFPA 70	(1999) National Electrical Code

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 6/NACE 3	(1994) Commercial Blast Cleaning

UNDERWRITERS LABORATORIES (UL)

UL Gas&Oil Dir	(1999)Gas and Oil Equipment Directory

1.2 GENERAL REQUIREMENTS

1.2.1 Welding

Piping shall be welded in accordance with qualified procedures using performance qualified welders and welding operators. Procedures and welders shall be qualified in accordance with ASME BPV IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer may be accepted as permitted by ASME B31.1. The Contracting Officer shall be notified at least 24 hours in advance of tests and the tests shall be performed at the work site if practicable. The Contracting Officer shall be furnished with a copy of qualified procedures and a list of names and identification symbols of qualified welders and welding operators. The welder or welding operator shall apply his assigned symbol near each weld he makes as a permanent record. Structural members shall be welded in accordance with Section 05090 WELDING, STRUCTURAL.

1.2.2 Standard Products

Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Asbestos or products containing asbestos shall not be used. Manufacturer's descriptive data and installation instructions shall be submitted for approval for compression-type mechanical joints used in joining dissimilar materials and for insulating joints. Valves, flanges and fittings shall be marked in accordance with MSS SP-25.

1.2.3 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 00700 GENERAL:

SD-02 Shop Drawings

Gas Piping System;

Drawings showing location, size and all branches of pipeline; location of all required shutoff valves; and instructions necessary for the installation of connectors and supports.

SD-03 Product Data

Qualifications;

Qualified procedures and a list of names and identification symbols of qualified welders and welding operators.

SD-6 Test Reports

Pressure Tests;

Test reports in booklet form tabulating test and measurements performed. The reports shall be dated after award of this contract, shall state the contractor's name and address, shall name the project and location, and shall list the specific requirements which are being certified.

PART 2 PRODUCTS

2.1 PIPE AND FITTINGS

2.1.1 Steel Pipe, Joints, and Fittings

Steel pipe shall conform to ASME B36.10M. Malleable-iron threaded fittings shall conform to ASME B16.3. Steel pipe flanges and flanged fittings including bolts, nuts, and bolt pattern shall be in accordance with ASME B16.5. Wrought steel buttwelding fittings shall conform to ASME B16.9. Socket welding and threaded forged steel fittings shall conform to ASME B16.11.

2.1.2 Steel Tubing, Joints and Fittings

Steel tubing shall conform to ASTM A 539. Tubing joints shall be made up with gas tubing fittings recommended by the tubing manufacturer.

2.1.3 Sealants for Steel Pipe Threaded Joints

Joint sealing compound shall be listed in UL Gas&Oil Dir, Class 20 or less. Tetrafluoroethylene tape shall conform to UL Gas&Oil Dir.

2.1.4 Identification

Pipe flow markings and metal tags shall be provided as required.

2.1.5 Flange Gaskets

Gaskets shall be nonasbestos compressed material in accordance with ASME B16.21, 1/16 inch thickness, full face or self-centering flat ring type. The gaskets shall contain aramid fibers bonded with styrene butadiene rubber (SBR) or nitrile butadiene rubber (NBR) suitable for a maximum 600 degree F service. NBR binder shall be used for hydrocarbon service.

2.1.6 Pipe Threads

Pipe threads shall conform to ASME B1.20.1.

2.1.7 Escutcheons

Escutcheons shall be chromium-plated steel or chromium-plated brass, either one piece or split pattern, held in place by internal spring tension or set screw.

2.1.8 Gas Transition Fittings

Gas transition fittings shall be manufactured steel fittings approved for jointing metallic and thermoplastic or fiberglass pipe. Approved transition fittings are those that conform to AGA Manual requirements for transitions fittings.

2.1.9 Insulating Pipe Joints

2.1.9.1 Insulating Joint Material

Insulating joint material shall be provided between flanged or threaded metallic pipe systems where shown to control galvanic or electrical action.

2.1.9.2 Threaded Pipe Joints

Joints for threaded pipe shall be steel body nut type dielectric unions with insulating gaskets.

2.1.9.3 Flanged Pipe Joints

Joints for flanged pipe shall consist of full face sandwich-type flange insulating gasket of the dielectric type, insulating sleeves for flange bolts, and insulating washers for flange nuts.

2.1.10 Flexible Connectors

Flexible connectors for connecting gas utilization equipment to building gas piping shall conform to ANSI Z21.45.

2.2 VALVES

Valves shall be suitable for shutoff or isolation service and shall conform to the following:

2.2.1 Valves

Valves shall conform to ASME B16.33 and shall be of materials and manufacture compatible with system materials used.

2.3 PIPE HANGERS AND SUPPORTS

Pipe hangers and supports shall conform to MSS SP-58 and MSS SP-69.

2.4 METERS, REGULATORS AND SHUTOFF VALVES

Meters, regulators and shutoff valves shall be as specified in Section 02556 GAS DISTRIBUTION SYSTEM.

PART 3 EXECUTION

3.1 EXCAVATION AND BACKFILLING

Earthwork shall be as specified in Section 02316 EXCAVATION, TRENCHING AND BACKFILLING FOR UTILITIES SYSTEMS.

3.2 GAS PIPING SYSTEM

Gas piping system shall be from the point of delivery, defined as the outlet of the meter set assembly, specified in Section 02556 GAS DISTRIBUTION SYSTEM, to the connections to each gas utilization device.

3.2.1 Protection of Materials and Components

Pipe and tube openings shall be closed with caps or plugs during installation. Equipment shall be protected from dirt, water, and chemical or mechanical damage. At the completion of all work, the entire system shall be thoroughly cleaned.

3.2.2 Workmanship and Defects

Piping, tubing and fittings shall be clear and free of cutting burrs and defects in structure or threading and shall be thoroughly brushed and chip-and scale-blown. Defects in piping, tubing or fittings shall not be repaired. When defective piping, tubing, or fittings are located in a system, the defective material shall be replaced.

3.3 PROTECTIVE COVERING

3.3.1 Underground Metallic Pipe

Buried metallic piping shall be protected from corrosion with protective coatings as specified in Section 02556 GAS DISTRIBUTION SYSTEM. When dissimilar metals are joined underground, gastight insulating fittings shall be used.

3.3.2 Aboveground Metallic Piping Systems

3.3.2.1 Ferrous Surfaces

Shop primed surfaces shall be touched up with ferrous metal primer. Surfaces that have not been shop primed shall be solvent cleaned. Surfaces that contain loose rust, loose mill scale and other foreign substances shall be mechanically cleaned by power wire brushing and primed with ferrous metal primer. Primed surface shall be finished with two coats of exterior oil paint.

3.3.2.2 Nonferrous Surfaces

Except for aluminum alloy pipe, nonferrous surfaces shall not be painted. Surfaces of aluminum alloy pipe and fittings shall be painted to protect against external corrosion where they contact masonry, plaster, insulation, or are subject to repeated wettings by such liquids as water, detergents or sewage. The surfaces shall be solvent-cleaned and treated with vinyl type wash coat. A first coat of aluminum paint and a second coat of alkyd gloss enamel or silicone alkyd copolymer enamel shall be applied.

3.4 INSTALLATION

Installation of the gas system shall be in conformance with the manufacturer's recommendations and applicable provisions of NFPA 54, AGA Manual, and as indicated. Pipe cutting shall be done without damage to the pipe. Unless otherwise authorized, cutting shall be done by an approved type of mechanical cutter. Wheel cutters shall be used where practicable. On steel pipe 6 inches and larger, an approved gas cutting and beveling machine may be used.

3.4.1 Metallic Piping Installation

Underground piping shall be buried a minimum of 18 inches below grade. Changes in direction of piping shall be made with fittings only; mitering or notching pipe to form elbows and tees or other similar type construction will not be permitted. Branch connection may be made with either tees or forged branch outlet fittings. Branch outlet fittings shall be forged, flared for improvement of flow where attached to the run, and reinforced against external strains.

3.4.2 Connections Between Metallic and Plastic Piping

Connections shall be made only outside, underground, and with approved transition fittings.

3.4.3 Concealed Piping in Buildings

When installing piping which is to be concealed, unions, tubing fittings, running threads, right- and left-hand couplings, bushings, and swing joints made by combinations of fittings shall not be used.

3.4.3.1 Piping in Partitions

Concealed piping shall be located in hollow rather than solid partitions. Tubing passing through walls or partitions shall be protected against physical damage.

3.4.3.2 Piping in Floors

Piping in solid floors shall be laid in channels suitably covered to permit access to the piping with minimum damage to the building.

3.4.5 Aboveground Piping

Aboveground piping shall be run as straight as practicable along the alignment indicated and with a minimum of joints. Piping shall be separately supported. Exposed horizontal piping shall not be installed farther than 6 inches from nearest parallel wall in laundry areas where clothes hanging could be attempted.

3.4.6 Final Gas Connections

Unless otherwise specified, final connections shall be made with rigid metallic pipe and fittings. Flexible connectors may be used for final connections to gas utilization equipment. In addition to cautions listed in instructions required by ANSI standards for flexible connectors, insure that flexible connectors do not pass through equipment cabinet. Provide accessible gas shutoff valve and coupling for each gas equipment item.

3.5 PIPE JOINTS

Pipe joints shall be designed and installed to effectively sustain the longitudinal pull-out forces caused by contraction of the piping or superimposed loads.

3.5.1 Threaded Metallic Joints

Threaded joints in metallic pipe shall have tapered threads evenly cut and shall be made with UL approved graphite joint sealing compound for gas service or tetrafluoroethylene tape applied to the male threads only. Threaded joints up to 1-1/2 inches in diameter may be made with approved tetrafluoroethylene tape. Threaded joints up to 2 inches in diameter may be made with approved joint sealing compound. After cutting and before threading, pipe shall be reamed and burrs shall be removed. Caulking of threaded joints to stop or prevent leaks shall not be permitted.

3.5.2 Welded Metallic Joints

Beveling, alignment, heat treatment, and inspection of welds shall conform to ASME B31.2. Weld defects shall be removed and repairs made to the weld, or the weld joints shall be entirely removed and rewelded. After filler metal has been removed from its original package, it shall be protected or stored so that its characteristics or welding properties are not affected adversely. Electrodes that have been wetted or have lost any of their coating shall not be used.

3.6 PIPE SLEEVES

Pipes passing through concrete or masonry walls or concrete floors or roofs shall be provided with pipe sleeves fitted into place at the time of construction. Sleeves shall not be installed in structural members except where indicated or approved. All rectangular and square openings shall be as detailed. Each sleeve shall extend through its respective wall, floor or roof, and shall be cut flush with each surface, except in mechanical room floors not located on grade

where clamping flanges or riser pipe clamps are used. Unless otherwise indicated, sleeves shall be large enough to provide a minimum clearance of 1/4 inch all around the pipe. Sleeves in bearing walls and wet areas shall be steel pipe. Sleeves in nonbearing walls, floors, or ceilings may be steel pipe, galvanized sheet metal with lock-type longitudinal seam, or moisture-resistant fiber or plastic.

3.7 ESCUTCHEONS

Escutcheons shall be provided for all finished surfaces where gas piping passes through floors, walls, or ceilings except in boiler, utility, or equipment rooms.

3.8 BUILDING STRUCTURE

Building structure shall not be weakened by the installation of any gas piping. Beams or joists shall not be cut or notched.

3.9 PIPING SYSTEM SUPPORTS

Gas piping systems in buildings shall be supported with pipe hooks, metal pipe straps, bands or hangers suitable for the size of piping or tubing. Gas piping system shall not be supported by other piping. Spacing of supports in gas piping and tubing installations shall conform to the requirements of NFPA 54. The selection and application of supports in gas piping and tubing installations shall conform to the requirements of MSS SP-69. In the support of multiple pipe runs on a common base member, a clip or clamp shall be used where each pipe crosses the base support member. Spacing of the base support members shall not exceed the hanger and support spacing required for any of the individual pipes in the multiple pipe run. The clips or clamps shall be rigidly connected to the common base member. A clearance of 1/8 inch shall be provided between the pipe and clip or clamp for all piping which may be subjected to thermal expansion.

3.10 ELECTRICAL BONDING AND GROUNDING

The gas piping system within the building shall be electrically continuous and bonded to a grounding electrode as required by NFPA 70. Conventional flange joints allow sufficient current flow to satisfy this requirement.

3.11 SHUTOFF VALVE

Main gas shutoff valve controlling the gas piping system shall be easily accessible for operation and shall be installed as indicated, protected from physical damage, and marked with a metal tag to clearly identify the piping system controlled.

3.12 TESTING

Before any section of a gas piping system is put into service, it shall be carefully tested to assure that it is gastight. Prior to testing, the system shall be blown out, cleaned and cleared of

all foreign material. Each joint shall be tested by means of an approved gas detector, soap and water, or an equivalent nonflammable solution. Testing shall be completed before any work is covered, enclosed, or concealed. All testing of piping systems shall be done with due regard for the safety of employees and the public during the test. Bulkheads, anchorage and bracing suitably designed to resist test pressures shall be installed if necessary. Oxygen shall not be used as a testing medium.

3.12.1 Pressure Tests

Before appliances are connected, piping systems shall be filled with air or an inert gas and shall withstand a minimum pressure of 3 pounds gauge for a period of not less than 10 minutes as specified in NFPA 54 without showing any drop in pressure. Oxygen shall not be used. Pressure shall be measured with a mercury manometer, slope gauge, or an equivalent device so calibrated as to be read in increments of not greater than 0.1 pound. The source of pressure shall be isolated before the pressure tests are made.

3.12.2 Test With Gas

Before turning gas under pressure into any piping, all openings from which gas can escape shall be closed. Immediately after turning on the gas, the piping system shall be checked for leakage by using a laboratory-certified gas meter, an appliance orifice, a manometer, or equivalent device. All testing shall conform to the requirements of NFPA 54. If leakage is recorded, the gas supply shall be shut off, the leak shall be repaired, and the tests repeated until all leaks have been stopped.

3.12.3 Purging

After testing is completed, and before connecting any appliances, all gas piping shall be fully purged. LPG piping tested using fuel gas with appliances connected does not require purging. Piping shall not be purged into the combustion chamber of an appliance. The open end of piping systems being purged shall not discharge into confined spaces or areas where there are ignition sources unless the safety precautions recommended in NFPA 54 are followed.

3.12.4 Labor, Materials and Equipment

All labor, materials and equipment necessary for conducting the testing and purging shall be furnished by the Contractor.

3.13 PIPE COLOR CODE MARKING

Color code marking of piping shall be as specified in Section 09900 PAINTING, GENERAL.

The End

SECTION 15250
THERMAL INSULATION FOR MECHANICAL SYSTEMS

PART 1 - GENERAL

1.1 APPLICABLE PUBLICATIONS: The publications listed below form a part of this specification. The publications are referred to in the text by basic designation only.

1.1.1 Federal Specification (Fed. Spec.):

L-P-535E (27 Apr. 1979)	Plastic Sheet (Sheeting): Plastic Strip: Poly(Vinyl Chloride) and Poly(Vinyl Chloride-Vinyl Acetate), Rigid

1.1.2 Military Specifications (Mil. Spec.)

MIL-A-3316B & Am-7, (21 Sept. 1983)	Adhesives, Fire-Resistant, Thermal & Insulation Insulation
MIL-C-19565C & Rev. C (23 Dec. 1980)	Coating Compounds, Thermal Insulation, Fire- and Water-Resistant, Vapor-Barrier
MIL-C-20079H & Am-1, Rev. H (29 Jun. 1983)	Cloth, Glass; Tape, Textile Glass; and Thread, Glass

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

A 167-86	Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
A 580-83	Stainless and Heat Resisting Steel Wire
C 449-82	Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement
C 534-99	Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
C 547-77	Mineral Fiber Preformed Pipe Insulation

C 920-86	Elastomeric Joint Sealants
C 921-79	Properties of Jacketing Materials for Thermal Insulation
E 84-87	Surface Burning Characteristics of Building Materials

1.1.4 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS) Publication:

SP-69	Pipe Hangers and Supports - Selection and Application (1983)

1.1.5 Midwest Insulation Contractors Association (MICA):

National Commercial and Industrial Insulation Standards - 1983, 2nd Ed.

1.2 DESCRIPTION: Field-applied insulation and accessories on mechanical systems shall be as specified herein; factory-applied insulation is specified under the piping, duct or equipment to be insulated.

1.3 GENERAL QUALITY CONTROL:

1.3.1 Standard Products: Materials shall be the standard products of manufacturers regularly engaged in the manufacture of such products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

1.3.2 Installer's Qualifications: Qualified installers shall have successfully completed three or more similar type jobs within the last 5 years.

1.3.3 Surface Burning Characteristics: Unless otherwise specified, installed insulation materials, adhesives, coatings, and other accessories shall have surface burning characteristics as determined by ASTM E 84 not to exceed 25 for flame spread and 50 for smoke-developed rating where used indoors.

1.3.3.1 All insulation shall be tested in the same densities and installed thicknesses as the material that will be used in actual construction applications.

1.3.3.2 Insulation that has been treated with a flame retardant additive to obtain the flame spread and smoke developed ratings shown above are not permitted.

1.3.4 Identification of Materials: Packages or standard containers of insulation, jacket material,

cements, adhesives, and coatings delivered for use, and all samples required for approval shall have manufacturer's stamp or label attached giving the name of the manufacturer and brand, and a description of the material.

1.4 SUBMITTALS:

1.4.1 Shop Drawings: Shop drawings shall be submitted in accordance with the SECTION 1A-GENERAL and shall include a complete list of materials, including manufacturer's descriptive and technical literature, performance data, catalog cuts, and installation instructions. Materials furnished under this section of the specification shall be submitted at one time. A schedule shall be submitted indicating the product number, k-value, thickness and furnished accessories for each mechanical system requiring insulation.

1.5 STORAGE: Materials shall be delivered in the manufacturer's unopened containers. Materials delivered and placed in storage shall be provided with protection from weather, humidity, dirt, dust and other contaminants by the Contractor.

PART 2 - PRODUCTS

2.1 GENERAL MATERIALS: Materials shall be compatible and shall not contribute to corrosion, soften, or otherwise attack surfaces to which applied in either the wet or dry state. Materials to be used on stainless steel surfaces shall meet ASTM C 795 requirements. Materials shall be asbestos free and conform to the following:

2.1.1 Adhesives: Mil. Spec. MIL-A-3316, Class 1, Grade A or Class 2 as specified.

2.1.2 Caulking: ASTM C 920, Type S, Grade NS, Class 25, Use A.

2.1.3 Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement: ASTM C 449.

2.1.4 Glass Tape: Mil. Spec. MIL-C-20079, Type II, Class 1 or 3. Tape shall be 4-inch wide rolls. Class 3 shall be 4.5 ounce/square yard.

2.1.5 Staples: Outward clinching type ASTM A 167, Type 304 or 316 stainless steel.

2.1.6 Jackets: ASTM C921 Type I, maximum moisture vapor transmission 0.02 perms, minimum puncture resistance 50 Beach units on all surfaces. Minimum tensile strength, 35 pounds/inch width. Jackets on insulation exposed in finished areas shall have white finish suitable for painting without sizing. All non-metallic jackets shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E 84.

2.1.7 Vapor Barrier Coating: Mil. Spec. MIL-C-19565, Type II. Color shall be white.

2.1.8 Wire: Soft annealed ASTM A 580 type 302, 304 or 316 stainless steel, 16 or 18 gage.

2.2 PIPE INSULATION MATERIALS shall be as follows:

2.2.1 Hot and Cold Water Pipe Insulation:

2.2.2 Mineral Fiber: ASTM C 547, Class 1.

2.2.3 Car Wash Solution Hoses:

2.2.4 Unicellular Plastic Foam shall be in accordance with C 534, Form T, except that D-Factor shall not exceed 0.28 at 75 degrees F mean temperature.

