DEPARTMENT OF THE ARMY
SAVANNAH DISTRICT, CORPS OF ENGINEERS
P.O. BOX 889
SAVANNAH, GEORGIA 31402-0889

REPLY TO
ATTENTION OF:

August 11, 2004

Contracting Division
A-E and Construction Branch

SUBJECT: DACA21-03-D-0015, Multiple Award Task Order Contract Construction and Design/Build for North Carolina (and SAD)

TMS Contracting, LLC
635 Frosty Morn Drive
Clarksville, Tennessee 37040

Gentlemen:

You are requested to submit a price proposal for work detailed in the scope of work, drawings and specifications posted on our website. The Task Order Request Number is TONC12-03-D-0015. The title of the task order is Install Security Fence, Building 1-1434 and PSBC Dispatch Center Consolidation (E-911), Building 2-5935, Fort Bragg, North Carolina. The period of performance is 240 calendar days. Liquidated damages are $536.96 per day.

This is a high priority requirement as defined in Army Federal Acquisition Regulation – AFAR Supplement 5101.602-2. Subject to availability of funds, the accounting classification will be: 21 4 2050 408 8021 P7000 3220 S09133. This project is also included in the financial plan for FY-05 at which time the accounting classification will be 21 5 2050 508 8021 P7000 3220 S09133. This statement is not a commitment of funds. Funds are not presently available for this acquisition. No contract award will be made until appropriated funds are made available from which payment for contract purposes can be made.

You are reminded that this project is being completed among your firm, The Clement Group, and GSC Contruction. Award will be made based on price.

To access the scope of work and specifications, and drawings go to http://ebs.sas.usce.army.mil. Scroll down the page to you come to the "blue" label that reads Construction – Simplified Acquisition. Select the project Number pertaining to your Solicitation/Contract TONC12-03-D-0015.

Your proposal should be signed by a duly authorized official of your company and is required no later than 2:00 P.M. local time September 1, 2004 to the above address ATTN: CT-C/Linda Elliott. You may fax your proposal to (912) 652-6001.

If you have any questions, please contact Linda Elliott at (912) 652-5076 or Cleveland Harding at (912) 652-5556.

Sincerely,

Julie A. Anderson
Contracting Officer

Enclosures

SCOPE OF WORK
11 AUGUST 2004

TASK ORDER FOR CONSTRUCTION OF
INSTALL SECURITY FENCE, BUILDING 1-1434, GY-00007-3
RENOVATE PSBC DISPATCH CENTER CONSOLIDATION (E-911), BUILDING 2-5935, GY-00005-1
FORT BRAGG, NC

1. **DESCRIPTION OF WORK:** Furnish all labor, equipment, incidentals, supervision and transportation for work necessary to INSTALL SECURITY FENCE, BUILDING 1-1434 AND CONSTRUCT ADDITIONAL PARKING LOT, GY-00007-3 AND RENOVATE PSBC DISPATCH CENTER CONSOLIDATION (E-911) AND CONSTRUCT ADDITIONAL PARKING LOTS, BUILDING 2-5935, GY-00005-1. The options are for Construct Additional Parking Lot and Street Light and to Provide and Install Trees. The options may be exercised 90 calendar days after award of the task order. All work shall be performed in accordance with the MATOC contract specifications, manufacturer's recommendations, and state building codes. All work shall comply with the Uniform Building Code, Life Safety Code, National Standard Plumbing Code and manufacturer's recommended practices. All electric work shall comply with NFPA 70, National Electric Code and NFPA 13 and 101, Life Safety Code and manufacturer's recommendations.

2. **PERFORMANCE PERIOD:** 240 calendar days

3. **CONTRACTOR REQUIREMENTS:**

   A. Project Involves Handling of Asbestos: No

   B. Occupancy During Construction: Yes
   See Specification Section 01005 paragraph 3.1 for INSTALL SECURITY FENCE, BUILDING 1-1434 AND CONSTRUCT ADDITIONAL PARKING LOT, GY-00007-3 AND Specification Section 01005 paragraph 3.1 for RENOVATE PSBC DISPATCH CENTER CONSOLIDATION (E-911) AND CONSTRUCT ADDITIONAL PARKING LOTS, BUILDING 2-5935, GY-00005-1

   C. Phasing of Work: Yes
   See Note 4 of General Project Requirements on Drawing Number X-1 of INSTALL SECURITY FENCE, BUILDING 1-1434.

   D. Construction Schedule: NAS

   E. CQC System Requirements: CQC System Manager.

4. **PRE-BID CONFERENCE:** No

5. **CONTRACT REQUIREMENTS:**

   A. After task order award:
   FRP0001 - Site Safety and Health Plan

FRP0002 - Quality Control Program
FRP0004 – Price Proposal
FRP0006 - Work Schedule
FRP0007 - Weekly Progress Report
FRP0016 - As-Built/In Progress Drawings

B. After construction completion, prior to final payment:
FRP0009 - System/Equipment Testing
FRP0010 - Operation and Maintenance Manuals to include Videos
FRP0011 – Training
FRP0012 - Equipment and Construction Warranties
FRP0013 - List of Standard Equipment and Service Organizations
FRP0017 - As-Built/Final Drawings

6. GOVERNMENT FURNISHED ITEMS/WORK: N/A

7. INTERFACE WITH GOVERNMENT PERSONNEL: Access to and from the site shall be coordinated through the Fort Bragg Area Office.

8. WAGE DETERMINATION: NC030032

9. LIQUIDATED DAMAGES: The contractor shall be assessed the amount of $536.96 liquidated damages per calendar day for failure to complete the prescribed work within the performance period stated in paragraph 2, above.

10. TIME EXTENSIONS FOR UNUSUALLY SEVERE WEATHER:

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
10	9	6	4	4	6	8	7	4	4	5	9

PAYMENT OFFICE:

The billing and payment will be through the Corps of Engineers Fort Bragg Area Office:

Mailing Address:	Shipping Address
U. S. Army Corps Of Engineers	U.S. Army Corps of Engineers
Fort Bragg Area Office	Fort Bragg Area Office
P.O. Box 70247	Building 3-1933 Butner Road
Fort Bragg, N.C. 28310	Fort Bragg, N.C. 28310-5000

11. ENCLOSURES:

A. Specifications: INSTALL SECURITY FENCES AT BUILDING 1-1434, GY-00007-3 AND CONSTRUCT E-911 COMMUNICATIONS CENTER, GY-00005-1

B. Drawings: INSTALL SECURITY FENCE, BUILDING 1-1434, GY-00007-3, Drawing Number: PWBC-6382 and CONSTRUCT E-911 COMMUNICATIONS CENTER, BUILDING 2-5935, GY-00005-1, DRAWING NUMBER: PWBC-6343

12. PRE BID SITE VISIT: Prior to the submission of any bids, all bidders are required to visit the project site location to become familiar with the project requirements. Failure to visit the project site will not disqualify a bid; however, the bidder is required to comply with the terms and conditions of any resultant contract by reason of such failure. In no event will a failure to inspect the site constitute grounds for a claim after award of the task order.

13. EXCAVATION PERMIT: The contractor shall have a completed and approved PWBC Excavation Permit prior to any excavation, to include sign or fence-post holes. The Contractor shall schedule an appointment to locate utility lines at least 5 days prior to any excavation with the PWBC Facilities Maintenance Division at telephone number 396-0321. A copy of the PWBC Excavation Permit will be provided at the Prework Conference. The Contractor shall be responsible for coordination with the Information Technology Business Center (ITBC), Outside Plant Branch, for locating communication lines prior to any excavation.

14. DISPOSAL AND BORROW PERMITS:

a. Disposal Permits: A permit is required to use the installation land clearing and inert debris and demolition landfills. Landfill permits shall be processed with the Environmental Compliance Branch of the PWBC Environmental & Natural Resources Division. Permits are issued for the life of the specific contract only. Only materials produced on the project for which the permits are issued may be disposed of in the land clearing and inert debris and demolition landfills. The Contractor shall keep a copy of the completed permit with the vehicle throughout the contract disposal operation. Copies of the disposal permit forms will be provided at the Prework Conference.

b. Borrow Permits: A permit is required to use the Fort Bragg borrow material pits. Borrow pit permits shall be processed with the Environmental Compliance Branch of the PWBC Environmental & Natural Resources Division. Permits are issued for the life of the specific contract only. Borrow materials may only be used on the project for which the permits are issued. The Contractor shall keep a copy of the completed permit with the vehicle throughout the contract borrow operation

15. HAUL ROUTES: The Contractor is required to obtain approval from the Resident Office for the routes he intends to use for transportation of borrow materials, construction debris, or demolition materials unless otherwise permitted in writing by the Resident. The axle load of earth-hauling equipment operating on paved streets shall not exceed 12,000 pounds.

16. UTILITY OUTAGES AND ROAD CLOSURES: Utility, road and railroad closures require a minimum 10 working days advance written notice and will be subject to Resident Office approval. In the case of a road closures, a sketch shall be provided showing the closure location and all necessary signs and barricades. Necessary signage, barricades, flag persons, lights (including temporary traffic control lights), and

markings for the safe movement of the public during construction shall be in accordance with the Manual on Uniform Traffic Control Devices, and shall be provided at no additional expense to the Government.

17. AVAILABILITY AND USE OF UTILITY SERVICES: Utility services required on the job site for the accomplishment of the work will be furnished at no cost to the Contractor; however, the Government will make no connections or alterations to the existing utility systems for the Contractor. Utilities for offices and/or storage buildings or areas will be billed to the Contractor monthly and will not be furnished free of charge. The Contractor shall be responsible for installing meters or other connections at no cost to the Government. At the conclusion of the contract, the Contractor shall remove all temporary connections, distribution lines, meters and associated paraphernalia unless otherwise directed by the Resident Office. Prior to installing any utility connections at an office/storage site, the plan will be approved by the Resident Office. When utility meters are installed, the Contractor shall notify the Resident Office for the initial meter reading. Failure to obtain this initial reading will result in the Contractor being charged for the entire amount shown on the meter.

18. CONTRACTOR STORAGE AND TRAILERS: The Contractor shall place or paint a sign on all of his storage trailer(s) and building(s) used on this contract. At a minimum, the sign shall contain the name of the Contractor and a telephone number at which the contractor can be reached. The trailer(s) and building(s) shall be completed with gates and/or doors which can be locked. Only material for this project shall be stored in the trailer(s) or building(s). The Contractor shall remove the storage trailer(s) or building(s) within 30 days after completion of the contract and prior to submitting his final invoice. The area around the storage trailer(s) and building(s) shall be kept clean.

19. SAFETY: Safety will be incompliance with the Corps of Engineers Safety Manual EM 185-11-1. Use of appropriate safety equipment is mandatory and not limited to hard hats and steel-toed shoes. Contractor is responsible for daily clean up and complete restoration of the area once the contract is complete.

20. HOURS OF WORK: Work shall be accomplished between the hours of 0730 thru 1630 hours daily, Monday through Friday on non-Government holidays. Legal holidays falling on Saturday are observed on the proceeding Friday and those falling on Sunday are observed on the following Monday. Work schedule and facility security to be coordinated with the Resident Office for facility access and security maintenance during duration of work. Contractor shall not work outside of the stated hours of work, without first obtaining approval from the Resident Office.

23. WARRANTY: The contractor shall provide a minimum of one (1) year warranty on all materials and workmanship from the date of the Government's acceptance of the work.

End Of Scope

SUPPLIES OR SERVICES AND PRICES/COST SCHEDULE

GY-00005-1P, PSBC DISPATCH CENTER CONSOLIDATION (E-911)
GY-00007-3P, INSTALL SECURITY FENCE, BUILDING 1-1434
FT. BRAGG, NORTH CAROLINA

TOTAL BID ITEMS 0001 THROUGH 0005 $_____._____

ITEM NO	SUPPLIES/SERVICES	QUANTITY	UNIT	UNIT PRICE	AMOUNT
0001	BASE BID	1.00	Lump Sum	$_____	$_____

Renovate areas for E-911 consolidation in Building 2-5935 and construct additional parking lots as specified in Contract Drawings and Technical Specifications, Complete (GY-00005-1P)

ITEM NO	SUPPLIES/SERVICES	QUANTITY	UNIT	UNIT PRICE	AMOUNT
0002	BASE BID	1.00	Lump Sum	$_____	$_____

Perform site demolition, install vehicle protection security bollards, gates and fencing as specified in Contract Drawings and Technical Specifications, Complete (GY-00007-3P)

ITEM NO	SUPPLIES/SERVICES	QUANTITY	UNIT	UNIT PRICE	AMOUNT
0003	OPTION 1	1.0	Lump Sum	$_____	$_____

Construct parking lot as specified in Contract Drawings and Technical Specifications, Complete (GY-00007-3P)

ITEM NO	SUPPLIES/SERVICES	QUANTITY	UNIT	UNIT PRICE	AMOUNT
0004	OPTION 2	1.0	Lump Sum	$_____	$_____

Provide and install trees along Northwest side of Building 1-1333 as specified in Contract Drawings and Technical Specifications, Complete (GY-00007-3P)

ITEM NO	SUPPLIES/SERVICES	QUANTITY	UNIT	UNIT PRICE	AMOUNT
0005	OPTION 3	1.0	Lump Sum	$_____	$_____

Construct parking lots as specified in Contract Drawings and Technical Specifications, Complete (GY-00005-1P)

General Decision Number NC030009 06/13/2003 NC9

Superseded General Decision No. NC020009

State: North Carolina

Construction Type:
HEAVY

County(ies):
STATEWIDE

SEWER AND WATER CONSTRUCTION PROJECTS AND HEAVY CONSTRCUTION PROJECTS (excluding Dam construction projects).

Modification Number	Publication Date
0	06/13/2003

COUNTY(ies):
STATEWIDE

SUNC2001A 02/12/1990

	Rates	Fringes
BOILERMAKERS:		
Storage Tank Erection/Repair	12.96	4.105
All Other Work:	16.20	4.105
BRICKLAYERS	7.23	
CARPENTERS	6.63	
CEMENT MASONS/FINISHERS	6.11	
ELECTRICIANS	8.56	
FENCE ERECTORS	5.15	
IRONWORKERS	8.20	
LABORERS:		
Unskilled	5.15	
Air Drill Operator	5.92	
Asphalt Rakers	5.15	
Pipelayers	5.17	
MANHOLE BUILDERS	5.81	
MILLWRIGHTS	5.27	
PAINTERS	7.12	
PLUMBERS & PIPEFITTERS	7.42	
POWER EQUIPMENT OPERATORS:		
Asphalt Distributor	5.77	
Asphalt Finisher	5.69	
Asphalt Paver	5.69	
Asphalt Screed	5.69	
Backhoe	6.40	
Boring Machine	5.65	
Bulldozer	5.96	
Crane	7.60	
Dragline	6.34	
Drill	7.23	
Loader	5.79	
Mechanic	7.16	
Motor Grader	6.24	
Roller	5.15	
Scraper, Pan	5.42	

Tractor	5.49
Trenching	6.58
Well Drillers	6.50
TRUCK DRIVERS	5.15
TV & GROUTING TECHNICIANS	9.21

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

Unlisted classifications needed for work not included within

the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29 CFR 5.5(a)(1)(ii)).

In the listing above, the "SU" designation means that rates listed under that identifier do not reflect collectively bargained wage and fringe benefit rates. Other designations indicate unions whose rates have been determined to be prevailing.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

* an existing published wage determination
* a survey underlying a wage determination
* a Wage and Hour Division letter setting forth a position on a wage determination matter
* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U. S. Department of Labor
200 Constitution Avenue, N. W.
Washington, D. C. 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N. W.
Washington, D. C. 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment

data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U. S. Department of Labor
200 Constitution Avenue, N. W.
Washington, D. C. 20210

4.) All decisions by the Administrative Review Board are final.

END OF GENERAL DECISION

General Decision Number NC030032 06/13/2003 NC32

Superseded General Decision No. NC020032

State: North Carolina

Construction Type:
BUILDING

County(ies):
CUMBERLAND

BUILDING CONSTRUCTION PROJECTS (does not include residential construction consisting of single family homes and apartments up to and including 4 stories).

Modification Number	Publication Date
0	06/13/2003

COUNTY(ies):
CUMBERLAND

SUNC1027A 10/24/1994

	Rates	Fringes
BRICKLAYERS/BLOCKLAYERS	12.50	
CARPENTERS (Including drywall hanging, acoustical tile installation and batt insulation	9.08	
CEMENT MASONS/CONCRETE FINISHERS	8.43	
ELECTRICIANS	9.71	
GLAZIERS	8.77	
HVAC MECHANIC (HVAC pipe only)	9.26	
INSULATORS (pipe)	10.42	.63
IRONWORKERS, STRUCTURAL	10.76	
LABORERS:		
Unskilled	6.23	
PAINTERS (Brush)	7.90	.04
PLUMBERS	10.28	
ROOFERS	6.75	
SHEET METAL WORKERS (Including HVAC Duct Work)	9.36	
SOFT FLOOR LAYERS/CARPET LAYERS	12.00	
TRUCK DRIVERS	7.10	

WELDERS - receive rate prescribed for craft performing operation to which welding is incidential.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29 CFR 5.5(a)(1)(ii)).

In the listing above, the "SU" designation means that rates listed under that identifier do not reflect collectively

bargained wage and fringe benefit rates. Other designations indicate unions whose rates have been determined to be prevailing.

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U. S. Department of Labor
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Washington, D. C. 20210

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END OF GENERAL DECISION

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DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01005

GENERAL AND SPECIAL PROVISIONS

PART 1 SCOPE OF WORK

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SECTION 01005

GENERAL AND SPECIAL PROVISIONS

PART 1 SCOPE OF WORK

The work consists of furnishing all labor, equipment, transportation, and materials necessary to perform all work in strict accordance with these specifications, schedules, applicable PWBC Drawings, and other contract documents. The scope of work of this contract includes, but is not limited to, the following specific items of work:

1.1 Civil Work. Provide and install new bollards, new crash gates and other work noted on drawings.

1.2 Architectural Work. None.

1.3 Mechanical Work. None.

1.4 Electrical Work. Provide and install all electric work noted on drawings.

2. PROJECT REQUIREMENTS:

2.1 Certificates of Compliance and Material Submittals. The Contractor shall submit for approval all certificates of compliance and material submittals required in these technical provisions. Required submittals shall be submitted for approval not later than 30 days prior to the approval date needed to achieve compliance with the approved project schedule. Approval must be received from the Contracting Officer or his representative before incorporating the materials into the work. The Contractor shall provide a Submittal Register listing all required submittals in the contract to the COR at the time of the first submittal. Submittal forms (form 59-2-R) and a sample Submittal Register (Form 4288) will be provided at the Prework Conference.

2.2 Safety and Environmental Plans. The Contractor shall submit a proposed safety plan in accordance with the current Corps of Engineers Safety Manual, EM-385-1-1, and shall submit anenvironmental protection plan in accordance with specifications section 01355A, Environmental Protection, if included in these technical provisions. A sample safety plan form will be provided at the Prework Conference.

2.3 Quality Control. The Contractor shall provide the job superintendent's name and telephone number to the Construction Management Division of the PWBC; building 3-1933, Butner Road; (910) 396-2308, prior to commencement of work. The Contractor shall furnish a daily Contractor Quality Control (CQC)/Superintendent's work report to the Contracting Officer's Representative (COR). A sample CQC report form will be provided at the Prework Conference.

2.4 Excavation Permit. The Contractor shall have a completed and approved PWBC Excavation Permit in his possession prior to any excavation, to include sign or fence-post holes. The Contractor shall schedule an appointment to locate utility lines at least 10 working days prior to any excavation with the PWBC Facilities Maintenance Division, building 3-1634, Butner Road. Utilities are usually located within 5-10 workdays from the date of request but, due to weather conditions, construction workloads, etc., longer periods

of time for these utility locates may be experienced. This will be accomplished by submitting a Facilities Maintenance Division Service Order. Service Orders are obtained by calling (910) 396-0321, or making the request on-line at http://www/bragg/army/mil/pwbc/. Service Order status can also be checked on-line at the same web address. A copy of the PWBC Excavation Permit form will be provided at the Prework Conference. The Contractor shall be responsible for coordination with the Information Technology Business Center (ITBC), Outside Plant Branch; building 1-1434, Scott Street; (910) 396-8200, for locating government-owned communication lines prior to any excavation. The Contractor shall also be responsible for coordination with any known or suspected non-governmental utilities such as Sprint telecommunications or cable television.

2.5 Disposal and Borrow Permits.

2.5.1 Disposal Permits. A permit is required to use the installation land clearing and inert debris and demolition landfills. Landfill permits shall be processed with the Environmental Compliance Branch of the PWBC Environmental & Natural Resources Division; building 3-1333, Butner Road; (910) 432-6336/-6352. Permits are issued for 60 days duration and for the specific contract only. Only materials produced on the project for which the permits are issued may be disposed of in the land clearing and inert debris and demolition landfills. The Contractor shall sort the debris for like mat erials, such as construction and debris materials, inert debris, etc. All metal products should be brought to the landfill separately and placed in the applicable container. The Contractor shall keep a copy of the completed permit with the vehicle throughout the contract disposal operation. Copies of the disposal permit forms will be provided at the Prework Conference. The land clearing and inert debris and demolition debris disposal site locations are shown on the drawings. Landfills and transfer site are open for customer service from 0730 to 1500 Monday through Friday except Federal holidays. When directed by the Contracting Officer the landfills may be available on an as-required basis for 2 to 6 hours approximately 12 weekends per year (Saturday, Sunday & Holiday).

2.5.2 Borrow Permits. A permit is required to use the Fort Bragg borrow material pits. Borrow pit permits shall be processed with the PWBC Facilities Maintenance Division, Roads and Equipment Branch; Building O-3454, Lamont Road, 396-6873. Permits are issued for the life of the specific contract only. Borrow materials may only be used on the project for which the permits are issued. The Contractor shall keep a copy of the completed permit with the vehicle throughout the contract borrow operation. Copies of the borrow permit forms will be provided at the Prework Conference. The borrow pit location is shown on the drawings.

2.6 Haul Routes. The Contractor is required to use the haul routes shown on the contract drawings for transportation of borrow materials, construction debris, or demolition materials unless otherwise permitted in writing by the COR. When haul routes are not designated in the contract, the Contractor must obtain approval from the COR for the routes he intends to use. The axle load of earth-hauling equipment operating on paved streets shall not exceed 12,000 pounds.

2.7 Utility Outages and Road Closures. Utility, road, and railroad closures require minimum 10 working days advance written notice and will be subject to COR approval. A sample utility outage/road closure request form will be provided at the Prework Conference. Utility outages will be held on normal work days, after hours or on weekend/holidays as coordinated with the Contracting Officer, Ft. Bragg PWBC and the utility provider. The decision on

when to have an outage (normal work hours, weekend, etc) will be based on the length of the outage and the normal business hours/hours of maximum usage for the facilities affected by the outage. Outages will be limited to a duration of 4 hours unless extenuating circumstances dictate otherwise. In the case of road closures, a sketch shall be provided showing the closure location and all necessary signs and barricades. Necessary signage, barricades, flagpersons, lights (including temporary traffic control lights), and markings for the safe movement of the public during construction shall be in accordance with the Manual on Uniform Traffic Control Devices, and shall be provided at no additional expense to the Government.

2.8 Availability and Use of Utility Services.

2.8.1 Payment for Utility Services. The Government will make all reasonably required utilities available to the Contractor from existing outlets and supplies, as specified in the contract. Unless otherwise provided in the contract, the amount of each utility service consumed shall be charged to and paid for by the Contractor at the prevailing rates. The rates listed below are current as of January 1, 2003 and are subject to change. The Contractor shall carefully conserve all utilities furnished.

2.8.2 Meters and Temporary Connections. The Contractor, at its expense and in a manner satisfactory to the Contracting Officer, shall provide and maintain necessary temporary connections, distribution lines, and meters required to measure the amount of each utility used for the purpose of determining charges. The Contractor shall notify the Contracting Officer's Representative, in writing, no less than 10 working days before the temporary connection is made. The Contracting Officers Representative will then provide the contractor with the name and phone number of the utility provider. The contractor will be responsible for contacting the utility provider and making arrangements for connections and billing. For temporary electrical connections the Government or applicable utility provider will provide the meter (meter base provided by contractor) and make the final hot connection after inspection and approval of the Contractor's temporary wiring installation. The Contractor shall not make the final electrical connection. For temporary water and sewer connections the contractor will provide the meter and after inspection/approval by the Contracting Officer's Representative make the final connection at the contractor's expense.

2.8.3 Use of Permanent Building Utility Connections. Utilities consumed by the contractor from permanent building utility connections shall also be metered and paid for by the contractor. When the permanent system is activated the initial meter reading shall be recorded and reported as specified below. On building renovation projects the initial meter reading shall be recorded when the contractor is given possession of the building to perform the work. The contractor shall pay for utilities consumed through the permanent building connection until the work has been completed or the government has occupied the facility, which ever occurs first.

2.8.4 Initial Meter Readings. Upon installation of the meter, the initial reading shall be recorded (in the presence of the Contracting Officer's Representative) and forwarded to the point of contact for utility service with a copy to the Contracting Officer's Representative.

2.8.5 Final Meter Reading. Before completion of the work and final acceptance of the work by the Government, the Contractor shall notify the Contracting Officer and the applicable utility provider, in writing, 10 working days before termination is desired. The Government or applicable utility provider will take a final meter reading. Electric service will be

disconnected by the provider. Water and sewer connections will be disconnected by the contractor, at his expenses and by a method approved by the Contracting Officer's Representative. The Contractor shall then remove all the temporary distribution lines, meters, meter bases, and associated paraphernalia. The Contractor shall pay all outstanding utility bills before final acceptance of the work by the Government.

2.8.6 Requirement for backflow prevention on temporary/permanent potable water connections. The contractor shall install a backflow prevention device on all connections to the potable water system. The backflow prevention device shall be a reduced pressure or double check type, meeting all the State code requirements for backflow preventers on potable water. If the contractor request the use of a fire hydrant and receives approval from the Contracting Officer's Representative a backflow prevention device and meter shall be installed prior to each use.

2.8.7 Utilities Charge Rates:
Water ---------- $1.9585 per 1,000 gallons
Electricity ------ $0.0752 per KW hour
Sewer ---------- $10.00/month for each connected trailer up to single wide size. The rate for larger trailers will be determined by the utility provider, however, this rate will not exceed $20.00/month per trailer.

2.9 As-Built Record Drawings. The Contractor shall be responsible for maintaining one set of master prints at the job-site on which he shall keep a careful and neat record of all deviations from the original contract drawings as the work progresses. The Contractor shall note all changes and corrections on these record drawings promptly as the changes occur, but in no case less often than a weekly basis. In addition to incorporated modifications, these record drawings shall also include the actual location of all subsurface utility lines installed or encountered, and the type of materials used. Contractor will receive a copy of the contract documents in an electronic format (CD or 3.5 inch diskette) at the time of award, the Contractor shall be responsible for transferring any as-built changes and plan sheet annotations described above onto the electronic format documents. The marked-up/annotated prints, or the annotated electronic drawings if applicable, shall be certified as to their correctness by an authorized representative of the Contractor and turned-over to the COR not later than 10 days after acceptance of the work by the Government.

2.10 Color Boards. Three sets of color boards shall be submitted by the Contractor, in addition to any samples required elsewhere in the technical provisions. Such submittals shall be made not less than 30 days prior to the date needed to comply with the approved project schedule. Each set of boards shall include samples of colors and finishes of all interior and exterior surfaces such as walls, partitions, floors, flashing, windows, and ceilings. The samples will be presented on 8-1/2" x 11" boards or modules with a maximum spread of 24" x 31-1/2" for foldouts, and so as to fit in a standard three ring binder. The Contractor shall certify that he has reviewed the color samples and that they are in compliance with the contract drawings and specifications. If multiple material and finish schemes are required, samples shall be identified by scheme and referenced by room names/numbers on the contract floor plans and room finish/color schedule. A sample color board submittal will be available for review at the Prework Conference.

3. SPECIAL PROVISIONS:

3.1 Occupancy. The facility will be occupied and in normal usage during accomplishment of the work. Interference with and inconvenience to the

occupants or routine use of the facility shall be held to an absolute minimum. The Contractor is responsible for providing such covering, shields, and barricades as are required to protect the facility occupants, furniture, equipment, supplies, etc., from dust, debris, weather intrusion, or other cause of damage resulting from construction.

3.2 Contractor Vehicle/Equipment Access to Fort Bragg. Fort Bragg is not a closed installation, but vehicular access is controlled. Contractors are required to register each vehicle that will be traveling installation roads or streets under its own power. Each such vehicle shall have a registration decal. Registration may be accomplished at the Main Vehicle Registration Center, building 8-1078 on Randolph Street near Bragg Boulevard, 0800-1700 hours Monday through Friday. Unregistered vehicles should expect be stopped and delayed at all access control points. Contractors and all commercially registered vehicles shall use the Knox Street access control point off Bragg Boulevard for all access to Fort Bragg.

3.3 Time Constraints

Work is to be completed between the hours of 7:00 AM to 4:00 PM, Monday thru Friday, with no work allowed on the Base on Federal government holidays.

3.4 Company Identification Clothes/ID's

All contractors employee's shall be required to wear company ID clothes and/or company ID Name tags.

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SECTION 01312A

QUALITY CONTROL SYSTEM (QCS)
08/02

1.1 GENERAL

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

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

1.1.1 Correspondence and Electronic Communications

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

1.1.2 Other Factors

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

1.2 QCS SOFTWARE

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

1.3 SYSTEM REQUIREMENTS

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

Hardware

IBM-compatible PC with 500 MHz Pentium or higher processor

128+ MB RAM for workstation / 256+ MB RAM for server

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

3 1/2 inch high-density floppy drive

Compact disk (CD) Reader, 8x speed or higher

SVGA or higher resolution monitor (1024 x 768, 256 colors)

Mouse or other pointing devise

Windows compatible printer (Laser printer must have 4+ MB of RAM)

Connection to the Internet, minimum 56 BPS

Software

MS Windows 98, ME, NT, or 2000

Word Processing software compatible with MS Word 97 or newer

Latest version of : Netscape Navigator, Microsoft Internet Explorer, or other browser that supports HTML 4.0 or higher

Electronic mail (E-mail), MAPI compatible

Virus protection software that is regularly upgraded with all issued manufacturer's updates

1.4 RELATED INFORMATION

1.4.1 QCS User Guide

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

1.4.2 Contractor Quality Control(CQC) Training

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

1.5 CONTRACT DATABASE

Prior to the pre-construction conference, the Government shall provide the Contractor with basic contract award data to use for QCS. The Government will provide data updates to the Contractor as needed, generally by files

attached to E-mail. These updates will generally consist of submittal reviews, correspondence status, QA comments, and other administrative and QA data.

1.6 DATABASE MAINTENANCE

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

1.6.1 Administration

1.6.1.1 Contractor Information

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

1.6.1.2 Subcontractor Information

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

1.6.1.3 Correspondence

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

1.6.1.4 Equipment

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

1.6.1.5 Management Reporting

QCS includes a number of reports that Contractor management can use to track the status of the project. The value of these reports is reflective of the quality of the data input, and is maintained in the various sections of QCS. Among these reports are: Progress Payment Request worksheet, QA/QC comments, Submittal Register Status, Three-Phase Inspection checklists.

1.6.2 Finances

1.6.2.1 Pay Activity Data

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

1.6.2.2 Payment Requests

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

1.6.3 Quality Control (QC)

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

1.6.3.1 Daily Contractor Quality Control (CQC) Reports.

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

1.6.3.2 Deficiency Tracking.

The Contractor shall use QCS to track deficiencies. Deficiencies identified by the Contractor will be numerically tracked using QC punch list items. The Contractor shall maintain a current log of its QC punch list items in the QCS database. The Government will log the deficiencies it has identified using its QA punch list items. The Government's QA punch

list items will be included in its export file to the Contractor. The Contractor shall regularly update the correction status of both QC and QA punch list items.

1.6.3.3 Three-Phase Control Meetings

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

1.6.3.4 Accident/Safety Tracking.

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

1.6.3.5 Features of Work

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

1.6.3.6 QC Requirements

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

1.6.4 Submittal Management

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

1.6.5 Schedule

The Contractor shall develop a construction schedule consisting of pay activities, in accordance with Contract Clause "Schedules for Construction Contracts", or Section 01320A, PROJECT SCHEDULE, as applicable. This schedule shall be input and maintained in the QCS database either manually or by using the Standard Data Exchange Format (SDEF) (see Section 01320A PROJECT SCHEDULE). The updated schedule data shall be included with each pay request submitted by the Contractor.