PART 3 - EXECUTION

3.1 APPLICATION - GENERAL:

3.1.1 Installation: Except as otherwise specified, material shall be installed in accordance with the manufacturer's written instructions. Insulation materials shall not be applied until tests specified in other sections of this specification are completed. Material such as rust, scale, dirt and moisture shall be removed from surfaces to receive insulation. Mineral fiber thermal insulating cement shall be mixed with demineralized water when used on stainless steel surfaces.

3.1.2 Painting and Finishing: Painting shall be as specified in SECTION: PAINTING, GENERAL.

3.1.3 Welding: No welding shall be done on piping, duct or equipment without written approval of the Contracting Officer. The capacitor discharge welding process may be used for securing metal fasteners to duct.

3.2 PIPE INSULATION INSTALLATION:

3.2.1 Pipe & Wash Solution Flexible Hose Insulation - General:

3.2.2 Pipe and hose insulation shall be continuous and installed on all fittings and appurtenances unless specified otherwise. Installation shall be with full length units of insulation and using a single cut piece to complete a run. Cut pieces or scraps abutting each other shall not be used. Insulation shall be omitted on the following:

a. Chromium plated pipe to plumbing fixtures.

b. Sanitary drain lines.

c. Unions.

d. Check valves.

e. Gas piping.

f. Compressed Air piping.

g. Car Wash solution hoses inside the Mechanical Room.

3.2.3 Pipes Passing Through Sleeves:

3.2.4 Pipe insulation shall be continuous through the sleeves.

3.2.5 Pipes Passing Through Hangers:

3.2.6 Insulation, whether hot or cold application, shall be continuous through hangers.

3.2.6.1 On support points where type 39 saddle or type 40 shield conforming to MSS SP-69 are permitted for a particular pipe attachment application, the type 39 saddle shall be used on all pipe 4 inches and larger. On piping under 4 inches, the type 40 galvanized protection shield may be used. Insulation or an insulation insert of a density at least 9 pcf shall be installed under each shield. The insert shall cover not less than the bottom 180 degree arc of the pipe. Inserts shall be the same thickness as the insulation, and shall extend 2 inches on each end beyond the protection shield. Inserts are not required with type 39 pipe saddles.

3.2.6.2 Inserts shall be covered with a jacket material of the same appearance and quality as the adjoining pipe insulation jacket, shall overlap the adjoining pipe jacket 1-1/2 inches, and shall be sealed as required for the pipe jacket.

3.2.6.3 Car Wash Solution Hoses: All wash solution hoses above the ceiling in the building shall be insulated with ¾ inch flexible cellular. Flexible cellular insulation shall be installed with seams and joints sealed with a contact adhesive.

3.2.7 Hot and Cold Pipes: All domestic hot and cold water pipe lines.

3.2.7.1 Insulation Thickness: Thickness of insulation shall be as indicated in Table I.

TABLE I
Pipe (Inches)

Service or Range of Temp (Degrees F)	Run-outs* 1-1/2	1/4 to 1-1/4	1/4 to to 3
Domestic			
Cold Water	(MF)	1	
Hot Water	(MF)	1	

NOTES: MF - Mineral Fiber

3.2.7.2 Vapor Barrier Jacket: Insulation shall be covered with a factory applied vapor barrier jacket or field applied seal welded PVC jacket.

3.2.7.3 Insulation for Straight Runs on Fibrous Glass Insulated Pipe:

3.2.7.4 Insulation shall be applied to the pipe with joints tightly butted. The ends of fibrous insulation shall be sealed off with vapor barrier coating at intervals not to exceed 15 feet.

3.2.7.5 Longitudinal laps of the jacket material shall overlap not less than 1-1/2 inches. Butt strips 3 inches wide shall be provided for circumferential joints.

3.2.7.6 Laps and butt strips shall be secured with adhesive and stapled on 4-inch centers if not factory self-sealing.

3.2.7.7 Factory self-sealing lap systems may be used when the ambient temperature is between 40 degrees and 120 degrees F during installation. The lap system shall be installed in accordance with manufacturer's recommendations. Stapler shall be used only if specifically recommended by the manufacturer. Where gaps occur, the section shall be replaced or the gap repaired by applying adhesive under the lap and then stapling.

3.2.7.8 Staples and seams, including those on self-sealing lap systems with adhesive on one side shall be coated with a vapor barrier coating. Double pressure-sensitive adhesive seams need not be coated.

3.2.7.9 Breaks and punctures in the jacket material shall be patched by wrapping a strip of jacket material around the pipe and securing it with adhesive, stapling, and coating as specified for butt strips. The patch shall extend not less than 1-1/2 inches past the break.

3.2.7.10 At penetrations such as thermometers and instrumentations, the void in the insulation shall be filled and sealed with a brush coat of vapor barrier.

3.2.7.11 Fibrous Glass Insulation on Flanges, Unions, Valves, Anchors, Fittings, and Accessories:

3.2.7.12 Pipe insulation shall have ends thoroughly coated with a vapor barrier coating not more than 6 inches from each flange, union, valve, anchor, or fitting in all directions.

3.2.7.13 Insulation may be premolded or segmented. Insulation of the same thickness and conductivity as the adjoining pipe insulation shall be used. If nesting size insulation is used, the insulation should be overlapped 2 inches or one pipe diameter. Loose fill mineral fiber or insulating cement shall be used to fill the voids. Insulation for elbows less than 3-inch size shall be premolded. Insulation for elbows 3-inch size and larger shall be either premolded or segmented. Elbows insulated using segments shall not have less than 3 segments per elbow. Insulation may be secured by wire or tape until finish is applied.

3.2.7.14 Upon completion of installation of insulation, two coats of vapor barrier coating with a minimum total thickness of 1/16 inch, shall be applied with glass tape embedded between coats. Tape seams shall overlap 1 inch. The coating shall extend out onto the adjoining pipe insulation 2 inches.

3.2.7.15 Insulation terminations shall be tapered to unions at a 45-degree angle.

3.2.7.16 Anchors attached directly to the pipe shall be insulated for a sufficient distance to prevent condensation but not less than 6 inches from the insulation surface.

3.2.7.17 Optional PVC Fitting Covers: At the option of the Contractor, premolded, one or two piece PVC fitting covers may be used in lieu of the vapor barrier and embedded glass tape. Factory premolded insulation segments or factory cut blanket inserts shall be used under the fitting covers for elbows. Insulation thickness for inserts shall be as recommended by the insulation manufacturer for the prescribed application temperatures. Elsewhere field cut inserts may be used. The covers shall be secured by PVC vapor barrier tape or adhesive or with tacks made for securing PVC covers. All tape seams and tacks shall then be coated with vapor barrier coating.

3.2.7.18 Unions, valves, fittings, and accessories shall be insulated and finished as specified for the applicable service. Two coats of an emulsion type weatherproof mastic recommended by the insulation manufacturer shall be applied with glass tape embedded between coats.

END OF SECTION

SECTION 15400
PLUMBING, GENERAL PURPOSE

PART 1 GENERAL

1.1 SCOPE

Provide new 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 International Code Council, International Plumbing Code (ICC IPC). Plumbing systems include piping less than 5 feet outside of building walls including connections to existing exterior distribution systems and connections to the car wash equipment as specified in Section 11000.

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 00700 GENERAL:

SD-02 Shop Drawings

Plumbing:

Detail drawings consisting of illustrations, schedules, performance charts, instructions, brochures, diagrams, and other information to illustrate the requirements and operations of each system. Detail drawings for the complete plumbing system including piping and flexible hose layouts and locations of connections dimensions for roughing-in, foundation, and support points; schematic diagrams and wiring diagrams or connection and interconnection diagrams. Detail drawings shall indicate clearances required for maintenance and operation. Where piping and equipment are to be supported other than as indicated, details shall include loadings and proposed support methods. Mechanical drawing plans, elevations, views, and details, shall be drawn to scale.

Electrical Schematics:

Complete electrical schematic lineless or full line interconnection and connection diagram each piece of mechanical equipment having more than one automatic or manual electrical control device.

SD-03 Product Data

Welding:

A copy of qualified procedures and a list of names and identification symbols of qualified welders and welding operators.

Plumbing Fixture Schedule:

Catalog cuts to include

SD-06 Test Reports

Tests General:

Test reports in booklet form showing all field tests performed to adjust each component of the pluming equipment; and all field tests performed to prove compliance with the specified performance criteria, completion and testing of the installed system. Each test report shall indicate the final position of controls.

Backflow Prevention Assembly Tests:

Certification of proper operation shall be as accomplished in accordance with state regulations by an individual certified by the state to perform such tests. If no state requirement exists, the Contractor shall have the manufacturer's representative test the device, to ensure the unit is properly installed and performing as intended. The Contractor shall provide written documentation of the tests performed and signed by the individual performing the tests.

SD-07 Certificates

Materials and Equipment:

Where materials or equipment are specified to comply with requirements of AGA, or ASME, proof of such compliance. The label or listing of the specified agency will be acceptable evidence. In lieu of the label or listing, a written certificate may be submitted from an approved, nationally recognized testing organization equipped

to perform such services, stating that the items have been tested and conform to the requirements and testing methods of the specified agency. Where equipment is specified to conform to requirements of the ASME Boiler and Pressure Vessel Code, the design, fabrication, and installation shall conform to the code.

Bolts:

Written certification by the bolt manufacturer that the bolts furnished comply with the specified requirements. The certification shall include illustrations of product-required markings, the date of manufacture, and the number of each type of bolt to be furnished based on this certification.

SD-10 Operation and Maintenance Data

Plumbing System:

Six copies of the operation manual outlining the step-by-step procedures required for system startup, operation and shutdown. The manual shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Six copies of the maintenance manual listing routine maintenance procedures, possible breakdowns and repairs. The manual shall include piping and equipment layout and simplified wiring and control diagrams of the system as installed.

1.3 REGULATORY REQUIREMENTS

Plumbing work shall be in accordance with ICC IPC.

1.4 PROJECT/SITE CONDITIONS

The Contractor shall become familiar with details of the work, verify dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

PART 2 PRODUCTS

2.1 MATERIALS

Materials for various services shall be in accordance with TABLES I and II-Pipe schedules shall be selected based on service requirements. Pipe fittings shall be compatible with the applicable pipe materials. Pipe threads (except dry seal) shall conform to ASME B1.20.1.

Material or equipment containing lead shall not be used in any potable water system. Hubless cast-iron soil pipe shall not be installed underground or under concrete floor slabs.

2.1.1 Pipe Joint Materials

Grooved pipe and hubless cast-iron soil pipe shall not be used under ground. Joints and gasket materials shall conform to the following:

a. Coupling for Cast-Iron Pipe: for hub and spigot type ASTM A 74, AWWA C606. For hubless type: CISPI 310

b. Coupling for Steel Pipe: AWWA C606.

c. Flange Gaskets: Gaskets shall be made of non-asbestos material in accordance with ASME B16.21. Gaskets shall be flat, 1/16 inch thick, and contain Aramid fibers bonded with Styrene Butadiene Rubber (SBR) or Nitro Butadiene Rubber (NBR). Gaskets shall be the full face or self centering flat ring type.

d. Neoprene Gaskets for Hub and Cast-Iron Pipe and Fittings: CISPI HSN-85.

d. Brazing Material: Brazing material shall conform to AWS A5.8, BCuP-5.

e. Brazing Flux: Flux shall be in paste or liquid form appropriate for use with brazing material. Flux shall be as follows: lead-free; have a 100 percent flushable residue; contain slightly acidic reagents; contain potassium borides; and contain fluorides. Silver brazing materials shall be in accordance with AWS A5.8.

f. Solder Material: Solder metal shall conform to ASTM B 32 95-5 tin-antimony.

g. Solder Flux: Flux shall be liquid form, non-corrosive, and conform to ASTM B 813, Standard Test 1.

h. PTFE Tape: PTFE Tape, for use with Threaded Metal or Plastic Pipe, ASTM D 3308.

i. Rubber Gaskets for Cast-Iron Soil-Pipe and Fittings (hub and spigot type and hubless type): ASTM C 564.

j. Flexible Elastomeric Seals: ASTM D 3139, ASTM D 3212 or ASTM F 477.

k. Bolts and Nuts for Grooved Pipe Couplings: Heat-treated carbon steel, ASTM A 183.

l. Flanged fittings including flanges, bolts, nuts, bolt patterns, etc., shall be in accordance with ASME B16.5 class 150 and shall have the manufacturer's trademark affixed in accordance with MSS SP-25. Flange material shall conform to ASTM A 105/A 105M. Blind flange material shall conform to ASTM A 516/A 516M cold service and ASTM A 515/A 515M for hot service. Bolts shall be high strength or intermediate strength with material conforming to ASTM A 193/A 193M.

2.1.2 Miscellaneous Materials

Miscellaneous materials shall conform to the following:

a. Water Hammer Arrester: PDI WH 201.

b. Copper, Sheet and Strip for Building Construction: ASTM B 370.

c. Hose Clamps: SAE J 1508.

d. Supports for Off-The-Floor Plumbing Fixtures: ASME A112.6.1M.

e. Metallic Cleanouts: ASME A112.36.2M.

f. Plumbing Fixture Setting Compound: A preformed flexible ring seal molded from hydrocarbon wax material. The seal material shall be nonvolatile nonasphaltic and contain germicide and provide watertight, gastight, odorproof and verminproof properties.

g. Coal-Tar Protective Coatings and Linings for Steel Water Pipelines: AWWA C203.

h. Hypochlorites: AWWA B300.

i. Liquid Chlorine: AWWA B301.

j. Polyethylene Encasement for Ductile-Iron Piping: AWWA C105.

k. Gauges - Pressure and Vacuum Indicating Dial Type - Elastic Element: ASME B40.1.

l. Thermometers: ASTM E 1.

2.1.3 Pipe Insulation Material

Insulation shall be as specified in Section 15250 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.2 PIPE HANGERS, INSERTS, AND SUPPORTS

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69.

2.3 VALVES

Valves shall be provided on supplies to equipment and fixtures. Valves shall be bronze with threaded bodies for pipe and solder-type connections for copper tubing. Pressure ratings shall be based upon the application. Valves shall conform to the following standards:

Description	Standard
Ball Valves with Flanged Butt-Welding Ends for General Service	MSS SP-72
Cast-Iron Plug Valves, Flanged and Threaded Ends	MSS SP-78
Bronze Gate, Globe, Angle, and Check Valves	MSS SP-80
Cast-Iron Globe and Angle Valves, Flanged and Threaded Ends	MSS SP-85
Vacuum Relief Valves	ASSE 1001
Water Pressure Reducing Valves	ASSE 1003
Water Heater Drain Valves	ASSE 1005
Temperature and Pressure Relief Valves for Hot Water Supply Systems	ANSI Z21.22

2.3.1 Wall Hydrants

Wall hydrants with vacuum-breaker backflow preventer shall have a nickle-brass or nickel-bronze wall plate or flange with nozzle and detachable key handle. A brass or bronze

operating rod shall be provided within a galvanized iron casing of sufficient length to extend through the wall so that the valve is inside the building, and the portion of the hydrant between the outlet and valve is self-draining. A brass or bronze valve with coupling and union elbow having metal-to-metal seat shall be provided. Valve rod and seat washer shall be removable through the face of the hydrant. The hydrant shall have 3/4 inch exposed hose thread on spout and 3/4 inch male pipe thread on inlet.

2.3.2 Relief Valves

Water heater shall have a combination pressure and temperature (P&T) relief valve. The pressure relief element of a P&T relief valve shall have adequate capacity to prevent excessive pressure buildup in the system when the system is operating at the maximum rate of heat input. The temperature element of a P&T relief valve shall have a relieving capacity which is at least equal to the total input of the heaters when operating at their maximum capacity. Relief valve shall be rated according to ANSI Z21.22. Relief valve shall have 1 inch minimum inlets, and 1 inch outlets. The discharge pipe from the relief valve shall be the size of the valve outlet.

2.4 FIXTURES

Fixtures shall be equipped with appurtenances such as traps, faucets, stop valves, and drain fittings. Each fixture and piece of equipment requiring connections to the drainage system, except grease interceptors, shall be equipped with a trap. Fixtures with the supply discharge below the rim shall be equipped with backflow preventers.

2.5 BACKFLOW PREVENTER

Backflow preventer shall be approved and listed by the Foundation For Cross-Connection Control & Hydraulic Research. Reduced pressure principle assemblies, double check valve assemblies, atmospheric (nonpressure) type vacuum breakers, and pressure type vacuum breakers shall be tested, approved, and listed in accordance with FCCCHR-01. Backflow preventer with intermediate atmospheric vent shall conform to ASSE 1012. Reduced pressure principle backflow preventer shall conform to ASSE 1013. Hose connection vacuum breaker shall conform to ASSE 1011. Air gaps in plumbing systems shall conform to ASME A112.1.2.

2.6 DRAINS

2.6.1 Floor Drains

Floor drains shall consist of a cast iron body, integral seepage pan, and adjustable perforated or slotted nickel-brass strainer, consisting of grate and threaded collar. Drains shall be of double

drainage pattern for embedding in the floor construction. The seepage pan shall have weep holes or channels for drainage to the drainpipe. The strainer shall be adjustable to floor thickness. A clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the flashing or waterproofing membrane shall be provided when required. Drains shall be provided with threaded or caulked connection. In lieu of a caulked joint between the drain outlet and waste pipe, a neoprene rubber gasket conforming to ASTM C 564 may be installed, provided that the drain is specifically designed for the rubber gasket compression type joint. Floor drains shall conform to ASME A112.21.1M.

2.6.2 Area Drains

Area drains shall be plain pattern with polished stainless steel perforated or slotted grate and bottom outlet. The drain shall be circular or square with a 12 inch nominal overall width or diameter and 10 inch nominal overall depth. Drains shall be cast iron with manufacturer's standard coating. Grate shall be easily lifted out for cleaning. Outlet shall be suitable for inside caulked connection to drain pipe. Drains shall conform to ASME A112.21.1M.

2.7 TRAPS

Unless otherwise specified, traps shall be copper-alloy adjustable tube type with slip joint inlet and swivel. Traps shall be without a cleanout. Tubes shall be copper alloy with walls not less than 0.032 inch thick within commercial tolerances, except on the outside of bends where the thickness may be reduced slightly in manufacture by usual commercial methods. Inlets shall have rubber washer and copper alloy nuts for slip joints above the discharge level. Swivel joints shall be below the discharge level and shall be of metal-to-metal type as required for the application. Nuts shall have flats for wrench grip. Outlets shall have internal pipe thread, except that when required for the application, the outlets shall have sockets for solder-joint connections. The depth of the water seal shall be not less than 2 inches. The interior diameter shall be not more than 1/8 inch over or under the nominal size, and interior surfaces shall be reasonably smooth throughout. A copper alloy "P" trap assembly consisting of an adjustable "P" trap and threaded trap wall nipple with cast brass wall flange shall be provided. The assembly shall be a standard manufactured unit and may have a rubber-gasketed swivel joint.