1.6.6 Import/Export of Data

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

1.7 IMPLEMENTATION

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

1.8 DATA SUBMISSION VIA COMPUTER DISKETTE OR CD-ROM

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

1.8.1 File Medium

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

1.8.2 Disk or CD-ROM Labels

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

1.8.3 File Names

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

1.9 MONTHLY COORDINATION MEETING

The Contractor shall update the QCS database each workday. At least monthly, the Contractor shall generate and submit an export file to the Government with schedule update and progress payment request. As required in Contract Clause "Payments", at least one week prior to submittal, the Contractor shall meet with the Government representative to review the planned progress payment data submission for errors and omissions. The Contractor shall make all required corrections prior to Government acceptance of the export file and progress payment request. Payment requests accompanied by incomplete or incorrect data submittals will be returned. The Government will not process progress payments until an acceptable QCS export file is received.

1.10 NOTIFICATION OF NONCOMPLIANCE

The Contracting Officer will notify the Contractor of any detected noncompliance with the requirements of this specification. The Contractor shall take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the work site, shall be deemed sufficient for the purpose of notification.

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SECTION 01320A

PROJECT SCHEDULE
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PART 1 GENERAL

1.1 REFERENCES

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

U.S. ARMY CORPS OF ENGINEERS (USACE)

ER 1-1-11	(1995) Progress, Schedules, and Network Analysis Systems

1.2 QUALIFICATIONS

The Contractor shall designate an authorized representative who shall be responsible for the preparation of all required project schedule reports.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

Pursuant to the Contract Clause, SCHEDULE FOR CONSTRUCTION CONTRACTS, a Project Schedule as described below shall be prepared. The scheduling of construction shall be the responsibility of the Contractor. Contractor management personnel shall actively participate in its development. Subcontractors and suppliers working on the project shall also contribute in developing and maintaining an accurate Project Schedule. The approved Project Schedule shall be used to measure the progress of the work, to aid in evaluating time extensions, and to provide the basis of all progress payments.

3.2 BASIS FOR PAYMENT

The schedule shall be the basis for measuring Contractor progress. Lack of an approved schedule or scheduling personnel will result in an inability of the Contracting Officer to evaluate Contractor's progress for the purposes of payment. Failure of the Contractor to provide all information, as specified below, shall result in the disapproval of the entire Project Schedule submission and the inability of the Contracting Officer to evaluate Contractor progress for payment purposes. In the case where Project Schedule revisions have been directed by the Contracting Officer and those revisions have not been included in the Project Schedule, the Contracting Officer may hold retainage up to the maximum allowed by contract, each payment period, until revisions to the Project Schedule have been made.

3.3 PROJECT SCHEDULE

The computer software system utilized by the Contractor to produce the Project Schedule shall be capable of providing all requirements of this

specification. Failure of the Contractor to meet the requirements of this specification shall result in the disapproval of the schedule. Manual methods used to produce any required information shall require approval by the Contracting Officer.

3.3.1 Use of the Critical Path Method

The Critical Path Method (CPM) of network calculation shall be used to generate the Project Schedule. The Contractor shall provide the Project Schedule in the Precedence Diagram Method (PDM).

3.3.2 Level of Detail Required

The Project Schedule shall include an appropriate level of detail. Failure to develop or update the Project Schedule or provide data to the Contracting Officer at the appropriate level of detail, as specified by the Contracting Officer, shall result in the disapproval of the schedule. The Contracting Officer will use, but is not limited to, the following conditions to determine the appropriate level of detail to be used in the Project Schedule:

3.3.2.1 Activity Durations

Contractor submissions shall follow the direction of the Contracting Officer regarding reasonable activity durations. Reasonable durations are those that allow the progress of activities to be accurately determined between payment periods (usually less than 2 percent of all non-procurement activities' Original Durations are greater than 20 days).

3.3.2.2 Procurement Activities

Tasks related to the procurement of long lead materials or equipment shall be included as separate activities in the project schedule. Long lead materials and equipment are those materials that have a procurement cycle of over 90 days. Examples of procurement process activities include, but are not limited to: submittals, approvals, procurement, fabrication, and delivery.

3.3.2.3 Critical Activities

The following activities shall be listed as separate line activities on the Contractor's project schedule:

a. Submission and approval of mechanical/electrical layout drawings.

b. Submission and approval of O & M manuals.

c. Submission and approval of as-built drawings.

d. Submission and approval of 1354 data and installed equipment lists.

e. Submission and approval of testing and air balance (TAB).

f. Submission of TAB specialist design review report.

g. Submission and approval of fire protection specialist.

h. Submission and approval of testing and balancing of HVAC plus commissioning plans and data.

i. Air and water balance dates.

j. HVAC commissioning dates.

k. Controls testing plan.

l. Controls testing.

m. Performance Verification testing.

n. Other systems testing, if required.

o. Prefinal inspection.

p. Correction of punchlist from prefinal inspection.

q. Final inspection.

3.3.2.4 Government Activities

Government and other agency activities that could impact progress shall be shown. These activities include, but are not limited to: approvals, inspections, utility tie-in, Government Furnished Equipment (GFE) and Notice to Proceed (NTP) for phasing requirements.

3.3.2.5 Responsibility

All activities shall be identified in the project schedule by the party responsible to perform the work. Responsibility includes, but is not limited to, the subcontracting firm, contractor work force, or government agency performing a given task. Activities shall not belong to more than one responsible party. The responsible party for each activity shall be identified by the Responsibility Code.

3.3.2.6 Work Areas

All activities shall be identified in the project schedule by the work area in which the activity occurs. Activities shall not be allowed to cover more than one work area. The work area of each activity shall be identified by the Work Area Code.

3.3.2.7 Modification or Claim Number

Any activity that is added or changed by contract modification or used to justify claimed time shall be identified by a mod or claim code that changed the activity. Activities shall not belong to more than one modification or claim item. The modification or claim number of each activity shall be identified by the Mod or Claim Number. Whenever possible, changes shall be added to the schedule by adding new activities. Existing activities shall not normally be changed to reflect modifications.

3.3.2.8 Bid Item

All activities shall be identified in the project schedule by the Bid Item to which the activity belongs. An activity shall not contain work in more than one bid item. The bid item for each appropriate activity shall be identified by the Bid Item Code.

3.3.2.9 Phase of Work

All activities shall be identified in the project schedule by the phases of work in which the activity occurs. Activities shall not contain work in more than one phase of work. The project phase of each activity shall be by the unique Phase of Work Code.

3.3.2.10 Category of Work

All Activities shall be identified in the project schedule according to the category of work which best describes the activity. Category of work refers, but is not limited, to the procurement chain of activities including such items as submittals approvals, procurement, fabrication, delivery, installation, start-up, and testing. The category of work for each activity shall be identified by the Category of Work Code.

3.3.2.11 Feature of Work

All activities shall be identified in the project schedule according to the feature of work to which the activity belongs. Feature of work refers, but is not limited to, a work breakdown structure for the project. The feature of work for each activity shall be identified by the Feature of Work Code.

3.3.3 Scheduled Project Completion

The schedule interval shall extend from NTP to the contract completion date.

3.3.3.1 Project Start Date

The schedule shall start no earlier than the date on which the NTP was acknowledged. The Contractor shall include as the first activity in the project schedule an activity called "Start Project". The "Start Project" activity shall have an "ES" constraint date equal to the date that the NTP was acknowledged, and a zero day duration.

3.3.3.2 Constraint of Last Activity

Completion of the last activity in the schedule shall be constrained by the contract completion date. Calculation on project updates shall be such that if the early finish of the last activity falls after the contract completion date, then the float calculation shall reflect a negative float on the critical path. The Contractor shall include as the last activity in the project schedule an activity called "End Project". The "End Project" activity shall have an "LF" constraint date equal to the completion date for the project, and a zero day duration.

3.3.3.3 Early Project Completion

In the event the project schedule shows completion of the project prior to the contract completion date, the Contractor shall identify those activities that have been accelerated and/or those activities that are scheduled in parallel to support the Contractor's "early" completion. Contractor shall specifically address each of the activities noted in the narrative report at every project schedule update period to assist the Contracting Officer in evaluating the Contractor's ability to actually complete prior to the contract period.

3.3.4 Interim Completion Dates

Contractually specified interim completion dates shall also be constrained to show negative float if the early finish date of the last activity in that phase falls after the interim completion date.

3.3.4.1 Start Phase

The Contractor shall include as the first activity for a project phase an activity called "Start Phase X" where "X" refers to the phase of work. The "Start Phase X" activity shall have an "ES" constraint date equal to the date on which the NTP was acknowledged, and a zero day duration.

3.3.4.2 End Phase

The Contractor shall include as the last activity in a project phase an activity called "End Phase X" where "X" refers to the phase of work. The "End Phase X" activity shall have an "LF" constraint date equal to the completion date for the project, and a zero day duration.

3.3.4.3 Phase X

The Contractor shall include a hammock type activity for each project phase called "Phase X" where "X" refers to the phase of work. The "Phase X" activity shall be logically tied to the earliest and latest activities in the phase.

3.3.5 Default Progress Data Disallowed

Actual Start and Finish dates shall not be automatically updated by default mechanisms that may be included in CPM scheduling software systems. Actual Start and Finish dates on the CPM schedule shall match those dates provided from Contractor Quality Control Reports. Failure of the Contractor to document the Actual Start and Finish dates on the Daily Quality Control report for every in-progress or completed activity, and failure to ensure that the data contained on the Daily Quality Control reports is the sole basis for schedule updating shall result in the disapproval of the Contractor's schedule and the inability of the Contracting Officer to evaluate Contractor progress for payment purposes. Updating of the percent complete and the remaining duration of any activity shall be independent functions. Program features which calculate one of these parameters from the other shall be disabled.

3.3.6 Out-of-Sequence Progress

Activities that have posted progress without all preceding logic being satisfied (Out-of-Sequence Progress) will be allowed only on a case-by-case approval of the Contracting Officer. The Contractor shall propose logic corrections to eliminate all out of sequence progress or justify not changing the sequencing for approval prior to submitting an updated project schedule.

3.3.7 Negative Lags

Lag durations contained in the project schedule shall not have a negative value.

3.4 PROJECT SCHEDULE SUBMISSIONS

The Contractor shall provide the submissions as described below. The data disk, reports, and network diagrams required for each submission are contained in paragraph SUBMISSION REQUIREMENTS.

3.4.1 Preliminary Project Schedule Submission

The Preliminary Project Schedule, defining the Contractor's planned operations for the first 60 calendar days shall be submitted for approval within 20 calendar days after the NTP is acknowledged. The approved preliminary schedule shall be used for payment purposes not to exceed 60 calendar days after NTP.

3.4.2 Initial Project Schedule Submission

The Initial Project Schedule shall be submitted for approval within 40 calendar days after NTP. The schedule shall provide a reasonable sequence of activities which represent work through the entire project and shall be at a reasonable level of detail.

3.4.3 Periodic Schedule Updates

Based on the result of progress meetings, specified in "Periodic Progress Meetings," the Contractor shall submit periodic schedule updates. These submissions shall enable the Contracting Officer to assess Contractor's progress. If the Contractor fails or refuses to furnish the information and project schedule data, which in the judgement of the Contracting Officer or authorized representative is necessary for verifying the Contractor's progress, the Contractor shall be deemed not to have provided an estimate upon which progress payment may be made.

3.4.4 Standard Activity Coding Dictionary

The Contractor shall use the activity coding structure defined in the Standard Data Exchange Format (SDEF) in ER 1-1-11, Appendix A. This exact structure is mandatory, even if some fields are not used.

3.5 SUBMISSION REQUIREMENTS

The following items shall be submitted by the Contractor for the preliminary submission, initial submission, and every periodic project schedule update throughout the life of the project:

3.5.1 Data Disks

Two data disks containing the project schedule shall be provided. Data on the disks shall adhere to the SDEF format specified in ER 1-1-11, Appendix A.

3.5.1.1 File Medium

Required data shall be submitted on 3.5 disks, formatted to hold 1.44 MB of data, under the MS-DOS Version 5. or 6.x, unless otherwise approved by the Contracting Officer.

3.5.1.2 Disk Label

A permanent exterior label shall be affixed to each disk submitted. The

label shall indicate the type of schedule (Preliminary, Initial, Update, or Change), full contract number, project name, project location, data date, name and telephone number or person responsible for the schedule, and the MS-DOS version used to format the disk.

3.5.1.3 File Name

Each file submitted shall have a name related to either the schedule data date, project name, or contract number. The Contractor shall develop a naming convention that will ensure that the names of the files submitted are unique. The Contractor shall submit the file naming convention to the Contracting Officer for approval.

3.5.2 Narrative Report

A Narrative Report shall be provided with the preliminary, initial, and each update of the project schedule. This report shall be provided as the basis of the Contractor's progress payment request. The Narrative Report shall include: a description of activities along the 2 most critical paths, a description of current and anticipated problem areas or delaying factors and their impact, and an explanation of corrective actions taken or required to be taken. The narrative report is expected to relay to the Government, the Contractor's thorough analysis of the schedule output and its plans to compensate for any problems, either current or potential, which are revealed through that analysis.

3.5.3 Approved Changes Verification

Only project schedule changes that have been previously approved by the Contracting Officer shall be included in the schedule submission. The Narrative Report shall specifically reference, on an activity by activity basis, all changes made since the previous period and relate each change to documented, approved schedule changes.

3.5.4 Schedule Reports

The format for each activity for the schedule reports listed below shall contain: Activity Numbers, Activity Description, Original Duration, Remaining Duration, Early Start Date, Early Finish Date, Late Start Date, Late Finish Date, Total Float. Actual Start and Actual Finish Dates shall be printed for those activities in progress or completed.

3.5.4.1 Activity Report

A list of all activities sorted according to activity number.

3.5.4.2 Logic Report

A list of Preceding and Succeeding activities for every activity in ascending order by activity number. Preceeding and succeeding activities shall include all information listed above in paragraph Schedule Reports. A blank line shall be left between each activity grouping.

3.5.4.3 Total Float Report

A list of all incomplete activities sorted in ascending order of total float. Activities which have the same amount of total float shall be listed in ascending order of Early Start Dates. Completed activities shall not be shown on this report.

3.5.4.4 Earnings Report

A compilation of the Contractor's Total Earnings on the project from the NTP until the most recent Monthly Progress Meeting. This report shall reflect the Earnings of specific activities based on the agreements made in the field and approved between the Contractor and Contracting Officer at the most recent Monthly Progress Meeting. Provided that the Contractor has provided a complete schedule update, this report shall serve as the basis of determining Contractor Payment. Activities shall be grouped by bid item and sorted by activity numbers. This report shall: sum all activities in a bid item and provide a bid item percent; and complete and sum all bid items to provide a total project percent complete. The printed report shall contain, for each activity: the Activity Number, Activity Description, Original Budgeted Amount, Total Quantity, Quantity to Date, Percent Complete (based on cost), and Earnings to Date.

3.5.5 Network Diagram

The network diagram shall be required on the initial schedule submission and on monthly schedule update submissions. The network diagram shall depict and display the order and interdependence of activities and the sequence in which the work is to be accomplished. The Contracting Officer will use, but is not limited to, the following conditions to review compliance with this paragraph:

3.5.5.1 Continuous Flow

Diagrams shall show a continuous flow from left to right with no arrows from right to left. The activity number, description, duration, and estimated earned value shall be shown on the diagram.

3.5.5.2 Project Milestone Dates

Dates shall be shown on the diagram for start of project, any contract required interim completion dates, and contract completion dates.

3.5.5.3 Critical Path

The critical path shall be clearly shown.

3.5.5.4 Banding

Activities shall be grouped to assist in the understanding of the activity sequence. Typically, this flow will group activities by category of work, work area and/or responsibility.

3.5.5.5 S-Curves

Earnings curves showing projected early and late earnings and earnings to date.

3.6 PERIODIC PROGRESS MEETINGS

Progress meetings to discuss payment shall include a monthly onsite meeting or other regular intervals mutually agreed to at the preconstruction conference. During this meeting the Contractor shall describe, on an activity by activity basis, all proposed revisions and adjustments to the project schedule required to reflect the current status of the project.

The Contracting Officer will approve activity progress, proposed revisions, and adjustments as appropriate.

3.6.1 Meeting Attendance

The Contractor's Project Manager and Scheduler shall attend the regular progress meeting.

3.6.2 Update Submission Following Progress Meeting

A complete update of the project schedule containing all approved progress, revisions, and adjustments, based on the regular progress meeting, shall be submitted not later than 4 working days after the monthly progress meeting.

3.6.3 Progress Meeting Contents

Update information, including Actual Start Dates, Actual Finish Dates, Remaining Durations, and Cost-to-Date shall be subject to the approval of the Contracting Officer. As a minimum, the Contractor shall address the following items on an activity by activity basis during each progress meeting.

3.6.3.1 Start and Finish Dates

The Actual Start and Actual Finish dates for each activity currently in-progress or completed .

3.6.3.2 Time Completion

The estimated Remaining Duration for each activity in-progress. Time-based progress calculations shall be based on Remaining Duration for each activity.

3.6.3.3 Cost Completion

The earnings for each activity started. Payment will be based on earnings for each in-progress or completed activity. Payment for individual activities will not be made for work that contains quality defects. A portion of the overall project amount may be retained based on delays of activities.

3.6.3.4 Logic Changes

All logic changes pertaining to NTP on change orders, change orders to be incorporated into the schedule, contractor proposed changes in work sequence, corrections to schedule logic for out-of-sequence progress, lag durations, and other changes that have been made pursuant to contract provisions shall be specifically identified and discussed.

3.6.3.5 Other Changes

Other changes required due to delays in completion of any activity or group of activities include: 1) delays beyond the Contractor's control, such as strikes and unusual weather. 2) delays encountered due to submittals, Government Activities, deliveries or work stoppages which make re-planning the work necessary. 3) Changes required to correct a schedule which does not represent the actual or planned prosecution and progress of the work.

3.7 REQUESTS FOR TIME EXTENSIONS

In the event the Contractor requests an extension of the contract completion date, or any interim milestone date, the Contractor shall furnish the following for a determination as to whether or not the Contractor is entitled to an extension of time under the provisions of the contract: justification, project schedule data, and supporting evidence as the Contracting Officer may deem necessary. Submission of proof of delay, based on revised activity logic, duration, and costs (updated to the specific date that the delay occurred) is obligatory to any approvals.

3.7.1 Justification of Delay

The project schedule shall clearly display that the Contractor has used, in full, all the float time available for the work involved with this request. The Contracting Officer's determination as to the number of allowable days of contract extension shall be based upon the project schedule updates in effect for the time period in question, and other factual information. Actual delays that are found to be caused by the Contractor's own actions, which result in the extension of the schedule, will not be a cause for a time extension to the contract completion date.

3.7.2 Submission Requirements

The Contractor shall submit a justification for each request for a change in the contract completion date of under 2 weeks based upon the most recent schedule update at the time of the NTP or constructive direction issued for the change. Such a request shall be in accordance with the requirements of other appropriate Contract Clauses and shall include, as a minimum:

a. A list of affected activities, with their associated project schedule activity number.

b. A brief explanation of the causes of the change.

c. An analysis of the overall impact of the changes proposed.

d. A sub-network of the affected area.

Activities impacted in each justification for change shall be identified by a unique activity code contained in the required data file.

3.7.3 Additional Submission Requirements

For any requested time extension of over 2 weeks, the Contracting Officer may request an interim update with revised activities for a specific change request. The Contractor shall provide this disk within 4 days of the Contracting Officer's request.

3.8 DIRECTED CHANGES

If the NTP is issued for changes prior to settlement of price and/or time, the Contractor shall submit proposed schedule revisions to the Contracting Officer within 2 weeks of the NTP being issued. The proposed revisions to the schedule will be approved by the Contracting Officer prior to inclusion of those changes within the project schedule. If the Contractor fails to submit the proposed revisions, the Contracting Officer may furnish the Contractor with suggested revisions to the project schedule. The Contractor shall include these revisions in the project schedule until

revisions are submitted, and final changes and impacts have been negotiated. If the Contractor has any objections to the revisions furnished by the Contracting Officer, the Contractor shall advise the Contracting Officer within 2 weeks of receipt of the revisions. Regardless of the objections, the Contractor shall continue to update the schedule with the Contracting Officer's revisions until a mutual agreement in the revisions is reached. If the Contractor fails to submit alternative revisions within 2 weeks of receipt of the Contracting Officer's proposed revisions, the Contractor will be deemed to have concurred with the Contracting Officer's proposed revisions. The proposed revisions will then be the basis for an equitable adjustment for performance of the work.

3.9 OWNERSHIP OF FLOAT

Float available in the schedule, at any time, shall not be considered for the exclusive use of either the Government or the Contractor.

-- End of Section --

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DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01330

SUBMITTAL PROCEDURES

09/00

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-- End of Section Table of Contents --

SECTION 01330

SUBMITTAL PROCEDURES
09/00

PART 1 GENERAL

1.1 SUBMITTAL IDENTIFICATION

Submittals required are identified by SD numbers and titles as follows:

SD-01 Preconstruction Submittals

SD-02 Shop Drawings

SD-03 Product Data

SD-04 Samples

SD-05 Design Data

SD-06 Test Reports

SD-07 Certificates

SD-08 Manufacturer's Instructions

SD-09 Manufacturer's Field Reports

SD-10 Operation and Maintenance Data

SD-11 Closeout Submittals

1.2 SUBMITTAL CLASSIFICATION

Submittals are classified as follows:

1.2.1 Government Approved

Government approval is required for extensions of design, critical materials, deviations, equipment whose compatibility with the entire system must be checked, and other items as designated by the Contracting Officer. Within the terms of the Contract Clause entitled "Specifications and Drawings for Construction," they are considered to be "shop drawings."

1.2.2 Information Only

All submittals not requiring Government approval will be for information only. They are not considered to be "shop drawings" within the terms of the Contract Clause referred to above.

1.3 APPROVED SUBMITTALS

The Contracting Officer's approval of submittals shall not be construed as a complete check, but will indicate only that the general method of construction, materials, detailing and other information are satisfactory. Approval will not relieve the Contractor of the responsibility for any error which may exist, as the Contractor under the Contractor Quality Control (CQC) requirements of this contract is responsible for dimensions,

the design of adequate connections and details, and the satisfactory construction of all work. After submittals have been approved by the Contracting Officer, no resubmittal for the purpose of substituting materials or equipment will be considered unless accompanied by an explanation of why a substitution is necessary.

1.4 DISAPPROVED SUBMITTALS

The Contractor shall make all corrections required by the Contracting Officer and promptly furnish a corrected submittal in the form and number of copies specified for the initial submittal. If the Contractor considers any correction indicated on the submittals to constitute a change to the contract, a notice in accordance with the Contract Clause "Changes" shall be given promptly to the Contracting Officer.

1.5 WITHHOLDING OF PAYMENT

Payment for materials incorporated in the work will not be made if required approvals have not been obtained.

PART 2 PRODUCTS (Not used)

PART 3 EXECUTION

3.1 GENERAL

The Contractor shall make submittals as required by the specifications. The Contracting Officer may request submittals in addition to those specified when deemed necessary to adequately describe the work covered in the respective sections. Units of weights and measures used on all submittals shall be the same as those used in the contract drawings. Each submittal shall be complete and in sufficient detail to allow ready determination of compliance with contract requirements. Prior to submittal, all items shall be checked and approved by the Contractor's Quality Control (CQC) System Manager and each item shall be stamped, signed, and dated by the CQC System Manager indicating action taken. Proposed deviations from the contract requirements shall be clearly identified. Submittals shall include items such as: Contractor's, manufacturer's, or fabricator's drawings; descriptive literature including (but not limited to) catalog cuts, diagrams, operating charts or curves; test reports; test cylinders; samples; O&M manuals (including parts list); certifications; warranties; and other such required submittals. Submittals requiring Government approval shall be scheduled and made prior to the acquisition of the material or equipment covered thereby. Samples remaining upon completion of the work shall be picked up and disposed of in accordance with manufacturer's Material Safety Data Sheets (MSDS) and in compliance with existing laws and regulations.

3.2 SUBMITTAL REGISTER

At the end of this section is a submittal register showing items of equipment and materials for which submittals are required by the specifications; this list may not be all inclusive and additional submittals may be required. Contractor will also be given the submittal register files, containing the computerized ENG Form and instructions on the use of the files. These submittal register files will be furnished on a separate diskette. Columns "c" through "f" have been completed by the Government; the Contractor shall complete columns "a", "b" and "g" through "r" and submit the forms (hard copy plus associated electronic file) to the

Contracting Officer for approval within 30 calendar days after Notice to Proceed. The Contractor shall keep this diskette up-to-date and shall submit it to the Government together with the monthly payment request. The approved submittal register will become the scheduling document and will be used to control submittals throughout the life of the contract. The submittal register and the progress schedules shall be coordinated.

3.3 SCHEDULING

Submittals covering component items forming a system or items that are interrelated shall be scheduled to be coordinated and submitted concurrently. Certifications to be submitted with the pertinent drawings shall be so scheduled. Adequate time (a minimum of 21 calendar days exclusive of mailing time) shall be allowed and shown on the register for review and approval. No delay damages or time extensions will be allowed for time lost in late submittals.

3.4 TRANSMITTAL FORM (ENG FORM 4025)

The sample transmittal form (ENG Form 4025) attached to this section shall be used for submitting both Government approved and information only submittals in accordance with the instructions on the reverse side of the form. These forms are included in the RMS-QC software that the Contractor is required to use for this contract. This form shall be properly completed by filling out all the heading blank spaces and identifying each item submitted. Special care shall be exercised to ensure proper listing of the specification paragraph and/or sheet number of the contract drawings pertinent to the data submitted for each item.

3.5 SUBMITTAL PROCEDURE

Submittals shall be made as follows:

3.5.1 Deviations

For submittals which include proposed deviations requested by the Contractor, the column "variation" of ENG Form 4025 shall be checked. The Contractor shall set forth in writing the reason for any deviations and annotate such deviations on the submittal. The Government reserves the right to rescind inadvertent approval of submittals containing unnoted deviations.

3.6 CONTROL OF SUBMITTALS

The Contractor shall carefully control his procurement operations to ensure that each individual submittal is made on or before the Contractor scheduled submittal date shown on the approved "Submittal Register."

3.7 GOVERNMENT APPROVED SUBMITTALS

Upon completion of review of submittals requiring Government approval, the submittals will be identified as having received approval by being so stamped and dated. Two copies of the submittal will be retained by the Contracting Officer and three copies of the submittal will be returned to the Contractor.

3.8 INFORMATION ONLY SUBMITTALS

Normally submittals for information only will not be returned. Approval of

the Contracting Officer is not required on information only submittals. The Government reserves the right to require the Contractor to resubmit any item found not to comply with the contract. This does not relieve the Contractor from the obligation to furnish material conforming to the plans and specifications; will not prevent the Contracting Officer from requiring removal and replacement of nonconforming material incorporated in the work; and does not relieve the Contractor of the requirement to furnish samples for testing by the Government laboratory or for check testing by the Government in those instances where the technical specifications so prescribe.

3.9 STAMPS

Stamps used by the Contractor on the submittal data to certify that the submittal meets contract requirements shall be similar to the following:

CONTRACTOR

(Firm Name)

_____ Approved

_____ Approved with corrections as noted on submittal data and/or attached sheets(s).

SIGNATURE: _____

TITLE: _____

DATE: _____

-- End of Section --

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION
INSTALL SECURITY FENCE, BLDG. 1-1434

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		01355A	SD-01 Preconstruction Submittals															
			Environmental Protection Plan	1.7	G													
		01780A	SD-02 Shop Drawings															
			As-Built Drawings	1.2.1	G													
			SD-03 Product Data															
			As-Built Record of Equipment and	1.2.2														
			Materials															
			Warranty Management Plan	1.3.1														
			Warranty Tags	1.3.5														
			Final Cleaning	1.6														
		02220	SD-07 Certificates															
			Demolition plan	1.10	G													
			Notifications	1.4.1	G													
			Notification of Demolition and	1.4.1	G													
			Renovation forms															
			SD-11 Closeout Submittals															
			Receipts	1.4.2														
		02300A	SD-07 Certificates															
			Earthwork	3.7.2														
			SD-06 Test Reports															
			Testing	3.13	G													
			Testing	3.13														
		02370	SD-02 Shop Drawings															
			Layout	3.2.2														
			Obstructions Below Ground	3.2.4														
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(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		02370	SD-03 Product Data															
			Geotextile Fabrics	2.1	G													
			SD-04 Samples															
			Materials		G													
		02630A	SD-03 Product Data															
			Placing Pipe	3.3	G													
		02722A	SD-03 Product Data															
			Plant, Equipment, and Tools	1.6														
			Waybills and Delivery Tickets															
			SD-06 Test Reports															
			Sampling and testing	1.4														
			Field Density Tests	1.4.2.4														
			Item Covered by Submittal	2.4	G													
		02741A	SD-03 Product Data															
			Mix Design	2.3	G													
			Contractor Quality Control	3.10	G													
			Material Acceptance and Percent	3.11	G													
			Payment															
			SD-04 Samples															
			Asphalt Cement Binder	2.2														
			Aggregates	2.1														
			SD-06 Test Reports															
			Aggregates	2.1	G													
			QC Monitoring	3.10.3.10														
			SD-07 Certificates															
			Asphalt Cement Binder	2.2	G													

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(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		02741A	Testing Laboratory	3.6														
		02763A	SD-03 Product Data															
			Equipment	1.4	G RE													
			Composition Requirements	2.2.1														
			Qualifications															
			SD-06 Test Reports															
			Sampling and Testing	2.4														
			SD-07 Certificates															
			Volatile Organic Compound	2.2.3														
			(VOC)															
		02770A	SD-03 Product Data															
			Concrete	2.1														
			SD-06 Test Reports															
			Field Quality Control	3.8														
		02821A	SD-07 Certificates															
			Chain Link Fence	2.1.1														
		02841	SD-03 Product Data															
			Spare parts	1.5.1														
			SD-06 Test Reports															
			Vehicle barrier system	1.5.3														
			SD-07 Certificates															
			List of equipment	1.5.2														
			List of product installation	1.5.2														
			SD-10 Operation and Maintenance															
			Data															
			Vehicle barrier	1.5.4	G													

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(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		03300	SD-08 Manufacturer’s Instructions															
			Liquid Membrane-Forming	2.3.2														
			Compounds															
			SD-06 Test Reports															
			Compressive strength tests	3.12.2.3														
			SD-07 Certificates															
			Concrete	2.1														
		09900	SD-02 Shop Drawings															
			Piping identification	3.12														
			stencil	3.12														
			SD-03 Product Data															
			Coating	2.1	G	RE												
			Manufacturer's Technical Data	2.1														
			Sheets															
			Sealant															
			SD-04 Samples															
			Color	1.9	G	RE												
			SD-07 Certificates															
			Applicator's qualifications	1.3														
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SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION
INSTALL SECURITY FENCE, BLDG. 1-1434

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
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			Data															
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SECTION 01355A

ENVIRONMENTAL PROTECTION
02/02

PART 1 GENERAL

1.1 REFERENCES

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

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

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

U.S. ARMY CORPS OF ENGINEERS (USACE)

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

1.2 DEFINITIONS

1.2.1 Environmental Pollution and Damage

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

1.2.2 Environmental Protection

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

1.2.3 Contractor Generated Hazardous Waste

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

1.2.4 Project Pesticide Coordinator

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

1.2.5 Land Application for Discharge Water

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

1.2.6 Pesticide

Pesticide is defined as any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest, or intended for use as a plant regulator, defoliant or desiccant.

1.2.7 Pests

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

1.2.8 Surface Discharge

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

1.2.9 Waters of the United States

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

1.2.10 Wetlands

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

1.3 GENERAL REQUIREMENTS

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

1.4 SUBCONTRACTORS

The Contractor shall ensure compliance with this section by subcontractors.

1.5 PAYMENT

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

1.6 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Environmental Protection Plan; G

The environmental protection plan.

1.7 ENVIRONMENTAL PROTECTION PLAN

Prior to commencing construction activities or delivery of materials to the site, the Contractor shall submit an Environmental Protection Plan for review and approval by the Contracting Officer. The purpose of the

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

1.7.1 Compliance

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

1.7.2 Contents

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

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

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

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

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

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

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

g. Traffic control plans including measures to reduce erosion of temporary roadbeds by construction traffic, especially during wet

weather. Plan shall include measures to minimize the amount of mud transported onto paved public roads by vehicles or runoff.

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

i. Drawing showing the location of borrow areas.

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

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

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

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

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

5. The names and locations of suppliers of containment materials and locations of additional fuel oil recovery, cleanup, restoration, and material-placement equipment available in case of an unforeseen spill emergency.

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

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

October). The report shall indicate the total amount of waste generated and total amount of waste diverted in cubic yards or tons along with the percent that was diverted.

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

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

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

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

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

q. A pesticide treatment plan shall be included and updated, as information becomes available. The plan shall include: sequence of treatment, dates, times, locations, pesticide trade name, EPA registration numbers, authorized uses, chemical composition, formulation, original and applied concentration, application rates of active ingredient (i.e. pounds of active ingredient applied), equipment

used for application and calibration of equipment. The Contractor is responsible for Federal, State, Regional and Local pest management record keeping and reporting requirements as well as any additional Project Office specific requirements.

1.7.3 Appendix

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

1.8 PROTECTION FEATURES

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

1.9 ENVIRONMENTAL ASSESSMENT OF CONTRACT DEVIATIONS

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

1.10 NOTIFICATION

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

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 ENVIRONMENTAL PERMITS AND COMMITMENTS

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

3.2 LAND RESOURCES

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

3.2.1 Work Area Limits

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

3.2.2 Landscape

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

3.2.3 Erosion and Sediment Controls

The Contractor shall be responsible for providing erosion and sediment control measures in accordance with Federal, State, and local laws and regulations. The erosion and sediment controls selected and maintained by the Contractor shall be such that water quality standards are not violated as a result of the Contractor's construction activities. The area of bare soil exposed at any one time by construction operations should be kept to a minimum. The Contractor shall construct or install temporary and permanent erosion and sediment control best management practices (BMPs) as indicated on the drawings. BMPs may include, but not be limited to, vegetation cover, stream bank stabilization, slope stabilization, silt fences, construction of terraces, interceptor channels, sediment traps, inlet and outfall protection, diversion channels, and sedimentation basins. Any

temporary measures shall be removed after the area has been stabilized.

3.2.4 Contractor Facilities and Work Areas

The Contractor's field offices, staging areas, stockpile storage, and temporary buildings shall be placed in areas designated on the drawings or as directed by the Contracting Officer. Temporary movement or relocation of Contractor facilities shall be made only when approved. Erosion and sediment controls shall be provided for on-site borrow and spoil areas to prevent sediment from entering nearby waters. Temporary excavation and embankments for plant and/or work areas shall be controlled to protect adjacent areas.

3.3 WATER RESOURCES

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

3.3.1 Cofferdams, Diversions, and Dewatering Operations

Construction operations for dewatering, removal of cofferdams, tailrace excavation, and tunnel closure shall be controlled at all times to maintain compliance with existing State water quality standards and designated uses of the surface water body. The Contractor shall comply with the State water quality standards and anti-degradation provisions and the Clean Water Act Section 404.

3.3.2 Stream Crossings

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

3.3.3 Wetlands

The Contractor shall not enter, disturb, destroy, or allow discharge of contaminants into any wetlands, except as authorized herein. The Contractor shall be responsible for the protection of wetlands shown on the drawings in accordance with paragraph ENVIRONMENTAL PERMITS, REVIEWS, AND APPROVALS. Authorization to enter specific wetlands identified shall not relieve the Contractor from any obligation to protect other wetlands within, adjacent to, or in the vicinity of the construction site and associated boundaries.

3.4 AIR RESOURCES

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

3.4.1 Particulates

Dust particles; aerosols and gaseous by-products from construction

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

3.4.2 Odors

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

3.4.3 Sound Intrusions

The Contractor shall keep construction activities under surveillance and control to minimize environment damage by noise. The Contractor shall comply with the provisions of the State rules.

3.4.4 Burning

Burning shall be prohibited on the Government premises.

3.5 CHEMICAL MATERIALS MANAGEMENT AND WASTE DISPOSAL

Disposal of wastes shall be as directed below, unless otherwise specified in other sections and/or shown on the drawings.

3.5.1 Solid Wastes

Solid wastes (excluding clearing debris) shall be placed in containers which are emptied on a regular schedule. Handling, storage, and disposal shall be conducted to prevent contamination. Segregation measures shall be employed so that no hazardous or toxic waste will become co-mingled with solid waste. Waste materials shall be hauled to the Government landfill site shown on the drawings. The Contractor shall comply with site procedures, Federal, State, and local laws and regulations pertaining to the use of landfill areas.

3.5.2 Chemicals and Chemical Wastes

Chemicals shall be dispensed ensuring no spillage to the ground or water. Periodic inspections of dispensing areas to identify leakage and initiate corrective action shall be performed and documented. This documentation will be periodically reviewed by the Government. Chemical waste shall be collected in corrosion resistant, compatible containers. Collection drums shall be monitored and removed to a staging or storage area when contents are within 6 inches of the top. Wastes shall be classified, managed, stored, and disposed of in accordance with Federal, State, and local laws

and regulations.

3.5.3 Contractor Generated Hazardous Wastes/Excess Hazardous Materials

Hazardous wastes are defined in 40 CFR 261, or are as defined by applicable State and local regulations. Hazardous materials are defined in 49 CFR 171 - 178. The Contractor shall, at a minimum, manage and store hazardous waste in compliance with 40 CFR 262 and shall manage and store hazardous waste in accordance with the Installation hazardous waste management plan. The Contractor shall take sufficient measures to prevent spillage of hazardous and toxic materials during dispensing. The Contractor shall segregate hazardous waste from other materials and wastes, shall protect it from the weather by placing it in a safe covered location, and shall take precautionary measures such as berming or other appropriate measures against accidental spillage. The Contractor shall be responsible for storage, describing, packaging, labeling, marking, and placarding of hazardous waste and hazardous material in accordance with 49 CFR 171 - 178, State, and local laws and regulations. The Contractor shall transport Contractor generated hazardous waste off Government property within 60 days in accordance with the Environmental Protection Agency and the Department of Transportation laws and regulations. The Contractor shall dispose of hazardous waste in compliance with Federal, State and local laws and regulations. Spills of hazardous or toxic materials shall be immediately reported to the Contracting Officer. Cleanup and cleanup costs due to spills shall be the Contractor's responsibility. The disposition of Contractor generated hazardous waste and excess hazardous materials are the Contractor's responsibility.

3.5.4 Fuel and Lubricants

Storage, fueling and lubrication of equipment and motor vehicles shall be conducted in a manner that affords the maximum protection against spill and evaporation. Fuel, lubricants and oil shall be managed and stored in accordance with all Federal, State, Regional, and local laws and regulations. Used lubricants and used oil to be discarded shall be stored in marked corrosion-resistant containers and recycled or disposed in accordance with 40 CFR 279, State, and local laws and regulations. Storage of fuel on the project site shall be accordance with all Federal, State, and local laws and regulations.

3.5.5 Waste Water

Disposal of waste water shall be as specified below.

a. Waste water from construction activities, such as onsite material processing, concrete curing, foundation and concrete clean-up, water used in concrete trucks, forms, etc. shall not be allowed to enter water ways or to be discharged prior to being treated to remove pollutants. The Contractor shall dispose of the construction related waste water off-Government property in accordance with all Federal, State, Regional and Local laws and regulations.

b. For discharge of ground water, the Contractor shall obtain a State or Federal permit specific for pumping and discharging ground water prior to surface discharging.

c. Water generated from the flushing of lines after disinfection or disinfection in conjunction with hydrostatic testing and/or

hydrostatic testing shall be discharged into the sanitary sewer with prior approval and/or notification to the Waste Water Treatment Plant's Operator.

3.6 RECYCLING AND WASTE MINIMIZATION

The Contractor shall participate in State and local government sponsored recycling programs.

3.7 NON-HAZARDOUS SOLID WASTE DIVERSION REPORT

The Contractor shall maintain an inventory of non-hazardous solid waste diversion and disposal of construction and demolition debris. The Contractor shall submit a report to the Contracting Officer on the first working day after each fiscal year quarter, starting the first quarter that non-hazardous solid waste has been generated. The following shall be included in the report:

a. Construction and Demolition (C&D) Debris Disposed in cubic yards or tons, as appropriate.

b. Construction and Demolition (C&D) Debris Recycled in cubic yards or tons, as appropriate.

c. Total C&D Debris Generated in cubic yards or tons, as appropriate.

d. Waste Sent to Waste-To-Energy Incineration Plant (This amount should not be included in the recycled amount) in cubic yards or tons, as appropriate.

3.8 HISTORICAL, ARCHAEOLOGICAL, AND CULTURAL RESOURCES

If during excavation or other construction activities any previously unidentified or unanticipated historical, archaeological, and cultural resources are discovered or found, all activities that may damage or alter such resources shall be temporarily suspended. Resources covered by this paragraph include but are not limited to: any human skeletal remains or burials; artifacts; shell, midden, bone, charcoal, or other deposits; rock or coral alignments, pavings, wall, or other constructed features; and any indication of agricultural or other human activities. Upon such discovery or find, the Contractor shall immediately notify the Contracting Officer so that the appropriate authorities may be notified and a determination made as to their significance and what, if any, special disposition of the finds should be made. The Contractor shall cease all activities that may result in impact to or the destruction of these resources. The Contractor shall secure the area and prevent employees or other persons from trespassing on, removing, or otherwise disturbing such resources.

3.9 BIOLOGICAL RESOURCES

The Contractor shall minimize interference with, disturbance to, and damage to fish, wildlife, and plants including their habitat. The Contractor shall be responsible for the protection of threatened and endangered animal and plant species including their habitat in accordance with Federal, State, Regional, and local laws and regulations.

3.10 INTEGRATED PEST MANAGEMENT

In order to minimize impacts to existing fauna and flora, the Contractor,

through the Contracting Officer, shall coordinate with the Project Pesticide Coordinator (PPC) at the earliest possible time prior to pesticide application. The Contractor shall discuss integrated pest management strategies with the PPC and receive concurrence from the PPC through the COR prior to the application of any pesticide associated with these specifications. Project Office Pest Management personnel shall be given the opportunity to be present at all meetings concerning treatment measures for pest or disease control and during application of the pesticide. The use and management of pesticides are regulated under 40 CFR 152 - 186.

3.10.1 Pesticide Delivery and Storage

Pesticides shall be delivered to the site in the original, unopened containers bearing legible labels indicating the EPA registration number and the manufacturer's registered uses. Pesticides shall be stored according to manufacturer's instructions and under lock and key when unattended.

3.10.2 Qualifications

For the application of pesticides, the Contractor shall use the services of a subcontractor whose principal business is pest control. The subcontractor shall be licensed and certified in the state where the work is to be performed.

3.10.3 Pesticide Handling Requirements

The Contractor shall formulate, treat with, and dispose of pesticides and associated containers in accordance with label directions and shall use the clothing and personal protective equipment specified on the labeling for use during all phases of the application. Material Safety Data Sheets (MSDS)shall be available for all pesticide products.

3.10.4 Application

Pesticides shall be applied by a State Certified Pesticide Applicator in accordance with EPA label restrictions and recommendation. The Certified Applicator shall wear clothing and personal protective equipment as specified on the pesticide label. Water used for formulating shall only come from locations designated by the Contracting Officer. The Contractor shall not allow the equipment to overflow. Prior to application of pesticide, all equipment shall be inspected for leaks, clogging, wear, or damage and shall be repaired prior to being used.

3.11 PREVIOUSLY USED EQUIPMENT

The Contractor shall clean all previously used construction equipment prior to bringing it onto the project site. The Contractor shall ensure that the equipment is free from soil residuals, egg deposits from plant pests, noxious weeds, and plant seeds. The Contractor shall consult with the USDA jurisdictional office for additional cleaning requirements.

3.12 MAINTENANCE OF POLLUTION FACILITIES

The Contractor shall maintain permanent and temporary pollution control facilities and devices for the duration of the contract or for that length of time construction activities create the particular pollutant.

3.13 MILITARY MUNITIONS

In the event the Contractor discovers or uncovers military munitions as defined in 40 CFR 260, the Contractor shall immediately stop work in that area and immediately inform the Contracting Officer.

3.14 TRAINING OF CONTRACTOR PERSONNEL

The Contractor's personnel shall be trained in all phases of environmental protection and pollution control. The Contractor shall conduct environmental protection/pollution control meetings for all Contractor personnel prior to commencing construction activities. Additional meetings shall be conducted for new personnel and when site conditions change. The training and meeting agenda shall include: methods of detecting and avoiding pollution; familiarization with statutory and contractual pollution standards; installation and care of devices, vegetative covers, and instruments required for monitoring purposes to ensure adequate and continuous environmental protection/pollution control; anticipated hazardous or toxic chemicals or wastes, and other regulated contaminants; recognition and protection of archaeological sites, artifacts, wetlands, and endangered species and their habitat that are known to be in the area.

3.15 POST CONSTRUCTION CLEANUP

The Contractor shall clean up all areas used for construction in accordance with Contract Clause: "Cleaning Up". The Contractor shall, unless otherwise instructed in writing by the Contracting Officer, obliterate all signs of temporary construction facilities such as haul roads, work area, structures, foundations of temporary structures, stockpiles of excess or waste materials, and other vestiges of construction prior to final acceptance of the work. The disturbed area shall be graded, filled and the entire area seeded unless otherwise indicated.

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SECTION 01451A

CONTRACTOR QUALITY CONTROL
01/03

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM D 3740	(2001) Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
ASTM E 329	(2000b) Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction

1.2 PAYMENT

Separate payment will not be made for providing and maintaining an effective Quality Control program, and all costs associated therewith shall be included in the applicable unit prices or lump-sum prices contained in the Bidding Schedule.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

The Contractor is responsible for quality control and shall establish and maintain an effective quality control system in compliance with the Contract Clause titled "Inspection of Construction." The quality control system shall consist of plans, procedures, and organization necessary to produce an end product which complies with the contract requirements. The system shall cover all construction operations, both onsite and offsite, and shall be keyed to the proposed construction sequence. The site project superintendent will be held responsible for the quality of work on the job and is subject to removal by the Contracting Officer for non-compliance with the quality requirements specified in the contract. The site project superintendent in this context shall be the highest level manager responsible for the overall construction activities at the site, including quality and production. The site project superintendent shall maintain a physical presence at the site at all times, except as otherwise acceptable to the Contracting Officer, and shall be responsible for all construction and construction related activities at the site.

3.2 QUALITY CONTROL PLAN

The Contractor shall furnish for review by the Government, not later than

14 days after receipt of notice to proceed, the Contractor Quality Control (CQC) Plan proposed to implement the requirements of the Contract Clause titled "Inspection of Construction." The plan shall identify personnel, procedures, control, instructions, tests, records, and forms to be used. The Government will consider an interim plan for the first 60 days of operation. Construction will be permitted to begin only after acceptance of the CQC Plan or acceptance of an interim plan applicable to the particular feature of work to be started. Work outside of the features of work included in an accepted interim plan will not be permitted to begin until acceptance of a CQC Plan or another interim plan containing the additional features of work to be started.

3.2.1 Content of the CQC Plan

The CQC Plan shall include, as a minimum, the following to cover all construction operations, both onsite and offsite, including work by subcontractors, fabricators, suppliers, and purchasing agents:

a. A description of the quality control organization, including a chart showing lines of authority and acknowledgment that the CQC staff shall implement the three phase control system for all aspects of the work specified. The staff shall include a CQC System Manager who shall report to the project superintendent.

b. The name, qualifications (in resume format), duties, responsibilities, and authorities of each person assigned a CQC function.

c. A copy of the letter to the CQC System Manager signed by an authorized official of the firm which describes the responsibilities and delegates sufficient authorities to adequately perform the functions of the CQC System Manager, including authority to stop work which is not in compliance with the contract. The CQC System Manager shall issue letters of direction to all other various quality control representatives outlining duties, authorities, and responsibilities. Copies of these letters shall also be furnished to the Government.

d. Procedures for scheduling, reviewing, certifying, and managing submittals, including those of subcontractors, offsite fabricators, suppliers, and purchasing agents. These procedures shall be in accordance with Section 01330 SUBMITTAL PROCEDURES.

e. Control, verification, and acceptance testing procedures for each specific test to include the test name, specification paragraph requiring test, feature of work to be tested, test frequency, and person responsible for each test. (Laboratory facilities approved by the Contracting Officer shall be used.)

f. Procedures for tracking preparatory, initial, and follow-up control phases and control, verification, and acceptance tests including documentation.

g. Procedures for tracking construction deficiencies from identification through acceptable corrective action. These procedures shall establish verification that identified deficiencies have been corrected.

h. Reporting procedures, including proposed reporting formats.

i. A list of the definable features of work. A definable feature of work is a task which is separate and distinct from other tasks, has separate control requirements, and may be identified by different trades or disciplines, or it may be work by the same trade in a different environment. Although each section of the specifications may generally be considered as a definable feature of work, there are frequently more than one definable features under a particular section. This list will be agreed upon during the coordination meeting.

3.2.2 Acceptance of Plan

Acceptance of the Contractor's plan is required prior to the start of construction. Acceptance is conditional and will be predicated on satisfactory performance during the construction. The Government reserves the right to require the Contractor to make changes in his CQC Plan and operations including removal of personnel, as necessary, to obtain the quality specified.

3.2.3 Notification of Changes

After acceptance of the CQC Plan, the Contractor shall notify the Contracting Officer in writing of any proposed change. Proposed changes are subject to acceptance by the Contracting Officer.

3.3 COORDINATION MEETING

After the Preconstruction Conference, before start of construction, and prior to acceptance by the Government of the CQC Plan, the Contractor shall meet with the Contracting Officer or Authorized Representative and discuss the Contractor's quality control system. The CQC Plan shall be submitted for review a minimum of 7 calendar days prior to the Coordination Meeting. During the meeting, a mutual understanding of the system details shall be developed, including the forms for recording the CQC operations, control activities, testing, administration of the system for both onsite and offsite work, and the interrelationship of Contractor's Management and control with the Government's Quality Assurance. Minutes of the meeting shall be prepared by the Government and signed by both the Contractor and the Contracting Officer. The minutes shall become a part of the contract file. There may be occasions when subsequent conferences will be called by either party to reconfirm mutual understandings and/or address deficiencies in the CQC system or procedures which may require corrective action by the Contractor.

3.4 QUALITY CONTROL ORGANIZATION

3.4.1 Personnel Requirements

The requirements for the CQC organization are a CQC System Manager and sufficient number of additional qualified personnel to ensure safety and contract compliance. The Safety and Health Manager shall receive direction and authority from the CQC System Manager and shall serve as a member of the CQC staff. Personnel identified in the technical provisions as requiring specialized skills to assure the required work is being performed properly will also be included as part of the CQC organization. The Contractor's CQC staff shall maintain a presence at the site at all times during progress of the work and have complete authority and responsibility to take any action necessary to ensure contract compliance. The CQC staff

shall be subject to acceptance by the Contracting Officer. The Contractor shall provide adequate office space, filing systems and other resources as necessary to maintain an effective and fully functional CQC organization. Complete records of all letters, material submittals, shop drawing submittals, schedules and all other project documentation shall be promptly furnished to the CQC organization by the Contractor. The CQC organization shall be responsible to maintain these documents and records at the site at all times, except as otherwise acceptable to the Contracting Officer.

3.4.2 CQC System Manager

The Contractor shall identify as CQC System Manager an individual within the onsite work organization who shall be responsible for overall management of CQC and have the authority to act in all CQC matters for the Contractor. The CQC System Manager shall be a graduate engineer, graduate architect, or a graduate of construction management, ~~with~~or have a minimum of 10 years construction experience on construction similar to this contract. This CQC System Manager shall be on the site at all times during construction and shall be employed by the prime Contractor. The CQC System Manager shall be assigned as System Manager but may have duties as project superintendent in addition to quality control. An alternate for the CQC System Manager shall be identified in the plan to serve in the event of the System Manager's absence. The requirements for the alternate shall be the same as for the designated CQC System Manager.

3.5 SUBMITTALS AND DELIVERABLES

Submittals, if needed, shall be made as specified in Section 01330 SUBMITTAL PROCEDURES. The CQC organization shall be responsible for certifying that all submittals and deliverables are in compliance with the contract requirements.

3.6 CONTROL

Contractor Quality Control is the means by which the Contractor ensures that the construction, to include that of subcontractors and suppliers, complies with the requirements of the contract. At least three phases of control shall be conducted by the CQC System Manager for each definable feature of the construction work as follows:

3.6.1 Preparatory Phase

This phase shall be performed prior to beginning work on each definable feature of work, after all required plans/documents/materials are approved/accepted, and after copies are at the work site. This phase shall include:

a. A review of each paragraph of applicable specifications, reference codes, and standards. A copy of those sections of referenced codes and standards applicable to that portion of the work to be accomplished in the field shall be made available by the Contractor at the preparatory inspection. These copies shall be maintained in the field and available for use by Government personnel until final acceptance of the work.

b. A review of the contract drawings.

c. A check to assure that all materials and/or equipment have been tested, submitted, and approved.

d. Review of provisions that have been made to provide required control inspection and testing.

e. Examination of the work area to assure that all required preliminary work has been completed and is in compliance with the contract.

f. A physical examination of required materials, equipment, and sample work to assure that they are on hand, conform to approved shop drawings or submitted data, and are properly stored.

g. A review of the appropriate activity hazard analysis to assure safety requirements are met.

h. Discussion of procedures for controlling quality of the work including repetitive deficiencies. Document construction tolerances and workmanship standards for that feature of work.

i. A check to ensure that the portion of the plan for the work to be performed has been accepted by the Contracting Officer.

j. Discussion of the initial control phase.

k. The Government shall be notified at least 24 hours in advance of beginning the preparatory control phase. This phase shall include a meeting conducted by the CQC System Manager and attended by the superintendent, other CQC personnel (as applicable), and the foreman responsible for the definable feature. The results of the preparatory phase actions shall be documented by separate minutes prepared by the CQC System Manager and attached to the daily CQC report. The Contractor shall instruct applicable workers as to the acceptable level of workmanship required in order to meet contract specifications.

3.6.2 Initial Phase

This phase shall be accomplished at the beginning of a definable feature of work. The following shall be accomplished:

a. A check of work to ensure that it is in full compliance with contract requirements. Review minutes of the preparatory meeting.

b. Verify adequacy of controls to ensure full contract compliance. Verify required control inspection and testing.

c. Establish level of workmanship and verify that it meets minimum acceptable workmanship standards. Compare with required sample panels as appropriate.

d. Resolve all differences.

e. Check safety to include compliance with and upgrading of the safety plan and activity hazard analysis. Review the activity analysis with each worker.

f. The Government shall be notified at least 24 hours in advance of beginning the initial phase. Separate minutes of this phase shall be prepared by the CQC System Manager and attached to the daily

CQC report. Exact location of initial phase shall be indicated for future reference and comparison with follow-up phases.

g. The initial phase should be repeated for each new crew to work onsite, or any time acceptable specified quality standards are not being met.

3.6.3 Follow-up Phase

Daily checks shall be performed to assure control activities, including control testing, are providing continued compliance with contract requirements, until completion of the particular feature of work. The checks shall be made a matter of record in the CQC documentation. Final follow-up checks shall be conducted and all deficiencies corrected prior to the start of additional features of work which may be affected by the deficient work. The Contractor shall not build upon nor conceal non-conforming work.

3.6.4 Additional Preparatory and Initial Phases

Additional preparatory and initial phases shall be conducted on the same definable features of work if: the quality of on-going work is unacceptable; if there are changes in the applicable CQC staff, onsite production supervision or work crew; if work on a definable feature is resumed after a substantial period of inactivity; or if other problems develop.

3.7 TESTS

3.7.1 Testing Procedure

The Contractor shall perform specified or required tests to verify that control measures are adequate to provide a product which conforms to contract requirements. Upon request, the Contractor shall furnish to the Government duplicate samples of test specimens for possible testing by the Government. Testing includes operation and/or acceptance tests when specified. The Contractor shall procure the services of a Corps of Engineers approved testing laboratory or establish an approved testing laboratory at the project site. The Contractor shall perform the following activities and record and provide the following data:

a. Verify that testing procedures comply with contract requirements.

b. Verify that facilities and testing equipment are available and comply with testing standards.

c. Check test instrument calibration data against certified standards.

d. Verify that recording forms and test identification control number system, including all of the test documentation requirements, have been prepared.

e. Results of all tests taken, both passing and failing tests, shall be recorded on the CQC report for the date taken. Specification paragraph reference, location where tests were taken, and the sequential control number identifying the test shall be given. If approved by the Contracting Officer, actual test reports may be submitted later with a reference to the test number and date taken. An information copy of tests performed by an offsite or

commercial test facility shall be provided directly to the Contracting Officer. Failure to submit timely test reports as stated may result in nonpayment for related work performed and disapproval of the test facility for this contract.

3.7.2 Testing Laboratories

3.7.2.1 Capability Check

The Government reserves the right to check laboratory equipment in the proposed laboratory for compliance with the standards set forth in the contract specifications and to check the laboratory technician's testing procedures and techniques. Laboratories utilized for testing soils, concrete, asphalt, and steel shall meet criteria detailed in ASTM D 3740 and ASTM E 329.

3.7.2.2 Capability Recheck

If the selected laboratory fails the capability check, the Contractor will be assessed a charge of $100 to reimburse the Government for each succeeding recheck of the laboratory or the checking of a subsequently selected laboratory. Such costs will be deducted from the contract amount due the Contractor.

3.7.3 Onsite Laboratory

The Government reserves the right to utilize the Contractor's control testing laboratory and equipment to make assurance tests, and to check the Contractor's testing procedures, techniques, and test results at no additional cost to the Government.

3.7.4 Furnishing or Transportation of Samples for Testing

Costs incidental to the transportation of samples or materials shall be borne by the Contractor. Samples of materials for test verification and acceptance testing by the Government shall be delivered to the Corps of Engineers Division Laboratory. Coordination for each specific test, exact delivery location, and dates will be made through the Area Office.

3.8 COMPLETION INSPECTION

3.8.1 Punch-Out Inspection

Near the end of the work, or any increment of the work established by a time stated in the SPECIAL CONTRACT REQUIREMENTS Clause, "Commencement, Prosecution, and Completion of Work", or by the specifications, the CQC Manager shall conduct an inspection of the work. A punch list of items which do not conform to the approved drawings and specifications shall be prepared and included in the CQC documentation, as required by paragraph DOCUMENTATION. The list of deficiencies shall include the estimated date by which the deficiencies will be corrected. The CQC System Manager or staff shall make a second inspection to ascertain that all deficiencies have been corrected. Once this is accomplished, the Contractor shall notify the Government that the facility is ready for the Government Pre-Final inspection.

3.8.2 Pre-Final Inspection

The Government will perform the pre-final inspection to verify that the

facility is complete and ready to be occupied. A Government Pre-Final Punch List may be developed as a result of this inspection. The Contractor's CQC System Manager shall ensure that all items on this list have been corrected before notifying the Government, so that a Final inspection with the customer can be scheduled. Any items noted on the Pre-Final inspection shall be corrected in a timely manner. These inspections and any deficiency corrections required by this paragraph shall be accomplished within the time slated for completion of the entire work or any particular increment of the work if the project is divided into increments by separate completion dates.

3.8.3 Final Acceptance Inspection

The Contractor's Quality Control Inspection personnel, plus the superintendent or other primary management person, and the Contracting Officer's Representative shall be in attendance at the final acceptance inspection. Additional Government personnel including, but not limited to, those from Base/Post Civil Facility Engineer user groups, and major commands may also be in attendance. The final acceptance inspection will be formally scheduled by the Contracting Officer based upon results of the Pre-Final inspection. Notice shall be given to the Contracting Officer at least 14 days prior to the final acceptance inspection and shall include the Contractor's assurance that all specific items previously identified to the Contractor as being unacceptable, along with all remaining work performed under the contract, will be complete and acceptable by the date scheduled for the final acceptance inspection. Failure of the Contractor to have all contract work acceptably complete for this inspection will be cause for the Contracting Officer to bill the Contractor for the Government's additional inspection cost in accordance with the contract clause titled "Inspection of Construction".

3.9 DOCUMENTATION

The Contractor shall maintain current records providing factual evidence that required quality control activities and/or tests have been performed. These records shall include the work of subcontractors and suppliers and shall be on an acceptable form that includes, as a minimum, the following information:

a. Contractor/subcontractor and their area of responsibility.

b. Operating plant/equipment with hours worked, idle, or down for repair.

c. Work performed each day, giving location, description, and by whom. When Network Analysis (NAS) is used, identify each phase of work performed each day by NAS activity number.

d. Test and/or control activities performed with results and references to specifications/drawings requirements. The control phase shall be identified (Preparatory, Initial, Follow-up). List of deficiencies noted, along with corrective action.

e. Quantity of materials received at the site with statement as to acceptability, storage, and reference to specifications/drawings requirements.

f. Submittals and deliverables reviewed, with contract reference, by whom, and action taken.

g. Offsite surveillance activities, including actions taken.

h. Job safety evaluations stating what was checked, results, and instructions or corrective actions.

i. Instructions given/received and conflicts in plans and/or specifications.

j. Contractor's verification statement.

These records shall indicate a description of trades working on the project; the number of personnel working; weather conditions encountered; and any delays encountered. These records shall cover both conforming and deficient features and shall include a statement that equipment and materials incorporated in the work and workmanship comply with the contract. The original and one copy of these records in report form shall be furnished to the Government daily within 24 hours after the date covered by the report, except that reports need not be submitted for days on which no work is performed. As a minimum, one report shall be prepared and submitted for every 7 days of no work and on the last day of a no work period. All calendar days shall be accounted for throughout the life of the contract. The first report following a day of no work shall be for that day only. Reports shall be signed and dated by the CQC System Manager. The report from the CQC System Manager shall include copies of test reports and copies of reports prepared by all subordinate quality control personnel.

3.10 SAMPLE FORMS

Sample forms enclosed at the end of this section.

3.11 NOTIFICATION OF NONCOMPLIANCE

The Contracting Officer will notify the Contractor of any detected noncompliance with the foregoing requirements. The Contractor shall take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the work site, shall be deemed sufficient for the purpose of notification. If the Contractor fails or refuses to comply promptly, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to such stop orders shall be made the subject of claim for extension of time or for excess costs or damages by the Contractor.

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SECTION 01500A

TEMPORARY CONSTRUCTION FACILITIES
02/97

1.1 GENERAL REQUIREMENTS

1.1.1 Site Plan

The Contractor shall prepare a site plan indicating the proposed location and dimensions of any area to be fenced and used by the Contractor, the number of trailers to be used, avenues of ingress/egress to the fenced area and details of the fence installation. This plan shall be submitted to the Government for approval. Any areas which may have to be graveled to prevent the tracking of mud shall also be identified. The Contractor shall also indicate if the use of a supplemental or other staging area is desired.

1.1.2 Identification of Employees

The Contractor shall be responsible for furnishing to each employee, and for requiring each employee engaged on the work to display, identification as approved and directed by the Contracting Officer. Prescribed identification shall immediately be delivered to the Contracting Officer for cancellation upon release of any employee. When required, the Contractor shall obtain and provide fingerprints of persons employed on the project. Contractor and subcontractor personnel shall wear identifying markings on hard hats clearly identifying the company employee's.

1.1.3 Employee Parking

Contractor employees shall park privately owned vehicles in an area designated by the Contracting Officer. This area will be within reasonable walking distance of the construction site. Contractor employee parking shall not interfere with existing and established parking requirements of the military installation.

1.2 AVAILABILITY AND USE OF UTILITY SERVICES

1.2.1 Payment for Utility Services

The Government will make all reasonably required utilities available to the Contractor from existing outlets and supplies, as specified in the contract. Unless otherwise provided in the contract, the amount of each utility service consumed shall be charged to or paid for by the Contractor at prevailing rates charged to the Government or, where the utility is produced by the Government, at reasonable rates determined by the Contracting Officer. The Contractor shall carefully conserve any utilities furnished without charge.

1.2.2 Meters and Temporary Connections

The Contractor, at its expense and in a manner satisfactory to the Contracting Officer, shall provide and maintain necessary temporary connections, distribution lines, and meter bases (Government will not provide meters) required to measure the amount of each utility used for the purpose of determining charges. The Contractor shall notify the Contracting Officer, and Basewide Electrical Distribution system Installer/Administrator "Sandhills Electric", in writing, 5 working days

before final electrical connection is desired so that a utilities contract can be established. The Government will provide a meter and make the final hot connection after inspection and approval of the Contractor's temporary wiring installation. The Contractor shall not make the final electrical connection.