2.8 PIPING AND MISCELLANEOUS APPURTENANCES FOR CAR WASH SYSTEM

Car Wash Equipment requiring plumbing connections will include stainless steel sink, hot water heater, reverse osmosis system; water softening system, high pressure pumping units; fluid module, flexible interconnecting hoses, spray wand booms, bubble brush booms, foam generators, water softener, reverse osmosis unit, spot free water storage tank, re-pressurization pump/tank unit, and freeze protection system. Provide all piping and fittings as indicated on

the drawings up to and including connection to the car wash equipment.Piping and devices shall be provided and installed to include but not limited to the following:

Domestic Hot and Cold Water Supply and Return Lines
Softened Water and Filtered Water Lines
Natural Gas Lines
Compressed Air Lines
Compressed Air Line Filters and Dryers
Compressed Air Line Regulators and Gages
Automatic Drain Valves
Gas Shut-off Valve
Water and Compressed Air Shut-off Valves
Water Bypass Valves
Insulation for piping, Tubing and Hoses
Manual and Automatic Pressure Relief Drain Lines
Flushing Lines
Overflow Lines
Vent Lines
Hot Water Heater Relief Valve
Hot Water Heater Vacuum Breaker Valve
Hot Water Heater Flue Vent and Roof Vent Cap

Dry type air filter shall be provided having a collection efficiency of 99 percent of particles larger than 10 microns. Filter body and media shall withstand a maximum 125PSI, capacity as indicated.

2.9 DOMESTIC WATER SERVICE METER

Cold water meter shall be of the positive displacement type conforming to AWWA C700. Meter register may be round or straight reading type, indicating.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

The plumbing system shall be installed complete with necessary fixtures, fittings, traps, valves, and accessories. Water and drainage piping shall be extended 5 feet outside the building, unless otherwise indicated. A full port ball valve and drain shall be installed on the water service line inside the building approximately 6 inches above the floor from point of entry. Piping shall be connected to the exterior service lines or capped or plugged if the exterior service is not in place. Sewer and water pipes shall be laid in separate trenches, except when

otherwise shown. Exterior underground utilities shall be at least 18 inches below the as indicated on the drawings. If trenches are closed or the pipes are otherwise covered before being connected to the service lines, the location of the end of each plumbing utility shall be type marked with a stake or other acceptable means. Valves shall be installed with control no lower than the valve body.

3.1.1 Water Pipe, Fittings, and Connections

3.1.1.1 Utilities

The piping shall be extended to fixtures, outlets, and equipment. The hot-water and cold-water piping system shall be arranged and installed to permit draining. The supply line to each item of equipment or fixture, except hydrants or other control valves which are supplied with integral stops, shall be equipped with a shutoff valve to enable isolation of the item for repair and maintenance without interfering with operation of other equipment or fixtures. Supply piping to fixtures, faucets and hydrants shall be anchored to prevent movement.

3.1.1.2 Cutting and Repairing

The work shall be carefully laid out in advance, and unnecessary cutting of construction shall be avoided. Damage to building, piping, wiring, or equipment as a result of cutting shall be repaired by mechanics skilled in the trade involved.

3.1.1.3 Protection of Fixtures, Materials, and Equipment

Pipe openings shall be closed with caps or plugs during installation. Fixtures and equipment shall be tightly covered and protected against dirt, water, chemicals, and mechanical injury. Upon completion of the work, the fixtures, materials, and equipment shall be thoroughly cleaned, adjusted, and operated. Safety guards shall be provided for exposed rotating equipment.

3.1.1.4 Mains, Branches, and Runouts

Piping shall be installed as indicated. Pipe shall be accurately cut and worked into place without springing or forcing. Structural portions of the building shall not be weakened. Aboveground piping shall run parallel with the lines of the building, unless otherwise indicated. Branch pipes from service lines may be taken from top, bottom, or side of main, using crossover fittings required by structural or installation conditions. Supply pipes, valves, and fittings shall be kept a sufficient distance from other work and other services to permit not less than 1/2 inch between finished covering on the different services. Bare and insulated water lines shall not bear directly against building structural elements so as to transmit sound

to the structure or to prevent flexible movement of the lines. Water pipe shall not be buried in or under floors unless specifically indicated or approved. Changes in pipe sizes shall be made with reducing fittings. Use of bushings will not be permitted except for use in situations in which standard factory fabricated components are furnished to accommodate specific excepted installation practice. Change in direction shall be made with fittings, except that bending of pipe 4 inches and smaller will be permitted, provided a pipe bender is used and wide sweep bends are formed. The center-line radius of bends shall be not less than six diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be acceptable.

3.1.1.5 Pipe Drains

Pipe drains indicated shall consist of 3/4 inch full port ball valve.

3.1.1.6 Expansion and Contraction of Piping

Allowance shall be made throughout for expansion and contraction of water pipe. Each hot-water and hot-water circulation riser shall have expansion loops or other provisions such as offsets, changes in direction, etc., where indicated and/or required. Risers shall be securely anchored as required or where indicated to force expansion to loops. Branch connections from risers shall be made with ample swing or offset to avoid undue strain on fittings or short pipe lengths. Horizontal runs of pipe over 50 feet in length shall be anchored to the wall or the supporting construction about midway on the run to force expansion, evenly divided, toward the ends. Sufficient flexibility shall be provided on branch runouts from mains and risers to provide for expansion and contraction of piping. Flexibility shall be provided by installing one or more turns in the line so that piping will spring enough to allow for expansion without straining. If mechanical grooved pipe coupling systems are provided, the deviation from design requirements for expansion and contraction may be allowed pending approval of Contracting Officer.

3.1.1.7 Commercial-Type Water Hammer Arresters

Commercial-type water hammer arresters shall be provided on hot- and cold-water supplies and shall be located as generally indicated, with precise location and sizing to be in accordance with PDI WH 201. Water hammer arresters, where concealed, shall be accessible by means of access doors or removable panels. Commercial-type water hammer arresters shall conform to PDI WH 201. Vertical capped pipe columns will not be permitted.

3.1.2 Compressed Air Piping

Compressed air piping shall be installed as specified for water piping and suitable for 125 psig working pressure. Compressed air piping shall have supply lines and discharge terminals legibly and permanently marked at both ends with the name of the system and the direction of flow.

3.1.3 Joints

Installation of pipe and fittings shall be made in accordance with the manufacturer's recommendations. Mitering of joints for elbows and notching of straight runs of pipe for tees will not be permitted. Joints shall be made up with fittings of compatible material and made for the specific purpose intended.

3.1.3.1 Threaded

Threaded joints shall have American Standard taper pipe threads conforming to ASME B1.20.1. Only male pipe threads shall be coated with graphite or with an approved graphite compound, or with an inert filler and oil, or shall have a polytetrafluoroethylene tape applied.

3.1.3.2 Unions and Flanges

Unions, flanges and mechanical couplings shall not be concealed in walls, ceilings, or partitions. Unions shall be used on pipe sizes 2-1/2 inches and smaller; flanges shall be used on pipe sizes 3 inches and larger.

3.1.3.3 Cast Iron Soil, Waste and Vent Pipe

Bell and spigot compression and hubless gasketed clamp joints for soil, waste and vent piping shall be installed per the manufacturer's recommendations.

3.1.3.4 Copper Tube and Pipe

The tube or fittings shall not be annealed when making connections. Connections shall be made with a multiflame torch.

a. Brazed. Brazed joints shall be made in conformance with AWS B2.2, MSS SP-73, and CDA Tube Handbook with flux and are acceptable for all pipe sizes. Copper to copper joints shall include the use of copper-phosphorus or copper-phosphorus-silver brazing metal without flux. Brazing of dissimilar metals (copper to bronze or brass) shall include the use of flux with either a copper-phosphorus, copper-phosphorus-silver or a silver brazing filler metal.

b. Soldered. Soldered joints shall be made with flux and are only acceptable for piping 2 inches and smaller. Soldered joints shall conform to ASME B31.5 and CDA Tube Handbook.

c. Copper Tube Extracted Joint. An extracted mechanical joint may be made in copper tube. Joint shall be produced with an appropriate tool by drilling a pilot hole and drawing out the tube surface to form a collar having a minimum height of three times the thickness of the tube wall. To prevent the branch tube from being inserted beyond the depth of the extracted joint, dimpled depth stops shall be provided. Branch tube shall be notched for proper penetration into fitting to ensure a free flow joint. Extracted joints shall be brazed in accordance with NAPHCC Plumbing Code using B-Cup series filler metal in accordance with MSS SP-73. Soldered extracted joints will not be permitted.

3.1.4 Dissimilar Pipe Materials

Connections between ferrous and non-ferrous copper water pipe shall be made with dielectric unions or flange waterways. Connecting joints between plastic and metallic pipe shall be made with transition fitting for the specific purpose.

3.1.5 Corrosion Protection for Buried Pipe and Fittings

3.1.5.1 Cast Iron and Ductile Iron

Pressure pipe shall have protective coating, a cathodic protection system, and joint bonding. Pipe, fittings, and joints shall have a protective coating. The protective coating shall be completely encasing polyethylene tube or sheet in accordance with AWWA C105. Joints and fittings shall be cleaned, coated with primer, and wrapped with tape. The pipe shall be cleaned, coated, and wrapped prior to pipe tightness testing. Joints and fittings shall be cleaned, coated, and wrapped after pipe tightness testing. Tape shall conform to AWWA C203 and shall be applied with a 50 percent overlap. Primer shall be as recommended by the tape manufacturer.

3.1.5.2 Steel

Steel pipe, joints, and fittings shall be cleaned, coated with primer, and wrapped with tape. Pipe shall be cleaned, coated, and wrapped prior to pipe tightness testing. Joints and fittings shall be cleaned, coated, and wrapped after pipe tightness testing. Tape shall conform to AWWA C203 and shall be applied with a 50 percent overlap. Primer shall be as recommended by the tape manufacturer.

3.1.6 Pipe Sleeves and Flashing

Pipe sleeves shall be furnished and set in their proper and permanent location.

3.1.6.1 Sleeve Requirements

Pipes passing through concrete or masonry walls or concrete floors or roofs shall be provided with pipe sleeves fitted into place at the time of construction. Sleeves are not required for cast-iron soil pipe passing through concrete slab on grade, except where penetrating a membrane waterproof floor. A modular mechanical type sealing assembly may be installed in lieu of a waterproofing clamping flange and caulking and sealing of annular space between pipe and sleeve. The seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and sleeve with corrosion-protected carbon steel bolts, nuts, and pressure plates. The links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and each nut. After the seal assembly is properly positioned in the sleeve, tightening of the bolt shall cause the rubber sealing elements to expand and provide a watertight seal between the pipe and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe and sleeve involved. Sleeves shall not be installed in structural members, except where indicated or approved. Rectangular and square openings shall be as detailed. Each sleeve shall extend through its respective floor, or roof, and shall be cut flush with each surface, except for special circumstances. Pipe sleeves passing through floors in wet areas such as mechanical equipment rooms, lavatories, kitchens, and other plumbing fixture areas shall extend a minimum of 4 inches above the finished floor. Unless otherwise indicated, sleeves shall be of a size to provide a minimum of 1/4 inch clearance between bare pipe and inside of sleeve or between jacket over insulation and sleeves. Sleeves in bearing walls shall be steel pipe or cast-iron pipe. Sleeves for membrane waterproof floors shall be steel pipe, cast-iron pipe, or plastic pipe. Membrane clamping devices shall be provided on pipe sleeves for waterproof floors. Sleeves in nonbearing walls or ceilings may be steel pipe, cast-iron pipe, galvanized sheet metal with lock-type longitudinal seam, or moisture-resistant fiber or plastic. Plastic sleeves shall not be used in nonbearing fire walls, roofs, or floor/ceilings. Except as otherwise specified, the annular space between pipe and sleeve, or between jacket over insulation and sleeve, shall be sealed as indicated with sealants conforming to ASTM C 920 and with a primer, backstop material and surface preparation as specified in Section 07900 JOINT SEALING. Pipes passing through sleeves in concrete floors over crawl spaces shall be sealed as specified above. The annular space between pipe and sleeve or between jacket over insulation and sleeve shall not be sealed for interior walls which are not designated as fire rated. Sleeves through below-grade walls in contact with earth shall be recessed 1/2 inch from wall surfaces on both sides. Annular space between pipe and sleeve shall be filled with backing material and sealants in the joint between the pipe and masonry wall as specified

above. Sealant selected for the earth side of the wall shall be compatible with dampproofing/waterproofing materials that are to be applied over the joint sealant.

3.1.6.2 Flashing Requirements

Pipes passing through roof or floor waterproofing membrane shall be installed through a 16 ounce copper flashing, each within an integral skirt or flange. Flashing shall be suitably formed, and the skirt or flange shall extend not less than 8 inches from the pipe and shall be set over the roof or floor membrane in a solid coating of bituminous cement. The flashing shall extend up the pipe a minimum of 10 inches. For cleanouts, the flashing shall be turned down into the hub and caulked after placing the ferrule. Pipes passing through pitched roofs shall be flashed, using lead or copper flashing, with an adjustable integral flange of adequate size to extend not less than 8 inches from the pipe in all directions and lapped into the roofing to provide a watertight seal. The annular space between the flashing and the bare pipe or between the flashing and the metal-jacket-covered insulation shall be sealed as indicated. Flashing for dry vents shall be turned down into the pipe to form a waterproof joint. Pipes, up to and including 10 inches in diameter, passing through roof or floor waterproofing membrane may be installed through a cast-iron sleeve with caulking recess, anchor lugs, flashing-clamp device, and pressure ring with brass bolts. Flashing shield shall be fitted into the sleeve clamping device. Pipes passing through wall waterproofing membrane shall be sleeved as described above. A waterproofing clamping flange shall be installed.

3.1.6.3 Waterproofing

Waterproofing at floor-mounted water closets shall be accomplished by forming a flashing guard from soft-tempered sheet copper. The center of the sheet shall be perforated and turned down approximately 1-1/2 inches to fit between the outside diameter of the drainpipe and the inside diameter of the cast-iron or steel pipe sleeve. The turned-down portion of the flashing guard shall be embedded in sealant to a depth of approximately 1-1/2 inches; then the sealant shall be finished off flush to floor level between the flashing guard and drainpipe. The flashing guard of sheet copper shall extend not less than 8 inches from the drainpipe and shall be lapped between the floor membrane in a solid coating of bituminous cement. If cast-iron water closet floor flanges are used, the space between the pipe sleeve and drainpipe shall be sealed with sealant and the flashing guard shall be upturned approximately 1-1/2 inches to fit the outside diameter of the drainpipe and the inside diameter of the water closet floor flange. The upturned portion of the sheet fitted into the floor flange shall be sealed.

3.1.6.4 Optional Counterflashing

Instead of turning the flashing down into a dry vent pipe, or caulking and sealing the annular space between the pipe and flashing or metal-jacket-covered insulation and flashing, counterflashing may be accomplished by utilizing the following:

a. A standard roof coupling for threaded pipe up to 6 inches in diameter.

b. A tack-welded or banded-metal rain shield around the pipe.

3.1.6.5 Pipe Penetrations of Slab on Grade Floors

Where pipes, fixture drains, floor drains, cleanouts or similar items penetrate slab on grade floors, except at penetrations of floors with waterproofing membrane as specified in paragraphs Flashing Requirements and Waterproofing, a groove 1/4 to 1/2 inch wide by 1/4 to 3/8 inch deep shall be formed around the pipe, fitting or drain. The groove shall be filled with a sealant as specified in Section 07900 JOINT SEALING.

3.1.7 Supports

3.1.7.1 General

Hangers used to support piping 2 inches and larger shall be fabricated to permit adequate adjustment after erection while still supporting the load. Pipe guides and anchors shall be installed to keep pipes in accurate alignment, to direct the expansion movement, and to prevent buckling, swaying, and undue strain. Piping subjected to vertical movement when operating temperatures exceed ambient temperatures shall be supported by variable spring hangers and supports or by constant support hangers. In the support of multiple pipe runs on a common base member, a clip or clamp shall be used where each pipe crosses the base support member. Spacing of the base support members shall not exceed the hanger and support spacing required for an individual pipe in the multiple pipe run. Threaded sections of rods shall not be formed or bent.

3.1.7.2 Pipe Hangers, Inserts, and Supports

Installation of pipe hangers, inserts and supports shall conform to MSS SP-58 and MSS SP-69, except as modified herein.

a. Types 5, 12, and 26 shall not be used.

b. Type 3 shall not be used on insulated pipe.

c. Type 18 inserts shall be secured to concrete forms before concrete is placed. Continuous inserts which allow more adjustment may be used if they otherwise meet the requirements for type 18 inserts.

d. Type 19 and 23 C-clamps shall be torqued per MSS SP-69 and shall have both locknuts and retaining devices furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.

e. Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.

f. Type 24 may be used only on trapeze hanger systems or on fabricated frames.

g. Type 39 saddles shall be used on insulated pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher. Type 39 saddles shall be welded to the pipe.

h. Type 40 shields shall:

(1) Be used on insulated pipe less than 4 inches.

(2) Be used on insulated pipe 4 inches and larger when the temperature of the medium is 60 degrees F or less.

(3) Have a high density insert for pipe 2 inches and larger and for smaller pipe sizes when the insulation is suspected of being visibly compressed, or distorted at or near the shield/insulation interface. High density inserts shall have a density of 8 pcf or greater.

i. Horizontal pipe supports shall be spaced as specified in MSS SP-69 and a support shall be installed not over 1 foot from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 5 feet apart at valves. Operating temperatures in determining hanger spacing for PVC or CPVC pipe shall be 120 degrees F for PVC and 180 degrees F for CPVC. Horizontal pipe runs shall include allowances for expansion and contraction.

j. Vertical pipe shall be supported at each floor, except at slab-on-grade, at intervals of not more than 15 feet nor more than 8 feet from end of risers, and at vent terminations. Vertical pipe risers shall include allowances for expansion and contraction.

k. Provide high density inserts with a density of 8 pcf or greater. Type 35 guides using steel, reinforced polytetrafluoroethylene (PTFE) or graphite slides shall be provided to allow longitudinal pipe movement. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered. Lateral restraints shall be provided as needed. Where steel slides do not require provisions for lateral restraint, use Type 40 shield attached to the pipe or insulation.

m. Pipe hangers on horizontal insulated pipe shall be the size of the outside diameter of the insulation. The insulation shall be continuous through the hanger on all pipe sizes and applications.

n. Where there are high system temperatures and welding to piping is not desirable, the type 35 guide shall include a pipe cradle, welded to the guide structure and strapped securely to the pipe. The pipe shall be separated from the slide material by at least 4 inches or by an amount adequate for the insulation, whichever is greater.

o. Hangers and supports for plastic pipe shall not compress, distort, cut or abrade the piping, and shall allow free movement of pipe except where otherwise required in the control of expansion/contraction.

3.1.8 Welded Installation

Plumbing pipe weldments shall be as indicated. Changes in direction of piping shall be made with welding fittings only; mitering or notching pipe to form elbows and tees or other similar type construction will not be permitted. Branch connection may be made with either welding tees or forged branch outlet fittings. Branch outlet fittings shall be forged, flared for improvement of flow where attached to the run, and reinforced against external strains. Beveling, alignment, heat treatment, and inspection of weld shall conform to ASME B31.1. Weld defects shall be removed and repairs made to the weld, or the weld joints shall be entirely removed and rewelded. After filler metal has been removed from its original package, it shall be protected or stored so that its characteristics or welding properties are not affected. Electrodes that have been wetted or that have lost any of their coating shall not be used.

3.1.9 Pipe Cleanouts

Pipe cleanouts shall be the same size as the pipe except that cleanout plugs larger than 4 inches will not be required. A cleanout installed in connection with cast-iron soil pipe shall consist of

a long-sweep 1/4 bend or one or two 1/8 bends extended to the place shown. An extra-heavy cast-brass or cast-iron ferrule with countersunk cast-brass head screw plug shall be caulked into the hub of the fitting and shall be flush with the floor. Cleanouts in connection with other pipe, where indicated, shall be T-pattern, 90-degree branch drainage fittings with cast-brass screw plugs, except plastic plugs shall be installed in plastic pipe. Plugs shall be the same size as the pipe up to and including 4 inches. Cleanout tee branches with screw plug shall be installed at the foot of soil and waste stacks, at the foot of interior downspouts, on each connection to building storm drain where interior downspouts are indicated, and on each building drain outside the building. Cleanout tee branches may be omitted on stacks in single story buildings with slab-on-grade construction or where less than 18 inches of crawl space is provided under the floor. Cleanouts on pipe concealed in partitions shall be provided with chromium plated bronze, nickel bronze, nickel brass or stainless steel flush type access cover plates. Round access covers shall be provided and secured to plugs with securing screw. Square access covers may be provided with matching frames, anchoring lugs and cover screws. Cleanouts in finished walls shall have access covers and frames installed flush with the finished wall. Cleanouts installed in finished floors subject to foot traffic shall be provided with a chrome-plated cast brass, nickel brass, or nickel bronze cover secured to the plug or cover frame and set flush with the finished floor. Heads of fastening screws shall not project above the cover surface. Where cleanouts are provided with adjustable heads, the heads shall be cast iron.

3.2 FIXTURES AND FIXTURE TRIMMINGS

Angle stops, straight stops, stops integral with the faucets, or concealed type of lock-shield, and loose-key pattern stops for supplies with threaded, sweat or solvent weld inlets shall be furnished and installed with fixtures. Where connections between copper tubing and faucets are made by rubber compression fittings, a beading tool shall be used to mechanically deform the tubing above the compression fitting. Exposed traps and supply pipes for fixtures and equipment shall be connected to the rough piping systems at the wall, unless otherwise specified under the item. Floor and wall escutcheons shall be as specified. Drain lines and hot water lines of fixtures for handicapped personnel shall be insulated and do not require polished chrome finish. Plumbing fixtures and accessories shall be installed within the space shown.

3.2.1 Fixture Connections

Where space limitations prohibit standard fittings in conjunction with the cast-iron floor flange, special short-radius fittings shall be provided. Connections between earthenware fixtures and flanges on soil pipe shall be made gastight and watertight with a closet-setting compound or neoprene gasket and seal. Use of natural rubber gaskets or putty will not be permitted. Fixtures with outlet flanges shall be set the proper distance from floor or wall to make a first-class joint with the closet-setting compound or gasket and fixture used.

3.2.2 Fixture and Equipment Mounting

All plumbing equipment shall be anchored to the concrete floor with expansion type anchor bolts.

3.2.3 Backflow Prevention Devices

Plumbing fixtures, equipment, and pipe connections shall not cross connect or interconnect between a potable water supply and any source of nonpotable water. Backflow preventers shall be installed where indicated and in accordance with NAPHCC Plumbing Code at all other locations necessary to preclude a cross-connect or interconnect between a potable water supply and any nonpotable substance. In addition backflow preventers shall be installed at all locations where the potable water outlet is below the flood level of the equipment, or where the potable water outlet will be located below the level of the nonpotable substance. Backflow preventers shall be located so that no part of the device will be submerged. Backflow preventers shall be of sufficient size to allow unrestricted flow of water to the equipment, and preclude the backflow of any nonpotable substance into the potable water system. Bypass piping shall not be provided around backflow preventers. Access shall be provided for maintenance and testing. Each device shall be a standard commercial unit.

3.2.4 Access Panels

Access panels shall be provided for concealed valves and controls, or any item requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced, maintained, or replaced. Access panels shall be as specified in Section 05500 MISCELLANEOUS METAL.

3.2.5 Sight Drains

Floor drains shall be provided as specified herein (indicated as sight drain on the drawings) with funnel so that the indirect waste will terminate 2 inches above the flood rim of the funnel to provide an acceptable air gap.

3.2.6 Traps

Each trap shall be placed as near the fixture as possible, and no fixture shall be double-trapped. Traps installed on cast-iron soil pipe shall be cast iron. Traps installed on steel pipe or copper tubing shall be recess-drainage pattern, or brass-tube type.

3.3 VIBRATION-ABSORBING FEATURES

Mechanical equipment, including compressors and pumps, shall be isolated from the building structure by approved vibration-absorbing features, unless otherwise shown. Each foundation shall include an adequate number of standard isolation units. Each unit shall consist of machine and floor or foundation fastening, together with intermediate isolation material, and shall be a standard product with printed load rating. Piping connected to mechanical equipment shall be provided with flexible connectors.

3.3.1 Tank-Mounted Compressor

Floor attachment shall be as recommended by compressor manufacturer.

3.4 IDENTIFICATION SYSTEMS

3.4.1 Identification Tags

Identification tags made of brass, engraved laminated plastic, or engraved anodized aluminum, indicating service and valve number shall be installed on valves, except those valves installed on supplies at plumbing fixtures. Tags shall be 1-3/8 inch minimum diameter, and marking shall be stamped or engraved. Indentations shall be black, for reading clarity. Tags shall be attached to valves with No. 12 AWG, copper wire, chrome-plated beaded chain, or plastic straps designed for that purpose.

3.4.2 Pipe Color Code Marking

Color code marking of piping shall be as specified in Section 09900 PAINTING, GENERAL.

3.5 ESCUTCHEONS

Escutcheons shall be provided at finished surfaces where bare or insulated piping, exposed to view, passes through floors, walls, or ceilings, except in boiler, utility, or equipment rooms. Escutcheons shall be fastened securely to pipe or pipe covering and shall be satin-finish, corrosion-resisting steel, polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Escutcheons shall be either one-piece or split-pattern, held in place by internal spring tension or setscrew.

3.6 PAINTING

Painting of pipes, hangers, supports, and other iron work, either in concealed spaces or exposed spaces, is specified in Section 09900 PAINTING, GENERAL.

3.7 TESTS, FLUSHING AND DISINFECTION

The following tests shall be performed on the plumbing system in accordance with IPC ICC.

a. Drainage and Vent Systems
b. Building Sewers
c. Hot and Cold Water Supply Systems
d. Soft Water and Filtered Water Systems
e. Compressed Air

3.7.1.1 Test of Backflow Prevention Assemblies

Backflow prevention assembly shall be tested using gauges specifically designed for the testing of backflow prevention assemblies. Gauges shall be tested annually for accuracy in accordance with the University of Southern California's Foundation of Cross Connection Control and Hydraulic Research or the American Water Works Association Manual of Cross Connection (Manual M-14). Report form for each assembly shall include, as a minimum, the following:

Data on Device	Data on Testing Firm
Type of Assembly	Name
Manufacturer	Address
Model Number	Certified Tester
Serial Number	Certified Tester No.
Size	Date of Test
Location	
Test Pressure Readings	Serial Number and Test Data of Gauges

If the unit fails to meet specified requirements, the unit shall be repaired and retested.

3.7.1.2 Compressed Air Piping

Piping systems shall be filled with oil-free dry air or gaseous nitrogen to 150 psig and hold this pressure for 2 hours with no drop in pressure.

3.7.2 Defective Work

If inspection or test shows defects, such defective work or material shall be replaced or repaired as necessary and inspection and tests shall be repeated. Repairs to piping shall be made with new materials. Caulking of screwed joints or holes will not be acceptable

3.7.3 System Flushing

Before operational tests or disinfection, potable water piping system shall be flushed with potable water. In general, sufficient water shall be used to produce a minimum water velocity of 2.5 feet per second through piping being flushed. Flushing shall be continued until entrained dirt and other foreign materials have been removed and until discharge water shows no discoloration. System shall be drained at low points. Strainer screens shall be removed, cleaned, and replaced. After flushing and cleaning, systems shall be prepared for testing by immediately filling water piping with clean, fresh potable water. Any stoppage, discoloration, or other damage to the finish, furnishings, or parts of the building due to the Contractor's failure to properly clean the piping system shall be repaired by the Contractor. When the system flushing is complete, the hot-water system shall be adjusted for uniform circulation. Flushing devices and automatic control systems shall be adjusted for proper operation.

3.7.4 Operational Test

Upon completion of flushing and prior to disinfection procedures, the Contractor shall subject the plumbing system to operating tests to demonstrate satisfactory functional and operational efficiency. Such operating tests shall cover a period of not less than 8 hours for each system and shall include the following information in a report with conclusion as to the adequacy of the system:

a. Time, date, and duration of test.

b. Water pressures at the most remote and the highest fixtures.

c. Operation of each fixture and fixture trim.

d. Operation of each valve, hydrant, and faucet.

e. Pump suction and discharge pressures.

f. Temperature of each domestic hot-water supply.

g. Operation of each floor and roof drain by flooding with water.

h. Operation of each vacuum breaker and backflow preventer.

i. Compressed air readings at each compressor and at each outlet. Each indicating instrument shall be read at 1/2 hour intervals. The report of the test shall be submitted

in quadruplicate. The Contractor shall furnish instruments, equipment, and personnel required for the tests; the Government will furnish the necessary water and electricity.

j. Car wash fluid concentrations, pressures, temperatures, flow rates and notation of pumps and solenoids operating sequence every 15 seconds during consecutive car washing timed interval over a two hour period.

3.7.5 Disinfection

After operational tests are complete, the entire domestic hot- and cold-water distribution system shall be disinfected. System shall be flushed as specified, before introducing chlorinating material. The chlorinating material shall be hypochlorites or liquid chlorine. Water chlorination procedure shall be in accordance with AWWA M20. The chlorinating material shall be fed into the water piping system at a constant rate at a concentration of at least 50 parts per million (ppm) A properly adjusted hypochlorite solution injected into the main with a hypochlorinator, or liquid chlorine injected into the main through a solution-feed chlorinator and booster pump shall be used. The chlorine residual shall be checked at intervals to ensure that the proper level is maintained. Chlorine application shall continue until the entire main is filled. The water shall remain in the system for a minimum of 24 hours. Each valve in the system being disinfected shall be opened and closed several times during the contact period to ensure its proper disinfection. Following the 24-hour period, no less than 25 ppm chlorine residual shall remain in the system. Water tanks shall be disinfected by the addition of chlorine directly to the filling water. Following a 6 hour period, no less than 50 ppm chlorine residual shall remain in the tank. If after the 24 hour and 6 hour holding periods, the residual solution contains less than 25 ppm and 50 ppm chlorine respectively, flush the piping and tank with potable water, and repeat the above procedures until the required residual chlorine levels are satisfied. The system including the tanks shall then be flushed with clean water until the residual chlorine level is reduced to less than one part per million. During the flushing period each valve and faucet shall be opened and closed several times. Samples of water in disinfected containers shall be obtained from several locations selected by the Contracting Officer. The samples of water shall be tested for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with AWWA EWW. The testing method used shall be either the multiple-tube fermentation technique or the membrane-filter technique. Disinfection shall be repeated until tests indicate the absence of coliform organisms (zero mean coliform density per 100 milliliters) in the samples for at least 2 full days. The system will not be accepted until satisfactory bacteriological results have been obtained.

3.8 POSTED INSTRUCTIONS

Framed instructions under glass or in laminated plastic, including wiring and control diagrams showing the complete layout of the entire plumbing and car wash system, shall be posted where directed. Condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system shall be prepared in typed form, framed as specified above for the wiring and control diagrams and posted beside the diagrams. The framed instructions shall be posted before acceptance testing of the systems.

3.9 PERFORMANCE OF EQUIPMENT

Provide all labor and miscellaneous materials to assist the Car Wash Equipment Manufacturer in the testing and adjusting of Government Furnished Car Wash Equipment as required under Section 13100, Car Wash & Vacuuming Equipment. Provide cleanup after testing is completed.

3.10 TABLES

TABLE I
PIPE AND FITTING MATERIALS FOR
DRAINAGE, WASTE, AND VENT PIPING SYSTEMS

		SERVICE			
Item #	Pipe and Fitting Materials	A	B	C	D
1	Cast iron soil pipe and fittings, hub and spigot, ASTM A 74 with compression gaskets	X	X	X	X
2	Cast iron soil pipe and fittings hubless, CISPI 301 and ASTM A 888		X		X
3	Cast iron drainage fittings, threaded, ASME B16.				X
4	Cast iron screwed fittings (threaded) ASME B16.4				X
5	Bronze sand casting grooved joint pressure fittings for non-ferrous pipe ASTM B 584		X		X
6	Seamless red brass pipe, ASTM B 43			X	X
7	Bronzed flanged fittings, ASME B16.24				X
8	Cast copper alloy solder joint pressure fittings, ASME B16.18				X
9	Seamless copper pipe, ASTM B 42				X
10	Cast bronze threaded fittings,			X	X

ASME B16.15				
11 Copper drainage tube, (DWV), ASTM B 306	X	X	X	X
12 Wrought copper and wrought alloy solder-joint drainage fittings. ASME B16.29	X	X	X	X
13 Cast copper alloy solder joint drainage fittings, DWV, ASME B16.23	X	X	X	X

SERVICE:

A - Underground Building Soil, Waste and Storm Drain
B - Aboveground Soil, Waste, Drain In Buildings
C - Underground Vent
D - Aboveground Vent

TABLE II
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

	SERVICE			
Item No. Pipe and Fitting Materials	A	B	C	D
1 Seamless red brass pipe, ASTM B 43	X	X		X
2 Bronze flanged fittings, ASME B16.24	X	X		X
3 Seamless copper pipe, ASTM B 42	X	X		X
4 Seamless copper water tube, ASTM B 88, ASTM B 88M	X*	X*	X*	X*

5	Cast bronze threaded fittings, ASME B16.15	X	X		X
6	Wrought copper & bronze solder-jt pressure fittings, ASME B16.22	X	X	X	X
7	Cast copper alloy solder-joint pressure fittings, ASME B16.18	X	X	X	X

A - Cold Water Aboveground
B - Hot Water Aboveground
C - Compressed Air
D - Cold Water Service Belowground
Indicated types are minimum wall thicknesses.
* - Type L – Hard

-------THE END-------

SECTION 15565
HEATING SYSTEM; GAS-FIRED HEATER

PART 1 - GENERAL

1.1 APPLICABLE PUBLICATIONS: The publications listed below form a part of this specification. The publications are referred to in the text by basic designation only.

1.1.1 Federal Specification (Fed. Spec.):

CC-M-1807A 18 Feb. 1986	Motors, Alternating Current, Fractional and Integral Horsepower (500 Hp and Smaller)

1.1.2 American Gas Association Laboratories (AGAL) Publication:

Directory of Certified Appliances and Accessories (Jul 1, 1986 and Monthly Supplemental Directories)

1.1.3 American National Standards Institute, Inc. (ANSI) Standards:

Z83.8-1985	Gas Unit Heaters
Z223.1-1984 & Z223.1a-1987	National Fuel Gas Code

1.1.4 Underwriters Laboratories, Inc. (UL) Publications:

Gas and Oil Equipment Directory (Sep 1986 with Quarterly Supplements)

UL 94	Tests for Flammability of Plastic Materials for Parts in Devices and Appliances (Jan 24, 1980, 3rd Ed.; Rev thru Mar 3, 1988)

1.2 GENERAL REQUIREMENTS:

1.2.1 Standard Products: Material and equipment shall be standard products of a manufacturer regularly engaged in manufacturing of the products. Equipment shall essentially duplicate equipment that has been in satisfactory use at least 2 years prior to bid opening.

1.2.2 Nameplates: Each major component of equipment shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the

equipment.

1.2.3 Equipment Guards: Belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts so located that any person may come in close proximity thereto shall be completely enclosed or guarded. High-temperature equipment and piping so located as to endanger personnel or create a fire hazard shall be guarded or covered with insulation of type specified for service.

1.2.4 Verification of Dimensions: The Contractor shall become thoroughly familiar with all details of the work, verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing any work.

1.3 SUBMITTALS:

1.3.1 Shop Drawings: Shop drawings shall be submitted in accordance with the SECTION - GENERAL and shall consist of illustrations, schedules, performance charts, instructions, brochures, diagrams, and other information to illustrate the requirements and operation of the system. Shop drawings shall be submitted for space heating equipment, controls, associated equipment, and for piping and wiring. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearances for maintenance and operation.

1.3.2 Spare-Parts Data: After approval of the shop drawings, and not later than 1 month prior to the date of beneficial occupancy, the Contractor shall furnish spare parts data for each different item of materials and equipment specified. The data shall include a complete list of parts and supplies, with current unit prices and source of supply.

1.3.3 Operating and Maintenance Instructions:

1.3.3.1 Operating Instructions: The Contractor shall furnish the Contracting Officer 6 complete copies of operating instructions outlining the step-by-step procedures required for system startup, operation and shutdown. The instructions shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and basic operating features.

1.3.3.2 Maintenance Instructions: The Contractor shall furnish the Contracting Officer 6 complete copies of maintenance instructions listing routine maintenance, possible breakdowns, repairs and troubleshooting guide. The instructions shall include simplified piping, wiring, and control diagrams for the system as installed.

1.3.4 Performance Test Reports: Upon completion and testing of the installed system, test reports

shall be submitted in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria. Each test report shall indicate the final position of controls.

1.4 DELIVERY AND STORAGE: All equipment delivered and placed in storage shall be stored with protection from weather, humidity and temperature variations, dirt and dust, or other contaminants.

PART 2 - PRODUCTS

2.1 ELECTRICAL WORK: Electrical motor driven equipment shall be provided complete with motors, motor starters, and controls. Motors shall conform to Fed. Spec. CC-M-1807. Electrical equipment and wiring shall be in accordance with SECTION: ELECTRICAL WORK, INTERIOR. Electrical characteristics shall be as specified or indicated. Motor starters shall be provided complete with thermal overload protection and other appurtenances necessary for the motor control specified. Each motor shall be of sufficient size to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor. Manual or automatic control and protective or signal devices required for the operation specified and any control wiring required for controls and devices specified, but not shown, shall be provided.

2.2 HEATER shall be equipped for and adjusted to burn natural gas. Each heater shall be provided with a gas pressure regulator that will satisfactorily limit the main gas burner supply pressure. Heater shall have a direct electric ignition system. Safety controls shall conform to the ANSI standard specified for each heater. Mounting brackets and hardware shall be furnished by the heater manufacturer and shall be factory finished to match the supported equipment.

2.2.1 Unit Heater:

2.2.1.1 Heater shall conform to requirements of ANSI Z83.8. Heat exchanger shall be stainless steel. Air discharge section shall be equipped with adjustable horizontal louvers. Products of combustion shall be vented to the outside atmosphere. Heater fan motor shall operate at a speed not in excess of 1,550 rpm . Fan shaft shall be directly connected to the driving motor. Heater shall be high-efficiency type with a minimum combustion efficiency of 83 percent. Heater shall have automatic electronic ignition.

2.2.1.2 Space thermostat shall be a heavy-duty single stage with 3-degree F differential and set point range of 40 to 75 degrees F. Thermostat shall control the fan and burner.

2.3 VENT PIPING shall be type B, conforming to the requirements of ANSI Z223.1.

2.4 INSULATION for piping and equipment and application shall be in accordance with

SECTION: THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.5 PAINTING AND FINISHING: Equipment and component items, when fabricated from ferrous metal, shall be factory finished with the manufacturer's standard finish.

PART 3 - EXECUTION

3.1 INSTALLATION: Equipment shall be installed as indicated and in accordance with the recommendations of the equipment manufacturer and the listing agency, except as otherwise specified.

3.1.1 Heating Equipment: Heater shall be installed at height indicated with clearance to combustibles complying with minimum distances as determined by the AGAL Directory of Certified Appliances and Accessories, the UL Gas and Oil Equipment Directory, and as indicated on each heater approval and listing plate. Heater shall be independently supported from the building structure as indicated and shall not rely on support from suspended ceiling systems.