1.2.3 Advance Deposit

An advance deposit for utilities consisting of an estimated month's usage or a minimum of $50.00 will be required. The last monthly bills for the fiscal year will normally be offset by the deposit and adjustments will be billed or returned as appropriate. Services to be rendered for the next fiscal year, beginning 1 October, will require a new deposit. Notification of the due date for this deposit will be mailed to the Contractor prior to the end of the current fiscal year.

1.2.4 Final Meter Reading

Before completion of the work and final acceptance of the work by the Government, the Contractor shall notify the Contracting Officer, in writing, 5 working days before termination is desired. The Government will take a final meter reading, disconnect service, and remove the meters. The Contractor shall then remove all the temporary distribution lines, meter bases, and associated paraphernalia. The Contractor shall pay all outstanding utility bills before final acceptance of the work by the Government.

1.2.5 Sanitation

The Contractor shall provide and maintain within the construction area minimum field-type sanitary facilities approved by the Contracting Officer. Government toilet facilities will not be available to Contractor's personnel.

1.2.6 Telephone

The Contractor shall make arrangements and pay all costs for telephone facilities desired.

1.3 BULLETIN BOARD, PROJECT SIGN, AND PROJECT SAFETY SIGN

1.3.1 Bulletin Board

Immediately upon beginning of work, the Contractor shall provide a weatherproof glass-covered bulletin board not less than 36 by 48 inches in size for displaying the Equal Employment Opportunity poster, a copy of the wage decision contained in the contract, Wage Rate Information poster, and other information approved by the Contracting Officer. The bulletin board shall be located at the project site in a conspicuous place easily accessible to all employees, as approved by the Contracting Officer. Legible copies of the aforementioned data shall be displayed until work is completed. Upon completion of work the bulletin board shall be removed by and remain the property of the Contractor.

1.3.2 Project and Safety Signs

The requirements for the signs, their content, and location shall be as shown on the drawings. The signs shall be erected within 15 days after receipt of the notice to proceed. The data required by the safety sign

shall be corrected daily, with light colored metallic or non-metallic numerals. Upon completion of the project, the signs shall be removed from the site.

1.4 PROTECTION AND MAINTENANCE OF TRAFFIC

During construction the Contractor shall provide access and temporary relocated roads as necessary to maintain traffic. The Contractor shall maintain and protect traffic on all affected roads during the construction period except as otherwise specifically directed by the Contracting Officer. Measures for the protection and diversion of traffic, including the provision of watchmen and flagmen, erection of barricades, placing of lights around and in front of equipment and the work, and the erection and maintenance of adequate warning, danger, and direction signs, shall be as required by the State and local authorities having jurisdiction. The traveling public shall be protected from damage to person and property. The Contractor's traffic on roads selected for hauling material to and from the site shall interfere as little as possible with public traffic. The Contractor shall investigate the adequacy of existing roads and the allowable load limit on these roads. The Contractor shall be responsible for the repair of any damage to roads caused by construction operations.

1.4.1 Haul Roads

The Contractor shall, at its own expense, construct access and haul roads necessary for proper prosecution of the work under this contract. Haul roads shall be constructed with suitable grades and widths; sharp curves, blind corners, and dangerous cross traffic shall be avoided. The Contractor shall provide necessary lighting, signs, barricades, and distinctive markings for the safe movement of traffic. The method of dust control, although optional, shall be adequate to ensure safe operation at all times. Location, grade, width, and alignment of construction and hauling roads shall be subject to approval by the Contracting Officer. Lighting shall be adequate to assure full and clear visibility for full width of haul road and work areas during any night work operations. Upon completion of the work, haul roads designated by the Contracting Officer shall be removed.Text

1.4.2 Barricades

The Contractor shall erect and maintain temporary barricades to limit public access to hazardous areas. Such barricades shall be required whenever safe public access to paved areas such as roads, parking areas or sidewalks is prevented by construction activities or as otherwise necessary to ensure the safety of both pedestrian and vehicular traffic. Barricades shall be securely placed, clearly visible with adequate illumination to provide sufficient visual warning of the hazard during both day and night.

1.5 CONTRACTOR'S TEMPORARY FACILITIES

1.5.1 Administrative Field Offices

The Contractor shall provide and maintain administrative field office facilities within the construction area at the designated site. Government office and warehouse facilities will not be available to the Contractor's personnel.

1.5.2 Storage Area

The Contractor shall construct a temporary 6 foot high chain link fence around trailers and materials. The fence shall include plastic strip inserts, colored green, so that visibility through the fence is obstructed. Fence posts may be driven, in lieu of concrete bases, where soil conditions permit. Trailers, materials, or equipment shall not be placed or stored outside the fenced area unless such trailers, materials, or equipment are assigned a separate and distinct storage area by the Contracting Officer away from the vicinity of the construction site but within the military boundaries. Trailers, equipment, or materials shall not be open to public view with the exception of those items which are in support of ongoing work on any given day. Materials shall not be stockpiled outside the fence in preparation for the next day's work. Mobile equipment, such as tractors, wheeled lifting equipment, cranes, trucks, and like equipment, shall be parked within the fenced area at the end of each work day.

1.5.3 Supplemental Storage Area

Upon Contractor's request, the Contracting Officer will designate another or supplemental area for the Contractor's use and storage of trailers, equipment, and materials. This area may not be in close proximity of the construction site but shall be within the military boundaries. Fencing of materials or equipment will not be required at this site; however, the Contractor shall be responsible for cleanliness and orderliness of the area used and for the security of any material or equipment stored in this area. Utilities will not be provided to this area by the Government.

1.5.4 Appearance of Trailers

Trailers utilized by the Contractor for administrative or material storage purposes shall present a clean and neat exterior appearance and shall be in a state of good repair. Trailers which, in the opinion of the Contracting Officer, require exterior painting or maintenance will not be allowed on the military property.

1.5.5 Maintenance of Storage Area

Fencing shall be kept in a state of good repair and proper alignment. Should the Contractor elect to traverse, with construction equipment or other vehicles, grassed or unpaved areas which are not established roadways, such areas shall be covered with a layer of gravel as necessary to prevent rutting and the tracking of mud onto paved or established roadways; gravel gradation shall be at the Contractor's discretion. Grass located within the boundaries of the construction site shall be mowed for the duration of the project. Grass and vegetation along fences, buildings, under trailers, and in areas not accessible to mowers shall be edged or trimmed neatly.

1.5.6 New Building

In the event a new building is constructed for the temporary project field office, it shall be a minimum 12 feet in width, 16 feet in length and have a minimum of 7 feet headroom. It shall be equipped with approved electrical wiring, at least one double convenience outlet and the required switches and fuses to provide 110-120 volt power. It shall be provided with a work table with stool, desk with chair, two additional chairs, and one legal size file cabinet that can be locked. The building shall be

waterproof, shall be supplied with heater, shall have a minimum of two doors, electric lights, a telephone, a battery operated smoke detector alarm, a sufficient number of adjustable windows for adequate light and ventilation, and a supply of approved drinking water. Approved sanitary facilities shall be furnished. The windows and doors shall be screened and the doors provided with dead bolt type locking devices or a padlock and heavy duty hasp bolted to the door. Door hinge pins shall be non-removable. The windows shall be arranged to open and to be securely fastened from the inside. Glass panels in windows shall be protected by bars or heavy mesh screens to prevent easy access to the building through these panels. In warm weather, air conditioning capable of maintaining the office at 50 percent relative humidity and a room temperature 20 degrees F below the outside temperature when the outside temperature is 95 degrees F, shall be furnished. Any new building erected for a temporary field office shall be maintained by the Contractor during the life of the contract and upon completion and acceptance of the work shall become the property of the Contractor and shall be removed from the site. All charges for telephone service for the temporary field office shall be borne by the Contractor, including long distance charges up to a maximum of $75.00 per month.

1.5.7 Security Provisions

Adequate outside security lighting shall be provided at the Contractor's temporary facilities. The Contractor shall be responsible for the security of its own equipment; in addition, the Contractor shall notify the appropriate law enforcement agency requesting periodic security checks of the temporary project field office.

1.6 PLANT COMMUNICATION

Whenever the Contractor has the individual elements of its plant so located that operation by normal voice between these elements is not satisfactory, the Contractor shall install a satisfactory means of communication, such as telephone or other suitable devices. The devices shall be made available for use by Government personnel.

1.7 TEMPORARY PROJECT SAFETY FENCING

As soon as practicable, but not later than 15 days after the date established for commencement of work, the Contractor shall furnish and erect temporary project safety fencing at the work site. The safety fencing shall be a high visibility orange colored, high density polyethylene grid or approved equal, a minimum of 42 inches high, supported and tightly secured to steel posts located on maximum 10 foot centers, constructed at the approved location. The safety fencing shall be maintained by the Contractor during the life of the contract and, upon completion and acceptance of the work, shall become the property of the Contractor and shall be removed from the work site.

1.8 CLEANUP

Construction debris, waste materials, packaging material and the like shall be removed from the work site daily. Any dirt or mud which is tracked onto paved or surfaced roadways shall be cleaned away. Materials resulting from demolition activities which are salvageable shall be stored within the fenced area described above or at the supplemental storage area. Stored material not in trailers, whether new or salvaged, shall be neatly stacked when stored.

1.9 RESTORATION OF STORAGE AREA

Upon completion of the project and after removal of trailers, materials, and equipment from within the fenced area, the fence shall be removed and will become the property of the Contractor. Areas used by the Contractor for the storage of equipment or material, or other use, shall be restored to the original or better condition. Gravel used to traverse grassed areas shall be removed and the area restored to its original condition, including top soil and seeding as necessary.

PART 2 PRODUCTS (NOT APPLICABLE)
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SECTION 01780A

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05/02

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SECTION 01780A

CLOSEOUT SUBMITTALS
05/02

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

As-Built Drawings; G

Drawings showing final as-built conditions of the project. ~~I~~The final CADD as-built drawings shall consist of one set of electronic CADD drawing files in the specified format, one set of mylar drawings, and one set of the approved working as-built drawings.

SD-03 Product Data

As-Built Record of Equipment and Materials

Two copies of the record listing the as-built materials and equipment incorporated into the construction of the project.

Warranty Management Plan

One set of the warranty management plan containing information relevant to the warranty of materials and equipment incorporated into the construction project, including the starting date of warranty of construction. The Contractor shall furnish with each warranty the name, address, and telephone number of each of the guarantor's representatives nearest to the project location.

Warranty Tags

Two record copies of the warranty tags showing the layout and design.

Final Cleaning

Two copies of the listing of completed final clean-up items.

1.2 PROJECT RECORD DOCUMENTS

1.2.1 As-Built Drawings

This paragraph covers as-built drawings complete, as a requirement of the contract. The terms "drawings," "contract drawings," "drawing files," "working as-built drawings" and "final as-built drawings" refer to contract drawings which are revised to be used for final as-built drawings.

1.2.1.1 Government Furnished Materials

One set of electronic CADD files in the specified software and format revised to reflect all bid amendments will be provided by the Government at the preconstruction conference for projects requiring CADD file as-built drawings.

1.2.1.2 Working As-Built and Final As-Built Drawings

The Contractor shall revise 2 sets of paper drawings by red-line process to show the as-built conditions during the prosecution of the project. These working as-built marked drawings shall be kept current on a weekly basis and at least one set shall be available on the jobsite at all times. Changes from the contract plans which are made in the work or additional information which might be uncovered in the course of construction shall be accurately and neatly recorded as they occur by means of details and notes. Final as-built drawings shall be prepared after the completion of each definable feature of work as listed in the Contractor Quality Control Plan (Foundations, Utilities, Structural Steel, etc., as appropriate for the project). The working as-built marked prints and final as-built drawings will be jointly reviewed for accuracy and completeness by the Contracting Officer and the Contractor prior to submission of each monthly pay estimate. If the Contractor fails to maintain the working and final as-built drawings as specified herein, the Contracting Officer will deduct from the monthly progress payment an amount representing the estimated cost of maintaining the as-built drawings. This monthly deduction will continue until an agreement can be reached between the Contracting Officer and the Contractor regarding the accuracy and completeness of updated drawings. The working and final as-built drawings shall show, but shall not be limited to, the following information:

a. The actual location, kinds and sizes of all sub-surface utility lines. In order that the location of these lines and appurtenances may be determined in the event the surface openings or indicators become covered over or obscured, the as-built drawings shall show, by offset dimensions to two permanently fixed surface features, the end of each run including each change in direction. Valves, splice boxes and similar appurtenances shall be located by dimensioning along the utility run from a reference point. The average depth below the surface of each run shall also be recorded.

b. The location and dimensions of any changes within the building structure.

c. Correct grade, elevations, cross section, or alignment of roads, earthwork, structures or utilities if any changes were made from contract plans.

d. Changes in details of design or additional information obtained from working drawings specified to be prepared and/or furnished by the Contractor; including but not limited to fabrication, erection, installation plans and placing details, pipe sizes, insulation material, dimensions of equipment foundations, etc.

e. The topography, invert elevations and grades of drainage installed or affected as part of the project construction.

f. Changes or modifications which result from the final inspection.

g. Where contract drawings or specifications present options, only the option selected for construction shall be shown on the final as-built prints.

h. If borrow material for this project is from sources on Government property, or if Government property is used as a spoil area, the Contractor shall furnish a contour map of the final borrow pit/spoil area elevations.

i. Systems designed or enhanced by the Contractor, such as HVAC controls, fire alarm, fire sprinkler, and irrigation systems.

j. Modifications (change order price shall include the Contractor's cost to change working and final as-built drawings to reflect modifications) and compliance with the following procedures.

(1) Directions in the modification for posting descriptive changes shall be followed.

(2) A Modification Circle shall be placed at the location of each deletion.

(3) For new details or sections which are added to a drawing, a Modification Circle shall be placed by the detail or section title.

(4) For minor changes, a Modification Circle shall be placed by the area changed on the drawing (each location).

(5) For major changes to a drawing, a Modification Circle shall be placed by the title of the affected plan, section, or detail at each location.

(6) For changes to schedules or drawings, a Modification Circle shall be placed either by the schedule heading or by the change in the schedule.

(7) The Modification Circle size shall be 1/2 inch diameter unless the area where the circle is to be placed is crowded. Smaller size circle shall be used for crowded areas.

1.2.1.3 Drawing Preparation

The as-built drawings shall be modified as may be necessary to correctly show the features of the project as it has been constructed by bringing the contract set into agreement with approved working as-built prints, and adding such additional drawings as may be necessary. These working as-built marked prints shall be neat, legible and accurate. These drawings are part of the permanent records of this project and shall be returned to the Contracting Officer after approval by the Government. Any drawings damaged or lost by the Contractor shall be satisfactorily replaced by the Contractor at no expense to the Government.

1.2.1.4 Computer Aided Design and Drafting (CADD) Drawings

Only personnel proficient in the preparation of CADD drawings shall be employed to modify the contract drawings or prepare additional new drawings. Additions and corrections to the contract drawings shall be equal in quality and detail to that of the originals. Line colors, line weights, lettering, layering conventions, and symbols shall be the same as the original line colors, line weights, lettering, layering conventions,

and symbols. If additional drawings are required, they shall be prepared using the specified electronic file format applying the same graphic standards specified for original drawings. The title block and drawing border to be used for any new final as-built drawings shall be identical to that used on the contract drawings. Additions and corrections to the contract drawings shall be accomplished using CADD files. The Contractor will be furnished "as-designed" drawings in AutoCad Release or Microstation format and shall return completed as built drawings in same format as government provided. The electronic files will be supplied on compact disc, read-only memory (CD-ROM). The Contractor shall be responsible for providing all program files and hardware necessary to prepare final as-built drawings. The Contracting Officer will review final as-built drawings for accuracy and the Contractor shall make required corrections, changes, additions, and deletions.

a. CADD colors shall be the "base" colors of red, green, and blue. Color code for changes shall be as follows:

(1) Deletions (red) - Deleted graphic items (lines) shall be colored red with red lettering in notes and leaders.

(2) Additions (Green) - Added items shall be drawn in green with green lettering in notes and leaders.

(3) Special (Blue) - Items requiring special information, coordination, or special detailing or detailing notes shall be in blue.

b. The Contract Drawing files shall be renamed in a manner related to the contract number (i.e., 98-C-10.DGN/DWG) as instructed in the Pre-Construction conference. Marked-up changes shall be made only to those renamed files. All changes shall be made on the layer/level as the original item. There shall be no deletions of existing lines; existing lines shall be over struck in red. Additions shall be in green with line weights the same as the drawing. Special notes shall be in blue on layer #63.

c. When final revisions have been completed, the cover sheet drawing shall show the wording "RECORD DRAWING AS-BUILT" followed by the name of the Contractor in letters at least 3/16 inch high. All other contract drawings shall be marked either "AS-Built" drawing denoting no revisions on the sheet or "Revised As-Built" denoting one or more revisions. Original contract drawings shall be dated in the revision block.

d. Within 10 days after Government approval of all of the working as-built drawings for a phase of work, the Contractor shall prepare the final CADD as-built drawings for that phase of work and submit two sets of blue-lined prints of these drawings for Government review and approval. The Government will promptly return one set of prints annotated with any necessary corrections. Within 7 days the Contractor shall revise the CADD files accordingly at no additional cost and submit one set of final prints for the completed phase of work to the Government. Within 10 days of substantial completion of all phases of work, the Contractor shall submit the final as-built drawing package for the entire project. The submittal shall consist of one set of electronic files on compact disc, read-only memory (CD-ROM), two sets of blue-line prints and one set of the approved working as-built drawings. They shall be complete in all details and identical in form and function to the contract drawing files supplied by the Government. Any transactions or adjustments necessary to accomplish

this is the responsibility of the Contractor. The Government reserves the right to reject any drawing files it deems incompatible with the customer's CADD system. Paper prints, drawing files and storage media submitted will become the property of the Government upon final approval. Failure to submit final as-built drawing files and marked prints as specified shall be cause for withholding any payment due the Contractor under this contract. Approval and acceptance of final as-built drawings shall be accomplished before final payment is made to the Contractor.

1.2.1.5 Manually Prepared Drawings

Manually prepared drawings shall not be accepted.

1.2.1.6 Payment

No separate payment will be made for as-built drawings required under this contract, and all costs accrued in connection with such drawings shall be considered a subsidiary obligation of the Contractor.

1.2.2 As-Built Record of Equipment and Materials

The Contractor shall furnish one copy of preliminary record of equipment and materials used on the project 15 days prior to final inspection. This preliminary submittal will be reviewed and returned 2 days after final inspection with Government comments. Two sets of final record of equipment and materials shall be submitted 10 days after final inspection. The designations shall be keyed to the related area depicted on the contract drawings. The record shall list the following data:

RECORD OF DESIGNATED EQUIPMENT AND MATERIALS DATA

Description	Specification Section	Manufacturer and Catalog, Model, and Serial Number	Composition and Size	Where Used

1.2.3 Final Approved Shop Drawings

The Contractor shall furnish final approved project shop drawings 30 days after transfer of the completed facility.

1.2.4 Construction Contract Specifications

The Contractor shall furnish final as-built construction contract specifications, including modifications thereto, 30 days after transfer of the completed facility.

1.2.5 Real Property Equipment

The Contractor shall furnish a list of installed equipment furnished under this contract. The list shall include all information usually listed on manufacturer's name plate. The "EQUIPMENT-IN-PLACE LIST" shall include, as applicable, the following for each piece of equipment installed: description of item, location (by room number), model number, serial number, capacity, name and address of manufacturer, name and address of equipment supplier, condition, spare parts list, manufacturer's catalog, and warranty. A draft list shall be furnished at time of transfer. The final list shall be furnished 30 days after transfer of the completed facility.

1.3 WARRANTY MANAGEMENT

1.3.1 Warranty Management Plan

The Contractor shall develop a warranty management plan which shall contain information relevant to the clause Warranty of Construction. At least 30 days before the planned pre-warranty conference, the Contractor shall submit the warranty management plan for Government approval. The warranty management plan shall include all required actions and documents to assure that the Government receives all warranties to which it is entitled. The plan shall be in narrative form and contain sufficient detail to render it suitable for use by future maintenance and repair personnel, whether tradesmen, or of engineering background, not necessarily familiar with this contract. The term "status" as indicated below shall include due date and whether item has been submitted or was accomplished. Warranty information made available during the construction phase shall be submitted to the Contracting Officer for approval prior to each monthly pay estimate. Approved information shall be assembled in a binder and shall be turned over to the Government upon acceptance of the work. The construction warranty period shall begin on the date of project acceptance and shall continue for the full product warranty period. A joint 4 month and 9 month warranty inspection shall be conducted, measured from time of acceptance, by the Contractor, Contracting Officer and the Customer Representative. Information contained in the warranty management plan shall include, but shall not be limited to, the following:

a. Roles and responsibilities of all personnel associated with the warranty process, including points of contact and telephone numbers within the organizations of the Contractors, subcontractors, manufacturers or suppliers involved.

b. Listing and status of delivery of all Certificates of Warranty for extended warranty items, to include roofs, HVAC balancing, pumps, motors, transformers, and for all commissioned systems such as fire protection and alarm systems, sprinkler systems, lightning protection systems, etc.

c. A list for each warranted equipment, item, feature of construction or system indicating:

1. Name of item.
2. Model and serial numbers.
3. Location where installed.
4. Name and phone numbers of manufacturers or suppliers.
5. Names, addresses and telephone numbers of sources of spare parts.
6. Warranties and terms of warranty. This shall include one-year overall warranty of construction. Items which have extended warranties shall be indicated with separate warranty expiration dates.
7. Cross-reference to warranty certificates as applicable.
8. Starting point and duration of warranty period.
9. Summary of maintenance procedures required to continue the warranty in force.
10. Cross-reference to specific pertinent Operation and Maintenance manuals.
11. Organization, names and phone numbers of persons to call for warranty service.
12. Typical response time and repair time expected for various

warranted equipment.

d. The Contractor's plans for attendance at the 4 and 9 month post-construction warranty inspections conducted by the Government.

e. Procedure and status of tagging of all equipment covered by extended warranties.

f. Copies of instructions to be posted near selected pieces of equipment where operation is critical for warranty and/or safety reasons.

1.3.2 Performance Bond

The Contractor's Performance Bond shall remain effective throughout the construction period.

a. In the event the Contractor fails to commence and diligently pursue any construction warranty work required, the Contracting Officer will have the work performed by others, and after completion of the work, will charge the remaining construction warranty funds of expenses incurred by the Government while performing the work, including, but not limited to administrative expenses.

b. In the event sufficient funds are not available to cover the construction warranty work performed by the Government at the Contractor's expense, the Contracting Officer will have the right to recoup expenses from the bonding company.

c. Following oral or written notification of required construction warranty repair work, the Contractor shall respond in a timely manner. Written verification will follow oral instructions. Failure of the Contractor to respond will be cause for the Contracting Officer to proceed against the Contractor.

1.3.3 Pre-Warranty Conference

Prior to contract completion, and at a time designated by the Contracting Officer, the Contractor shall meet with the Contracting Officer to develop a mutual understanding with respect to the requirements of this section. Communication procedures for Contractor notification of construction warranty defects, priorities with respect to the type of defect, reasonable time required for Contractor response, and other details deemed necessary by the Contracting Officer for the execution of the construction warranty shall be established/reviewed at this meeting. In connection with these requirements and at the time of the Contractor's quality control completion inspection, the Contractor shall furnish the name, telephone number and address of a licensed and bonded company which is authorized to initiate and pursue construction warranty work action on behalf of the Contractor. This point of contact will be located within the local service area of the warranted construction, shall be continuously available, and shall be responsive to Government inquiry on warranty work action and status. This requirement does not relieve the Contractor of any of its responsibilities in connection with other portions of this provision.

1.3.4 Contractor's Response to Construction Warranty Service Requirements

Following oral or written notification by the Contracting Officer, the Contractor shall respond to construction warranty service requirements in accordance with the "Construction Warranty Service Priority List" and the

three categories of priorities listed below. The Contractor shall submit a report on any warranty item that has been repaired during the warranty period. The report shall include the cause of the problem, date reported, corrective action taken, and when the repair was completed. If the Contractor does not perform the construction warranty within the timeframes specified, the Government will perform the work and backcharge the construction warranty payment item established.

1.3.5 Warranty Tags

At the time of installation, each warranted item shall be tagged with a durable, oil and water resistant tag approved by the Contracting Officer. Each tag shall be attached with a copper wire and shall be sprayed with a silicone waterproof coating. The date of acceptance and the QC signature shall remain blank until project is accepted for beneficial occupancy. The tag shall show the following information.

a. Type of product/material_____.

b. Model number_____.

c. Serial number_____.

d. Contract number_____.

e. Warranty period_____from_____to_____.

f. Inspector's signature_____.

g. Construction Contractor_____.

Address_____.

Telephone number_____.

h. Warranty contact_____.

Address_____.

Telephone number_____.

i. Warranty response time priority code_____.

j. WARNING - PROJECT PERSONNEL TO PERFORM ONLY OPERATIONAL MAINTENANCE DURING THE WARRANTY PERIOD.

1.4 MECHANICAL TESTING, ADJUSTING, BALANCING, AND COMMISSIONING

Prior to final inspection and transfer of the completed facility; all reports, statements, certificates, and completed checklists for testing, adjusting, balancing, and commissioning of mechanical systems shall be submitted to and approved by the Contracting Officer as specified in applicable technical specification sections.

1.5 OPERATION AND MAINTENANCE MANUALS

Operation manuals and maintenance manuals shall be submitted as specified. Operation manuals and maintenance manuals provided in a common volume shall be clearly differentiated and shall be separately indexed.

1.6 FINAL CLEANING

The premises shall be left broom clean. Stains, foreign substances, and temporary labels shall be removed from surfaces. Carpet and soft surfaces shall be vacuumed. Equipment and fixtures shall be cleaned to a sanitary condition. Filters of operating equipment shall be replaced. Debris shall be removed from roofs, drainage systems, gutters, and downspouts. Paved areas shall be swept and landscaped areas shall be raked clean. The site shall have waste, surplus materials, and rubbish removed. The project area shall have temporary structures, barricades, project signs and construction facilities removed. A list of completed clean-up items shall be submitted on the day of final inspection.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

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SECTION 02220

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SECTION 02220

DEMOLITION
05/02

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A10.6	(1990) Safety Requirements for Demolition Operations

AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI Guideline K	(1997) Containers for Recovered Fluorocarbon Refrigerants

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

40 CFR 61-SUBPART M	National Emission Standard for Asbestos
40 CFR 82	Protection of Stratospheric Ozone; Refrigerant Recycling

U.S. ARMY CORPS OF ENGINEERS (USACE)

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

1.2 GENERAL REQUIREMENTS

Do not begin demolition until authorization is received from the Contracting Officer. Remove rubbish and debris from the project site; do not allow accumulations inside or outside the buildings. The work includes demolition, salvage of identified items and materials, and removal of resulting rubbish and debris. Rubbish and debris shall be removed from Government property daily, unless otherwise directed, to avoid accumulation at the demolition site. Materials that cannot be removed daily shall be stored in areas specified by the Contracting Officer. In the interest of occupational safety and health, the work shall be performed in accordance with EM 385-1-1, Section 23, Demolition, and other applicable Sections.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-07 Certificates

Demolition plan; G

Notifications; G

Notification of Demolition and Renovation forms; G

Submit proposed salvage, demolition and removal procedures to the Contracting Officer for approval before work is started.

SD-11 Closeout Submittals

Receipts

1.4 REGULATORY AND SAFETY REQUIREMENTS

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

1.4.1 Notifications

Furnish timely notification of demolition and renovation projects to Federal, State, regional, and local authorities in accordance with 40 CFR 61-SUBPART M. Notify the State's environmental protection agency and the Contracting Officer in writing 10 working days prior to the commencement of work in accordance with 40 CFR 61-SUBPART M.

Complete and submit Notification of Demolition and Renovation forms to Federal and State authorities and Contracting Officer, postmarked or delievered at least ten working days prior to commencement of work, in accordance with 40 CFR 61-SUBPART M. Complete paragraphs I, II, III.B, III.C (if applicable), VIII, and IX thru XIX of form. Copy of form is attached at end of this section.

1.4.2 Receipts

Submit a shipping receipt or bill of lading for all containers of ozone depleting substance (ODS) shipped to the Defense Depot, Richmond, Virginia.

1.5 DUST AND DEBRIS CONTROL

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

1.6 PROTECTION

1.6.1 Traffic Control Signs

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

1.6.2 Existing Work

Before beginning any demolition work, the Contractor shall survey the site and examine the drawings and specifications to determine the extent of the work. The Contractor shall take necessary precautions to avoid damage to existing items to remain in place, to be reused, or to remain the property of the Government; any damaged items shall be repaired or replaced as approved by the Contracting Officer. The Contractor shall coordinate the work of this section with all other work and shall construct and maintain shoring, bracing, and supports as required. The Contractor shall ensure that structural elements are not overloaded and shall be responsible for increasing structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under this contract. Do not overload structural elements. Provide new supports and reinforcement for existing construction weakened by demolition or removal work. Repairs, reinforcement, or structural replacement must have Contracting Officer approval.

1.6.3 Weather Protection

For portions of the building to remain, protect building interior and materials and equipment from the weather at all times. Where removal of existing roofing is necessary to accomplish work, have materials and workmen ready to provide adequate and temporary covering of exposed areas so as to ensure effectiveness and to prevent displacement.

1.6.4 Trees

Trees within the project site which might be damaged during demolition, and which are indicated to be left in place, shall be protected by a 6 foot high fence. The fence shall be securely erected a minimum of 5 feet from the trunk of individual trees or follow the outer perimeter of branches or clumps of trees. Any tree designated to remain that is damaged during the work under this contract shall be replaced in kind or as approved by the Contracting Officer.

1.6.5 Facilities

Protect electrical and mechanical services and utilities. Where removal of existing utilities and pavement is specified or indicated, provide approved barricades, temporary covering of exposed areas, and temporary services or connections for electrical and mechanical utilities. Floors, roofs, walls, columns, pilasters, and other structural components that are designed and constructed to stand without lateral support or shoring, and are determined to be in stable condition, shall remain standing without additional bracing, shoring, of lateral support until demolished, unless directed otherwise by the Contracting Officer. The Contractor shall ensure that no elements determined to be unstable are left unsupported and shall be responsible for placing and securing bracing, shoring, or lateral supports as may be required as a result of any cutting, removal, or demolition work performed under this contract.

1.6.6 Protection of Personnel

During the demolition work the Contractor shall continuously evaluate the condition of the structure being demolished and take immediate action to protect all personnel working in and around the demolition site. No area, section, or component of floors, roofs, walls, columns, pilasters, or other structural element will be allowed to be left standing without sufficient

bracing, shoring, or lateral support to prevent collapse or failure while workmen remove debris or perform other work in the immediate area.

1.7 BURNING

The use of burning at the project site for the disposal of refuse and debris will not be permitted.

1.8 FOREIGN OBJECT DAMAGE (FOD)

Aircraft and aircraft engines are subject to FOD from debris and waste material lying on airfield pavements. Remove all such materials that may appear on operational aircraft pavements due to the Contractor's operations. If necessary, the Contracting Officer may require the Contractor to install a temporary barricade at the Contractor's expense to control the spread of FOD potential debris. The barricade shall consist of a fence covered with a fabric designed to stop the spread of debris; anchor the fence and fabric to prevent displacement by winds or jet/prop blasts. Remove barricade when no longer required.

1.9 RELOCATIONS

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

1.10 Required Data

Demolition plan shall include procedures for careful removal and disposition of materials specified to be salvaged, coordination with other work in progress, a disconnection schedule of utility services, a detailed description of methods and equipment to be used for each operation and of the sequence of operations.

1.11 Environmental Protection

The work shall comply with the requirements of Section 01355 ENVIRONMENTAL PROTECTION.

1.12 USE OF EXPLOSIVES

Use of explosives will not be permitted.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 EXISTING FACILITIES TO BE REMOVED

3.1.1 Patching

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

the adjacent existing surface and shall match the existing adjacent surface as closely as possible as to texture and finish. Patching shall be as specified and indicated, and shall include:

a. Holes and depressions caused by previous physical damage or left as a result of removals in existing masonry walls to remain shall be completely filled with an approved masonry patching material, applied in accordance with the manufacturer's printed instructions.

b. Where existing partitions have been removed leaving damaged or missing resilient tile flooring, patch to match the existing floor tile.

c. Patch acoustic lay-in ceiling where partitions have been removed. The transition between the different ceiling heights shall be effected by continuing the higher ceiling level over to the first runner on the lower ceiling and closing the vertical opening with a painted sheet metal strip.