3.1.2 Vent: Vent piping and structural penetrations shall be located as indicated. Vent pipes shall extend through the roof or an outside wall and shall terminate in compliance with ANSI Z223.1. Vent passing through waterproof membranes shall be provided with the necessary flashings to obtain waterproof installations.

3.1.3 Gas Piping: Gas piping shall be connected as indicated and shall comply with the applicable requirements at SECTION: GAS PIPING SYSTEMS.

3.2 TESTS shall be performed in the presence of the Contracting Officer. The Contractor shall furnish instruments and qualified personnel required for the tests. All gas, water, and electricity will be furnished by the Government. Upon completion and prior to acceptance of the installation, heaters shall be subjected to such tests as required to demonstrate satisfactory heating capacities, ignition and extinguishing sequences, safety shutoff operation, optimum burning efficiency, and proper venting.

END OF SECTION

SECTION 16375
ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND

PART 1 - GENERAL

1.1 APPLICABLE PUBLICATIONS: The publications listed below form a part of this specification. The publications are referred to in the text by the basic designation only.

1.1.1 Military Specification (Mil. Spec.):

DoD-P-21035A	Paint, High Zinc Dust Content, Galvanizing Repair (Metric)

1.1.2 Federal Specifications (Fed. Spec.):

W-F-1814A/GEN & Suppl 1 12 Nov. 1985	Fuses, Cartridge, High Interrupting Capacity
W-S-610C & Am-1 11 Jun. 1984	Splice Conductor
FF-P-101F 30 May 1984	Padlocks

1.1.3 American National Standards Institute, Inc. (ANSI) Standards:

C2-1987	National Electrical Safety Code
C12.1-1982	Code for Electricity Metering
C12.4-1984	Mechanical Demand Registers
C12.10-1978	Watthour Meters
C57.12.26-1987	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

C80.1-1983	Rigid Steel Conduit - Zinc Coated
C119.1-1986	Sealed Insulated Underground Connector Systems Rated 600 Volts
Z35.1-1972	Accident Prevention Signs

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

A 123-84	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
A 153-82 (R 1987)	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
B 8-86	Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
B 117-85	Salt Spray (Fog) Testing
D 923-86	Sampling Electrical Insulating Liquids
D 1654-79a (R 1984)	Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
D 3304-77 (R 1983)	Analysis of Environmental Materials for Polychlorinated Biphenyls

1.1.5 Institute of Electrical and Electronics Engineers (IEEE) Standards:

No. 48-1975	Standard Test Procedures and Requirements for High-Voltage Alternating-Current Cable Terminations
No. 142-1982	Recommended Practice for Grounding of Industrial and Commercial Power Systems
No. 386-1985	600V
FB 1-1983	Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies
SG 2-1986	High-Voltage Fuses

TC 6-1983	PVC and ABS Plastic Utilities Duct for Underground Installation
WC 7-1982 Incl Rev 1 and 2	Cross-Linked-Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
WC 8-1976 (R 1982) Incl Rev 1 thru 8	Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

1.1.6 National Fire Protection Association (NFPA) Standard:

70-1987 & Errata & Int Am 87-1 & Int Am 87-2	National Electrical Code

1.1.7 Underwriters Laboratories Inc. (UL) Publications:

UL 6	Rigid Metal Conduit (Oct 23, 1981, 9th Ed.; Rev Oct 10, 1983; Errata Aug 29, 1986)
UL 198E	Class R Fuses (Apr 22, 1982, 3rd Ed.; Rev thru Sep 4, 1987)
UL 467	Grounding and Bonding Equipment (Nov 22, 1984, 6th Ed.; Rev thru Apr 30, 1985)
UL 514	Metallic Outlet Boxes (Dec 1, 1983, 7th Ed.; Rev thru Oct 27, 1987)
UL 854	Service-Entrance Cables (Feb 9, 1987, 7th Ed.; Rev thru Feb 10, 1987)
UL 124	Intermediate Metal Conduit (Oct 10, 1983, 1st Ed.; Rev Apr 10, 1986)

1.2 GENERAL REQUIREMENTS: Items of the same classification shall be identical including equipment, assemblies, parts, and components.

1.2.1 Code Compliance: The installation shall comply with the requirements and

recommendations of NFPA 70 and ANSI C2.

1.2.2 Standard Product: Material and equipment shall be a standard product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

1.2.3 Nameplates: Each major component of equipment shall have as a minimum the manufacturer's name, address, and catalog or style number on a nameplate securely attached to the item of equipment. Nameplates for individual items of electrical equipment shall be as specified in referenced publications and shall be provided on each item of equipment. Transformer nameplates shall be permanently marked with a statement to the effect that the transformer dielectric to be supplied is non-PCB classified with less than 50 parts per million (ppm) PCB content. If transformer nameplate is not so marked, the Contractor shall furnish manufacturer's certification for each transformer that the dielectric is non-PCB classified with less than 50 ppm PCB content. Certifications shall be related to serial numbers on transformer nameplates. Transformer dielectric exceeding the 50 ppm PCB content or transformers without certification will be considered as PCB insulated and will not be acceptable. In lieu of the manufacturer's certification, the Contractor may submit a test sample of the dielectric in accordance with ASTM D 923 and have tests performed per ASTM D 3304 at an EPA-approved testing facility to obtain this certification. Transformers with test results indicating PCB levels exceeding 50 ppm shall be replaced or decontaminated in accordance with approved EPA procedures to achieve the acceptable levels, and the certification specified shall be submitted and approved prior to acceptance of the transformer and approved dielectric. It is not permissible to dilute contaminated dielectric in an attempt to lower the level of contamination. The PCB contaminated dielectric must be marked as PCB and transported to and incinerated by an approved EPA waste disposal facility and the Contractor shall furnish certification of proper disposal.

1.2.4 Prevention of Corrosion:

1.2.4.1 Metallic materials shall be protected against corrosion as specified. Aluminum shall not be used in contact with earth or concrete. Where aluminum conductors are connected to dissimilar metal, fittings conforming to UL 486B shall be used.

1.2.4.2 Ferrous metal hardware shall be hot-dip galvanized in accordance with ASTM A 123 and A 153.

1.2.5 Verification of Dimensions: The Contractor shall become familiar with details of the work, shall verify dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing any work.

1.3 SUBMITTALS:

1.3.1 Proof of Compliance: Where materials or equipment are specified to conform to the standards or publications, and requirements of AASHTO, ANSI, ASTM, AEIC, FM, IEEE, IES, NEMA, NFPA, or UL, or to conform to a Fed. Spec., the Contractor shall submit proof that the items furnished under this section of the specifications conform to the specified requirements. The label of, or listing in the Electrical Construction Materials Directory of UL or listing in the Approval Guide of FM or the manufacturer's certification or published catalog specification data statement that the items comply with applicable specifications, standards, or publications and with the manufacturer's standards will be acceptable evidence of such compliance.

1.3.2 Shop Drawings: After receiving complete material lists and before installation of any of these items, the Contractor shall submit complete shop drawings and such other descriptive data as the Contracting Officer may require to demonstrate compliance with the contract documents as required by the Section 1A - General. Shop drawings shall be submitted for the following items and such other items as the Contracting Officer may direct:

a. Medium Voltage Cable.

b. Medium Voltage Separable and Insulated Connector.

c. Medium Voltage Cable Terminator.

d. Transformers, pad mounted type.

If departures from the contract drawings are deemed necessary by the Contractor, complete details of such departures, including changes in related portions of the project and the reasons therefore, shall be submitted with the shop drawings. Approved departures shall be made at no additional cost to the Government.

1.3.3 List of Equipment and Materials: A complete itemized listing of equipment and materials proposed for incorporation into the work shall be submitted. Each such itemization shall include an item number, the quantity of items proposed, the name of the manufacturer of each such item.

1.3.4 Instruction Manuals: Six copies of instruction manuals shall be furnished within 7 calendar days following the completion of factory tests and shall include assembly, installation, operation and maintenance instructions, spare parts data which provides supplier name, current cost, catalog order number, and a recommended list of spare parts to be stocked and all documents previously submitted and approved. Manuals shall also include data outlining step-by-step procedures for system startup and operation, and a troubleshooting guide which lists possible operational problems

and corrective action to be taken. A brief description of all equipment and their basic operating features shall also be included. Documents shall be bound in a suitable binder adequately marked or identified on the spine and front cover. A table of contents page shall be included and marked with pertinent contract information contents of the manual. Tabs shall be provided to separate different types of documents, such as catalog ordering information, drawings, instructions, and spare parts data. Index sheets shall be provided for each section of the manual when warranted by the quantity of documents included under separate tabs or dividers. Three additional copies of the instruction manuals shall be submitted within 30 calendar days following the approval of the manuals.

1.3.5 Manufacturer's Certifications:

1.3.5.1 Certificates of Compliance:Certificates shall be prepared by the manufacturers when the manufacturer's published data or drawings do not indicate conformance with other requirements of these specifications.

1.3.5.2 Certified Factory Test Reports: Certified factory test reports shall be submitted when manufacturers perform routine factory tests normally performed by the manufacturer, including tests required by standards listed in paragraph APPLICABLE PUBLICATIONS. Additional certification is required to verify each transformer has passed a production line impulse test consisting of one reduced-wave and one full-wave lightning impulse test on each fully-insulated high-voltage terminal.

1.3.6 Contractor's Data: The Contractor shall submit the following types of data to supplement the manufacturer's data and drawings and Contractor's drawings.

1.3.6.1 Certifications: Certifications shall be submitted when specified or required, including Certification of the Qualifications of Medium-Voltage Cable Installers, Certified Factory and Field Test Reports, and Certificates of Compliance submitted in lieu of other proofs of compliance with these contract provisions.

1.3.6.2 Certified Field Test Reports: Field tests shall be made and test reports shall be written and certified by the Contractor to the Contracting Officer. Field tests shall include cable, operational, and resistance-to-ground tests.

1.3.6.3 Certification of the Qualifications of Medium-Voltage Cable Installers: The Contractor shall submit a certification, to and for the approval of the Contracting Officer, that contains the names and the qualifications of persons recommended to perform the splicing and termination of medium-voltage cables approved for installation under this contract. The certification shall indicate that persons recommended to perform actual splicing and terminations

have been adequately trained in the proper techniques and have had at least 3 recent years of experience in splicing and terminating the same or similar types of cables approved for installation. In addition, persons recommended by the Contractor may be required to perform a dummy or practice splice and termination, in the presence of the Contracting Officer, before being approved as a qualified installer of medium-voltage cables. If that additional requirement is imposed, the Contractor shall provide short sections of the approved types of cables along with the approved type of splice and termination kits, and detailed manufacturer's instruction for the proper splicing and termination of the approved cable types.

1.3.7 Contractor's Drawings: The Contractor shall submit drawings as required to supplement contract drawings, manufacturer's data and drawings, and Contractor's data to demonstrate compliance with applicable contract requirements. Drawings shall be dimensioned or scaled to show the relative arrangement and mounting details of the equipment or equipment assemblies.

PART 2 - PRODUCTS AND EXECUTION

2.1 MATERIALS AND COMPONENTS: Materials and equipment shall conform to the following requirements:

2.2.1 Cables: Cables shall be of annealed copper.

2.2.2 Low-Voltage Cables: Low-voltage cables shall conform to UL 854 for Type USE service entrance cable and shall utilize either cross-linked, thermosetting-polyethylene or ethylene-propylene-rubber insulation..

2.2.3 Medium-Voltage Cables: Medium-voltage cables shall be cross-linked-thermosetting-polyethylene-insulated conforming to NEMA WC 7 or ethylene-propylene-rubber-insulated conforming to NEMA WC 8. Outer covering over insulation shall be a thermoplastic jacket surrounding a metallic tape shield. Jackets, shields, and coverings shall conform to NEMA WC 7 or WC 8. Cables shall have both conductor and insulation shielding for each phase.

2.2.4 Grounding Cables: Grounding cables shall be bare, except where installed in conduit with associated phase conductors. Insulated cable shall be of the same material, green color-coded, and shall be insulated to match associated phase conductors, except that cable need be rated no more than 600 volt. Bare cables shall be ASTM B 8 soft-drawn unless otherwise indicated; aluminum is not acceptable.

2.2.5 Cable Joints, Terminations, and Connectors:

2.2.5.1 Medium-Voltage Cable Terminations: IEEE No. 48.

2.2.5.2 Medium-Voltage Separable Insulated Connectors: IEEE Nos. 386 and 592. Connectors shall be of the load-break type shall be of suitable construction for the application and the type of cable connected, and shall include cable shield adaptors. External clamping points and test points shall be provided.

2.2.5.3 Connectors for Low-Voltage Cables: Fed. Spec. W-S-610; UL 486A for copper conductors and ANSI C119.1 for sealed insulated connectors.

2.2.6 Concrete: Concrete shall be 2500 psi at 28 days. Duct liner shall be of monolithic construction.

2.2.7 Conduit and Fittings, Steel:

2.2.7.1 Conduit, Intermediate Metal: UL 1242.

2.2.7.2 Conduit, Rigid: ANSI C80.1 and UL 6.

2.2.8 Conduit Outlets and Fittings: NEMA FB 1, and UL 514.

2.2.9 Duct and Conduit Caulking Compound: Compounds for sealing ducts and conduit shall have a putty-like consistency workable with the hands at temperatures as low as 35 degrees F, shall not slump at a temperature of 300 degrees F, and shall not harden materially when exposed to the air. Compounds shall readily caulk or adhere to clean surfaces of asbestos-cement, fiber, or plastic ducts; metallic conduits or conduit coatings; concrete, masonry, or lead; any cable sheaths, jackets, covers, or insulation materials; and the common metals. Compounds shall form a seal without dissolving, noticeably changing characteristics, or removing any of the ingredients. Compounds shall have no injurious effect upon the hands of workmen or upon materials.

2.2.10 Duct and Fittings, Nonmetallic Type for Installation Underground: Wall thicknesses and fittings shall be suitable for the application. Ducts shall be single, round-bore type. Ducts shall be of the same material when used for applications requiring the same type of wall thickness. Conduit fittings shall conform to the applicable NEMA TC 6, Type EB, thinwall standards, except that where NEMA standards for conduit fittings do not exist for the type of plastic installed, fittings shall be as recommended by the conduit manufacturer.

2.2.11 Grounding and Bonding: Equipment, UL 467. Wire, ASTM B 8, softdrawn copper. All connections below grade shall be fusion welded. Connections above grade shall be fusion welded or be made with connectors which comply with UL 467.

2.2.12 Nameplates: Nameplates shall be made of corrosion-resistant metal with not less than 1/4-inch tall raised or engraved characters. The nameplate shall be mounted on the front of the enclosure.

2.2.13 Padlocks: Padlocks shall conform to Fed. Spec. FF-P-101, type EB, size 1-3/4" with 6 pins.

2.2.14 Protective Apparatus and Metering Devices:

2.2.14.1 Fuses, Medium-Voltage, Including Current-Limiting Types: NEMA SG 2.

2.2.14.2 Fuses, Low-Voltage, Current-Limiting Types: Fed. Spec. W-F-1814, Class L or UL 198E, Class R.

2.2.14.3 Watthour Meter: ANSI C12.1 and C12.10, except numbered terminal wiring sequence and case size may be the manufacturer's standard. Watthour meter shall be of the type having a 15-minute, cumulative form, demand register meeting ANSI C12.4 and provided with not less than two and one-half stators.

2.2.15 Transformer Stations: Pad-Mounted Compartmental Type, ANSI C57.12.26.

2.2.16 Warning Signs, High-Voltage: ANSI Z35.1, porcelain enameled steel or approved equal.

2.3 GENERAL INSTALLATION REQUIREMENTS: Steel conduits installed underground shall be installed and protected from corrosion in conformance with the requirements of SECTION: ELECTRICAL WORK, INTERIOR. Except as covered herein, excavation, trenching, and backfilling shall conform to the requirements of SECTION: EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS.

2.4 CABLES, GENERAL REQUIREMENTS: The type of installation, sizes, and number of cables shall be as indicated. Conductors larger than No. 8 AWG shall be stranded. Each circuit shall be identified by means of fiber, laminated plastic, or nonferrous-metal tags, or approved equal, in each manhole, each handhole, each junction box, and at each terminal. Loads shall be divided as evenly as practicable on the various phases of the system. Manufacturer's written recommendations shall be furnished for each type of splice and medium-voltage cable joint and termination, and for fireproofing application methods, and shall be approved before any work is done. Medium-voltage cable joints and terminations shall be the standard product of a manufacturer and shall be either of the factory preformed type or of the kit type containing tapes and other required parts. Medium-voltage cable joints shall be made by qualified cable splicers. Compounds and tapes shall be electrical grade suitable for the cable insulation provided and shall use design materials and

techniques recommended by the manufacturer. Maximum length of cable pull and cable pulling tensions shall not exceed the cable manufacturer's recommendations.

2.4.1 Duct Line Installation: Cables shall be installed in duct lines. Neutral and ground conductors shall be installed in the same duct with their associated phase conductors.

2.4.2 Connection to Buildings: Cables shall be extended into the various buildings as indicated, and shall be properly connected to the first applicable termination point in each building. Interfacing with building interior conduit systems shall be as indicated. After installation of cables, conduits shall be sealed with caulking compound to prevent entrance of moisture or gases into buildings.

2.5 MEDIUM-VOLTAGE CABLES: Medium-voltage cables shall be suitable for a rated circuit voltage of 15 kV. Other parts of the cable system such as joints and terminations shall have ratings not less than the rating of the cables on which they are installed. Separable insulated connectors shall have nominal voltage ratings coordinated to associated apparatus ratings rather than cable ratings when used to connect cable to apparatus. Cables shall be provided with 133 percent insulation level. Neutral conductors of grounded neutral systems shall be of the same insulation material as phase conductors, except that a 600-volt insulation rating is acceptable.

2.5.1 Cable Joints: Joints are not permitted in cable runs of 1,000 feet or less.

2.5.2 Terminations: Terminations shall be IEEE No. 48, Class 1 or Class 2; of the molded elastomer, wet-process porcelain, prestretched elastomer, heat-shrinkable elastomer, or taped type. Acceptable elastomers are track-resistant silicone rubber or track-resistant ethylene propylene compounds, such as ethylene propylene rubber or ethylene propylene diene monomer. Separable insulated connectors may be used for apparatus terminations, when such apparatus is provided with suitable bushings. Terminations shall be of the outdoor type, except that where installed inside outdoor equipment housings which are sealed against normal infiltration of moisture and outside air, indoor, Class 2 terminations are acceptable. Class 3 terminations are not acceptable. Terminations, where required, shall be provided with mounting brackets suitable for the intended installation and with grounding provisions for the cable and the metallic tape shield.

2.5.3 Factory Preformed Type: Molded elastomer, wet-process porcelain, prestretched, and heat-shrinkable terminations shall utilize factory preformed components to the maximum extent practicable rather than tape build-up. Terminations shall have basic impulse levels as required for the system voltage level.

2.6 LOW-VOLTAGE CABLES: Cable shall be rated 600 volts. Other parts of cable systems such as splices and terminations shall be rated at not less than 600 Volts. Splices in wires No. 10 AWG

and smaller shall be made with an insulated, solderless, pressure type connector, Type I, Class 1, Grade B, Style G, or Type II, Class 1 of Fed. Spec. W-S-610 and conforming to the applicable requirements of UL 486A. Splices in wires No. 8 AWG and larger shall be made with noninsulated, solderless, pressure type connector, Type II, Class 2 of Fed. Spec. W-S-610, conforming to the applicable requirements of UL 486A and UL 486B. They shall then be covered with an insulation and jacket material equivalent to the conductor insulation and jacket. All splices below grade or in wet locations shall be sealed type conforming to ANSI C119.1 or shall be waterproofed by a sealant filled, thick wall, heat shrinkable, thermosetting tubing or by pouring a thermosetting resin into a mold that surrounds the joined conductors.

2.7 DUCT LINES: Duct lines shall be concrete-encased, thin-wall type.

2.7.1 Requirements: Numbers and sizes of ducts shall be as indicated. Duct lines shall be laid with a minimum slope of 4 inches per 100 feet. Manufactured 90-degree duct bends may be used only for pole or equipment risers, unless specifically indicated as acceptable. The minimum manufactured bend radius shall be 18 inches for ducts of less than 3-inch diameter, and 36 inches for ducts 3 inches or greater in diameter. Otherwise, long sweep bends having a minimum radius of 25 feet shall be used for a change of direction of more than 5 degrees, either horizontally or vertically. Both curved and straight sections may be used to form long sweep bends as required, but the maximum curve used shall be 30 degrees and manufactured bends shall be used. Ducts shall be provided with end bells whenever duct lines terminate in manholes or handholes. Duct line markers shall be provided as indicated at the ends of long duct line stubouts or for other ducts whose locations are indeterminate because of duct curvature or terminations at completely below-grade structures. In lieu of markers, a 5-mil brightly colored plastic tape not less than 3 inches in width and suitably inscribed at not more than 10 feet on centers with a continuous metallic backing and a corrosion resistant 1-mil metallic foil core to permit easy location of the duct line, shall be placed approximately 12 inches below finished grade levels of such lines.

2.7.2 Treatment: Ducts shall be kept clean of concrete, dirt, or foreign substances during construction. Field cuts requiring tapers shall be made with proper tools and match factory tapers. After a duct line is completed, a standard flexible mandrel shall be used for cleaning followed by a brush with stiff bristles. Mandrels shall be at least 12 inches long and have diameters l/4 inch less than the inside diameter of the duct being cleaned. Pneumatic rodding may be used to draw in lead wires. A coupling recommended by the duct manufacturer shall be used whenever an existing duct is connected to a duct of different material or shape. Ducts shall be stored to avoid warping and deterioration with ends sufficiently plugged to prevent entry of any water or solid substances. Ducts shall be thoroughly cleaned before being laid. Plastic ducts shall be stored on a flat surface and protected from the direct rays of the sun.

2.7.3 Concrete Encasement: Each single duct shall be completely encased in concrete with a

minimum of 3 inches of concrete around each duct, except that only 2 inches of concrete are required between adjacent electric power or adjacent communication ducts and 4 inches of concrete shall be provided between adjacent electric power and communication ducts. Duct line encasements shall be monolithic construction. At any point, except railroad crossings, tops of concrete encasements shall be not less than 18 inches below finished grade or paving. Separators or spacing blocks shall be made of steel, concrete, plastic, or a combination of these materials placed not further apart than 4 feet on centers. Ducts shall be securely anchored to prevent movement during the placement of concrete and joints shall be staggered at least 6 inches vertically.

2.7.4 Installation of Couplings: Joints in each type of duct shall be made up in accordance with the manufacturer's recommendations for the particular type of duct and coupling selected and as approved. In the absence of specific recommendations, various types of duct joint couplings shall be made watertight as specified. Plastic duct joints shall be made by brushing a plastic solvent cement on insides of plastic coupling fittings and on outsides of duct ends. Each duct and fitting shall then be slipped together with a quick one-quarter-turn twist to set the joint tightly.

2.8 TRANSFORMER STATION: Transformer station shall be of the outdoor type having the ratings and arrangements indicated. Medium-voltage ratings of cable terminations for use on primary systems shall be 15 kV between phases for 133 percent insulation level. The voltage rating of protective devices for use on primary or secondary systems shall be not less than the nominal voltage of the system to which they are connected.

2.8.1 Pad-Mounted Tamperproof Compartmental Transformer Station: Pad-mounted tamperproof compartmental transformer station shall be of the loop feed type. Protective devices shall have ratings compatible with the associated transformer rating. Transformer station shall be assembled and coordinated by one manufacturer. Transformer station shall be shipped as a complete unit so that field installation requirements are limited to mounting unit on an existing concrete pad and connecting it to an existing primary, to an existing secondary for the Dyess Credit Union and to a new secondary line for the Car Wash building. The existing 150 KVA transformer shall be disconnected, removed and replaced with a new transformer as indicated. A transformer with base dimensions shall be provided which will fit within the overall dimensions of the existing concrete pad. The existing pad shall be modified as required to stub up new conduit under the transformer compartment. All work to replace the existing transformer shall be performed after hours or on weekends to minimize the down time to the Dyess Credit Union, which is sharing the secondary service.

Transformer station shall be provided with a corrosion-resistant finish. Stainless steel pins and hinges shall be provided. Barriers are required between high- and low-voltage compartments. High-voltage compartment doors shall be interlocked with low-voltage compartment doors to prevent access to any high-voltage section unless its associated low-voltage section door has first

been opened. Compartments shall be sized to meet the specific dimensional requirements of ANSI C57.12.26. Pentahead locking bolts shall be provided.

2.8.2 High-Voltage Compartments: High-voltage compartments shall be dead-front construction. Primary protection shall include load-break switching, drawout dry-well-mounted current-limiting fuses, and medium-voltage separable connectors. Switches shall be of the group-operated four-position sectionalizer type. Switches may be mounted inside transformer tanks with switch operating handles located in high-voltage compartments and equipped with metal loops for hook stick operation. Fuses shall be interlocked with switches so that fuses can be removed only when the associated switch is in the OFF position. Adjacent to medium-voltage cable connections, a nameplate or equivalent stencilled inscription shall be provided inscribed "Do not open cable connectors unless switch is off." Adjacent to switches, nameplates shall identify switch operating handles and ON and OFF positions.

2.8.3 Transformer Tank Sections: Transformers shall be three-phase Delta-wye, oil-immersed units with two separate windings per phase. Capacities and ratings shall be as shown. Four 2-1/2 percent rated kVA high-voltage taps shall be provided two above and two below rated primary voltage. Operating handles for primary tap changers shall be located within high-voltage compartments, externally to transformer tanks.

2.8.4 Low-Voltage Compartments: Low-voltage compartments shall be dead-front construction. Neutrals shall be provided with fully-insulated bushings. No ground straps shall be provided between neutrals and ground pads. Clamp type cable terminations, suitable for both copper and aluminum conductors entering from below, shall be provided as necessary.

2.8.5 Accessories: Instruction nameplates shall include the number of gallons of transformer oil. High-voltage warning signs shall be permanently attached to each side of transformer stations. Stainless steel ground connection pads shall be provided in both the high- and low-voltage compartments. Dial-type thermometer, liquid-level gage, and drain valve with built-in sampling device shall be provided for each transformer station.

2.8.6 Installation: Transformer station shall be mounted on an existing concrete pad where an existing transformer shall be removed. Unit shall be carefully installed so as not to scratch finishes. After installation, finished surfaces shall be inspected and scratches touched up with a finish furnished by the manufacturer especially for this purpose.

2.8.7 Concrete Pad: New transformer shall be provided that will fit on an existing concrete pad. Existing pad shall be modified to provide new conduits under the pad as indicated for new secondary conductors.

2.8.8 Padlock: Padlock shall be provided for pad-mounted compartmental transformer station.

2.9 PARAGRAPH NOT USED

2.10 GROUNDING: Neutral conductors, cable shields, metallic cable sheaths and armor, metallic conduits, cable terminations, junction boxes, poles, surge arresters, fencing enclosing electrical equipment, and other noncurrent-carrying metallic parts of equipment shall be grounded.

2.10.1 General Requirements: A resistance of not greater than 25 ohms shall be provided, unless otherwise specified. Ground resistances shall be measured in normally dry conditions not less than 48 hours after rainfall. Resistances of systems requiring separate ground rods, rather than a counterpoise, shall be measured separately before bonding below grade. The combined ground resistance of separate systems bonded together below grade may be used to meet the specified ground resistance, but the minimum number of rods indicated must still be provided.

2.10.2 Ground Rods: Ground rods shall be galvanized steel conforming to UL 467 not less than 3/4 inch in diameter by 10 feet in length. Unless otherwise indicated, ground rods shall be driven into the ground until tops of rods are approximately 1 foot below finished grade. In counterpoise systems, tops of ground rods shall be approximately at elevations of counterpoises. Where the specified ground resistance cannot be met with the indicated number of ground rods, additional grounds rods, longer ground rods, shall be installed and connected until the specified resistance is obtained, except that not more than three additional 8-foot ground rods shall be required at any one installation. Ground rods shall be spaced as evenly as possible at least 6 feet apart and connected 2 feet below grade.

2.10.3 Connections: Connections below grade shall be made by a fusion-welding process. Connections above grade shall be made by a fusion-welding process. Where ground wires are connected to aluminum-composition conductors, specially treated or lined copper-to-aluminum connectors suitable for this purpose shall be utilized.

2.10.4 Neutral Grounding: Neutral conductors shall be grounded where indicated. Ground wires shall be not less than No. 1/0 AWG, except that where the rated phase current exceeds 400 amperes, the size of neutral ground wires shall be increased to not less than one-half the size of the cross-sectional area of the individual phase conductors.

2.10.5 Equipment Grounding: Equipment frames of metal-enclosed equipment, medium-voltage cable shields at cable joints and terminations, and other noncurrent-carrying metal items, shall be grounded unless otherwise indicated. Connections to earth shall be made in the same manner as required for neutral grounding. Equipment or devices operating at less than 750 volts may be connected to secondary neutral grounds. Equipment operating at more than 750 volts to ground

shall be provided with grounds separate from secondary neutral grounds, but both grounds shall be bonded together below grade at the ground rods or may utilize a common counterpoise.

2.10.6 Transformer Station Grounding: Existing ground wires and ground rods below grade shall be connected to new transformer equipment case ground pads and transformer neutrals. Connections shall be not smaller than No. 1/0 AWG.

2.11 TESTS:

2.11.1 Operating Test: After the installation is completed, the Contractor shall conduct an operating test for approval. Equipment shall be demonstrated to operate in accordance with the requirements herein. Tests shall be performed in the presence of the Contracting Officer. The Contractor shall furnish instruments and personnel required for the test and the Government will furnish the necessary electric power.

2.11.2 Ground-Resistance Measurements: Ground-resistance measurements of existing transformer ground shall be taken and certified by the Contractor to the Contracting Officer. No part of the electrical distribution system shall be energized prior to the resistance testing of that system's ground rods and grounding system and submission of test results to the Contracting Officer. Test reports shall indicate the location of the ground rod and grounding system and the resistance and the soil conditions at the time the test was performed. When the building water service is used as a ground or part of the grounding system, ground-resistance measurements shall also be made of this connection. Ground-resistance measurements shall be made in normally dry weather, not less than 48 hours after rainfall, and with the ground under test isolated from other grounds. The resistance to ground shall be measured using the fall-of-potential method described in IEEE No. 142.

2.11.3 Medium-Voltage Cable Test: After installation and before the operating test or connection to an existing system, the medium-voltage cable system shall be given a high potential test. Direct-current voltage shall be applied on each phase conductor of the system by connecting conductors as one terminal and connecting grounds or metallic shielding of the cable as the other terminal for each test. Prior to making the test, the cables shall be isolated by opening applicable protective devices and disconnecting equipment. The method, voltage, length of time, and other characteristics of the test shall be in accordance with NEMA WC 7 or WC 8 for the particular type of cable installed, and shall not exceed the recommendations of IEEE No. 404 for cable joints and IEEE No. 48 for cable terminations unless the cable and accessory manufacturers indicate higher voltages are acceptable for testing. Should any cable fail due to a weakness of conductor insulation or due to defects or injuries incidental to the installation or because of improper installation of cable, cable joints, terminations, or other connections, the Contractor shall make necessary repairs or replace cables as directed.

2.12 PAINTING AND FINISHING: Transformer station shall be provided with factory coated corrosion-resistant high temperature rated Scotchlite Brown finish which shall withstand 500 hours of exposure to the salt spray test specified in ASTM B 117 without loss of paint or release of adhesion of the paint primer coat to the metal surface in excess of 1/16 inch from the test mark. The scribed test mark and test evaluation shall be in accordance with ASTM D 1654 with a rating of not less than 7 in accordance with Table 1, (procedure A). Cut edges or otherwise damaged surfaces of hot-dip galvanized sheet steel or mill galvanized sheet steel shall be coated with a zinc rich paint conforming to Mil. Spec. DoD-P-21035.

END OF SECTION

SECTION 16415
ELECTRICAL WORK, INTERIOR

PART 1 - GENERAL

1.1 APPLICABLE PUBLICATIONS: The publications listed below, form a part of this specification. The publications are referred to in the text by the basic designation only.

1.1.1 Federal Specifications (Fed. Spec.):

J-C-30A & Am-1	Cable and Wire, Electrical (Power, Fixed Installation)
L-P-387A & Am-1 & Int Am-2	Plastic Sheet, Laminated, Thermosetting (For Designation Plates)
L-P-1035A	Plastic Molding Material, Vinyl Chloride Polymer and Vinyl Chloride-Vinyl Acetate Copolymer, Rigid
W-B-30A & Am-2	Ballast, Fluorescent Lamp (Non-Polychlorinated Biphenyl Type)
W-C-375B/GEN	Circuit Breakers, Molded Case; Branch Circuit and Service (General Specification)
W-C-586C	Conduit Outlet Boxes, Bodies, and Entrance Caps, Electrical: Cast Metal
W-C-596F/GEN & Suppl 1	Connector, Electrical, Power, General Specification for
W-F-406C	Fittings for Cable, Power, Electrical and Conduit, Metal, Flexible
W-F-408D	Fittings for Conduit, Metal, Rigid (Thick-Wall and Thin-Wall (EMT) Type)
W-F-1662A & Int Am-2	Fixture, Lighting (Fluorescent, Alternating-Current Recessed and Surface Ceiling)
W-J-800E & Am-1	Junction Box: Extension, Junction Box; Cover, Junction Box (Steel Cadmium, or Zinc Coated)

W-L-00116D	Lamps, Fluorescent (General Specification)
W-P-115B	Panel, Power Distribution
W-P-455A & Am-6	Plate, Wall, Electrical
W-S-610C & Am-1	Splice Conductor
HH-I-595C	Insulation Tape, Electrical, Pressure-Sensitive Adhesive, Plastic
WW-C-566C	Conduit, Metal, Flexible

1.1.2 American National Standards Institute, Inc. (ANSI) Standards:

C78.380-1984	Method for the Designation of High-Intensity Discharge Lamps
C82.4-1985	Ballasts for High-Intensity-Discharge and Low-Pres-sure Sodium Lamps (Multiple Supply Type)

1.1.3 National Electrical Manufacturers Association (NEMA) Standards:

BU 1-1983	Busways
RN 1-1986	Polyvinyl-Chloride (PVC) Externally Coated Rigid Steel Conduit and Intermediate Metal Conduit

1.1.4 National Fire Protection Association (NFPA) Publication:

70-1987	National Electrical Code

1.1.5 Underwriters Laboratories Inc. (UL) Publications:

UL 6	Rigid Metal Conduit (Oct 23, 1981, 9th Ed.; Rev Oct 10, 1983; Errata Aug 29, 1986)
UL 57	Electric Lighting Fixtures (Aug 30, 1972, 12th Ed.; Erratum Sep 23, 1975; Rev thru Jul 22, 1982)
UL 98	Enclosed and Dead-Front Switches (Jan 13, 1987, 11th Ed.; Rev Jan 14, 1987)

UL 360	Liquid-Tight Flexible Steel Conduit (Aug 18, 1986, 3rd Ed.)
UL 467	Grounding and Bonding Equipment (Nov 22, 1984, 6th Ed.; Rev Apr 30, 1985)
UL 498	Attachment Plugs and Receptacles (Sep 17, 1981,10th Ed.; Rev thru Sep 24, 1984; Errata Jul 23, 1986)
UL 506	Specialty Transformers (Dec 26, 1979, 9th Ed.; Rev thru Sept 3, 1986; Errata Dec 26, 1984)
UL 797	Electrical Metallic Tubing (Oct 10, 1983, 5th Ed.)
UL 844	Electric Lighting Fixtures for Use in Hazardous (Classified) Locations (Nov 29, 1984, 9th Ed.; Rev Oct 10, 1985)
UL 924	Emergency Lighting and Power Equipment (Mar 16, 1984, 6th Ed.; Rev thru Aug 16, 1985)
UL 943	Ground-Fault Circuit Interrupters (Sep 11, 1985, 2nd Ed.)
UL 1029	High-Intensity-Discharge Lamp Ballasts (Aug 25, 1980, 3rd Ed.; Rev thru May 16, 1983)
UL 1242	Intermediate Metal Conduit (Oct 10, 1983, 1st Ed.; Rev Apr 10, 1986)
UL 1570	Standard for Fluorescent Lighting Fixtures (Nov 22, 1982, 2nd Ed.; Rev thru Sep 16, 1985)

1.2. GENERAL:

1.2.1 Rules: The installation shall conform to the requirements of NFPA 70, unless more stringent requirements are indicated herein or shown.

1.2.2 Coordination: The drawings indicate the extent and the gen-eral location and arrangement of equipment, conduit, and wiring. The Contractor shall become familiar with all details of the work and verify all dimensions in the field so that the outlets and equipment will be properly located and readily accessible. Lighting fixtures, outlets, and other equipment and materials shall be located to avoid interference with mechanical or structural features; otherwise, lighting fixtures shall be symmetrically located according to the room arrangement when uniform illumination is required, or asymmetrically located to suit conditions fixed by design and shown. Raceways, junction and outlet boxes, and lighting fixtures shall not be supported from sheet metal roof decks. If any

conflicts occur necessitating departures from the drawings, details of and reasons for departures shall be submitted and approved prior to implementing any change.

1.2.3 Standard Products: Material and equipment shall be a standard product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

1.2.4 Identification Nameplates: Major items of electrical equipment and major components shall be permanently marked with an identification name to identify the equipment by type or function and specific unit number as indicated. Unless otherwise specified, all identification nameplates shall be made of laminated plastic in accordance with Fed. Spec. L-P-387 with black outer layers and a white core. Edges shall be chamfered. Plates shall be fastened with black-finished round-head drive screws or approved nonadhesive metal fasteners. When the nameplate is to be installed on an irregular shaped object, the Contractor shall devise an approved support suitable for the application. In all instances, the nameplate shall be installed in a conspicuous location. At the option of the Contractor, the equipment manufacturer's standard embossed nameplate material with black paint-filled letters may be furnished in lieu of laminated plastic. The following equipment, as a minimum, shall be provided with identification nameplates:

Minimum 1/4-Inch High Letters	Minimum 1/8-Inch High Letters
Panelboard	Control Devices (Relays, Contactors, Etc.)
Starters	
Transformers	
Equipment Enclosures	

1.3 APPROVAL OF MATERIALS AND EQUIPMENT: Materials and equipment will be approved based on the manufacturer's published data.

1.3.1 Underwriters Laboratories Inc. (UL) Publications: The label or listing of the Underwriters Laboratories Inc., will be accepted as evidence that the materials or equipment conform to the applicable standards of that agency. In lieu of this label or listing, the Contractor shall submit a statement from a nationally recognized, adequately equipped testing agency indicating that the items have been tested in accordance with required procedures and that the materials and equipment comply with all contract requirements. However, materials and equipment installed in hazardous locations must bear the UL label unless the data submitted from other testing agency is specifically approved in writing by the Contracting Officer.

1.3.2 Non-Underwriters Laboratories Inc. (UL) Publications: For other than equipment and materials specified to conform to UL publications, a manufacturer's statement indicating complete compliance with the applicable Federal Specification, or standard of the American Society for

Testing and Materials, National Electrical Manufacturers, or other commercial standard, is acceptable.