3.2 DISPOSITION OF MATERIAL

3.2.1 Title to Materials

Except where specified in other sections, all materials and equipment removed, and not reused, shall become the property of the Contractor and shall be removed from Government property. Title to materials resulting from demolition, and materials and equipment to be removed, is vested in the Contractor upon approval by the Contracting Officer of the Contractor's demolition and removal procedures, and authorization by the Contracting Officer to begin demolition. The Government will not be responsible for the condition or loss of, or damage to, such property after contract award. Materials and equipment shall not be viewed by prospective purchasers or sold on the site.

3.2.2 Salvaged Materials and Equipment

Remove materials and equipment that are indicated to be removed by the Contractor and that are to remain the property of the Government, and deliver to a storage site.

Contractor shall salvage items and material to the maximum extent possible.

Material salvaged for the Contractor shall be stored as approved by the Contracting Officer and shall be removed from Government property before completion of the contract. Material salvaged for the Contractor shall not be sold on the site.

Salvaged items to remain the property of the Government shall be removed in a manner to prevent damage, and packed or crated to protect the items from damage while in storage or during shipment. Items damaged during removal or storage shall be repaired or replaced to match existing items. Containers shall be properly identified as to contents.

3.2.2 Disposal of Ozone Depleting Substance (ODS)

Class I and Class II ODS are defined in Section, 602(a) and (b), of The Clean Air Act. Prevent discharge of Class I and Class II ODS to the atmosphere. Place recovered ODS in cylinders meeting ARI Guideline K suitable for the type ODS (filled to no more than 80 percent capacity) and

provide appropriate labeling. Products, equipment and appliances containing ODS in a sealed, self-contained system (e.g. residential refrigerators and window air conditioners) shall be disposed of in accordance with 40 CFR 82.

3.2.3 Unsalvageable Material

Concrete, masonry, and other noncombustible material, except concrete permitted to remain in place, shall be disposed of in the disposal area located as noted within drawing package.

3.3 CLEANUP

Debris and rubbish shall be removed from basement and similar excavations. Debris shall be removed and transported in a manner that prevents spillage on streets or adjacent areas. Local regulations regarding hauling and disposal shall apply.

3.3.1 Debris and Rubbish

Debris and rubbish shall be removed from basement and similar excavations. Debris shall be removed and transported in a manner that prevents spillage on streets or adjacent areas. Local regulations regarding hauling and disposal shall apply.

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SECTION 02300A

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SECTION 02300A

EARTHWORK
12/97

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN 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 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 2487	(1998) Classification of Soils for Engineering Purposes (Unified Soil Classification System)
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, SW, SP, SM. Satisfactory materials for grading shall be comprised of stones less than 8 inches, except for fill material for pavements which shall be comprised of stones less than 3 inches in any dimension.

1.2.2 Unsatisfactory Materials

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

1.2.3 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 1557abbreviated as a percent of laboratory maximum density.

1.2.5 Overhaul

Overhaul is the authorized transportation of satisfactory excavation or borrow materials in excess of the free-haul limit of 7+30 stations. Overhaul is the product of the quantity of materials hauled beyond the free-haul limit, and the distance such materials are hauled beyond the free-haul limit, expressed in station yards.

1.2.6 Topsoil

Material suitable for topsoils obtained from excavations is defined as GW, GP, GM, SW, SP and SM.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-07 Design Data

Earthwork;

Notification of encountering rock in the project. Advance notice on shoulder construction for rigid pavements.

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

SD-06 Test Reports

Testing; G

Within 24 hours of conclusion of physical tests, 4 copies of test results, including calibration curves and results of calibration tests.

SD-13 Certificates

Testing;

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

1.4 SUBSURFACE DATA

Subsurface soil boring logs are appended to the SPECIAL CONTRACT REQUIREMENTS. These data represent the best subsurface information available; however, variations may exist in the subsurface between boring locations.

1.5 CLASSIFICATION OF EXCAVATION

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 unstratified masses, which cannot be removed without systematic drilling and firmly cemented conglomerate deposits possessing the characteristics of solid rock impossible to remove without systematic drilling. 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 shall be disposed of in designated waste disposal or spoil areas. Satisfactory material removed from excavations shall be used, insofar as practicable, in the construction of fills, embankments, subgrades, shoulders, bedding (as backfill), and for similar purposes. No satisfactory excavated material shall be wasted without specific written authorization. Satisfactory material authorized to be wasted shall be disposed of in designated areas approved for surplus material storage or designated waste areas as directed. Newly designated waste areas on Government-controlled land shall be cleared and grubbed before disposal of waste material thereon. Coarse rock from excavations shall be stockpiled and used for constructing slopes or embankments

adjacent to streams, or sides and bottoms of channels and for protecting against erosion. No excavated material shall be disposed of to obstruct the flow of any stream, endanger a partly finished structure, impair the efficiency or appearance of any structure, or be detrimental to the completed work in any way.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 STRIPPING OF TOPSOIL

Topsoil shall be stripped to a depth of 6 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 stockpiled in locations indicated.

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. Where pile foundations are to be used, the excavation of each pit shall be stopped at an elevation 1 foot above the base of the footing, as specified, before piles are driven. After the pile driving has been completed, loose and displaced material shall be removed and excavation completed, leaving a smooth, solid, undisturbed surface to receive the concrete or masonry.

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. 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

The Contractor shall notify the Contracting Officer sufficiently in advance of the opening of any excavation or borrow pit to permit elevations and measurements of the undisturbed ground surface to be taken. Except as otherwise permitted, borrow pits and other excavation areas shall be excavated providing adequate drainage. Overburden and other spoil material shall be transported to designated spoil areas or otherwise disposed of as directed. Borrow pits shall be neatly trimmed and drained after the excavation is completed. The Contractor shall ensure that excavation of any area, operation of borrow pits, or dumping of spoil material results in minimum detrimental effects on natural environmental conditions.

3.5 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 02630 STORM-DRAINAGE SYSTEM; 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 8"; 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 8" inchesin 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. After rolling, the surface of the subgrade and parking area for roadways shall not show deviations greater than 3/8 inch when tested with a 12 foot straightedge applied both parallel and at right angles to the centerline of the area. 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 95 percent of laboratory maximum density.

3.9.2.1 Subgrade for Pavements

Subgrade for pavements shall be compacted to at least 95 percentage laboratory maximum density for the depth below the surface of the pavement shown. When more than one soil classification is present in the subgrade, the top 12 inches of subgrade shall be scarified, windrowed, thoroughly blended, reshaped, and compacted.

3.9.2.2 Subgrade for Shoulders

Subgrade for shoulders shall be compacted to at least 90 percentage laboratory maximum density for the 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 a thickness of 6 inches and graded to the elevations and slopes shown. Topsoil shall not be spread when frozen or excessively wet or dry. Material required for topsoil in excess of that produced by excavation within the grading limits shall be obtained from 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 . 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 50.0 cubic yards stockpiled or in-place source material. Gradation of fill and backfill material shall be determined in accordance with ASTM C 136 or ASTM D 422.

3.13.2 In-Place Densities

a. One test per 1,500 square feet, or fraction thereof, of each lift of fill or backfill areas compacted by other than hand-operated machines.

b. One test per 1,500 square feet, or fraction thereof, of each lift of fill or backfill areas compacted by hand-operated machines.

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

3.13.3 Omitted

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 25 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.

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DIVISION 02 - SITE CONSTRUCTION

SECTION 02370

SOIL SURFACE EROSION CONTROL

03/00

PART 1 GENERAL

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SECTION 02370

SOIL SURFACE EROSION CONTROL
03/00

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 1777	(1996) Thickness of Textile Materials
ASTM D 3776	(1996) Mass per Unit Area (Weight)of Fabric
ASTM D 3787	(1989) Bursted Strength of Knitted Goods: Constant-Rate-of-Traverse (CRT), Ball Burst Test
ASTM D 3884	(1992) Test Method for Abrasion Resistance of Textile Fabrics (Rotary Platform, Double Head Method)
ASTM D 4355	(1992) Deterioration of Geotextiles From Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus)
ASTM D 4491	(1999) Water Permeability of Geotextiles by Permittivity
ASTM D 4533	(1991; R 1996) Trapezoidal Tearing Strength of Geotextiles
ASTM D 4632	(1991; R 1996) Grab Breaking Load and Elongation of Geotextiles
ASTM D 4751	(1999) Determining Apparent Opening Size of a Geotextile
ASTM D 4833	(1998; R 1996el) Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
ASTM D 4972	(1995a) pH of Soils
ASTM D 5268	(1996) Topsoil Used for Landscaping Purposes

1.2 DESCRIPTION OF WORK

The work shall consist of furnishing and installing soil surface erosion control materials, including fine grading, blanketing, stapling, mulching and miscellaneous related work, within project limits and in areas outside

the project limits where the soil surface is disturbed from work under this contract at the designated locations. This work shall include all necessary materials, labor, supervision and equipment for installation of a complete system.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Layout
Obstructions Below Ground
Erosion Control; G, RE

Scale drawings defining areas to receive recommended materials as required by federal, state or local regulations.

Calendar time period for the seed establishment period. When there is more than one seed establishment period, the boundaries of the seeded area covered for each period shall be described.

SD-03 Product Data

Geotextile Fabrics; G

Manufacturer's literature including physical characteristics, application and installation instructions.

SD-04 Samples

Materials; G

a.
Geotextile fabrics; .

1.4 DELIVERY, INSPECTION, STORAGE, AND HANDLING

Materials shall be stored in designated areas and as recommended by the manufacturer protected from the elements, direct exposure, and damage. Containers shall not be dropped from trucks. Material shall be free of defects that would void required performance or warranty. Geosynthetic binders and synthetic soil binders shall be delivered in the manufacturer's original sealed containers and stored in a secure area.

a. Erosion control blankets and geotextile fabric shall be furnished in rolls with suitable wrapping to protect against moisture and extended ultraviolet exposure prior to placement. Erosion control blanket and geotextile fabric rolls shall be labeled to provide identification sufficient for inventory and quality control purposes.

1.5 SUBSTITUTIONS

Substitutions will not be allowed without written request and approval from the Contracting Officer.

1.6 WARRANTY

Erosion control material shall have a warranty for use and durable condition for project specific installations. Temporary erosion control materials shall carry a minimum eighteen month warranty. Permanent erosion control materials shall carry a minimum three year warranty.PART 2 PRODUCTS

2.1 GEOTEXTILE FABRICS

Geotextile fabrics shall be woven of polypropylene filaments formed into a stable network so that the filaments retain their relative position to each other. Sewn seams shall have strength equal to or greater than the geotextile itself. Fabric shall be installed to withstand maximum velocity flows as recommended by the manufacturer. The geotextile shall conform to the following minimum average roll values:

Property	Performance	Test Method
Weight		ASTM D 3776
Thickness		ASTM D 1777
Permeability		ASTM D 4491
Abrasion Resistance, Type (percent strength retained)	58 percent X 81 percent	ASTM D 3884
Tensile Grab Strength	1,467 N X 1, 933 N	ASTM D 4632
Grab Elongation	15percent X 20percent	ASTM D 4632
Burst Strength	5,510 kN/m^2	ASTM D 3787
Puncture Strength	733 N	ASTM D 4833
Trapezoid Tear	533 N X 533 N	ASTM D 4533
Apparent Opening Size	40 US Std Sieve	ASTM D 4751
UV Resistance @ 500 hrs	90 percent	ASTM D 4355

2.2 WATER

Unless otherwise directed, water shall be the responsibility of the Contractor. Water shall be potable or supplied by an existing irrigation system.PART 3 EXECUTION

3.1 CONDITIONS

The Contractor shall submit a construction work sequence schedule, with the state or local government approved erosion control plan a minimum of 30 days prior to start of construction. The work schedule shall coordinate the timing of land disturbing activities with the provision of erosion control measures. Erosion control operations shall be performed under favorable weather conditions; when excessive moisture, frozen ground or other unsatisfactory conditions prevail, the work shall be stopped as directed. When special conditions warrant a variance to earthwork operations, a revised construction schedule shall be submitted for approval. Erosion control materials shall not be applied in adverse weather conditions which could affect their performance.

3.1.1 Finished Grade

The Contractor shall verify that finished grades are as indicated on the drawings; finish grading and compaction shall be completed in accordance

with Section 02300 "Earthwork", prior to the commencement of the work. The location of underground utilities and facilities in the area of the work shall be verified and marked. Damage to underground utilities and facilities shall be repaired at the Contractor's expense.

3.2 SITE PREPARATION

3.2.1 Soil Test

Soil shall be tested in accordance with ASTM D 5268 and ASTM D 4972 for determining the particle size and mechanical analysis. Sample collection onsite shall be random over the entire site. The test shall determine the soil particle size as compatible for the specified material.

3.2.2 Layout

Erosion control material locations may be adjusted to meet field conditions. When soil tests result in unacceptable particle sizes, a shop drawing shall be submitted indicating the corrective measures.

3.2.3 Protecting Existing Vegetation

When there are established lawns in the work area, the turf shall be covered and/or protected or replaced after construction operations. Existing trees, shrubs, and plant beds that are to be preserved shall be barricaded along the dripline. Damage to existing trees shall be mitigated by the Contractor at no additional cost to the Government. Damage shall be assessed by a state certified arborist or other approved professional using the National Arborist Association's tree valuation guideline.

3.2.4 Obstructions Below Ground

When obstructions below ground affect the work, shop drawings showing proposed adjustments to placement of erosion control material shall be submitted for approval.

3.3 CLEAN-UP

Excess material, debris, and waste materials shall be disposed offsite at an approved landfill or recycling center. Adjacent paved areas shall be cleared. Immediately upon completion of the installation in an area, the area shall be protected against traffic or other use by erecting barricades and providing signage as required, or as directed.

3.4 WATERING SOD

Water shall be applied to supplement rainfall at a sufficient rate to ensure moist soil conditions to a minimum 1 inch depth. Run-off and puddling shall be prevented. Watering trucks shall not be driven over turf areas, unless otherwise directed. Watering of other adjacent areas or plant material shall be prevented.

3.5 MAINTENANCE RECORD

A record shall be furnished describing the maintenance work performed, record of measurements and findings for product failure, recommendations for repair, and products replaced.

3.5.1 Maintenance

Maintenance shall include eradicating weeds; protecting embankments and ditches from surface erosion; maintaining the performance of the erosion control materials and mulch; protecting installed areas from traffic.

3.5.1.1 Maintenance Instructions

Written instructions containing drawings and other necessary information shall be furnished, describing the care of the installed material; including, when and where maintenance should occur, and the procedures for material replacement.

3.5.1.2 Patching and Replacement

Unless otherwise directed, material shall be placed, seamed or patched as recommended by the manufacturer. Material not meeting the required performance as a result of placement, seaming or patching shall be removed from the site. The Contractor shall replace the unacceptable material at no additional cost to the Government.

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SECTION 02630A

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03/00

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SECTION 02630A

STORM-DRAINAGE SYSTEM
03/00

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 198	(1998) Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 536	(1999el) Ductile Iron Castings
ASTM C 32	(1999el) Sewer and Manhole Brick (Made from Clay or Shale)
ASTM C 55	(1999) Concrete Brick
ASTM C 62	(1997a) Building Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C 139	(1999) Concrete Masonry Units for Construction of Catch Basins and Manholes
ASTM C 270	(1997) Mortar for Unit Masonry
ASTM C 443	(1998) Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
ASTM D 1056	(1998) Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D 1171	(1994) Rubber Deterioration - Surface Ozone Cracking Outdoors or Chamber (Triangular Specimens)
ASTM D 1557	(1998) Laboratory Compaction Characteristics of Soil Using Modified Effort 2,700 kN-m/cu.m.
ASTM D 1752	(1984; R 1996el) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D 2167	(1994) Density and Unit Weight of Soil in Place by the Rubber Balloon Method

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Placing Pipe; G

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery and Storage

Materials delivered to site shall be inspected for damage, unloaded, and stored with a minimum of handling. Materials shall not be stored directly on the ground. The inside of pipes and fittings shall be kept free of dirt and debris. Before, during, and after installation, plastic pipe and fittings shall be protected from any environment that would result in damage or deterioration to the material. The Contractor shall have a copy of the manufacturer's instructions available at the construction site at all times and shall follow these instructions unless directed otherwise by the Contracting Officer.

1.3.2 Handling

Materials shall be handled in a manner that ensures delivery to the trench in sound, undamaged condition. Pipe shall be carried to the trench, not dragged.

PART 2 PRODUCTS

2.1 PIPE FOR CULVERTS AND STORM DRAINS

Pipe for culverts and storm drains shall be of the sizes indicated and shall conform to the requirements specified.

2.1.1 Concrete Pipe

ASTM C 76, Class III.

2.2 DRAINAGE STRUCTURES

2.2.1 Flared End Sections

Sections shall be of a standard design fabricated from zinc coated steel sheets meeting requirements of ASTM A 929/A 929M.

2.3 MISCELLANEOUS MATERIALS

2.3.1 Concrete

Unless otherwise specified, concrete and reinforced concrete shall conform to the requirements for 4000 psi concrete under Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. The concrete mixture shall have air content by volume of concrete, based on measurements made immediately after discharge from the mixer, of 5 to 7 percent when maximum size of coarse aggregate exceeds

37.5 mm. Air content shall be determined in accordance with ASTM C 231. The concrete covering over steel reinforcing shall not be less than 1 inch thick for covers and not less than 1.5 inches thick for walls and flooring. Concrete covering deposited directly against the ground shall have a thickness of at least 3 inches between steel and ground. Expansion-joint filler material shall conform to ASTM D 1751, or ASTM D 1752, or shall be resin-impregnated fiberboard conforming to the physical requirements of ASTM D 1752.

2.3.2 Mortar

Mortar for pipe joints, connections to other drainage structures, and brick or block construction shall conform to ASTM C 270, Type M, except that the maximum placement time shall be 1 hour. The quantity of water in the mixture shall be sufficient to produce a stiff workable mortar but in no case shall exceed 6 gallons of water per sack of cement. Water shall be clean and free of harmful acids, alkalies, and organic impurities. The mortar shall be used within 30 minutes after the ingredients are mixed with water. The inside of the joint shall be wiped clean and finished smooth. The mortar head on the outside shall be protected from air and sun with a proper covering until satisfactorily cured.

2.3.3 Precast Concrete Segmental Blocks

Precast concrete segmental block shall conform to ASTM C 139, not more than thick, not less than 8 inches long, and of such shape that joints can be sealed effectively and bonded with cement mortar.

2.3.4 Brick

Brick shall conform to ASTM C 62, Grade SW; ASTM C 55, Grade S-I or S-II; or ASTM C 32, Grade MS. Mortar for jointing and plastering shall consist of one part portland cement and two parts fine sand. Lime may be added to the mortar in a quantity not more than 25 percent of the volume of cement. The joints shall be filled completely and shall be smooth and free from surplus mortar on the inside of the structure. Brick structures shall be plastered with 5 inches of mortar over the entire outside surface of the walls. For square or rectangular structures, brick shall be laid in stretcher courses with a header course every sixth course. For round structures, brick shall be laid radially with every sixth course a stretcher course.

2.3.5 Precast Reinforced Concrete Manholes

Precast reinforced concrete manholes shall conform to ASTM C 478. Joints between precast concrete risers and tops shall be made with flexible watertight, rubber-type gaskets meeting the requirements of paragraph JOINTS.

2.3.6 Frame and Cover for Gratings

Frame and cover for gratings shall be cast gray iron, ASTM A 48, Class 35B; cast ductile iron, ASTM A 536, Grade 65-45-12; or cast aluminum, ASTM B 26/B 26M, Alloy 356.OT6. Weight, shape, size, and waterway openings for grates and curb inlets shall be as indicated on the plans.

2.3.7 Joints

2.3.7.1 Flexible Watertight Joints

a. Materials: Flexible watertight joints shall be made with plastic or rubber-type gaskets for concrete pipe and with factory-fabricated resilient materials for clay pipe. The design of joints and the physical requirements for plastic gaskets shall conform to AASHTO M 198, and rubber-type gaskets shall conform to ASTM C 443. Factory-fabricated resilient joint materials shall conform to ASTM C 425. Gaskets shall have not more than one factory-fabricated splice, except that two factory-fabricated splices of the rubber-type gasket are permitted if the nominal diameter of the pipe being gasketed exceeds 53 inches.

b. Test Requirements: Watertight joints shall be tested and shall meet test requirements of paragraph HYDROSTATIC TEST ON WATERTIGHT JOINTS. Rubber gaskets shall comply with the oil resistant gasket requirements of ASTM C 443. Certified copies of test results shall be delivered to the Contracting Officer before gaskets or jointing materials are installed. Alternate types of watertight joint may be furnished, if specifically approved.

2.3.7.2 Flexible Watertight, Gasketed Joints

a. Gaskets: When infiltration or exfiltration is a concern for pipe lines, the couplings may be required to have gaskets. The closed-cell expanded rubber gaskets shall be a continuous band approximately 7 inches wide and approximately .5 inch thick, meeting the requirements of ASTM D 1056, Type 2 A1 and shall have a quality retention rating of not less than 70 percent when tested for weather resistance by ozone chamber exposure, Method B of ASTM D 1171. Rubber O-ring gaskets shall be .75 inch in diameter for pipe diameters of 35.5 inches or smaller and .75 inch in diameter for larger pipe having .5 inch deep end corrugation. Rubber O-ring gaskets shall be 1.5 inches in diameter for pipe having 1 inch deep end corrugations. O-rings shall meet the requirements of AASHTO M 198 or ASTM C 443. Flexible plastic gaskets shall conform to requirements of AASHTO M 198, Type B.

2.4 STEEL LADDER

Steel ladder shall be provided where the depth of the manhole exceeds 4 meters. These ladders shall be not less than 16 inches in width, with .75 inch diameter rungs spaced 12 inches apart. The two stringers shall be a minimum .25 inch thick and 2.5 inches wide. Ladders and inserts shall be galvanized after fabrication in conformance with ASTM A 123/A 123M.

2.5 RESILIENT CONNECTORS

Flexible, watertight connectors used for connecting pipe to manholes and inlets shall conform to ASTM C 923.

2.6 HYDROSTATIC TEST ON WATERTIGHT JOINTS

2.6.1 Concrete

A hydrostatic test shall be made on the watertight joint types as proposed. Only one sample joint of each type needs testing; however, if the sample

joint fails because of faulty design or workmanship, an additional sample joint may be tested. During the test period, gaskets or other jointing material shall be protected from extreme temperatures which might adversely affect the performance of such materials. Performance requirements for joints in reinforced and nonreinforced concrete pipe shall conform to AASHTO M 198 or ASTM C 443.

PART 3 EXECUTION

3.1 EXCAVATION FOR PIPE CULVERTS, STORM DRAINS, AND DRAINAGE STRUCTURES

Excavation of trenches, and for appurtenances and backfilling for culverts and storm drains, shall be in accordance with the applicable portions of Section 02316 "Excavation, Trenching, and Backfilling for Utilities Systems" and the requirements specified below.

3.1.1 Trenching

The width of trenches at any point below the top of the pipe shall be not greater than the outside diameter of the pipe plus 12 inches to permit satisfactory jointing and thorough tamping of the bedding material under and around the pipe. Sheeting and bracing, where required, shall be placed within the trench width as specified. Contractor shall not overexcavate. Where trench widths are exceeded, redesign with a resultant increase in cost of stronger pipe or special installation procedures will be necessary. Cost of this redesign and increased cost of pipe or installation shall be borne by the Contractor without additional cost to the Government.

3.1.2 Removal of Unstable Material

Where wet or otherwise unstable soil incapable of properly supporting the pipe, as determined by the Contracting Officer, is unexpectedly encountered in the bottom of a trench, such material shall be removed to the depth required and replaced to the proper grade with select granular material, compacted as provided in paragraph BACKFILLING. When removal of unstable material is due to the fault or neglect of the Contractor in his performance of shoring and sheeting, water removal, or other specified requirements, such removal and replacement shall be performed at no additional cost to the government.

3.2 BEDDING

The bedding surface for the pipe shall provide a firm foundation of uniform density throughout the entire length of the pipe.

3.2.1 Concrete Pipe Requirements

When no bedding class is specified or detailed on the drawings, concrete pipe shall be bedded in a soil foundation accurately shaped and rounded to conform to the lowest one-fourth of the outside portion of circular pipe or to the lower curved portion of pipe arch for the entire length of the pipe or pipe arch. When necessary, the bedding shall be tamped. Bell holes and depressions for joints shall be not more than the length, depth, and width required for properly making the particular type of joint.

3.3 PLACING PIPE

Each pipe shall be thoroughly examined before being laid; defective or damaged pipe shall not be used. Plastic pipe shall be protected from

exposure to direct sunlight prior to laying, if necessary to maintain adequate pipe stiffness and meet installation deflection requirements. Pipelines shall be laid to the grades and alignment indicated. Proper facilities shall be provided for lowering sections of pipe into trenches. Lifting lugs in vertically elongated metal pipe shall be placed in the same vertical plane as the major axis of the pipe. Pipe shall not be laid in water, and pipe shall not be laid when trench conditions or weather are unsuitable for such work. Diversion of drainage or dewatering of trenches during construction shall be provided as necessary.

3.3.1 Concrete

Laying shall proceed upgrade with spigot ends of bell-and-spigot pipe and tongue ends of tongue-and-groove pipe pointing in the direction of the flow.

3.4 JOINTING

3.4.1 Concrete

3.4.1.1 Cement-Mortar Bell-and-Spigot Joint

The first pipe shall be bedded to the established gradeline, with the bell end placed upstream. The interior surface of the bell shall be thoroughly cleaned with a wet brush and the lower portion of the bell filled with mortar as required to bring inner surfaces of abutting pipes flush and even. The spigot end of each subsequent pipe shall be cleaned with a wet brush and uniformly matched into a bell so that sections are closely fitted. After each section is laid, the remainder of the joint shall be filled with mortar, and a bead shall be formed around the outside of the joint with sufficient additional mortar. If mortar is not sufficiently stiff to prevent appreciable slump before setting, the outside of the joint shall be wrapped or bandaged with cheesecloth to hold mortar in place.

3.4.1.2 Plastic Sealing Compound Joints for Tongue-and-Grooved Pipe

Sealing compounds shall follow the recommendation of the particular manufacturer in regard to special installation requirements. Surfaces to receive lubricants, primers, or adhesives shall be dry and clean. Sealing compounds shall be affixed to the pipe not more than 3 hours prior to installation of the pipe, and shall be protected from the sun, blowing dust, and other deleterious agents at all times. Sealing compounds shall be inspected before installation of the pipe, and any loose or improperly affixed sealing compound shall be removed and replaced. The pipe shall be aligned with the previously installed pipe, and the joint pulled together. If, while making the joint with mastic-type sealant, a slight protrusion of the material is not visible along the entire inner and outer circumference of the joint when the joint is pulled up, the pipe shall be removed and the joint remade. After the joint is made, all inner protrusions shall be cut off flush with the inner surface of the pipe. If nonmastic-type sealant material is used, the "Squeeze-Out" requirement above will be waived.

3.4.1.3 Flexible Watertight Joints

Gaskets and jointing materials shall be as recommended by the particular manufacturer in regard to use of lubricants, cements, adhesives, and other special installation requirements. Surfaces to receive lubricants, cements, or adhesives shall be clean and dry. Gaskets and jointing materials shall be affixed to the pipe not more than 24 hours prior to the installation of the pipe, and shall be protected from the sun, blowing

dust, and other deleterious agents at all times. Gaskets and jointing materials shall be inspected before installing the pipe; any loose or improperly affixed gaskets and jointing materials shall be removed and replaced. The pipe shall be aligned with the previously installed pipe, and the joint pushed home. If, while the joint is being made the gasket becomes visibly dislocated the pipe shall be removed and the joint remade.

3.5 DRAINAGE STRUCTURES

3.5.1 Manholes and Inlets

Construction shall be of reinforced concrete, plain concrete, brick, precast reinforced concrete, precast concrete segmental blocks, prefabricated corrugated metal, or bituminous coated corrugated metal; complete with frames and covers or gratings; and with fixed galvanized steel ladders or fitted with precast step inserts for precast structures where indicated. Pipe studs and junction chambers of prefabricated corrugated metal manholes shall be fully bituminous-coated and paved when the connecting branch lines are so treated. Pipe connections to concrete manholes and inlets shall be made with flexible, watertight connectors.

3.5.2 Walls and Headwalls

Construction shall be as indicated.

3.6 STEEL LADDER INSTALLATION

Ladder shall be adequately anchored to the wall by means of steel inserts spaced not more than6.5 feet vertically, and shall be installed to provide at least 6 inchesof space between the wall and the rungs. The wall along the line of the ladder shall be vertical for its entire length.

3.7 BACKFILLING

3.7.1 Backfilling Pipe in Trenches

After the pipe has been properly bedded, selected material from excavation or borrow, at a moisture content that will facilitate compaction, shall be placed along both sides of pipe in layers not exceeding 6 inches in compacted depth. The backfill shall be brought up evenly on both sides of pipe for the full length of pipe. The fill shall be thoroughly compacted under the haunches of the pipe. Each layer shall be thoroughly compacted with mechanical tampers or rammers. This method of filling and compacting shall continue until the fill has reached an elevation of at least 12 inches above the top of the pipe. The remainder of the trench shall be backfilled and compacted by spreading and rolling or compacted by mechanical rammers or tampers in layers not exceeding 12 inches. Tests for density shall be made as necessary to ensure conformance to the compaction requirements specified below. Where it is necessary, in the opinion of the Contracting Officer, that sheeting or portions of bracing used be left in place, the contract will be adjusted accordingly. Untreated sheeting shall not be left in place beneath structures or pavements.

3.7.2 Backfilling Pipe in Fill Sections

For pipe placed in fill sections, backfill material and the placement and compaction procedures shall be as specified below. The fill material shall be uniformly spread in layers longitudinally on both sides of the pipe, not exceeding 6 inches in compacted depth, and shall be compacted by rolling

parallel with pipe or by mechanical tamping or ramming. Prior to commencing normal filling operations, the crown width of the fill at a height of 12 inches above the top of the pipe shall extend a distance of not less than twice the outside pipe diameter on each side of the pipe or 4 meters, whichever is less. After the backfill has reached at least 12 inches above the top of the pipe, the remainder of the fill shall be placed and thoroughly compacted in layers not exceeding 12 inches.

3.7.3 Movement of Construction Machinery

When compacting by rolling or operating heavy equipment parallel with the pipe, displacement of or injury to the pipe shall be avoided. Movement of construction machinery over a culvert or storm drain at any stage of construction shall be at the Contractor's risk. Any damaged pipe shall be repaired or replaced.

3.7.4 Compaction

3.7.4.1 General Requirements

Cohesionless materials include gravels, gravel-sand mixtures, sands, and gravelly sands. Cohesive materials include clayey and silty gravels, gravel-silt mixtures, clayey and silty sands, sand-clay mixtures, clays, silts, and very fine sands. When results of compaction tests for moisture-density relations are recorded on graphs, cohesionless soils will show straight lines or reverse-shaped moisture-density curves, and cohesive soils will show normal moisture-density curves.

3.7.4.2 Minimum Density

Backfill over and around the pipe and backfill around and adjacent to drainage structures shall be compacted at the approved moisture content to the following applicable minimum density, which will be determined as specified below.

a. Under airfield and heliport pavements, paved roads, streets, parking areas, and similar-use pavements including adjacent shoulder areas, the density shall be not less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless material, up to the elevation where requirements for pavement subgrade materials and compaction shall control.

b. Under unpaved or turfed traffic areas, density shall not be less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless material.

c. Under nontraffic areas, density shall be not less than that of the surrounding material.

3.7.5 Determination of Density

Testing shall be the responsibility of the Contractor and performed at no additional cost to the Government. Testing shall be performed by an approved commercial testing laboratory or by the Contractor subject to approval. Tests shall be performed in sufficient number to ensure that specified density is being obtained. Laboratory tests for moisture-density relations shall be made in accordance with ASTM D 1557 except that mechanical tampers may be used provided the results are correlated with

those obtained with the specified hand tamper. Field density tests shall be determined in accordance with ASTM D 2167. Test results shall be furnished the Contracting Officer. The calibration checks of both the density and moisture gauges shall be made at the beginning of a job on each different type of material encountered and at intervals as directed.