1.3.3 Shop Drawings: Shop drawings shall be submitted for approval in accordance with SECTION 1A-GENERAL and shall consist of a complete list of equipment and materials, including manufacturer's descriptive and technical data; catalog cuts; and any special installation instructions that may be required. Shop drawings shall be submitted for all materials and equipment specified. Drawings shall show applicable schematic diagrams; equipment layout and anchorage; and conduit and cable trays runs, anchorage, and support.

PART 2 - PRODUCTS AND EXECUTION

2.1 WORKMANSHIP: Materials and equipment shall be installed in accordance with recommendations of the manufacturer and as shown.

2.2 MATERIALS AND EQUIPMENT shall conform to the respective publications and other requirements specified below. Materials and equipment not listed below shall be as specified elsewhere in this section.

2.2.1 Fluorescent Lamp Ballast: High-power-factor type conforming to Fed. Spec. W-B-30, Class P, automatic-resetting type.

2.2.2 Cables: Cables shall conform to Fed. Spec. J-C-30 and shall be of annealed copper. Cables shall be single-conductor type, unless otherwise indicated.

2.2.3 Grounding Cables: Grounding cables shall have green low-voltage insulation.

2.2.4 Molded-Case and Insulated-Case Circuit Breakers: Fed. Spec. W-C-375.

2.2.5 Conduit:

2.2.5.1 Flexible Steel Conduit: Fed. Spec. WW-C-566 and UL 360.

2.2.5.2 Rigid Metal Conduit: UL 6.

2.2.5.3 PVC Coated Rigid Steel Conduit: NEMA RN 1.

2.2.5.4 Intermediate Metal Conduit: UL 1242.

2.2.5.5 Plastic Resin System: L-P-1035, composition, type, class, and grade suitable for the purpose, thickness as required for NEMA RN 1, Type A-40.

2.2.6 Connectors, Wire Pressure: Fed. Spec. W-S-610.

2.2.7 Device Plates: Fed. Spec. W-P-455.

2.2.8 Fittings, Cable and Conduit: Fed. Spec. W-F-406 and W-F-408.

2.2.9 Conduit Seal: UL 886, Class I, Group C,D. With sealing compound of the type approved for condition use.

2.2.10 Fixtures: Standard Drawings 40-06-04 and UL 57, unless otherwise specified or indicated.

2.2.11 Fluorescent, General-Purpose Fixtures: W-F-1662 and UL 1570.

2.2.12 Current Limiting Fuses: Fed. Spec. W-F-1814 and UL 198C.

2.2.13 Lamps:

2.2.13.1 Fluorescent Lamps: Fed. Spec. W-L-116.

2.2.13.2 Incandescent Lamps, Large: Fed. Spec. W-L-101.

2.2.14 Conduit, Cast-Metal or Malleable Metal: Fed. Spec. W-C-586.

2.2.15 Outlet Boxes:

2.2.15.1 Sheet-Steel Outlet Boxes: Fed. Spec. W-J-800.

2.2.15.2 Switch, Box, (Enclosed), Surface-mounted: UL 98.

2.2.16 Panelboard: Dead-front construction, Fed. Spec. W-P-115.

2.2.17 Lighting and appliance power feeder, and distribution panelboard, Class 1, type as specified hereinafter.

2.2.18 Receptacles:

2.2.18.1 General Grade Receptacles: Fed. Spec. W-C-596.

2.2.18.2 Standard Grade Receptacles: UL 498.

2.2.18.3 Ground Fault Interrupters: UL 943, Class A or B.

2.2.19 Service Equipment: Fed. Spec. W-S-865, Type NDD or NDS as indicated and UL 869.

2.2.20 Splice, Conductor: Fed. Spec. W-S-610.

2.2.21 Plastic Tape: Fed. Spec. HH-I-595.

2.2.22 Dry-Type Utilization Transformers: UL 506 as modified herein.

2.2.23 Tubing, Electrical, Zinc-Coated Steel (EMT): UL 797.

2.2.24 Grounding and Bonding Equipment: UL 467.

2.2.25 Ground Rods: Ground rods shall be of galvanized steel not less than 3/4-inch in diameter, 8 feet long, driven full length into the earth.

2.2.26 Ground Bus: The ground bus shall be flat copper in one piece, if practicable. Connections and splices shall be of the brazed, welded, or bolted type, except that bolted connections shall be used for connections to removable equipment.

2.3 GROUNDING:

2.3.1 Equipment Ground: Except where specifically indicated otherwise, all exposed noncurrent carrying metallic parts of electrical equipment, metallic raceway systems, ground bus, grounding conductor and neutral conductor of the wiring system shall be grounded. The ground connection shall be made at the neutral bus in the main service equipment and shall extend to the point of entrance of the metallic water service. Connection to the water pipe shall be made by a suitable ground clamp. If flanged pipes are encountered, connection shall be made with the lug bolted to the street side of the flange connection. Metallic water service shall be grounded as described by NFPA 70. Generally all supplemental grounding electrodes shall be ground rods. Where there are no metallic water services to the building, ground connections shall be made to driven rods on the exterior of the building.

2.3.2 Ground Rods: The maximum resistance measured in accordance with IEEE No. 142 of a driven ground shall not exceed 25 ohms under normally dry conditions. If this resistance cannot be obtained with a single rod, 2 additional rods not less than 6 feet on centers, or if sectional type rods are used, 2 additional sections may be coupled and driven with the first rod. If the resultant resistance exceeds 25 ohms measured not less than 48 hours after rainfall, the Contracting Officer shall be notified in writing immediately.

2.3.3 Ground Bus: Ground bus shall be provided in the electrical panelboard as indicated. Noncurrent-carrying metal parts, transformer neutrals and other electrical equipment shall be effectively grounded by bonding to the bus. The ground bus shall be bonded to both the entrance

ground, and to a ground rod or rods as specified above having the upper ends terminating approximately 4-inches above the floor.

2.4 WIRING METHODS:

2.4.1 General Requirements: Unless otherwise indicated, wiring shall consist of insulated conductors installed in rigid zinc-coated steel conduit, electrical metallic tubing, or intermediate metal conduit.

2.4.2 Conduit and Tubing Systems: Conduit and tubing systems shall be installed as indicated. Conduit sizes shown are based on conductor insulation types as described in paragraph WIRING METHODS. Minimum size of raceways shall be 3/4-inch. Electrical metallic tubing may be installed only within buildings. Electrical metallic tubing may be installed in concrete and grout in dry locations. Electrical metallic tubing installed in concrete or grout shall be provided with concrete tight fittings. EMT will not be installed in location indicated to be damp or wet locations. Penetrations of above grade floor slabs, time-rated partitions and fire walls shall be firestopped in accordance with SECTION: FIRESTOPPING. Except as otherwise specified, IMC may be used as an option for rigid steel conduit in areas as permitted by the NFPA 70. Raceways shall be kept 6 inches away from parallel runs of infrared radiant heating pipe and its tail pipe. Raceways shall be concealed where possible within finished walls, ceilings, and floors other than slabs-on- grade. Raceways crossing structural expansion joints shall be provided with suitable expansion fittings or other suitable means to compensate for the building expansion and contraction and to provide for continuity of grounding.

2.4.3 Installing Conductors and Conduit Below Slab-on-Grade or in the Ground: All electrical wiring below slab-on-grade shall be protected by a conduit system. No conduit system shall be installed horizontally within concrete slabs-on-grade. For slab-on-grade construction, horizontal runs of rigid steel or IMC shall be installed below the floor slab. Conduit passing vertically through slabs-on-grade shall be rigid steel or IMC. Rigid steel or IMC conduits installed below slab-on-grade or in the earth shall have a factory-applied polyvinyl chloride coating system.

2.4.4 Exposed Raceways: Exposed raceways shall be installed parallel or perpendicular to walls, structural members, or intersections of vertical planes and ceilings.

2.4.5 Changes in Direction of Runs: Changes in direction of runs shall be made with symmetrical bends or cast-metal fittings. Field-made bends and offsets shall be made with an approved hickey or conduit-bending machine. Crushed or deformed raceways shall not be installed. Trapped raceways in damp and wet locations shall be avoided where possible. Care shall be taken to prevent the lodgment of plaster, dirt, or trash in raceways, boxes, fittings and equipment during the course of construction. Clogged raceways shall be entirely freed of obstructions or shall be replaced.

2.4.6 Supports: Raceways shall be securely and rigidly fastened in place at intervals of not more than 10 feet with approved pipe straps, wall brackets, conduit clamps, conduit hangers, threaded C-clamps with retainers, or ceiling trapeze. Loads and supports shall be coordinated with supporting structure to prevent damage or deformation to the structures, but no load shall be applied to joist bridging. Fastenings shall be by machine screws, welded threaded studs, heat-treated or spring-steel-tension clamps on steel work. Raceways or pipe straps shall not be welded to steel structures. In partitions of light steel construction, sheet-metal screws may be used. Conduit shall not be supported using wire or nylon ties. Raceways shall be installed as a complete system and be independently supported from the structure. Supporting means will not be shared between electrical raceways and mechanical piping or ducts and shall not be fastened to hung ceiling supports. Conduits shall be fastened to all sheet-metal boxes and cabinets with two locknuts where required by the NFPA 70, where insulating bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, a single locknut and bushing may be used. Bushings shall be installed on the ends of all conduits and shall be of the insulating type where required by the NFPA 70. Threadless fittings for electrical metallic tubing shall be of a type approved for the conditions encountered. A pull wire shall be inserted in each empty raceway in which wiring is to be installed by others if the raceway is more than 50 feet in length and contains more than the equivalent of two 90-degree bends, or where the raceway is more than 150 feet in length. The pull wire shall be of No. 14 AWG zinc-coated steel, having not less than 200-pound tensile strength. Not less than 10 inches of slack shall be left at each end of the pull wire.

2.4.7 Exposed Risers: Exposed risers shall be supported by U-clamp hangers at intervals not to exceed 10 feet.

2.4.8 Communications Raceways: Communications raceways indicated shall be installed in accordance with the previous requirements for conduit and tubing. Additional pull or junction boxes shall be installed to comply with these limitations whether or not indicated. Inside radii of bends in conduits of 1-inch size or larger shall be not less than ten times the nominal diameter.

2.4.9 Conductors: Conductors in raceways shall be of copper. Wire connectors of insulating material or solderless pressure connectors properly taped shall be utilized for all splices where possible. Soldered mechanical joints insulated with tape shall be kept to a minimum.

2.4.9.1 Sizes shall be not less than indicated. Branch-circuit conductors shall be not smaller than No. 12 AWG. Conductors for branch circuits of 120 volts more than 100 feet long and of 277 volts more than 230 feet long, from panel to load center, shall be No. 10 AWG. Class 1 remote control and signal circuit conductors shall be not less than No. 14 AWG. Class 2 remote control and signal circuit conductors shall be not less than No. 16 AWG.

2.4.9.2 The conductor sizes are based on the use of THW insulation for conductors. Other acceptable NFPA 70 types of insulated conductors of equivalent ampacity may be substituted at the Contracting Officer's approval.

2.4.9.3 Conductor identification of each phase shall be by color-coded insulation. The color of the insulation of the ungrounded conductors of different voltage systems shall be as follows:

120/208 volt, 3-phase: black, red, and blue with white neutral and green ground. 277/480 volt, 3-phase: brown, yellow, and purple with grey neutral and green ground.

Control circuit conductor identification shall be made by color-coded insulated conductors, plastic-coated self-sticking printed markers, permanently attached stamped metal foil markers, or equivalent means as approved. Conductor identification shall be provided within each enclosure where a tap, splice, or termination is made. Control circuit terminals of equipment shall be properly identified. Terminal and conductor identification shall match that shown on approved shop drawings. Hand lettering or marking is not acceptable. Where insulation of the required color is not available, electrical tape of the required color shall be half-lapped for the entire length within the indicated enclosures.

2.5 BOXES AND SUPPORTS: Boxes shall be provided in the wiring or raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures. Boxes for metallic raceways, 4-inch by 4-inch nominal size and smaller, shall be of the cast-metal hub type when located in normally wet locations, when surface mounted on outside of exterior surfaces, when located in hazardous areas, and when installed exposed up to 7 feet above interior floors and walkways. Large size boxes shall be NEMA classification as shown. Boxes in other locations shall be sheet steel. When "C" brackets are used, additional box support shall be provided on the side of the box opposite the brackets. Boxes for mounting lighting fixtures shall be not less than 4-inches square except that smaller boxes may be installed as required by fixture configuration, as approved. Boxes installed for concealed wiring shall be provided with suitable extension rings as required. Indicated elevations are approximate, except where minimum mounting heights for hazardous areas are required by NFPA 70. Unless otherwise indicated, boxes for wall switches shall be mounted 48 inches above finished floors. Cast-metal boxes installed in wet locations and boxes installed flush with the outside of exterior surfaces shall be gasketed. Separate boxes shall be provided for flush or recessed fixtures when required by the fixture terminal operating temperature, and fixtures shall be readily removable for access to the boxes unless ceiling access panels are provided. Boxes and supports shall be fastened with machine screws or welded studs on steel work. In open overhead spaces, cast-metal boxes threaded to raceways need not be separately supported except where used for fixture support; cast-metal boxes having threadless connectors and sheet metal boxes shall be supported directly from the building structure or by bar hangers. Hangers shall not be fastened to or supported from joist bridging. Cast-metal boxes with 3/32-inch wall thickness are acceptable. Where bar hangers are used, the bar shall be attached to raceways on opposite sides of the box and the raceway shall be supported with an approved type fastener not more than 24 inches from the box. Penetration of more than 1-1/2 inches into reinforced-concrete beams or more than 3/4-inch into reinforced-concrete joists shall avoid cutting any main reinforcing steel.

2.5.1 Boxes for Use with Raceway Systems: Boxes for use with raceway systems shall be not less than 1-1/2 inches deep except where shallower boxes required by structural conditions are approved. Sheetmetal boxes for other than lighting-fixtures shall be not less than 4 inches square except that 4- by 2-inch boxes may be used where only one raceway enters the outlet. Minimum size boxes for telephone outlets shall be not smaller than 4-1/2 inches square and 3-1/2 inches deep.

2.5.2 Pull Boxes: Pull boxes of not less than the minimum size required by the NFPA 70 shall be constructed of aluminum or galvanized sheet steel, except where cast-metal boxes are required in ocations specified above. Boxes shall be furnished with screw-fastened covers. Where several feeders pass through a common pull box, the feeders shall be tagged to indicate clearly the electrical characteristics, circuit number, and panel designation.

2.5.3 Conduit Stub-Ups: Conduits stubbed up through concrete floors for connections to freestanding equipment shall be provided with a short elbow and an adjustable top or coupling threaded inside for plugs, set flush with the finished floor. Wiring shall be extended in rigid threaded conduit to equipment, except that where required, flexible conduit may be used 6 inches above the floor. Screwdriver-operated threaded flush plugs shall be installed in conduits from which no equipment connections are made to suit the devices installed.

2.6 DEVICE PLATES: One-piece type device plates shall be provided for all outlets and fittings. Plates on walls shall be of satin finish corrosion resistant steel. Screws shall be of metal with countersunk heads, in a color to match the finish of the plate. Plates shall be installed with all four edges in continuous contact with finished wall surfaces or surface mounted outlet box without the use of mats or similar devices. Plates shall be installed with an alinement tolerance of 1/16-inch. The use of sectional-type device plates will not be permitted. Plates installed in wet locations shall be gasketed and provided with a hinged, gasketed cover, unless otherwise specified. Device plates for telephone and intercommunication outlets shall have a 3/8-inch bushed opening in center.

2.7 RECEPTACLES:

2.7.1 Single and Duplex Receptacles: Single and duplex receptacles shall be rated 20 amperes, 125 volts, two-pole, three-wire, grounding type with polarized parallel slots. Bodies shall be of ivory phenolic compound supported by mounting strap having plaster ears. Contact arrangement shall be such that contact is made on two sides of an inserted blade. Receptacle shall be side- or back-wired with two screws per terminal. The third grounding pole shall be connected to the metal mounting yoke. Receptacles with ground fault circuit interrupters (indicated with "GFCI" on plans) shall have the class and current rating as indicated.

2.7.2 Weatherproof Receptacles: Weatherproof receptacles shown shall be mounted in a box with a gasketed, weatherproof, cast-metal cover plate and gasketed cap over each receptacle opening. The cap shall be provided with a spring-hinged flap.

2.8 WALL SWITCHES shall be of the totally enclosed tumbler type with bodies of phenolic compound. Handles shall be ivory. Wiring terminals shall be of the screw type or of the solderless pressure type having suitable conductor-release arrangement. Not more than one switch shall be installed in a single-gang position. Switches shall be rated 20-ampere 277-volt for use on alternating current only. Pilot lights indicated shall consist of yoke-mounted candelabra-base sockets rated at 75 watts, 125 volts, and fitted with glass or plastic jewels. A clear 6-watt lamp shall be furnished and installed in each pilot switch. Jewels for use with switches controlling motors shall be green, and jewels for other purposes shall red.

2.9 CIRCUIT BREAKERS: Molded-case circuit breakers shall have voltage, current, and interrupting ratings as indicated. Single-pole breakers shall be full module size; two poles shall not be installed in a single module. Multipole breakers shall be of the common-trip type having a single operating handle but for sizes of 100 amperes or less may consist of single-pole breakers permanently factory assembled into a multipole unit having an internal, mechanical, nontamperable common trip mechanism and external handle ties. Breakers shall have interchangeable, adjustable magnetic, trips in 225 amperes frame and larger. Breakers coordinated with current-limiting fuses shall have a combined interrupting capacity of 100,000 symmetrical amperes. All poles of associated breakers shall open if any fuse blows. Breakers equipped with ground fault interrupters shall have ground fault class, interrupting capacity, and voltage and current ratings indicated.

2.10 SERVICE EQUIPMENT: Service-disconnecting means shall be of the fusible safety switch type as indicated with external handle for manual operation. When service disconnecting means is a part of an assembly, the assembly shall be listed as suitable for service entrance equipment. Enclosures shall be sheet metal with hinged cover for surface mounting unless otherwise indicated.

2.11 PANELBOARD: Panelboard shall conform to Fed. Spec. W-P-115. Circuit breakers and switches used as a motor disconnecting means and not in sight of the motor shall be capable of being locked in the open position. Door locks shall be keyed alike. Nameplates shall be as approved. Directories shall be typed to indicate loads served by each circuit and mounted in a holder behind a clear protective covering.

2.11.1 Panelboard: Panelboard shall be circuit breaker equipped, Type I, Class 1. Panelboard shall not exceed 78 inches in height and shall be so mounted that the height of the top operating handle will not exceed 6 feet 6 inches from the floor.

2.12 PARAGRAPH NOT USED

2.13 MOTOR-DISCONNECT MEANS: Each motor shall be provided with a disconnecting means when required by the NFPA 70 even though not indicated. For single-phase motors, a single- or double-pole toggle switch, rated only for alternating current, will be acceptable for capacities less than 30 amperes, provided the ampere rating of the switch is at least 125 percent of the motor

rating. Switches shall disconnect all ungrounded conductors.

2.14 TRANSFORMERS: Utilization transformers shall be general- purpose dry-type in an indoor or weatherproof enclosure as indicated. Single- or three-phase transformers shall have not less than two windings per phase. Full-capacity NEMA standard taps shall be provided in the high-voltage winding. Transformers shall be the quiet type with sound level not exceeding 40 dB the following:

2.15 LAMPS AND LIGHTING FIXTURES: Fixtures may be provided with No. 18 AWG stranded copper conductors in 3/8-inch flexible metal conduits not over 6 feet long where flexible metal conduits are permitted by NFPA 70.