3.8 PIPELINE TESTING

Lines shall be tested for leakage by low pressure air or water testing or exfiltration tests, as appropriate. Low pressure air testing for vitrified clay pipes shall conform to ASTM C 828. Low pressure air testing for concrete pipes shall conform to ASTM C 924. Low pressure air testing for plastic pipe shall conform to ASTM F 1417. Low pressure air testing procedures for other pipe materials shall use the pressures and testing times prescribed in ASTM C 828 or ASTM C 924, after consultation with the pipe manufacturer. Testing of individual joints for leakage by low pressure air or water shall conform to ASTM C 1103. Prior to exfiltration tests, the trench shall be backfilled up to at least the lower half of the pipe. If required, sufficient additional backfill shall be placed to prevent pipe movement during testing, leaving the joints uncovered to permit inspection. Visible leaks encountered shall be corrected regardless of leakage test results. When the water table is 24 inches or more above the top of the pipe at the upper end of the pipeline section to be tested, infiltration shall be measured using a suitable weir or other device acceptable to the Contracting Officer. An exfiltration test shall be made by filling the line to be tested with water so that a head of at least is provided above both the water table and the top of the pipe at the upper end of the pipeline to be tested. The filled line shall be allowed to stand until the pipe has reached its maximum absorption, but not less than 4 hours. After absorption, the head shall be reestablished. The amount of water required to maintain this water level during a 2-hour test period shall be measured. Leakage as measured by the exfiltration test shall not exceed 0.2 gallons per inch in diameter per 100 feet 0.2 gallons per inch in diameter per 100 feet of pipeline per hour. When leakage exceeds the maximum amount specified, satisfactory correction shall be made and retesting accomplished. Testing, correcting, and retesting shall be made at no additional cost to the Government.

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SECTION 02722A

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05/01

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SECTION 02722A

AGGREGATE AND/OR GRADED-CRUSHED AGGREGATE BASE COURSE
05/01

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO T 180	(1997) Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and an 457 mm (18-in) Drop
AASHTO T 224	(1996) Correction for Coarse Particles in the Soil Compaction Test

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 29/C 29M	(1997) Bulk Density ("Unit Weight") and Voids in Aggregates
ASTM C 88	(1999a) Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C 117	(1995) Materials Finer Than 75 micrometer (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 127	(1988; R 1993el) Specific Gravity and Absorption of Course Aggregate
ASTM C 128	(1997) Specific Gravity and Absorption of Fine Aggregate
ASTM C 131	(1996) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(1996a) Sieve Analysis of Fine and Coarse Aggregates
ASTM D 75	(1987; R 1997) Sampling Aggregates
ASTM D 1556	(2000) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(1991; R 1998) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu.m.))

ASTM D 2167	(1994) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2487	(2000) Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 4318	(2000) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM E 11	(1995) Wire-Cloth Sieves for Testing Purposes

1.2 DEFINITIONS

For the purposes of this specification, the following definitions apply.

1.2.1 Aggregate Base Course

Aggregate base course (ABC) is well graded, durable aggregate uniformly moistened and mechanically stabilized by compaction.

1.2.2 Graded-crushed Aggregate Base Course

Graded-crushed aggregate (GCA) base course is well graded, crushed, durable aggregate uniformly moistened and mechanically stabilized by compaction. GCA is similar to ABC, but it has more stringent requirements and it produces a base course with higher strength and stability.

1.2.3 Degree of Compaction

Degree of compaction shall be expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557 or AASHTO T 180, Method D and corrected with AASHTO T 224.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Plant, Equipment, and Tools

List of proposed equipment to be used in performance of construction work, including descriptive data.

Waybills and Delivery Tickets

Copies of waybills and delivery tickets during the progress of the work. Before the final statement is allowed, the Contractor shall file certified waybills and certified delivery tickets for all aggregates actually used.

SD-06 Test Reports

Sampling and testing
Field Density Tests

Calibration curves and related test results prior to using the device or equipment being calibrated. Copies of field test results within 24 hours after the tests are performed. Certified copies of test results for approval not less than 30 days before material is required for the work.

1.4 SAMPLING AND TESTING

Sampling and testing shall be the responsibility of the Contractor. Sampling and testing shall be performed by a testing laboratory approved in accordance with Section 01451 CONTRACTOR QUALITY CONTROL. Work requiring testing will not be permitted until the testing laboratory has been inspected and approved. The materials shall be tested to establish compliance with the specified requirements; testing shall be performed at the specified frequency. The Contracting Officer may specify the time and location of the tests. Copies of test results shall be furnished to the Contracting Officer within 24 hours of completion of the tests.

1.4.1 Sampling

Samples for laboratory testing shall be taken in conformance with ASTM D 75. When deemed necessary, the sampling will be observed by the Contracting Officer.

1.4.2 Tests

The following tests shall be performed in conformance with the applicable standards listed.

1.4.2.1 Sieve Analysis

Sieve analysis shall be made in conformance with ASTM C 117 and ASTM C 136. Sieves shall conform to ASTM E 11.

1.4.2.2 Liquid Limit and Plasticity Index

Liquid limit and plasticity index shall be determined in accordance with ASTM D 4318.

1.4.2.3 Moisture-Density Determinations

The maximum density and optimum moisture content shall be determined in accordance with ASTM D 1557.

1.4.2.4 Field Density Tests

Density shall be field measured in accordance with ASTM D 1556 or ASTM D 2167.

1.4.2.5 Wear Test

Wear tests shall be made on ABC course material in conformance with ASTM C 131.

1.4.2.6 Soundness

Soundness tests shall be made on GCA in accordance with ASTM C 88.

1.4.3 Testing Frequency

1.4.3.1 Initial Tests

One of each of the following tests shall be performed on the proposed material prior to commencing construction to demonstrate that the proposed material meets all specified requirements when furnished. If materials from more than one source are going to be utilized, this testing shall be completed for each source.

a. Sieve Analysis including No. 635 size material.

b. Liquid limit and plasticity index.

c. Moisture-density relationship.

d. Wear.

e. Soundness.

1.4.3.2 In Place Tests

Each of the following tests shall be performed on samples taken from the placed and compacted ABC. Samples shall be taken and tested at the rates indicated.

a. Density tests shall be performed on every lift of material placed and at a frequency of one set of tests for every 250 square yards, or portion thereof, of completed area.

b. Sieve Analysis including No. 635 size material shall be performed for every 500 tons, or portion thereof, of material placed.

c. Liquid limit and plasticity index tests shall be performed at the same frequency as the sieve analysis.

1.4.4 Approval of Material

The source of the material shall be selected 7 days prior to the time the material will be required in the work. Tentative approval of material will be based on initial test results. Final approval of the materials will be based on sieve analysis, liquid limit, and plasticity index tests performed on samples taken from the completed and fully compacted ABC.

1.5 WEATHER LIMITATIONS

Construction shall be done when the atmospheric temperature is above 35 degrees F. When the temperature falls below 35 degrees F, the Contractor shall protect all completed areas by approved methods against detrimental effects of freezing. Completed areas damaged by freezing, rainfall, or other weather conditions shall be corrected to meet specified requirements.

1.6 PLANT, EQUIPMENT, AND TOOLS

All plant, equipment, and tools used in the performance of the work will be

subject to approval before the work is started and shall be maintained in satisfactory working condition at all times. The equipment shall be adequate and shall have the capability of producing the required compaction, meeting grade controls, thickness control, and smoothness requirements as set forth herein.

PART 2 PRODUCTS

2.1 AGGREGATES

The ABC shall consist of clean, sound, durable particles of crushed stone, crushed slag, crushed gravel, crushed recycled concrete, angular sand, or other approved material. ABC shall be free of lumps of clay, organic matter, and other objectionable materials or coatings. The portion retained on the No. 4 sieve shall be known as coarse aggregate; that portion passing the No. 4 sieve shall be known as fine aggregate.

2.1.1 Coarse Aggregate

Coarse aggregates shall be angular particles of uniform density. When the coarse aggregate is supplied from more than one source, aggregate from each source shall meet the specified requirements and shall be stockpiled separately.

a. Crushed Gravel: Crushed gravel shall be manufactured by crushing gravels, and shall meet all the requirements specified below.

b. Crushed Stone: Crushed stone shall consist of freshly mined quarry rock, and shall meet all the requirements specified below.

c. Crushed Recycled Concrete: Crushed recycled concrete shall consist of previously hardened portland cement concrete or other concrete containing pozzolanic binder material. The recycled material shall be free of all reinforcing steel, bituminous concrete surfacing, and any other foreign material and shall be crushed and processed to meet the required gradations for coarse aggregate. Crushed recycled concrete shall meet all other applicable requirements specified below.

d. Crushed Slag: Crushed slag shall be an air-cooled blast-furnace product having an air dry unit weight of not less than 65 pcf as determined by ASTM C 29/C 29M, and shall meet all the requirements specified below.

2.1.1.1 Aggregate Base Course

ABC coarse aggregate shall not show more than 50 percent loss when subjected to the Los Angeles abrasion test in accordance with ASTM C 131. The amount of flat and elongated particles shall not exceed 30 percent. A flat particle is one having a ratio of width to thickness greater than 3; an elongated particle is one having a ratio of length to width greater than 3. In the portion retained on each sieve specified, the crushed aggregates shall contain at least 50 percent by weight of crushed pieces having two or more freshly fractured faces with the area of each face being at least equal to 75 percent of the smallest midsectional area of the piece. When two fractures are contiguous, the angle between planes of the fractures must be at least 30 degrees in order to count as two fractured faces. Crushed gravel shall be manufactured from gravel particles 50 percent of which, by weight, are retained on the maximum size sieve listed in TABLE 1.

2.1.2 Fine Aggregate

Fine aggregates shall be angular particles of uniform density. When the fine aggregate is supplied from more than one source, aggregate from each source shall meet the specified requirements.

2.1.2.1 Aggregate Base Course

ABC fine aggregate shall consist of screenings, angular sand, crushed recycled concrete fines, or other finely divided mineral matter processed or naturally combined with the coarse aggregate.

2.1.3 Gradation Requirements

The specified gradation requirements shall apply to the completed base course. The aggregates shall have a maximum size of 1.5 inches and shall be continuously well graded within the limits specified in TABLE 1. Sieves shall conform to ASTM E 11.

TABLE I. GRADATION OF AGGREGATES

Percentage by Weight Passing Square-Mesh Sieve

Sieve Designation	No. 1	No. 2	No. 3
2 inch	100	----	----
1-1/2 inch	70-100	100	----
1 inch	45-80	60-100	100
1/2 inch	30-60	30-65	40-70
No. 4	20-50	20-50	20-50
No. 10	15-40	15-40	15-40
No. 40	5-25	5-25	5-25
No. 200	0-8	0-8	0-8

NOTE 1: Particles having diameters less than 0.0008 inch shall not be in excess of 3 percent by weight of the total sample tested.

NOTE 2: The values are based on aggregates of uniform specific gravity. If materials from different sources are used for the coarse and fine aggregates, they shall be tested in accordance with ASTM C 127 and ASTM C 128 to determine their specific gravities. If the specific gravities vary by more than 10 percent, the percentages passing the various sieves shall be corrected as directed by the Contracting Officer.

2.1.4 Liquid Limit and Plasticity Index

Liquid limit and plasticity index requirements shall apply to the completed course and shall also apply to any component that is blended to meet the required gradation. The portion of any component or of the completed course passing the No. 40 sieve shall be either nonplastic or have a liquid limit not greater than 25 and a plasticity index not greater than 5.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

When the ABC is constructed in more than one layer, the previously constructed layer shall be cleaned of loose and foreign matter by sweeping

with power sweepers or power brooms, except that hand brooms may be used in areas where power cleaning is not practicable. Adequate drainage shall be provided during the entire period of construction to prevent water from collecting or standing on the working area. Line and grade stakes shall be provided as necessary for control. Grade stakes shall be in lines parallel to the centerline of the area under construction and suitably spaced for string lining.

3.2 OPERATION OF AGGREGATE SOURCES

Aggregate sources shall be cleared, stripped and excavated to working depths producing excavation faces that are as nearly vertical as practicable for the materials being excavated. Strata of unsuitable materials overlying or occurring in the deposit shall be wasted. Methods of operating aggregate sources, and the processing and blending of the materials, shall be changed or modified if necessary to obtain material conforming to the specified requirements. Upon completion of the work, aggregate sources shall be conditioned to drain readily and be left in a satisfactory condition.

3.3 STOCKPILING MATERIAL

Prior to stockpiling of material, storage sites shall be cleared and leveled by the Contractor. All materials, including approved material available from excavation and grading, shall be stockpiled in the manner and at the locations designated. Aggregates shall be stockpiled on the cleared and leveled areas designated by the Contracting Officer to prevent segregation. Materials obtained from different sources shall be stockpiled separately.

3.4 PREPARATION OF UNDERLYING COURSE

Prior to constructing the ABC, the underlying course or subgrade shall be cleaned of all foreign substances. At the time of construction of the ABC, the underlying course shall contain no frozen material. The surface of the underlying course or subgrade shall meet specified compaction and surface tolerances. The underlying course shall conform to Section 02300 EARTHWORK. Ruts or soft yielding spots in the underlying courses, areas having inadequate compaction, and deviations of the surface from the requirements set forth herein shall be corrected by loosening and removing soft or unsatisfactory material and by adding approved material, reshaping to line and grade, and recompacting to specified density requirements. For cohesionless underlying courses containing sands or gravels, as defined in ASTM D 2487, the surface shall be stabilized prior to placement of the ABC. Stabilization shall be accomplished by mixing ABC into the underlying course and compacting by approved methods. The stabilized material shall be considered as part of the underlying course and shall meet all requirements of the underlying course. The finished underlying course shall not be disturbed by traffic or other operations and shall be maintained by the Contractor in a satisfactory condition until the ABC is placed.

3.5 INSTALLATION

3.5.1 Mixing the Materials

The coarse and fine aggregates shall be mixed in a stationary plant, or in a traveling plant or bucket loader on an approved paved working area. The Contractor shall make adjustments in mixing procedures or in equipment as

directed to obtain true grades, to minimize segregation or degradation, to obtain the required water content, and to insure a satisfactory ABC meeting all requirements of this specification.

3.5.2 Placing

The mixed material shall be placed on the prepared subgrade or subbase in layers of uniform thickness with an approved spreader. When a compacted layer 6 inches or less in thickness is required, the material shall be placed in a single layer. When a compacted layer in excess of 6 inches is required, the material shall be placed in layers of equal thickness. No layer shall exceed 6 inches or less than 3 inches when compacted. The layers shall be so placed that when compacted they will be true to the grades or levels required with the least possible surface disturbance. Where the ABC is placed in more than one layer, the previously constructed layers shall be cleaned of loose and foreign matter by sweeping with power sweepers, power brooms, or hand brooms, as directed. Such adjustments in placing procedures or equipment shall be made as may be directed to obtain true grades, to minimize segregation and degradation, to adjust the water content, and to insure an acceptable ABC.

3.5.3 Grade Control

The finished and completed ABC shall conform to the lines, grades, and cross sections shown. Underlying material(s) shall be excavated and prepared at sufficient depth for the required ABC thickness so that the finished ABC with the subsequent surface course will meet the designated grades.

3.5.4 Edges of Base Course

The ABC shall be placed so that the completed section will be a minimum of 5 feet wider, on all sides, than the next layer that will be placed above it. Additionally, approved fill material shall be placed along the outer edges of ABC in sufficient quantities to compact to the thickness of the course being constructed, or to the thickness of each layer in a multiple layer course, allowing in each operation at least a 2 foot width of this material to be rolled and compacted simultaneously with rolling and compacting of each layer of ABC. If this base course material is to be placed adjacent to another pavement section, then the layers for both of these sections shall be placed and compacted along this edge at the same time.

3.5.5 Compaction

Each layer of the ABC shall be compacted as specified with approved compaction equipment. Water content shall be maintained during the compaction procedure to within plus or minus 100 percent of the optimum water content determined from laboratory tests as specified in paragraph SAMPLING AND TESTING. Rolling shall begin at the outside edge of the surface and proceed to the center, overlapping on successive trips at least one-half the width of the roller. Alternate trips of the roller shall be slightly different lengths. Speed of the roller shall be such that displacement of the aggregate does not occur. In all places not accessible to the rollers, the mixture shall be compacted with hand-operated power tampers. Compaction shall continue until each layer has a degree of compaction that is at least 100 percent of laboratory maximum density through the full depth of the layer. The Contractor shall make such adjustments in compacting or finishing procedures as may be directed to

obtain true grades, to minimize segregation and degradation, to reduce or increase water content, and to ensure a satisfactory ABC. Any materials that are found to be unsatisfactory shall be removed and replaced with satisfactory material or reworked, as directed, to meet the requirements of this specification.

3.5.6 Thickness

Compacted thickness of the aggregate course shall be as indicated inches. No individual layer shall exceed 6 inches nor be less than 3 inches in compacted thickness. The total compacted thickness of the ABC course shall be within 1/2 inch of the thickness indicated. Where the measured thickness is more than 1/2 inch deficient, such areas shall be corrected by scarifying, adding new material of proper gradation, reblading, and recompacting as directed. Where the measured thickness is more than 1/2 inch thicker than indicated, the course shall be considered as conforming to the specified thickness requirements. Average job thickness shall be the average of all thickness measurements taken for the job, but shall be within 1/4 inch of the thickness indicated. The total thickness of the ABC course shall be measured at intervals in such a manner as to ensure one measurement for each 500 square yards of base course. Measurements shall be made in 3 inch diameter test holes penetrating the base course.

3.5.7 Proof Rolling

Proof rolling of the areas indicated shall be in addition to the compaction specified and shall consist of the application of 30 coverages with a heavy pneumatic-tired roller having four or more tires, each loaded to a minimum of 30,000 pounds and inflated to a minimum of 150 psi. In areas designated, proof rolling shall be applied to the top of the underlying material on which ABC is laid and to each layer of ABC. Water content of the underlying material shall be maintained at optimum or at the percentage directed from start of compaction to completion of proof rolling of that layer. Water content of each layer of the ABC shall be maintained at the optimum percentage directed from start of compaction to completion of proof rolling. Any ABC materials or any underlying materials that produce unsatisfactory results by proof rolling shall be removed and replaced with satisfactory materials, recompacted and proof rolled to meet these specifications.

3.5.8 Finishing

The surface of the top layer of ABC shall be finished after final compaction and proof rolling by cutting any overbuild to grade and rolling with a steel-wheeled roller. Thin layers of material shall not be added to the top layer of base course to meet grade. If the elevation of the top layer of ABC is 1/2 inch or more below grade, then the top layer should be scarified to a depth of at least 3 inches and new material shall be blended in, compacted and proof rolled to bring to grade. Adjustments to rolling and finishing procedures shall be made as directed to minimize segregation and degradation, obtain grades, maintain moisture content, and insure an acceptable base course. Should the surface become rough, corrugated, uneven in texture, or traffic marked prior to completion, the unsatisfactory portion shall be scarified, reworked and recompacted or it shall be replaced as directed.

3.5.9 Smoothness

The surface of the top layer shall show no deviations in excess of 3/8 inch

when tested with a 10 foot straightedge. Measurements shall be taken in successive positions parallel to the centerline of the area to be paved. Measurements shall also be taken perpendicular to the centerline at 49 foot intervals. Deviations exceeding this amount shall be corrected by removing material and replacing with new material, or by reworking existing material and compacting it to meet these specifications.

3.6 TRAFFIC

Traffic shall not be allowed on the completed ABC course.

3.7 MAINTENANCE

The ABC shall be maintained in a satisfactory condition until the full pavement section is completed and accepted. Maintenance shall include immediate repairs to any defects and shall be repeated as often as necessary to keep the area intact. Any ABC that is not paved over prior to the onset of winter, shall be retested to verify that it still complies with the requirements of this specification. Any area of ABC that is damaged shall be reworked or replaced as necessary to comply with this specification.

3.8 DISPOSAL OF UNSATISFACTORY MATERIALS

Any unsuitable materials that must be removed shall be disposed of in waste disposal areas indicated. No additional payments will be made for materials that must be replaced.

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SECTION 02725

PERVIOUS AC PAVING AND GROUNDWATER RECHARGE BEDS

09/03

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SECTION 02725

PERVIOUS AC PAVING AND GROUNDWATER RECHARGE BEDS
09/03

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-## Title

Item Covered by Submittal; G

Text explaining details of information to be submitted.

PART 2 PRODUCTS

2.1 PARTS

Part titles are the three part titles (GENERAL, PRODUCTS, and EXECUTION) established by CSI. All three parts must be included in sections in Divisions 2 through 16. Part titles in sections in Divisions 00 and 01 may be omitted if not necessary for the subject matter being presented. Divisions 00 and 01 sections without part titles must still contain the part 1 PART TAGS at the appropriate location, and all paragraphs in the section must be numbered with the prefix 1 (1.1, 1.2, etc.).

2.2 PARAGRAPHS

This is a first tier or main paragraph. Numbered paragraph levels are as follows:

1.1 Main Paragraphs (First Tier Paragraphs)
1.1.1 Subparagraphs (Second Tier Paragraphs)
1.1.1.1 Subparagraphs (Third Tier Paragraphs)

Subdivisions below the third tier should be avoided, but when necessary they should carry alpha designations (a, b, etc.). Subdivisions below the third tier will not appear on the table of contents generated through SPECSINTACT.

2.3 MAIN PARAGRAPH TITLES

All numbered paragraphs and subparagraphs must have titles which are entered three spaces after the number. Titles for paragraphs with alpha designations are optional, but must be consistent within any main paragraph.

2.4 Item Covered by Submittal

An item covered by submittal should be tagged in a paragraph describing the requirements for the item in order for that paragraph number to be entered on the submittal register. If the name of the item is also the title of

the paragraph, it is preferable to tag the paragraph title, otherwise it is permissible to tag the name of the item in the paragraph text.

PART 3 EXECUTION

3.1 SEQUENCE OF MAIN PARAGRAPHS

Sequence of main paragraphs should follow the sequence provided in the document GUIDANCE FOR THE PREPARATION OF CORPS OF ENGINEERS GUIDE SPECIFICATIONS (CEGS) to the extent those titles are appropriate for the subject matter involved. When the titles provided are not appropriate, care should still be taken to maintain the same subject matter sequence as provided in the guidance document.

3.2 DATE OF TEMPLATE

The date of this template is 1 October 2000. This template will be updated from time-to-time to reflect current requirements.

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SECTION 02741A

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09/99

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SECTION 02741A

HOT-MIX ASPHALT (HMA) FOR ROADS
09/99

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO MP 2	(1998; Interim 1999) Superpave Volumetric Mix Design
AASHTO TP53	(1998; Interim 1999) Determining Asphalt Content of Hot Mix Asphalt by the Ignition Method

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 29/C 29M	(1997) Bulk Density ("Unit Weight") and Voids in Aggregates
ASTM C 88	(1999a) Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C 117	(1995) Materials Finer than 75 micrometer (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 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 566	(1997) Evaporable Total Moisture Content of Aggregate by Drying
ASTM C 1252	(1998) Uncompacted Void Content of Fine Aggregate (as Influenced by Particle Shape, Surface Texture, and Grading)
ASTM D 140	(1998) Sampling Bituminous Materials
ASTM D 242	(1995) Mineral Filler for Bituminous Paving Mixtures
ASTM D 946	(1999) Penetration-Graded Asphalt Cement for Use in Pavement Construction
ASTM D 995	(1995b) Mixing Plants for Hot-Mixed,

	Hot-Laid Bituminous Paving Mixtures
ASTM D 1461	(1985)) Moisture or Volatile Distillates in Bituminous Paving Mixtures
ASTM D 1559	(1989) Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
ASTM D 2041	(1995) Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
ASTM D 2172	(1995) Quantitative Extraction of Bitumen from Bituminous Paving Mixtures
ASTM D 2419	(1995) Sand Equivalent Value of Soils and Fine Aggregate
ASTM D 2489	(1984; R 1994el) Degree of Particle Coating of Bituminous-Aggregate Mixtures
ASTM D 2726	(1996el) Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixture
ASTM D 2950	(1997) Density of Bituminous Concrete in Place by Nuclear Method
ASTM D 3381	(1999) Viscosity-Graded Asphalt Cement for Use in Pavement Construction
ASTM D 3665	(1999) Random Sampling of Construction Materials
ASTM D 3666	(1998) Minimum Requirements for Agencies Testing and Inspecting Bituminous Paving Materials
ASTM D 4125	(1994el)Asphalt Content of Bituminous Mixtures by the Nuclear Method
ASTM D 4791	(1999) Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
ASTM D 4867/D 4867M	(1996) Effect of Moisture on Asphalt Concrete Paving Mixtures
ASTM D 5444	(1998) Mechanical Size Analysis of Extracted Aggregate
ASTM D 6307	(1998) Asphalt Content of Hot Mix Asphalt by Ignition Method

ASPHALT INSTITUTE (AI)

AI MS-2	(1997) Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types

AI MS-22	(1998; 2nd Edition) Construction of Hot-Mix Asphalt Pavements

CALIFORNIA DEPARTMENT OF TRANSPORTATION (CDT)

CDT Test 526	(1978) Operation of California Profilograph and Evaluation of Profiles

CORPS OF ENGINEERS (COE)

COE CRD-C 171	(1995) Test Method for Determining Percentage of Crushed Particles in Aggregate

1.2 DESCRIPTION OF WORK

The work shall consist of pavement courses composed of mineral aggregate and asphalt material heated and mixed in a central mixing plant and placed on a prepared course. HMA designed and constructed in accordance with this section shall conform to the lines, grades, thicknesses, and typical cross sections shown on the drawings. Each course shall be constructed to the depth, section, or elevation required by the drawings and shall be rolled, finished, and approved before the placement of the next course.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Mix Design; G

Proposed JMF.

Contractor Quality Control; G.

Quality control plan.

Material Acceptance and Percent Payment;G.

Acceptance test results and pay calculations.

SD-04 Samples

Asphalt Cement Binder

5 gallon sample for mix design verification.

Aggregates

Sufficient materials to produce 200 lb. of blended mixture for mix design verification.

SD-06 Test Reports

Aggregates; G

QC Monitoring

Aggregate and QC test results.

SD-07 Certificates

Asphalt Cement Binder; G.

Copies of certified test data.

Testing Laboratory

Certification of compliance.

Plant Scale Calibration Certification

1.4 ASPHALT MIXING PLANT

Plants used for the preparation of hot-mix asphalt shall conform to the requirements of ASTM D 995 with the following changes:

a. Truck Scales. The asphalt mixture shall be weighed on approved certified scales at the Contractor's expense. Scales shall be inspected and sealed at least annually by an approved calibration laboratory.

b. Testing Facilities. The Contractor shall provide laboratory facilities at the plant for the use of the Government's acceptance testing and the Contractor's quality control testing.

c. Inspection of Plant. The Contracting Officer shall have access at all times, to all areas of the plant for checking adequacy of equipment; inspecting operation of the plant; verifying weights, proportions, and material properties; checking the temperatures maintained in the preparation of the mixtures and for taking samples. The Contractor shall provide assistance as requested, for the Government to procure any desired samples.

d. Storage Bins. Use of storage bins for temporary storage of hot-mix asphalt will be permitted as follows:

(1) The asphalt mixture may be stored in non-insulated storage bins for a period of time not exceeding 3 hours.

(2) The asphalt mixture may be stored in insulated storage bins for a period of time not exceeding 8 hours. The mix drawn from bins shall meet the same requirements as mix loaded directly into trucks.

1.5 HAULING EQUIPMENT

Trucks used for hauling hot-mix asphalt shall have tight, clean, and smooth metal beds. To prevent the mixture from adhering to them, the truck beds shall be lightly coated with a minimum amount of paraffin oil, lime solution, or other approved material. Petroleum based products shall not be used as a release agent. Each truck shall have a suitable cover to protect the mixture from adverse weather. When necessary to ensure that the mixture will be delivered to the site at the specified temperature, truck beds shall be insulated or heated and covers (tarps) shall be securely fastened.

1.6 ASPHALT PAVERS

Asphalt pavers shall be self-propelled, with an activated screed, heated as necessary, and shall be capable of spreading and finishing courses of hot-mix asphalt which will meet the specified thickness, smoothness, and grade. The paver shall have sufficient power to propel itself and the hauling equipment without adversely affecting the finished surface.

1.6.1 Receiving Hopper

The paver shall have a receiving hopper of sufficient capacity to permit a uniform spreading operation. The hopper shall be equipped with a distribution system to place the mixture uniformly in front of the screed without segregation. The screed shall effectively produce a finished surface of the required evenness and texture without tearing, shoving, or gouging the mixture.

1.6.2 Automatic Grade Controls

If an automatic grade control device is used, the paver shall be equipped with a control system capable of automatically maintaining the specified screed elevation. The control system shall be automatically actuated from either a reference line and/or through a system of mechanical sensors or sensor-directed mechanisms or devices which will maintain the paver screed at a predetermined transverse slope and at the proper elevation to obtain the required surface. The transverse slope controller shall be capable of maintaining the screed at the desired slope within plus or minus 0.1 percent. A transverse slope controller shall not be used to control grade. The controls shall be capable of working in conjunction with any of the following attachments:

a. Ski-type device of not less than 29.5 feet in length.

b. Taut stringline set to grade.

c. Short ski or shoe for joint matching.

d. Laser control.

1.7 ROLLERS

Rollers shall be in good condition and shall be operated at slow speeds to avoid displacement of the asphalt mixture. The number, type, and weight of rollers shall be sufficient to compact the mixture to the required density while it is still in a workable condition. Equipment which causes excessive crushing of the aggregate shall not be used.

1.8 WEATHER LIMITATIONS

The hot-mix asphalt shall not be placed upon a wet surface or when the surface temperature of the underlying course is less than specified in Table 1. The temperature requirements may be waived by the Contracting Officer, if requested; however, all other requirements, including compaction, shall be met.

Table 1. Surface Temperature Limitations of Underlying Course

Mat Thickness, In.	Degrees C
3 In. or greater	5
Less than 3 In.	8

PART 2 PRODUCTS

2.1 AGGREGATES

Aggregates shall consist of crushed stone, crushed gravel, crushed slag, screenings, natural sand and mineral filler, as required. The portion of material retained on the No. 4 sieve is coarse aggregate. The portion of material passing the No. 4 sieve and retained on the No. 200 sieve is fine aggregate. The portion passing the No. 200 sieve is defined as mineral filler. All aggregate test results and samples shall be submitted to the Contracting Officer at least 14 days prior to start of construction.

2.1.1 Coarse Aggregate

Coarse aggregate shall consist of sound, tough, durable particles, free from films of material that would prevent thorough coating and bonding with the asphalt material and free from organic matter and other deleterious substances. All individual coarse aggregate sources shall meet the following requirements:

a. The percentage of loss shall not be greater than 40 percent after 500 revolutions when tested in accordance with ASTM C 131.

b. The percentage of loss shall not be greater than 18 percent after five cycles when tested in accordance with ASTM C 88 using magnesium sulfate or 12 percent when using sodium sulfate.

c. At least 75 percent by weight of coarse aggregate shall have at least two or more fractured faces when tested in accordance with COE CRD-C 171. Fractured faces shall be produced by crushing.

d. The particle shape shall be essentially cubical and the aggregate shall not contain more than 20% percent, by weight, of flat and elongated particles (3:1 ratio of maximum to minimum) when tested in accordance with ASTM D 4791.

e. Slag shall be air-cooled, blast furnace slag, and shall have a compacted weight of not less than 75 lb/cu ft when tested in accordance with ASTM C 29/C 29M.

2.1.2 Fine Aggregate

Fine aggregate shall consist of clean, sound, tough, durable particles. The aggregate particles shall be free from coatings of clay, silt, or any objectionable material and shall contain no clay balls. All individual fine aggregate sources shall have a sand equivalent value not less than 45 when tested in accordance with ASTM D 2419.

The fine aggregate portion of the blended aggregate shall have an uncompacted void content not less than 43.0 percent when tested in

accordance with ASTM C 1252 Method A.

2.1.3 Mineral Filler

Mineral filler shall be nonplastic material meeting the requirements of ASTM D 242.

2.1.4 Aggregate Gradation

The combined aggregate gradation shall conform to gradations specified in Table 2, when tested in accordance with ASTM C 136 and ASTM C 117, and shall not vary from the low limit on one sieve to the high limit on the adjacent sieve or vice versa, but grade uniformly from coarse to fine.

Table 2. Aggregate Gradations

Sieve Size, inch	Gradation 1 Percent Passing by Mass	Gradation 2 Percent Passing by Mass	Gradation 3 Percent Passing by Mass
1	100	---	---
3/4	76-96	100	---
1/2	68-88	76-96	100
3/8	60-82	69-89	76-96
No. 4	45-67	53-73	58-78
No. 8	32-54	38-60	40-60
No. 16	22-44	26-48	28-48
No. 30	15-35	18-38	18-38
No. 50	9-25	11-27	11-27
No. 100	6-18	6-18	6-18
No. 200	3-6	3-6	3-6

2.2 ASPHALT CEMENT BINDER

Asphalt cement binder shall conform to ASTM D 3381 Table 2, Viscosity Grade ASTM D 946 penetration grade. Test data indicating grade certification shall be provided by the supplier at the time of delivery of each load to the mix plant. Copies of these certifications shall be submitted to the Contracting Officer. The supplier is defined as the last source of any modification to the binder. The Contracting Officer may sample and test the binder at the mix plant at any time before or during mix production. Samples for this verification testing shall be obtained by the Contractor in accordance with ASTM D 140 and in the presence of the Contracting Officer. These samples shall be furnished to the Contracting Officer for the verification testing, which shall be at no cost to the Contractor. Samples of the asphalt cement specified shall be submitted for approval not less than 14 days before start of the test section.

2.3 MIX DESIGN

The Contractor shall develop the mix design. The asphalt mix shall be composed of a mixture of well-graded aggregate, mineral filler if required, and asphalt material. The aggregate fractions shall be sized, handled in separate size groups, and combined in such proportions that the resulting mixture meets the grading requirements of the job mix formula (JMF). No hot-mix asphalt for payment shall be produced until a JMF has been approved. The hot-mix asphalt shall be designed using procedures contained in AI MS-2 and the criteria shown in Table 3. If the Tensile Strength

Ratio (TSR) of the composite mixture, as determined by ASTM D 4867/D 4867M is less than 75, the aggregates shall be rejected or the asphalt mixture treated with an approved anti-stripping agent. The amount of anti-stripping agent added shall be sufficient to produce a TSR of not less than 75. If an antistrip agent is required, it shall be provided by the Contractor at no additional cost. Sufficient materials to produce 200 pound of blended mixture shall be provided to the Contracting Officer for verification of mix design at least 14 days prior to construction of test section.

At the option of the contractor a currently used DOT superpave hot mix may be used in lieu of developing a new hot mix design study as described herein. The superpave volumetric mix shall be designed in accordance with AASHTO MP 2.

2.3.1 JMF Requirements

The job mix formula shall be submitted in writing by the Contractor for approval at least 14 days prior to the start of the test section and shall include as a minimum:

a. Percent passing each sieve size.

b. Percent of asphalt cement.

c. Percent of each aggregate and mineral filler to be used.

d. Asphalt viscosity grade, penetration grade, or performance grade.

e. Number of blows of hammer per side of molded specimen.

f. Laboratory mixing temperature.

g. Lab compaction temperature.

h. Temperature-viscosity relationship of the asphalt cement.

i. Plot of the combined gradation on the 0.45 power gradation chart, stating the nominal maximum size.

j. Graphical plots of stability, flow, air voids, voids in the mineral aggregate, and unit weight versus asphalt content as shown in AI MS-2.

k. Specific gravity and absorption of each aggregate.

l. Percent natural sand.

m. Percent particles with 2 or more fractured faces (in coarse aggregate).

n. Fine aggregate angularity.

o. Percent flat or elongated particles (in coarse aggregate).

p. Tensile Strength Ratio(TSR).

q. Antistrip agent (if required) and amount.

r. List of all modifiers and amount.

s. Percentage and properties (asphalt content, binder properties, and aggregate properties) of reclaimed asphalt pavement (RAP) in accordance with paragraph RECYCLED HOT-MIX ASPHALT, if RAP is used.

Table 3. Marshall Design Criteria

Test Property	75 Blow Mix	50 Blow Mix
Stability, pounds minimum	*1800	*1000
Flow, 0.01 inch	8-16	8-18
Air voids, percent	3-5	3-5
Percent Voids in mineral aggregate VMA, (minimum)		
Gradation 1	13.0	13.0
Gradation 2	14.0	14.0
Gradation 3	15.0	15.0
TSR, minimum percent	75	75

* This is a minimum requirement. The average during construction shall be significantly higher than this number to ensure compliance with the specifications.
** Calculate VMA in accordance with AI MS-2, based on ASTM D 2726 bulk specific gravity for the aggregate.

2.3.2 Adjustments to Field JMF

The Laboratory JMF for each mixture shall be in effect until a new formula is approved in writing by the Contracting Officer. Should a change in sources of any materials be made, a new laboratory jmf design shall be performed and a new JMF approved before the new material is used. The Contractor will be allowed to adjust the Laboratory JMF within the limits specified below to optimize mix volumetric properties with the approval of the Contracting Officer. Adjustments to the Laboratory JMF shall be applied to the field (plant) established JMF and limited to those values as shown. Adjustments shall be targeted to produce or nearly produce 4 percent voids total mix (VTM).

TABLE 4. Field (Plant) Established JMF Tolerances

Sieves	Adjustments (plus or minus), percent
No. 4	3
No. 8	3
No. 200	1
Binder Content	0.40

If adjustments are needed that exceed these limits, a new mix design shall be developed. Tolerances given above may permit the aggregate grading to

be outside the limits shown in Table 2; while not desirable, this is acceptable.

2.4 RECYCLED HOT MIX ASPHALT

Recycled HMA shall consist of reclaimed asphalt pavement (RAP), coarse aggregate, fine aggregate, mineral filler, and asphalt cement. The RAP shall be of a consistent gradation and asphalt content and properties. When RAP is fed into the plant, the maximum RAP chunk size shall not exceed 2 inches. The recycled HMA mix shall be designed using procedures contained in AI MS-2 and AI MS-22. The job mix shall meet the requirements of paragraph MIX DESIGN. The amount of RAP shall not exceed 30 percent.

2.4.1 RAP Aggregates and Asphalt Cement

The blend of aggregates used in the recycled mix shall meet the requirements of paragraph AGGREGATES. The percentage of asphalt in the RAP shall be established for the mixture design according to ASTM D 2172 using the appropriate dust correction procedure.

2.4.2 RAP Mix

The blend of new asphalt cement and the RAP asphalt binder shall meet the penetration or viscosity requirements in paragraph ASPHALT CEMENT BINDER. The virgin asphalt cement shall not be more than two standard asphalt material grades different than that specified in paragraph ASPHALT CEMENT BINDER.

PART 3 EXECUTION

3.1 PREPARATION OF ASPHALT BINDER MATERIAL

The asphalt cement material shall be heated avoiding local overheating and providing a continuous supply of the asphalt material to the mixer at a uniform temperature. The temperature of unmodified asphalts shall be no more than 170 degrees C when added to the aggregates. Modified asphalts shall be no more than 185 degrees C when added to the aggregates.

3.2 PREPARATION OF MINERAL AGGREGATE

The aggregate for the mixture shall be heated and dried prior to mixing. No damage shall occur to the aggregates due to the maximum temperature and rate of heating used. The temperature of the aggregate and mineral filler shall not exceed 170 degrees C when the asphalt cement is added. The temperature shall not be lower than is required to obtain complete coating and uniform distribution on the aggregate particles and to provide a mixture of satisfactory workability.

3.3 PREPARATION OF HOT-MIX ASPHALT MIXTURE

The aggregates and the asphalt cement shall be weighed or metered and introduced into the mixer in the amount specified by the JMF. The combined materials shall be mixed until the aggregate obtains a uniform coating of asphalt binder and is thoroughly distributed throughout the mixture. Wet mixing time shall be the shortest time that will produce a satisfactory mixture, but no less than 25 seconds for batch plants. The wet mixing time for all plants shall be established by the Contractor, based on the procedure for determining the percentage of coated particles described in ASTM D 2489, for each individual plant and for each type of aggregate used.

The wet mixing time will be set to at least achieve 95 percent of coated particles. The moisture content of all hot-mix asphalt upon discharge from the plant shall not exceed 0.5 percent by total weight of mixture as measured by ASTM D 1461.

3.4 PREPARATION OF THE UNDERLYING SURFACE

Immediately before placing the hot mix asphalt, the underlying course shall be cleaned of dust and debris. A tack coat shall be applied in accordance with the contract specifications.

3.5 TEST SECTION

Prior to full production, the Contractor shall place a test section for each JMF used. The contractor shall construct a test section 250-500 feet long and two paver passes wide placed for two lanes, with a longitudinal cold joint. The test section shall be of the same depth as the course which it represents. The underlying grade or pavement structure upon which the test section is to be constructed shall be the same as the remainder of the course represented by the test section. The equipment and personnel used in construction of the test section shall be the same equipment to be used on the remainder of the course represented by the test section. The test section shall be placed as part of the project pavement as approved by the Contracting Officer.

3.5.1 Sampling and Testing for Test Section

One random sample shall be taken at the plant, triplicate specimens compacted, and tested for stability, flow, and laboratory air voids. A portion of the same sample shall be tested for aggregate gradation and asphalt content. Four randomly selected cores shall be taken from the finished pavement mat, and four from the longitudinal joint, and tested for density. Random sampling shall be in accordance with procedures contained in ASTM D 3665. The test results shall be within the tolerances shown in Table 5 for work to continue. If all test results meet the specified requirements, the test section shall remain as part of the project pavement. If test results exceed the tolerances shown, the test section shall be removed and replaced at no cost to the Government and another test section shall be constructed. The test section shall be paid for with the first lot of paving

Table 5. Test Section Requirements for Material and Mixture Properties

Property	Specification Limit
Aggregate Gradation-Percent Passing (Individual Test Result)	
No. 4 and larger	JMF plus or minus 8
No. 8, No. 16, No. 30, and No. 50	JMF plus or minus 6
No. 100 and No. 200	JMF plus or minus 2.0
Asphalt Content, Percent (Individual Test Result)	JMF plus or minus 0.5
Laboratory Air Voids, Percent (Average of 3 specimens)	JMF plus or minus 1.0

Table 5. Test Section Requirements for Material and Mixture Properties

Property	Specification Limit
VMA, Percent (Average of 3 specimens)	13 minimum
Stability, kilograms (Average of 3 specimens)	500 minimum
Flow, 1 inch (Average of 3 specimens)	2-4
Mat Density, Percent of Marshall (Average of 4 Random Cores)	97.0 - 100.5
Joint Density, Percent of Marshall (Average of 4 Random Cores)	95.5 - 100.5

3.5.2 Additional Test Sections

If the initial test section should prove to be unacceptable, the necessary adjustments to the JMF, plant operation, placing procedures, and/or rolling procedures shall be made. A second test section shall then be placed. Additional test sections, as required, shall be constructed and evaluated for conformance to the specifications. Full production shall not begin until an acceptable section has been constructed and accepted.

3.6 TESTING LABORATORY

The laboratory used to develop the JMF shall meet the requirements of ASTM D 3666. A certification signed by the manager of the laboratory stating that it meets these requirements or clearly listing all deficiencies shall be submitted to the Contracting Officer prior to the start of construction. The certification shall contain as a minimum:

a. Qualifications of personnel; laboratory manager, supervising technician, and testing technicians.

b. A listing of equipment to be used in developing the job mix.

c. A copy of the laboratory's quality control system.

d. Evidence of participation in the AASHTO Materials Reference Laboratory (AMRL) program.

3.7 TRANSPORTING AND PLACING

3.7.1 Transporting

The hot-mix asphalt shall be transported from the mixing plant to the site in clean, tight vehicles. Deliveries shall be scheduled so that placing and compacting of mixture is uniform with minimum stopping and starting of the paver. Adequate artificial lighting shall be provided for night placements. Hauling over freshly placed material will not be permitted until the material has been compacted as specified, and allowed to cool to 65 degrees C. To deliver mix to the paver, the Contractor shall use a material transfer vehicle which shall be operated to produce continuous forward motion of the paver.

3.7.2 Placing

The mix shall be placed and compacted at a temperature suitable for obtaining density, surface smoothness, and other specified requirements. Upon arrival, the mixture shall be placed to the full width by an asphalt paver; it shall be struck off in a uniform layer of such depth that, when the work is completed, it shall have the required thickness and conform to the grade and contour indicated. The speed of the paver shall be regulated to eliminate pulling and tearing of the asphalt mat. Unless otherwise permitted, placement of the mixture shall begin along the centerline of a crowned section or on the high side of areas with a one-way slope. The mixture shall be placed in consecutive adjacent strips having a minimum width of 10 feet. The longitudinal joint in one course shall offset the longitudinal joint in the course immediately below by at least 12 inches; however, the joint in the surface course shall be at the centerline of the pavement. Transverse joints in one course shall be offset by at least 10 feet from transverse joints in the previous course. Transverse joints in adjacent lanes shall be offset a minimum of 10 feet. On isolated areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impractical, the mixture may be spread and luted by hand tools.

3.8 COMPACTION OF MIXTURE

After placing, the mixture shall be thoroughly and uniformly compacted by rolling. The surface shall be compacted as soon as possible without causing displacement, cracking or shoving. The sequence of rolling operations and the type of rollers used shall be at the discretion of the Contractor. The speed of the roller shall, at all times, be sufficiently slow to avoid displacement of the hot mixture and be effective in compaction. Any displacement occurring as a result of reversing the direction of the roller, or from any other cause, shall be corrected at once. Sufficient rollers shall be furnished to handle the output of the plant. Rolling shall continue until the surface is of uniform texture, true to grade and cross section, and the required field density is obtained. To prevent adhesion of the mixture to the roller, the wheels shall be kept properly moistened but excessive water will not be permitted. In areas not accessible to the roller, the mixture shall be thoroughly compacted with hand tampers. Any mixture that becomes loose and broken, mixed with dirt, contains check-cracking, or is in any way defective shall be removed full depth, replaced with fresh hot mixture and immediately compacted to conform to the surrounding area. This work shall be done at the Contractor's expense. Skin patching will not be allowed.

3.9 JOINTS

The formation of joints shall be made ensuring a continuous bond between the courses and to obtain the required density. All joints shall have the same texture as other sections of the course and meet the requirements for smoothness and grade.

3.9.1 Transverse Joints

The roller shall not pass over the unprotected end of the freshly laid mixture, except when necessary to form a transverse joint. When necessary to form a transverse joint, it shall be made by means of placing a bulkhead or by tapering the course. The tapered edge shall be cut back to its full depth and width on a straight line to expose a vertical face prior to placing material at the joint . The cutback material shall be removed from

the project. In both methods, all contact surfaces shall be given a light tack coat of asphalt material before placing any fresh mixture against the joint.

3.9.2 Longitudinal Joints

Longitudinal joints which are irregular, damaged, uncompacted, cold (less than 85 degrees C at the time of placing adjacent lanes), or otherwise defective, shall be cut back a minimum of 2 inches from the edge with a cutting wheel to expose a clean, sound vertical surface for the full depth of the course. All cutback material shall be removed from the project. All contact surfaces shall be given a light tack coat of asphalt material prior to placing any fresh mixture against the joint. The Contractor will be allowed to use an alternate method if it can be demonstrated that density, smoothness, and texture can be met.

3.10 CONTRACTOR QUALITY CONTROL

3.10.1 General Quality Control Requirements

The Contractor shall develop an approved Quality Control Plan. Hot-mix asphalt for payment shall not be produced until the quality control plan has been approved. The plan shall address all elements which affect the quality of the pavement including, but not limited to:

a. Mix Design

b. Aggregate Grading

c. Quality of Materials

d. Stockpile Management

e. Proportioning

f. Mixing and Transportation

g. Mixture Volumetrics

h. Moisture Content of Mixtures

i. Placing and Finishing

j. Joints

k. Compaction

l.Surface Smoothness

3.10.2 Testing Laboratory

The Contractor shall provide a fully equipped asphalt laboratory located at the plant or job site. The laboratory shall meet the requirements as required in ASTM D 3666. The effective working area of the laboratory shall be a minimum of 150 square feet with a ceiling height of not less than 7.5 feet. Lighting shall be adequate to illuminate all working areas. It shall be equipped with heating and air conditioning units to maintain a temperature of 75 degrees F plus or minus 5 degrees F. Laboratory facilities shall be kept clean and all equipment shall be

maintained in proper working condition. The Contracting Officer shall be permitted unrestricted access to inspect the Contractor's laboratory facility, to witness quality control activities, and to perform any check testing desired. The Contracting Officer will advise the Contractor in writing of any noted deficiencies concerning the laboratory facility, equipment, supplies, or testing personnel and procedures. When the deficiencies are serious enough to adversely affect test results, the incorporation of the materials into the work shall be suspended immediately and will not be permitted to resume until the deficiencies are corrected.

3.10.3 Quality Control Testing

The Contractor shall perform all quality control tests applicable to these specifications and as set forth in the Quality Control Program. The testing program shall include, but shall not be limited to, tests for the control of asphalt content, aggregate gradation, temperatures, aggregate moisture, moisture in the asphalt mixture, laboratory air voids, stability, flow, in-place density, grade and smoothness. A Quality Control Testing Plan shall be developed as part of the Quality Control Program.

3.10.3.1 Asphalt Content

A minimum of two tests to determine asphalt content will be performed per lot (a lot is defined in paragraph MATERIAL ACCEPTANCE AND PERCENT PAYMENT) by one of the following methods: the extraction method in accordance with ASTM D 2172, Method A or B, the ignition method in accordance with the AASHTO TP53or ASTM D 6307, or the nuclear method in accordance with ASTM D 4125, provided the nuclear gauge is calibrated for the specific mix being used. For the extraction method, the weight of ash, as described in ASTM D 2172, shall be determined as part of the first extraction test performed at the beginning of plant production; and as part of every tenth extraction test performed thereafter, for the duration of plant production. The last weight of ash value obtained shall be used in the calculation of the asphalt content for the mixture.

3.10.3.2 Gradation

Aggregate gradations shall be determined a minimum of twice per lot from mechanical analysis of recovered aggregate in accordance with ASTM D 5444. When asphalt content is determined by the nuclear method, aggregate gradation shall be determined from hot bin samples on batch plants, or from the cold feed on drum mix plants. For batch plants, aggregates shall be tested in accordance with ASTM C 136 using actual batch weights to determine the combined aggregate gradation of the mixture.

3.10.3.3 Temperatures

Temperatures shall be checked at least four times per lot, at necessary locations, to determine the temperature at the dryer, the asphalt cement in the storage tank, the asphalt mixture at the plant, and the asphalt mixture at the job site.

3.10.3.4 Aggregate Moisture

The moisture content of aggregate used for production shall be determined a minimum of once per lot in accordance with ASTM C 566.

3.10.3.5 Moisture Content of Mixture

The moisture content of the mixture shall be determined at least once per lot in accordance with ASTM D 1461 or an approved alternate procedure.

3.10.3.6 Laboratory Air Voids, Marshall Stability and Flow

Mixture samples shall be taken at least four times per lot and compacted into specimens, using 50 blows per side with the Marshall hammer as described in ASTM D 1559. After compaction, the laboratory air voids of each specimen shall be determined, as well as the Marshall stability and flow.

3.10.3.7 In-Place Density

The Contractor shall conduct any necessary testing to ensure the specified density is achieved. A nuclear gauge may be used to monitor pavement density in accordance with ASTM D 2950.

3.10.3.8 Grade and Smoothness

The Contractor shall conduct the necessary checks to ensure the grade and smoothness requirements are met in accordance with paragraph MATERIAL ACCEPTANCE AND PERCENT PAYMENT.

3.10.3.9 Additional Testing

Any additional testing, which the Contractor deems necessary to control the process, may be performed at the Contractor's option.

3.10.3.10 QC Monitoring

The Contractor shall submit all QC test results to the Contracting Officer on a daily basis as the tests are performed. The Contracting Officer reserves the right to monitor any of the Contractor's quality control testing and to perform duplicate testing as a check to the Contractor's quality control testing.

3.10.4 Sampling

When directed by the Contracting Officer, the Contractor shall sample and test any material which appears inconsistent with similar material being produced, unless such material is voluntarily removed and replaced or deficiencies corrected by the Contractor. All sampling shall be in accordance with standard procedures specified.

3.10.5 Control Charts

For process control, the Contractor shall establish and maintain linear control charts on both individual samples and the running average of last four samples for the parameters listed in Table 6, as a minimum. These control charts shall be posted as directed by the Contracting Officer and shall be kept current at all times. The control charts shall identify the project number, the test parameter being plotted, the individual sample numbers, the Action and Suspension Limits listed in Table 6 applicable to the test parameter being plotted, and the Contractor's test results. Target values from the JMF shall also be shown on the control charts as indicators of central tendency for the cumulative percent passing, asphalt content, and laboratory air voids parameters. When the test results exceed

either applicable Action Limit, the Contractor shall take immediate steps to bring the process back in control. When the test results exceed either applicable Suspension Limit, the Contractor shall halt production until the problem is solved. The Contractor shall use the control charts as part of the process control system for identifying trends so that potential problems can be corrected before they occur. Decisions concerning mix modifications shall be made based on analysis of the results provided in the control charts. The Quality Control Plan shall indicate the appropriate action which shall be taken to bring the process into control when certain parameters exceed their Action Limits.

Table 6. Action and Suspension Limits for the Parameters to be Plotted on Individual and Running Average Control Charts

Parameter to be Plotted	Running Average of Individual Samples		Last Four Samples	
	Action Limit	Suspension Limit	Action Limit	Suspension Limit
No. 4 sieve, Cumulative % Passing, deviation from JMF target; plus or minus values	6	8	4	5
No. 30 sieve, Cumulative % Passing, deviation from JMF target; plus or minus values	4	6	3	4
No. 200 sieve, Cumulative % Passing, deviation from JMF target; plus or minus values	1.4	2.0	1.1	1.5
Stability, pounds (minimum)				
75 Blow JMF	1800	1700	1900	1800
50 Blow JMF	1000	900	1100	1000
Flow, 0.01 inches				
75 Blow	8 min. 16 max.	7 min. 17 max.	9 min. 15 max.	8 min. 16 max.
50 Blow	8 min. 18 max.	7 min. 19 max.	9 min. 17 max.	8 min. 18 max.
Asphalt content, % deviation from JMF target; plus or minus value	0.4	0.5	0.2	0.3
Laboratory Air Voids, % deviation from JMF target value	No specific action and suspension limits set since this parameter is used to determine percent payment			
In-place Mat Density, % of Marshall density	No specific action and suspension limits set since this parameter is used to determine percent payment			
In-place Joint Density, % of Marshall density	No specific action and suspension limits set since this parameter is used to determine percent payment			

3.11 MATERIAL ACCEPTANCE AND PERCENT PAYMENT

3.11.1 Sublot Sampling

One random mixture sample for determining laboratory air voids, theoretical maximum density, and for any additional testing the Contracting Officer desires, will be taken from a loaded truck delivering mixture to each sublot, or other appropriate location for each sublot. All samples will be selected randomly, using commonly recognized methods of assuring randomness conforming to ASTM D 3665 and employing tables of random numbers or computer programs. Laboratory air voids will be determined from three

laboratory compacted specimens of each sublot sample in accordance with ASTM D 1559. The specimens will be compacted within 2 hours of the time the mixture was loaded into trucks at the asphalt plant. Samples will not be reheated prior to compaction and insulated containers will be used as necessary to maintain the temperature.

3.11.2 Additional Sampling and Testing

The Contracting Officer reserves the right to direct additional samples and tests for any area which appears to deviate from the specification requirements. The cost of any additional testing will be paid for by the Government. Testing in these areas will be in addition to the lot testing, and the requirements for these areas will be the same as those for a lot.

3.11.3 Laboratory Air Voids

Laboratory air voids will be calculated by determining the Marshall density of each lab compacted specimen using ASTM D 2726 and determining the theoretical maximum density of every other sublot sample using ASTM D 2041. Laboratory air void calculations for each sublot will use the latest theoretical maximum density values obtained, either for that sublot or the previous sublot. The mean absolute deviation of the four laboratory air void contents (one from each sublot) from the JMF air void content will be evaluated and a pay factor determined from Table 7. All laboratory air void tests will be completed and reported within 24 hours after completion of construction of each lot.

3.11.4 Mean Absolute Deviation

An example of the computation of mean absolute deviation for laboratory air voids is as follows: Assume that the laboratory air voids are determined from 4 random samples of a lot (where 3 specimens were compacted from each sample). The average laboratory air voids for each sublot sample are determined to be 3.5, 3.0, 4.0, and 3.7. Assume that the target air voids from the JMF is 4.0.

3.11.5 In-place Density

3.11.5.1 General Density Requirements

For determining in-place density, one random core will be taken by the Government from the mat (interior of the lane) of each sublot, and one random core will be taken from the joint (immediately over joint) of each sublot. Each random core will be full thickness of the layer being placed. When the random core is less than 1 inch thick, it will not be included in the analysis. In this case, another random core will be taken. After air drying to a constant weight, cores obtained from the mat and from the joints will be used for in-place density determination.

3.11.5.2 Mat and Joint Densities

The average in-place mat and joint densities are expressed as a percentage of the average Marshall density for the lot. The Marshall density for each lot will be determined as the average Marshall density of the four random samples (3 specimens compacted per sample). The average in-place mat density and joint density for a lot are determined and compared with Table 8 to calculate a single pay factor per lot based on in-place density, as described below. First, a pay factor for both mat density and joint density are determined from Table 8. The area associated with the joint is

then determined and will be considered to be 10 feet wide times the length of completed longitudinal construction joint in the lot. This area will not exceed the total lot size. The length of joint to be considered will be that length where a new lane has been placed against an adjacent lane of hot-mix asphalt pavement, either an adjacent freshly paved lane or one paved at any time previously. The area associated with the joint is expressed as a percentage of the total lot area. A weighted pay factor for the joint is determined based on this percentage (see example below). The pay factor for mat density and the weighted pay factor for joint density is compared and the lowest selected. This selected pay factor is the pay factor based on density for the lot. When the Marshall density on both sides of a longitudinal joint is different, the average of these two densities will be used as the Marshall density needed to calculate the percent joint density. All density results for a lot will be completed and reported within 24 hours after the construction of that lot.

3.11.6 Grade

The final wearing surface of pavement shall conform to the elevations and cross sections shown and shall vary not more than .06 inch from the plan grade established and approved at site of work. Finished surfaces at juncture with other pavements shall coincide with finished surfaces of abutting pavements. Deviation from the plan elevation will not be permitted in areas of pavements where closer conformance with planned elevation is required for the proper functioning of drainage and other appurtenant structures involved. The final wearing surface of the pavement will be tested for conformance with specified plan grade requirements. The grade will be determined by running lines of levels at intervals of 25 feet, or less, longitudinally and transversely, to determine the elevation of the completed pavement surface. Within 5 working days, after the completion of a particular lot incorporating the final wearing surface, the Contracting Officer will inform the Contractor in writing, of the results of the grade-conformance tests. When more than 5 percent of all measurements made within a lot are outside the .06 inch tolerance, the pay factor based on grade for that lot will be 95 percent. In areas where the grade exceeds the tolerance by more than 50 percent, the Contractor shall remove the surface lift full depth; the Contractor shall then replace the lift with hot-mix asphalt to meet specification requirements, at no additional cost to the Government. Diamond grinding may be used to remove high spots to meet grade requirements. Skin patching for correcting low areas or planing or milling for correcting high areas will not be permitted.

3.11.7 Surface Smoothness

The Contractor shall use one of the following methods to test and evaluate surface smoothness of the pavement. All testing shall be performed in the presence of the Contracting Officer. Detailed notes of the results of the testing shall be kept and a copy furnished to the Government immediately after each day's testing. The profilograph method shall be used for all longitudinal and transverse testing, except where the runs would be less than 60 meters in length and the ends where the straightedge shall be used. Where drawings show required deviations from a plane surface (crowns, drainage inlets, etc.), the surface shall be finished to meet the approval of the Contracting Officer.

3.11.7.1 Smoothness Requirements

a. Straightedge Testing: The finished surfaces of the pavements shall have no abrupt change of .25 inch or more, and all pavements shall be

within the tolerances specified in Table 9 when checked with an approved straightedge.

Table 9. Straightedge Surface Smoothness--Pavements

Pavement Category	Direction of Testing	Tolerance, inches
All paved areas	Longitudinal	6
	Transverse	6

b. Profilograph Testing: The finished surfaces of the pavements shall have no abrupt change of .25 inch or more, and all pavement shall have a Profile Index not greater than specified in Table 10 when tested with an approved California-type profilograph. If the extent of the pavement in either direction is less than 180 feet, that direction shall be tested by the straightedge method and shall meet requirements specified above.

Table 10. Profilograph Surface Smoothness--Pavements

Pavement Category	Direction of Testing	Maximum Specified Profile Index (mm/km)
All Paved Areas	Longitudinal	140

3.11.7.2 Testing Method

After the final rolling, but not later than 24 hours after placement, the surface of the pavement in each entire lot shall be tested by the Contractor in such a manner as to reveal all surface irregularities exceeding the tolerances specified above. Separate testing of individual sublots is not required. If any pavement areas are ground, these areas shall be retested immediately after grinding. The entire area of the pavement shall be tested in both a longitudinal and a transverse direction on parallel lines. The transverse lines shall be 24.5 feet or less apart, as directed. The longitudinal lines shall be at the centerline of each paving lane for lines less than 20 feet and at the third points for lanes 20 feet or greater. Other areas having obvious deviations shall also be tested. Longitudinal testing lines shall be continuous across all joints.

a. Straightedge Testing. The straightedge shall be held in contact with the surface and moved ahead one-half the length of the straightedge for each successive measurement. The amount of surface irregularity shall be determined by placing the freestanding (unleveled) straightedge on the pavement surface and allowing it to rest upon the two highest spots covered by its length, and measuring the maximum gap between the straightedge and the pavement surface in the area between these two high points.

b. Profilograph Testing. Profilograph testing shall be performed using approved equipment and procedures described in CDT Test 526. The equipment shall utilize electronic recording and automatic computerized reduction of data to indicate "must-grind" bumps and the Profile Index for the pavement. The "blanking band" shall be .2 inch wide and the "bump template" shall span 1 inch with an offset of .4 inch. The profilograph shall be operated by an approved, factory-trained operator on the alignments specified above. A copy of the reduced tapes shall be furnished the Government at the end of each day's testing.

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SECTION 02763A

PAVEMENT MARKINGS
04/01

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 792	(1998) Density and Specific Gravity (Relative Density) of Plastics by Displacement
ASTM D 4505	(1996) Preformed Plastic Pavement Marking Tape for Extended Service Life
ASTM E 28	(1999) Softening Point of Resins by Ring and Ball Apparatus

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS TT-P-1952	(Rev D; Canc. Notice 1) Paint, Traffic and Airfield Marking, Waterborne (Metric)

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Equipment; G, RE

Lists of proposed equipment, including descriptive data, and notifications of proposed Contractor actions as specified in this section. List of removal equipment shall include descriptive data indicating area of coverage per pass, pressure adjustment range, tank and flow capacities, and safety precautions required for the equipment operation.

Composition Requirements;

Manufacturer's current printed product description and Material Safety Data Sheets (MSDS) for each type paint/color proposed for use.

Qualifications;

Document certifying that personnel are qualified for equipment

operation and handling of chemicals.

SD-06 Test Reports

Sampling and Testing;

Certified copies of the test reports, prior to the use of the materials at the jobsite. Testing shall be performed in an approved independent laboratory.

SD-07 Certificates

Volatile Organic Compound (VOC);

Certificate stating that the proposed pavement marking paint meets the VOC regulations of the local Air Pollution Control District having jurisdiction over the geographical area in which the project is located.

1.3 DELIVERY AND STORAGE

All materials shall be delivered and stored in sealed containers that plainly show the designated name, formula or specification number, batch number, color, date of manufacture, manufacturer's name, and directions, all of which shall be plainly legible at time of use.

1.4 EQUIPMENT

All machines, tools and equipment used in the performance of the work shall be approved and maintained in satisfactory operating condition. Equipment operating on roads and runways shall display low speed traffic markings and traffic warning lights.

1.4.1 Paint Application Equipment

The equipment to apply paint to pavements shall be a self-propelled or mobile-drawn pneumatic spraying machine with suitable arrangements of atomizing nozzles and controls to obtain the specified results. The machine shall have a speed during application not less than 5 mph, and shall be capable of applying the stripe widths indicated, at the paint coverage rate specified in paragraph APPLICATION, and of even uniform thickness with clear-cut edges. Equipment used for marking streets and highways shall be capable of placing the prescribed number of lines at a single pass as solid lines, intermittent lines or a combination of solid and intermittent lines using a maximum of two different colors of paint as specified. The paint applicator shall have paint reservoirs or tanks of sufficient capacity and suitable gauges to apply paint in accordance with requirements specified. Tanks shall be equipped with suitable air-driven mechanical agitators. The spray mechanism shall be equipped with quick-action valves conveniently located, and shall include necessary pressure regulators and gauges in full view and reach of the operator. Paint strainers shall be installed in paint supply lines to ensure freedom from residue and foreign matter that may cause malfunction of the spray guns. The paint applicator shall be readily adaptable for attachment of an air-actuated dispenser for the reflective media approved for use. Pneumatic spray guns shall be provided for hand application of paint in areas where the mobile paint applicator cannot be used.