Ballasted fixtures shall have ballasts which are compatible with the specific type and rating of lamps indicated and shall comply with the applicable provisions of the publications referenced.

2.15.1 Lamps: Lamps of the type, wattage, and voltage rating indicated shall be delivered to the project in the original cartons and installed in the fixtures just prior to the completion of the project.

2.15.2 Incandescent lamps shall be for 125-Volt operation unless otherwise indicated.

2.15.3 Fluorescent lamps shall have standard cool-white color characteristics and shall be of a type that will not require starter switches. Lamps shall be of the rapid-start type unless otherwise shown or approved.

2.15.4 Fixtures: Unless indicated otherwise on the drawings, fixtures shall be as shown. Fixtures of similar designs to those indicated with equivalent energy efficiency, light-distribution and brightness characteristics, and of equal finish and quality will be acceptable if approved.

2.15.4.1 Accessories such as straps, mounting plates, nipples, or brackets shall be provided for proper installation.

2.15.4.2 Suspended fixtures shall be provided with mounting hardware as indicated. Pendants 4 feet or longer shall be braced to limit swinging.

2.16 EQUIPMENT CONNECTIONS: All wiring not furnished and installed under other sections of the specifications for the connection of electrical equipment as indicated on the drawings shall be furnished and installed under this section of the specifications. Connections shall comply with the applicable requirements of paragraph WIRING METHODS. Flexible conduits 6 feet or less in length shall be provided to all electrical equipment subject to periodic removal, vibration, or movement and for all motors. Liquid-tight conduits shall be used in damp or wet locations and where indicated on plans.

2.16.1 Motors and Motor Control: Control equipment furnished under this section of the

specifications, and shown on the drawings, shall be connected under this section of the specifications unless shown or specified otherwise. Except as otherwise specifically noted, automatic-control wiring, signaling, and protective devices are not included in this section of the specifications, but shall be furnished and installed under other sections of the specifications. Control wiring not shown on the drawings shall be furnished under the other sections of the specifications.

2.16.2 Installation of Government-Furnished Equipment: Wiring shall be extended to the equipment, and proper connections made thereto.

2.17 PAINTING AND FINISHING: Field-applied paint on exposed surfaces shall be provided under SECTION: PAINTING, GENERAL.

2.18 REPAIR OF EXISTING WORK: The work shall be carefully laid out in advance, and where cutting, channeling, chasing, or drilling of floors, walls, partitions, ceiling, or other surfaces is necessary for the proper installation, support, or anchorage of the conduit, raceways, or other electrical work, this work shall be carefully done, and any damage to building, piping, or equipment shall be repaired by skilled mechanics of the trades involved, at no additional cost to the Government.

2.19 TESTS: After the interior-wiring-system installation is completed, and at such time as the Contracting Officer may direct, the Contractor shall conduct an operating test for approval. The equipment shall be demonstrated to operate in accordance with the requirements of this specification. The test shall be performed in the presence of the Contracting Officer. The Contractor shall furnish all instruments and personnel required for the tests, and the Government will furnish the necessary electric power. No part of the electrical distribution system shall be energized prior to the resistance testing of that systems ground rods and submission of test results to the Contracting Officer. Test reports shall indicate the location of the rod and the resistance and the soil conditions at the time the test was performed.

END OF SECTION

SECTION 16721
FIRE DETECTION AND ALARM SYSTEM

PART 1 - GENERAL

1.1 APPLICABLE PUBLICATIONS: The publications listed below form a part of this specification. The publications are referred to in the text by the basic designation only.

1.1.1 Federal Standard (Fed. Std.):

No. 595A & Change Notices 2, 3, 4, 5, 7 & Errata, 8, 9	Colors

1.1.2 American National Standards Inst. (ANSI) Publication:

C62.41-1980	Guide for Surge Voltage in Low-Voltage AC Power Circuits

1.1.3 Factory Mutual System (FM) Publication:

Approval Guide (Equipment, Materials, Services for Conservation of Property) 1987

1.1.4 National Fire Protection Association (NFPA) Standards:

70-1987 & Errata & Int Am 70-87-2	National Electrical Code
72A-1985	Local Protective Signaling Systems for Guard's Tour Fire Alarm and Supervisory Service
72D-1986	Proprietary Protective Signaling Systems
72E-1984	Automatic Fire Detectors
72H-1984	Testing Procedures for Signaling Systems

1.1.5 Underwriters Laboratories, Inc. (UL) Publications:

Fire Protection Equipment Directory (Jan 1987 with Quarterly Supplements)

UL 38	Manually Actuated Signaling Boxes For Use with Fire-Protective Signaling Systems (Jul 23, 1981, 4th Ed.; Rev thru Dec 19, 1985)
UL 464	Audible Signal Appliances (Dec 1, 1981, 5th Ed.; Errata; Rev thru Dec 20, 1985)
UL 521	Heat Detectors for Fire Protective Signaling Systems (Sep 29, 1978, 4th Ed.; Rev thru Sep 16, 1986)
UL 864	Control Units for Fire Protective Signaling Systems (Jun 6, 1980, 6th Ed.; Rev thru May 26, 1987)

1.2 GENERAL REQUIREMENTS:

1.2.1 Standard Products: Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Equipment shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site.

1.2.2 Nameplates: Major components of equipment shall have the manufacturer's name, address, type or style, voltage and current rating, and catalog number on a noncorrosive and nonheat sensitive plate which is securely attached to the equipment.

1.2.3 Tags: Tags with stamped identification number shall be furnished for keys and locks.

1.2.4 Verification of Dimensions: The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work. Contractor shall coordinate exact location with other mechanical and electrical equipment to be provided.

1.2.5 Compliances: The fire detection and internal alarm system shall be configured in accordance with NFPA 72A and 72D. The equipment furnished shall be compatible and be UL listed for manual and automatic fire alarm service and suitable as releasing device control system.

1.2.6 Manufacturer's Services: Services of a manufacturer's representative who is experienced in the installation, adjustment, and operation of the equipment specified shall be provided. The representative shall supervise the installation, adjustment, and testing of the equipment.

1.3 SUBMITTALS:

1.3.1 Shop Drawings: Shop drawings shall be submitted in accordance with SECTION, GENERAL and shall consist of a complete set of equipment and materials, including manufacturer's descriptive and technical literature; performance charts and curves; catalog cuts; and installation instructions. Shop drawings shall also contain complete wiring and schematic diagrams and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. These schematic drawings shall indicate each wire and color code and be suitable for use as "As Built" drawings from which repairs and/or future modifications may be made. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearances for maintenance and operation. The contractor's submittal shall be signed by a registered fire protection engineer who is regularly engaged in fire protection and detection design of these systems or a registered professional engineer who has had at least 2 years experience in design of these systems. Qualifications with verification or license number of the registered engineer shall be submitted to and approved by the Contracting Officer. The fire detection and the alarm notification devices in the Car Wash building shall be coordinated with, and connected to the existing Fire Alarm Control Panel in the Dyess Credit Union, Bldg 7206. All required modifications to the existing FACP in Bldg 7206 shall be provided as required for a new zone of detection and notification in the Car Wash building.

1.3.2 Calculations: Substantiating battery calculations shall be submitted for supervisory and alarm power requirements for the existing FACP in Bldg 7206. Ampere-hour requirements shall be submitted with the calculations. Battery recharging period shall be included with the calculations. New batteries shall be provided for the existing FACP as required for all existing zones and the new detection zone in the Car Wash building.

1.3.3 Contractor shall conduct training course for operating staff as designated by the Contracting Officer. The training course shall be scheduled in writing 10 days in advance and shall start after the system is functionally completed but prior to final acceptance tests. The course shall be of sufficient length to cover operating and maintenance instructions.

1.3.4 Performance Test Reports: Upon completion and testing of the installed system, test reports shall be submitted in booklet form showing all field tests performed to prove compliance with the specified performance criteria. Each test report shall indicate the final position of controls.

1.4 DELIVERY AND STORAGE: All equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variation, dirt and dust, and any other contaminants.

1.5 SYSTEM DESIGN:

1.5.1 General: The existing system in the Credit Union, Bldg 7201, is a, microprocesspr based, supervised, UL and FM approved, zoned fire detection and alarm system. Electrical supervision shall be Style D in accordance with NFPA for detection and alarm. All circuits are capable of operating under a single ground or open condition, except primary and emergency power supplies.

1.5.2 Operational Features: The system has the following operating features:

1.5.2.1 Electrical, Style "D" supervision of alarm initiating circuits and alarm indicating circuits.

1.5.2.2 Electrical supervision of the primary power (ac) supply, presence of the battery, battery voltage, and alarm zone modules within the control panel.

1.5.2.3 Trouble buzzer and trouble lamp (light emitting diode or neon light) to activate upon a single break, open, or ground fault condition which prevents the required normal operation of the system. The trouble signal shall also operate upon loss of primary power (ac) supply, absence of a battery supply, low battery voltage, removal of alarm zone modules, and disconnection of the circuit used for transmitting alarm signals off-premises.

1.5.2.4 New audible alarm indicating circuits shall be programmed.

1.5.2.5 Zones for alarm initiating circuit and notification circuit shall be arranged as indicated on the contract drawings.

1.5.3 Sequence of Operation:

1.5.3.1 A general alarm condition is caused by the tripping of one-zone heat detecting circuit or from any manual pull station in which the following will occur:

a. Transmission of a signal over the station radio fire reporting system.
b. Visual indication of the zone operated on the fire alarm control panel annunciator.
c. Continuous sounding and visual indication of the general alarm through the alarm indicating devices located both in the existing Credit Union building and in the new Car Wash building.

1.5.4 The existing transceiver shall be arranged and connected to transmit supervisory, trouble, and each signal initiating zone originating at the fire alarm panel. Transceiver shall send a different signal for each reporting zone. The annunciator shall reflect the location and type of devices of each zone such as "heat detector -hazard" as opposed to simply show zone number. Letters shall be in block format.

1.6 OVERVOLTAGE AND SURGE PROTECTION:

1.6.1 Power Line Surge Protection: All equipment connected to alternating current circuits shall be protected from power line surges. Equipment shall meet requirements of ANSI C62.41. Fuses shall not be used for surge protection.

1.6.2 Communications Link Surge Protection: All communications equipment shall be protected against surges induced on any communications link. All cables and conductors, except fiber optics, which serve as communications links shall have surge protection circuits installed at each end that meet the following two waveforms:

1.6.2.1 A 10 microsecond by 1000 microsecond waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.

1.6.2.2 An 8 microsecond by 20 microsecond waveform with a peak voltage of 1000 volts and a peak current of 500 amperes. Protection shall be provided at the equipment. Additional triple electrode gas surge protectors, rated for the application, shall be installed on each wireline circuit within three feet of the building cable entrance. Fuses shall not be used for surge protection.

1.6.3 Sensor Wiring Surge Protection: All digital and analog inputs and outputs shall be protected against surges induced by sensor wiring installed outdoors and as shown. The inputs and outputs shall be tested with the following two waveforms:

1.6.3.1 A 10 microsecond by 1000 microsecond waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.

1.6.3.2 An 8 microsecond by 20 microsecond waveform with a peak voltage of 1000 volts and a peak current of 500 amperes. Fuses shall not be used for surge protection.

PART 2 - PRODUCTS

2.1 CIRCUIT CONNECTIONS shall be screw-type terminals with each terminal marked for identification.

2.2 STORAGE BATTERIES, if determined necessary by the battery calculations, shall be provided as required to replace existing batteries in the existing FACP; and shall be the sealed, nickel-cadmium with pocket plates types requiring no additional water. The batteries shall have ample capacity, with primary power disconnected, to operate the fire alarm system for a period of 48 hours. Following this period of operation via batteries, the batteries shall have ample capacity to operate all components of the system, including all alarm signaling devices in the total alarm mode for a period of 5 minutes. Batteries shall be sized to deliver 50 percent more ampere/hours than required for the calculated capacities.

2.3 MANUAL FIRE ALARM STATION shall conform to the applicable requirements of UL 38. Manual stations shall be connected into alarm initiating circuits. Station shall be installed on surface mounted outlet boxes. Station shall be single action type. Station shall be provided with painted red cast housing with raised letter operating and functional instructions in contrasting color and shall be fabricated with metal mechanical parts or flame retardant polycarbonate material (plastic will not be acceptable). Station requiring the breaking of glass or plastic panels for operation are not acceptable. The use of a key or wrench shall be required to reset the station. Gravity or mercury switches are not acceptable. Switches and contacts shall be rated for the voltage and current upon which they shall operate. Station shall have a separate screw terminal for each conductor. Surface mounted boxes shall be painted the same color as the fire alarm manual stations. Stations located in hazardous area as defined by NFPA 70 shall be type approved for such locations.

2.4 FIRE DETECTING DEVICES shall comply with the applicable requirements of NFPA 72E and UL 521. The detector shall be mounted as specified or indicated. Detector base shall have terminals for making connections. No solder connections will be allowed. Detectors shall be connected into alarm initiating circuits.

2.4.1 Heat Detectors: Heat detectors shall be designed for detection of fire by rate-compensating principle. Detectors shall be located in accordance with their listing by UL or FM and the requirements of NFPA 72E, except at least two detectors shall be provided in all rooms of 600 square feet or larger in area. Temperature rating of detectors shall be in accordance with NFPA 72E. Detectors, located in areas subject to moisture or exterior atmospheric conditions or hazardous locations as defined by NFPA 70, shall be types approved for such locations. Detectors shall have screw terminals for making all wiring connections. All detectors shall be self-restoring. Fusible or fall-away elements will not be acceptable.

2.4.2 Rate-Compensating Detectors: Detectors shall be designed for surface outlet box mounting and supported independently of wiring connections. Detector shall be hermetically sealed and automatically resetting. The detector shall be rated at 190 degrees F. unless noted otherwise.

2.5 SIGNALING DEVICES: Audible signal devices shall be heavy duty, adjustable sound level type conforming to the applicable requirements of UL 464. Devices shall be connected into alarm indicating circuits.

2.5.1 Alarm Bells: Bells shall be 6 inch surface mounted with matching mounting back box. Bells shall be the underdome type producing a sound output rating of at least 84 DBA at 10 feet. Single stroke, electrically operated, supervised, heavy duty solenoid bell shall be used for coded application.

2.5.2 Visual Indicator: The visual fire alarm indicator shall be an electrically operated assembly

with a flame retardant polycarbonate translucent (plastic not acceptable) dome with red letters to be read from any angle. A visual alarm will be located at each audible device and may be a combined unit. The visual indicator shall be rated for 2000 operations.

2.6 FIRE DETECTION AND ALARM SYSTEM PERIPHERAL EQUIPMENT:

2.6.1 Conduit: Conduit shall be as specified in SECTION, ELECTRICAL WORK, INTERIOR.

2.6.2 Wiring: Wiring for light circuits shall be shielded No. 12 AWG minimum. Wiring for 120V AC power shall be No. 12 AWG minimum. Wiring for low voltage dc circuits shall be No. 14 AWG minimum. Power wiring and control wiring shall be isolated. All wiring shall conform to NFPA 70. System field wiring shall be solid copper and installed in metallic conduit or electrical metallic tubing. All conductors shall be color coded. Conductors used for the same functions shall be distinctively color coded. Two different color codes shall be used for each alarm circuit; one for each loop. Wiring code color shall remain uniform throughout the circuit. Pigtail or T-tap connections to alarm initiating and alarm indicating circuits are unacceptable.

2.6.3 Special Tools and Spare Parts: Special tools necessary for the maintenance of the equipment shall be furnished. Two spare sets of fuses of each type and size required and five spare lamps and LED's of each type shall be furnished. Two percent of the total number of each detector, but no less than two each, shall be furnished. Fuses and lamps shall be mounted in the fire alarm panel, annunciator panel or visual device as appropriate. Two spare glass rods for each manual fire alarm station shall be provided.

PART 3 - EXECUTION

3.1 INSTALLATION: All work shall be installed as shown and in accordance with the manufacturer's diagrams and recommendations, unless otherwise specified. Where there is a conflict in requirements, the most stringent shall apply. Where specific guidance is not provided, the applicable NFPA Standard will apply.

3.1.1 Wiring: Wiring for systems shall be installed in 3/4-inch minimum diameter conduit; however, the wiring for the fire alarm system shall not be installed in conduits, junction boxes, or outlet boxes with conductors of lighting and power systems. No more than one conductor shall be installed under any screw terminal. All circuit conductors entering or leaving any mounting box, outlet box enclosure or cabinet shall be connected to terminals with each terminal marked in accordance with the wiring diagram for identification. Connections shall be made with either crimp-on terminal spade lugs or with approved pressure type terminal blocks. All wiring within any control equipment shall be readily accessible without removing any component parts. The fire alarm equipment manufacturer's representative shall be present for the connection of wiring to the control panel.

3.1.2 Detectors: Detectors shall be installed in accordance with NFPA 72E. Detectors shall be at least 12 inches from any part of any lighting fixture. Detectors shall be located at least 3 feet from diffusers of air handling systems. Each detector shall be provided with appropriate mounting hardware as required by its mounting location. Detectors which mount in free space shall be mounted directly to the end of the stubbed down rigid conduit drop. Conduit drops shall be firmly secured to minimize detector sway. Where length of conduit drop from ceiling or wall surface exceeds 3 feet, sway bracing shall be provided.

3.1.3 Signaling Devices: Signaling devices shall be mounted a minimum of 8 feet above the finished floor unless limited by ceiling height or otherwise indicated.

3.1.4 Grounding shall be provided to building ground.

3.2 TESTING: The Contractor shall notify the Contracting Officer 10 days before the performance and acceptance tests are to be conducted. The tests shall be performed in the presence of the Contracting Officer and base fire department representative, under the supervision of the fire alarm system manufacturer's qualified representative. The Contractor shall furnish all instruments and personnel required for the tests.

3.2.1 Performance Tests: Upon completion of the installation, the system shall be subjected to functional and operational performance tests including tests of each installed heat detector by the Contractor. Tests shall include the meggering of all system conductors to determine that the system is free from grounded or open circuits. The megger test shall be conducted prior to the installation of fire alarm equipment. Smoke detector bases shall be equipped with jumpers for the megger test. When all corrections are made, the system shall be retested to assure that it is functional.

3.2.2 Acceptance Test: The Contractor shall submit proposed test procedures for approval at least 10 days prior to commencement of acceptance testing. The test shall be reconducted to verify correction of any defect found in the initial testing. The testing shall be in accordance with NFPA 72H. A certificate shall be issued by a service company listed in the UL Fire Protection Equipment Directory under Protective Signaling Services - Local, Auxiliary, Remote Station and Proprietary (UUJS). The test shall include the following:

3.2.2.1 Test of each function of the existing control panel.

3.2.2.2 Test of each circuit in both trouble and normal modes.

3.2.2.3 Tests of alarm initiating devices in both normal and trouble conditions.

3.2.2.4 Tests of each auxiliary control circuit and device.

3.2.2.5 Tests of each alarm indicating device.

3.2.2.6 Tests of the battery charger and batteries.

3.2.2.7 Complete operational tests under emergency power supply.

3.2.2.8 Visual inspection of all wiring.

3.2.2.9 Opening the circuit at each alarm initiating and indicating device to test the wiring supervisory feature.

3.2.2.10 Test to insure alarm initiating circuit displays properly on fire alarm control panel and on annunciator if provided.

3.2.2.11 Test to insure each appropriate zone is transmitted to the Central Fire Station equipment. This includes each fire zone, trouble signal, and supervisory signal.

END OF SECTION