1.4.2 Thermoplastic Application Equipment

1.4.2.1 Thermoplastic Material

Thermoplastic material shall be applied to the primed pavement surface by spray techniques or by the extrusion method, wherein one side of the shaping die is the pavement and the other three sides are contained by, or are part of, suitable equipment for heating and controlling the flow of material. By either method, the markings shall be applied with equipment that is capable of providing continuous uniformity in the dimensions of the stripe.

1.4.2.2 Application Equipment

a. Application equipment shall provide continuous mixing and agitation of the material. Conveying parts of the equipment between the main material reservoir and the extrusion shoe or spray gun shall prevent accumulation and clogging. All parts of the equipment which come into contact with the material shall be easily accessible and exposable for cleaning and maintenance. All mixing and conveying parts up to and including the extrusion shoes and spray guns shall maintain the material at the required temperature with heat-transfer oil or electrical-element-controlled heat.

b. The application equipment shall be constructed to ensure continuous uniformity in the dimensions of the stripe. The applicator shall provide a means for cleanly cutting off stripe ends squarely and shall provide a method of applying "skiplines". The equipment shall be capable of applying varying widths of traffic markings.

c. The applicator shall be equipped with a drop-on type bead dispenser capable of uniformly dispensing reflective glass spheres at controlled rates of flow. The bead dispenser shall be automatically operated and shall begin flow prior to the flow of composition to assure that the strip is fully reflectorized.

1.4.2.3 Mobile and Maneuverable

Application equipment shall be mobile and maneuverable to the extent that straight lines can be followed and normal curves can be made in a true arc. The equipment used for the placement of thermoplastic pavement markings shall be of two general types: mobile applicator and portable applicator.

a. Mobile Application Equipment: The mobile applicator shall be defined as a truck-mounted, self-contained pavement marking machine that is capable of hot applying thermoplastic by either the extrusion or spray method. The unit shall be equipped to apply the thermoplastic marking material at temperatures exceeding 375 degrees F, at widths varying from 3 to 12 inches and in thicknesses varying from 0.020 to 0.190 inch and shall have an automatic drop-on bead system. The mobile unit shall be capable of operating continuously and of installing a minimum of 20,000 lineal feet of longitudinal markings in an 8-hour day.

(1) The mobile unit shall be equipped with a melting kettle which holds a minimum of 6000 pounds of molten thermoplastic material. The kettle shall be capable of heating the thermoplastic composition to temperatures of 375 to 425 degrees F. A thermostatically controlled heat transfer liquid shall be used. Heating of the composition by direct flame will not be allowed. Oil and material temperature gauges shall be visible

at both ends of the kettle. The mobile unit shall be equipped with a minimum of two extrusion shoes located one on each side of the truck, and shall be capable of marking simultaneous edgeline and centerline stripes. Each extrusion shoe shall be a closed, oil-jacketed unit; shall hold the molten thermoplastic at a temperature of 375 to 425 degrees F; and shall be capable of extruding a line of 3 to 8 inches in width; and at a thickness of not less than 0.125 inch nor more than 0.190 inch, and of generally uniform cross section.

(2) The mobile unit shall be equipped with an electronic programmable line pattern control system. The control system shall be capable of applying skip or solid lines in any sequence, through any and all of the extrusion shoes, or the spray guns, and in programmable cycle lengths. In addition, the mobile unit shall be equipped with an automatic counting mechanism capable of recording the number of lineal feet of thermoplastic markings applied to the pavement surface with an accuracy of 0.5 percent.

b. Portable Application Equipment: The portable applicator shall be defined as hand-operated equipment, specifically designed for placing special markings such as crosswalks, stopbars, legends, arrows, and short lengths of lane, edge and centerlines. The portable applicator shall be capable of applying thermoplastic pavement markings by the extrusion method. The portable applicator shall be loaded with hot thermoplastic composition from the melting kettles on the mobile applicator. The portable applicator shall be equipped with all the necessary components, including a materials storage reservoir, bead dispenser, extrusion shoe, and heating accessories, so as to be capable of holding the molten thermoplastic at a temperature of 375 to 425 degrees F, of extruding a line of 3 to 12 inches in width, and in thicknesses of not less than 0.125 inch nor more than 0.190 inch and of generally uniform cross section.

1.4.3 Preformed Tape Application Equipment

Mechanical application equipment shall be used for the placement of preformed marking tape. Mechanical application equipment shall be defined as a mobile pavement marking machine specifically designed for use in applying precoated, pressure-sensitive pavement marking tape of varying widths, up to 12 inches. The applicator shall be equipped with rollers, or other suitable compactive device, to provide initial adhesion of the preformed, pressure-sensitive marking tape with the pavement surface. Additional hand-operated rollers shall be used as required to properly seat the thermoplastic tape.

1.5 HAND-OPERATED, PUSH-TYPE MACHINES

All machines, tools, and equipment used in performance of the work shall be approved and maintained in satisfactory operating condition. Hand-operated push-type machines of a type commonly used for application of paint to pavement surfaces will be acceptable for marking small streets and parking areas. Applicator machine shall be equipped with the necessary paint tanks and spraying nozzles, and shall be capable of applying paint uniformly at coverage specified. Sandblasting equipment shall be provided as required for cleaning surfaces to be painted. Hand-operated spray guns shall be provided for use in areas where push-type machines cannot be used.

1.6 MAINTENANCE OF TRAFFIC

1.6.1 Roads, Streets, and Parking Areas

When traffic must be rerouted or controlled to accomplish the work, the necessary warning signs, flagpersons, and related equipment for the safe passage of vehicles shall be provided.

PART 2 PRODUCTS

2.1 PAINT

The paint shall be homogeneous, easily stirred to smooth consistency, and shall show no hard settlement or other objectionable characteristics during a storage period of 6 months. Paints for airfields, roads, and streets shall conform to FS TT-P-1952, color as selected. Pavement marking paints shall comply with applicable state and local laws enacted to ensure compliance with Federal Clean Air Standards. Paint materials shall conform to the restrictions of the local Air Pollution Control District.

2.2 THERMOPLASTIC COMPOUNDS

The thermoplastic reflectorized pavement marking compound shall be extruded or sprayed in a molten state onto a primed pavement surface. Following a surface application of glass beads and upon cooling to normal pavement temperatures, the marking shall be an adherent reflectorized strip of the specified thickness and width that is capable of resisting deformation by traffic.

2.2.1 Composition Requirements

The binder component shall be formulated as a hydrocarbon resin. The pigment, beads and filler shall be uniformly dispersed in the binder resin. The thermoplastic composition shall be free from all skins, dirt, and foreign objects and shall comply with the following requirements:

	Percent by Weight	
Component	White	Yellow
Binder	17 min.	17 min.
Titanium dioxide	10 min.	-
Glass beads,	20 min.	20 min.
Calcium carbonate & inert fillers	49 max.	*
Yellow pigments	-	*

*Amount and type of yellow pigment, calcium carbonate and inert fillers shall be at the option of the manufacturer, providing the other composition requirements of this specification are met.

2.2.2 Physical Properties

2.2.2.1 Color

The color shall be as indicated.

2.2.2.2 Drying Time

When installed at 70 degrees F and in thicknesses between 1/8 and 3/16 inch, the composition shall be completely solid and shall show no damaging effect from traffic after curing 15 minutes.

2.2.2.3 Softening Point

The composition shall have a softening point of not less than 194 degrees F when tested in accordance with ASTM E 28.

2.2.2.4 Specific Gravity

The specific gravity of the composition shall be between 1.9 and 2.2 as determined in accordance with ASTM D 792.

2.2.3 Asphalt Concrete Primer

The primer for asphalt concrete pavements shall be a thermosetting adhesive with a solids content of pigment reinforced synthetic rubber and synthetic plastic resin dissolved and/or dispersed in a volatile organic compound (VOC). Solids content shall not be less than 10 percent by weight at 70 degrees F and 60 percent relative humidity. A wet film thickness of 0.005 inch plus or minus 0.001 inch, shall dry to a tack-free condition in less than 5 minutes.

2.2.4 Portland Cement Concrete Primer

The primer for Portland cement concrete pavements shall be an epoxy resin primer. The primer shall be of the type recommended by the manufacturer of the thermoplastic composition. Epoxy primers recommended by the manufacturer shall be approved by the Contracting Officer prior to use. Requests for approval shall be accompanied with technical data, instructions for use, and a 1 quart sample of the primer material.

2.3 PREFORMED TAPE

The preformed tape shall be an adherent reflectorized strip in accordance with ASTM D 4505 Type I or IV, Class optional.

2.4 SAMPLING AND TESTING

Materials proposed for use shall be stored on the project site in sealed and labeled containers, or segregated at source of supply, sufficiently in advance of needs to allow 60 days for testing. Upon notification by the Contractor that the material is at the site or source of supply, a sample shall be taken by random selection from sealed containers by the Contractor in the presence of a representative of the Contracting Officer. Samples shall be clearly identified by designated name, specification number, batch number, manufacturer's formulation number, project contract number, intended use, and quantity involved. Testing shall be performed in an approved independent laboratory. If materials are approved based on reports furnished by the Contractor, samples will be retained by the

Government for possible future testing should the material appear defective during or after application.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Surfaces to be marked shall be thoroughly cleaned before application of the pavement marking material. Dust, dirt, and other granular surface deposits shall be removed by sweeping, blowing with compressed air, rinsing with water or a combination of these methods as required. Rubber deposits, surface laitance, existing paint markings, and other coatings adhering to the pavement shall be completely removed with scrapers, wire brushes, sandblasting, approved chemicals, or mechanical abrasion as directed. Areas of old pavement affected with oil or grease shall be scrubbed with several applications of trisodium phosphate solution or other approved detergent or degreaser, and rinsed thoroughly after each application. After cleaning, oil-soaked areas shall be sealed with cut shellac to prevent bleeding through the new paint. Pavement surfaces shall be allowed to dry, when water is used for cleaning, prior to striping or marking. Surfaces shall be recleaned, when work has been stopped due to rain.

3.1.1 Pretreatment for Early Painting

Where early painting is required on rigid pavements, a pretreatment with an aqueous solution containing 3 percent phosphoric acid and 2 percent zinc chloride shall be applied to prepared pavement areas prior to painting.

3.1.2 Cleaning Existing Pavement Markings

In general, markings shall not be placed over existing pavement marking patterns. Existing pavement markings, which are in good condition but interfere or conflict with the newly applied marking patterns, shall be removed. Deteriorated or obscured markings that are not misleading or confusing or interfere with the adhesion of the new marking material do not require removal. New preformed and thermoplastic pavement markings shall not be applied over existing preformed or thermoplastic markings. Whenever grinding, scraping, sandblasting or other operations are performed the work must be conducted in such a manner that the finished pavement surface is not damaged or left in a pattern that is misleading or confusing. When these operations are completed the pavement surface shall be blown off with compressed air to remove residue and debris resulting from the cleaning work.

3.1.3 Cleaning Concrete Curing Compounds

On new Portland cement concrete pavements, cleaning operations shall not begin until a minimum of 30 days after the placement of concrete. All new concrete pavements shall be cleaned by either sandblasting or water blasting. When water blasting is performed, thermoplastic and preformed markings shall be applied no sooner than 24 hours after the blasting has been completed. The extent of the blasting work shall be to clean and prepare the concrete surface as follows:

a. There is no visible evidence of curing compound on the peaks of the textured concrete surface.

b. There are no heavy puddled deposits of curing compound in the valleys of the textured concrete surface.

c. All remaining curing compound is intact; all loose and flaking material is removed.

d. The peaks of the textured pavement surface are rounded in profile and free of sharp edges and irregularities.

e. The surface to be marked is dry.

3.2 APPLICATION

All pavement markings and patterns shall be placed as shown on the plans.

3.2.1 Paint

Paint shall be applied to clean, dry surfaces, and only when air and pavement temperatures are above 40 degrees F and less than 95 degrees F. Paint temperature shall be maintained within these same limits. New asphalt pavement surfaces and new Portland concrete cement shall be allowed to cure for a period of not less than 30 days before applications of paint. Paint shall be applied pneumatically with approved equipment at rate of coverage specified . The Contractor shall provide guide lines and templates as necessary to control paint application. Special precautions shall be taken in marking numbers, letters, and symbols. Edges of markings shall be sharply outlined.

3.2.1.1 Rate of Application

a. Reflective Markings: Pigmented binder shall be applied evenly to the pavement area to be coated at a rate of 105 plus or minus 5 square feet per gallon. Glass spheres shall be applied uniformly to the wet paint ~~[on airfield pavement at a rate of 8]~~ [on road and street pavement at a rate of 6] plus or minus 0.5 pounds of glass spheres per gallon of paint.

b. Nonreflective Markings: Paint shall be applied evenly to the pavement surface to be coated at a rate of 105 plus or minus 5 square feet per gallon.

3.2.1.2 Drying

The maximum drying time requirements of the paint specifications will be strictly enforced to prevent undue softening of bitumen, and pickup, displacement, or discoloration by tires of traffic. If there is a delay in drying of the markings, painting operations shall be discontinued until cause of the slow drying is determined and corrected.

3.2.2 Thermoplastic Compounds

Thermoplastic pavement markings shall be placed upon dry pavement; surface dry only will not be considered an acceptable condition. At the time of installation, the pavement surface temperature shall be a minimum of 40 degrees F and rising. Thermoplastics, as placed, shall be free from dirt or tint.

3.2.2.1 Longitudinal Markings

All centerline, skipline, edgeline, and other longitudinal type markings shall be applied with a mobile applicator. All special markings, crosswalks, stop bars, legends, arrows, and similar patterns shall be

placed with a portable applicator, using the extrusion method.

3.2.2.2 Primer

After surface preparation has been completed the asphalt and/or concrete pavement surface shall be primed. The primer shall be applied with spray equipment. Primer materials shall be allowed to "set-up" prior to applying the thermoplastic composition. The asphalt concrete primer shall be allowed to dry to a tack-free condition, usually occurring in less than 10 minutes. The Portland cement concrete primer shall be allowed to dry in accordance with the thermoplastic manufacturer's recommendations. To shorten the curing time of the epoxy resins an infrared heating device may be used on the concrete primer.

a. Asphalt Concrete Primer: Primer shall be applied to all asphalt concrete pavements at a wet film thickness of 0.005 inch, plus or minus 0.001 inch (265-400 square feet per gallon).

b. Portland Cement Concrete Primer: Primer shall be applied to all concrete pavements (including concrete bridge decks) at a wet film thickness of between 0.04 to 0.05 inch (320-400 square feet per gallon).

3.2.2.3 Markings

After the primer has "set-up", the thermoplastic shall be applied at temperatures no lower than 375 degrees F nor higher than 425 degrees F at the point of deposition. Immediately after installation of the marking, drop-on glass spheres shall be mechanically applied so that the spheres are held by and imbedded in the surface of the molten material.

a. Extruded Markings: All extruded thermoplastic markings shall be applied at the specified width and at a thickness of not less than 0.125 inch nor more than 0.190 inch.

b. Sprayed Markings: All sprayed thermoplastic markings shall be applied at the specified width and the thicknesses designated in the contract plans. If the plans do not specify a thickness, centerline markings shall be applied at a wet thickness of 0.090 inch, plus or minus 0.005 inch, and edgeline markings at a wet thickness of 0.060 inch, plus or minus 0.005 inch.

3.2.3 Preformed Tape

The pavement surface temperature shall be a minimum of 60 degrees F and the ambient temperature shall be a minimum of 60 degrees F and rising. The preformed markings shall be placed in accordance with the manufacturer's written instructions.

3.3 MARKING REMOVAL

Pavement marking, including plastic tape, shall be removed in the areas shown on the drawings. Removal of marking shall be as complete as possible without damage to the surface. Aggregate shall not be exposed by the removal process. After the markings are removed, the cleaned pavement surfaces shall exhibit adequate texture for remarking as specified in paragraph SURFACE PREPARATION. Contractor shall demonstrate removal of pavement marking in an area designated by the Contracting Officer. The demonstration area will become the standard for the remainder of the work.

3.3.1 Equipment Operation

Equipment shall be controlled and operated to remove markings from the pavement surface, prevent dilution or removal of binder from underlying pavement, and prevent emission of blue smoke from asphalt or tar surfaces.

3.3.2 Cleanup and Waste Disposal

The worksite shall be kept clean of debris and waste from the removal operations. Cleanup shall immediately follow removal operations in areas subject to air traffic. Debris shall be disposed of at approved sites.

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SECTION 02770A

CONCRETE SIDEWALKS AND CURBS AND GUTTERS
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PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN 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 A 185	(1997) Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM A 615/A 615M	(1996a) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 616/A 616M	(1996a) 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 C 31/C 31M	(1996) Making and Curing Concrete Test Specimens in the Field
ASTM C 143	(1990a) Slump of Hydraulic Cement Concrete
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 231	(1997) Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 309	(1997) Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 920	(1995) Elastomeric Joint Sealants
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 1996) Preformed Sponge Rubber and

	Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D 3405	(1996) Joint Sealants, Hot-Applied, for Concrete and Asphalt Pavements

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Concrete

Copies of certified delivery tickets for all concrete used in the construction.

SD-06 Test Reports

Field Quality Control

Copies of all test reports within 24 hours of completion of the test.

1.3 WEATHER LIMITATIONS

1.3.1 Placing During Cold Weather

Concrete placement shall not take place when the air temperature reaches 5 degrees C and is falling, or is already below that point. Placement may begin when the air temperature reaches 2 degrees C and is rising, or is already above 5 degrees C. Provisions shall be made to protect the concrete from freezing during the specified curing period. If necessary to place concrete when the temperature of the air, aggregates, or water is below 35 degrees F, placement and protection shall be approved in writing. Approval will be contingent upon full conformance with the following provisions. The underlying material shall be prepared and protected so that it is entirely free of frost when the concrete is deposited. Mixing water and aggregates shall be heated as necessary to result in the temperature of the in-place concrete being between 10 and 30 degrees C. Methods and equipment for heating shall be approved. The aggregates shall be free of ice, snow, and frozen lumps before entering the mixer. Covering and other means shall be provided for maintaining the concrete at a temperature of at least 10 degrees for not less than 72 hours after placing, and at a temperature above freezing for the remainder of the curing period.

1.3.2 Placing During Warm Weather

The temperature of the concrete as placed shall not exceed 30 degrees C except where an approved retarder is used. The mixing water and/or aggregates shall be cooled, if necessary, to maintain a satisfactory placing temperature. The placing temperature shall not exceed 37 degrees C at any time.

1.4 PLANT, EQUIPMENT, MACHINES, AND TOOLS

1.4.1 General Requirements

Plant, equipment, machines, and tools used in the work shall be subject to approval and shall be maintained in a satisfactory working condition at all times. The equipment shall have the capability of producing the required product, meeting grade controls, thickness control and smoothness requirements as specified. Use of the equipment shall be discontinued if it produces unsatisfactory results. The Contracting Officer shall have access at all times to the plant and equipment to ensure proper operation and compliance with specifications.

1.4.2 Slip Form Equipment

Slip form paver or curb forming machine, will be approved based on trial use on the job and shall be self-propelled, automatically controlled, crawler mounted, and capable of spreading, consolidating, and shaping the plastic concrete to the desired cross section in 1 pass.

PART 2 PRODUCTS

2.1 CONCRETE

Concrete shall conform to the applicable requirements of Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE except as otherwise specified. Concrete shall have a minimum compressive strength of 3500 psi3500 psi at 28 days. Maximum size of aggregate shall be 1.5 inches.

2.1.1 Air Content

Mixtures shall have air content by volume of concrete of 5 to 7 percent, based on measurements made immediately after discharge from the mixer.

2.1.2 Slump

The concrete slump shall be 2 inches plus or minus 1 inch where determined in accordance with ASTM C 143.

2.1.3 Reinforcement Steel

Reinforcement bars shall conform to ASTM A 615/A 615M, ASTM A 616/A 616M, or ASTM A 617/A 617M. Wire mesh reinforcement shall conform to ASTM A 185.

2.2 CONCRETE CURING MATERIALS

2.2.1 Impervious Sheet Materials

Impervious sheet materials shall conform to ASTM C 171, type optional, except that polyethylene film, if used, shall be white opaque.

2.2.2 Burlap

Burlap shall conform to AASHTO M 182.

2.2.3 White Pigmented Membrane-Forming Curing Compound

White pigmented membrane-forming curing compound shall conform to ASTM C 309, Type 2.

2.3 CONCRETE PROTECTION MATERIALS

Concrete protection materials shall be a linseed oil mixture of equal parts, by volume, of linseed oil and either mineral spirits, naphtha, or turpentine. At the option of the contractor, commercially prepared linseed oil mixtures, formulated specifically for application to concrete to provide protection against the action of deicing chemicals may be used, except that emulsified mixtures are not acceptable.

2.4 JOINT FILLER STRIPS

2.4.1 Contraction Joint Filler for Curb and Gutter

Contraction joint filler for curb and gutter shall consist of hard-pressed fiberboard.

2.4.2 Expansion Joint Filler, Premolded

Expansion joint filler, premolded, shall conform to ASTM D 1751 or ASTM D 1752, 9 mm thick, unless otherwise indicated.

2.5 JOINT SEALANTS

2.5.1 Joint Sealant, Cold-Applied

Joint sealant, cold-applied shall conform to ASTM C 920.

2.5.2 Joint Sealant, Hot-Poured

Joint sealant, hot-poured shall conform to ASTM D 3405.

2.6 FORM WORK

Form work shall be designed and constructed to ensure that the finished concrete will conform accurately to the indicated dimensions, lines, and elevations, and within the tolerances specified. Forms shall be of wood or steel, straight, of sufficient strength to resist springing during depositing and consolidating concrete. Wood forms shall be surfaced plank, 2 inches nominal thickness, straight and free from warp, twist, loose knots, splits or other defects. Wood forms shall have a nominal length of 10 feet. Radius bends may be formed with .75 inch boards, laminated to the required thickness. Steel forms shall be channel-formed sections with a flat top surface and with welded braces at each end and at not less than two intermediate points. Ends of steel forms shall be interlocking and self-aligning. Steel forms shall include flexible forms for radius forming, corner forms, form spreaders, and fillers. Steel forms shall have a nominal length of 10 feet with a minimum of 3 welded stake pockets per form. Stake pins shall be solid steel rods with chamfered heads and pointed tips designed for use with steel forms.

2.6.1 Sidewalk Forms

Sidewalk forms shall be of a height equal to the full depth of the finished sidewalk.

2.6.2 Curb and Gutter Forms

Curb and gutter outside forms shall have a height equal to the full depth

of the curb or gutter. The inside form of curb shall have batter as indicated and shall be securely fastened to and supported by the outside form. Rigid forms shall be provided for curb returns, except that benders or thin plank forms may be used for curb or curb returns with a radius of 10 feet or more, where grade changes occur in the return, or where the central angle is such that a rigid form with a central angle of 90 degrees cannot be used. Back forms for curb returns may be made of 1.5 inches benders, for the full height of the curb, cleated together. In lieu of inside forms for curbs, a curb "mule" may be used for forming and finishing this surface, provided the results are approved.

PART 3 EXECUTION

3.1 SUBGRADE PREPARATION

The subgrade shall be constructed to the specified grade and cross section prior to concrete placement. Subgrade shall be placed and compacted as directed.

3.1.1 Sidewalk Subgrade

The subgrade shall be tested for grade and cross section with a template extending the full width of the sidewalk and supported between side forms.

3.1.2 Curb and Gutter Subgrade

The subgrade shall be tested for grade and cross section by means of a template extending the full width of the curb and gutter. The subgrade shall be of materials equal in bearing quality to the subgrade under the adjacent pavement.

3.1.3 Maintenance of Subgrade

The subgrade shall be maintained in a smooth, compacted condition in conformity with the required section and established grade until the concrete is placed. The subgrade shall be in a moist condition when concrete is placed. The subgrade shall be prepared and protected to produce a subgrade free from frost when the concrete is deposited.

3.2 FORM SETTING

Forms shall be set to the indicated alignment, grade and dimensions. Forms shall be held rigidly in place by a minimum of 3 stakes per form placed at intervals not to exceed 4 feet. Corners, deep sections, and radius bends shall have additional stakes and braces, as required. Clamps, spreaders, and braces shall be used where required to ensure rigidity in the forms. Forms shall be removed without injuring the concrete. Bars or heavy tools shall not be used against the concrete in removing the forms. Any concrete found defective after form removal shall be promptly and satisfactorily repaired. Forms shall be cleaned and coated with form oil each time before concrete is placed. Wood forms may, instead, be thoroughly wetted with water before concrete is placed, except that with probable freezing temperatures, oiling is mandatory.

3.2.1 Sidewalks

Forms for sidewalks shall be set with the upper edge true to line and grade with an allowable tolerance of in any .1 inch long section. After forms are set, grade and alignment shall be checked with a .1 inch straightedge.

Forms shall have a transverse slope as indicated with the low side adjacent to the roadway. Side forms shall not be removed for 12 hours after finishing has been completed.

3.2.2 Curbs and Gutters

The forms of the front of the curb shall be removed not less than 2 hours nor more than 6 hours after the concrete has been placed. Forms back of curb shall remain in place until the face and top of the curb have been finished, as specified for concrete finishing. Gutter forms shall not be removed while the concrete is sufficiently plastic to slump in any direction.

3.3 SIDEWALK CONCRETE PLACEMENT AND FINISHING

3.3.1 Formed Sidewalks

Concrete shall be placed in the forms in one layer. When consolidated and finished, the sidewalks shall be of the thickness indicated. After concrete has been placed in the forms, a strike-off guided by side forms shall be used to bring the surface to proper section to be compacted. The concrete shall be consolidated with an approved vibrator, and the surface shall be finished to grade with a strike off.

3.3.2 Concrete Finishing

After straightedging, when most of the water sheen has disappeared, and just before the concrete hardens, the surface shall be finished with a wood float or darby to a smooth and uniformly fine granular or sandy texture free of waves, irregularities, or tool marks. A scored surface shall be produced by brooming with a fiber-bristle brush in a direction transverse to that of the traffic, followed by edging.

3.3.3 Edge and Joint Finishing

All slab edges, including those at formed joints, shall be finished with an edger having a radius of .1 inch. Transverse joint shall be edged before brooming, and the brooming shall eliminate the flat surface left by the surface face of the edger. Corners and edges which have crumbled and areas which lack sufficient mortar for proper finishing shall be cleaned and filled solidly with a properly proportioned mortar mixture and then finished.

3.3.4 Surface and Thickness Tolerances

Finished surfaces shall not vary more than .3 inch from the testing edge of a .1 inch straightedge. Permissible deficiency in section thickness will be up to .25 inch.

3.4 CURB AND GUTTER CONCRETE PLACEMENT AND FINISHING

3.4.1 Formed Curb and Gutter

Concrete shall be placed to the section required in a single lift. Consolidation shall be achieved by using approved mechanical vibrators. Curve shaped gutters shall be finished with a standard curb "mule".

3.4.2 Curb and Gutter Finishing

Approved slipformed curb and gutter machines may be used in lieu of hand placement.

3.4.3 Concrete Finishing

Exposed surfaces shall be floated and finished with a smooth wood float until true to grade and section and uniform in texture. Floated surfaces shall then be brushed with a fine-hair brush with longitudinal strokes. The edges of the gutter and top of the curb shall be rounded with an edging tool to a radius of .5 inch. Immediately after removing the front curb form, the face of the curb shall be rubbed with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. The front curb surface, while still wet, shall be brushed in the same manner as the gutter and curb top. The top surface of gutter and entrance shall be finished to grade with a wood float.

3.4.4 Joint Finishing

Curb edges at formed joints shall be finished as indicated.

3.4.5 Surface and Thickness Tolerances

Finished surfaces shall not vary more than .25 inch from the testing edge of a .1 inch straightedge. Permissible deficiency in section thickness will be up to .25 inch.

3.5 SIDEWALK JOINTS

Sidewalk joints shall be constructed to divide the surface into rectangular areas. Transverse contraction joints shall be spaced at a distance equal to the sidewalk width or 5 feet on centers, whichever is less, and shall be continuous across the slab. Longitudinal contraction joints shall be constructed along the centerline of all sidewalks 10 feet or more in width. Transverse expansion joints shall be installed at sidewalk returns and opposite expansion joints in adjoining curbs. Where the sidewalk is not in contact with the curb, transverse expansion joints shall be installed as indicated. Expansion joints shall be formed about structures and features which project through or into the sidewalk pavement, using joint filler of the type, thickness, and width indicated.

3.5.1 Sidewalk Contraction Joints

The contraction joints shall be formed in the fresh concrete by cutting a groove in the top portion of the slab to a depth of at least one-fourth of the sidewalk slab thickness, using a jointer to cut the groove, or by sawing a groove in the hardened concrete with a power-driven saw, unless otherwise approved. Sawed joints shall be constructed by sawing a groove in the concrete with a .1 inch blade to the depth indicated. An ample supply of saw blades shall be available on the job before concrete placement is started, and at least one standby sawing unit in good working order shall be available at the jobsite at all times during the sawing operations.

3.5.2 Sidewalk Expansion Joints

Expansion joints shall be formed with .5 inchjoint filler strips. Joint filler shall be placed with top edge .25 inch below the surface and shall

be held in place with steel pins or other devices to prevent warping of the filler during floating and finishing. Immediately after finishing operations are completed, joint edges shall be rounded with an edging tool having a radius of .1 inch, and concrete over the joint filler shall be removed. At the end of the curing period, expansion joints shall be cleaned and filled with joint sealant.

3.5.3 Reinforcement Steel Placement

Reinforcement steel shall be accurately and securely fastened in place with suitable supports and ties before the concrete is placed.

3.6 CURB AND GUTTER JOINTS

Curb and gutter joints shall be constructed at right angles to the line of curb and gutter.

3.6.1 Contraction Joints

Contraction joints shall be constructed directly opposite contraction joints in abutting portland cement concrete pavements and spaced so that monolithic sections between curb returns will not be less than 5 feet nor greater than 15 feet in length. Contraction joints shall be constructed by means of .1 inch thick separators and of a section conforming to the cross section of the curb and gutter. Separators shall be removed as soon as practicable after concrete has set sufficiently to preserve the width and shape of the joint and prior to finishing.

3.6.2 Expansion Joints

Expansion joints shall be formed by means of preformed expansion joint filler material cut and shaped to the cross section of curb and gutter. Expansion joints shall be provided in curb and gutter directly opposite expansion joints of abutting portland cement concrete pavement, and shall be of the same type and thickness as joints in the pavement. Where curb and gutter do not abut portland cement concrete pavement, expansion joints at least .5 inch in width shall be provided at intervals not exceeding 39.5 feet. Expansion joints shall be provided in nonreinforced concrete gutter at locations indicated. Expansion joints shall be sealed immediately following curing of the concrete or as soon thereafter as weather conditions permit. Expansion joints and the top 1 inchdepth of curb and gutter contraction-joints shall be sealed with joint sealant. The joint opening shall be thoroughly cleaned before the sealing material is placed. Sealing material shall not be spilled on exposed surfaces of the concrete. Concrete at the joint shall be surface dry and atmospheric and concrete temperatures shall be above 10 degrees C at the time of application of joint sealing material. Excess material on exposed surfaces of the concrete shall be removed immediately and concrete surfaces cleaned.

3.7 CURING AND PROTECTION

3.7.1 General Requirements

Concrete shall be protected against loss of moisture and rapid temperature changes for at least 7 days from the beginning of the curing operation. Unhardened concrete shall be protected from rain and flowing water. All equipment needed for adequate curing and protection of the concrete shall be on hand and ready for use before actual concrete placement begins. Protection shall be provided as necessary to prevent cracking of the

pavement due to temperature changes during the curing period.

3.7.1.1 Impervious Sheeting Method

The entire exposed surface shall be wetted with a fine spray of water and then covered with impervious sheeting material. Sheets shall be laid directly on the concrete surface with the light-colored side up and overlapped 12 incheswhen a continuous sheet is not used. The curing medium shall not be less than 18-incheswider than the concrete surface to be cured, and shall be securely weighted down by heavy wood planks, or a bank of moist earth placed along edges and laps in the sheets. Sheets shall be satisfactorily repaired or replaced if torn or otherwise damaged during curing. The curing medium shall remain on the concrete surface to be cured for not less than 7 days.

3.7.2 Backfilling

After curing, debris shall be removed and the area adjoining the concrete shall be backfilled, graded, and compacted to conform to the surrounding area in accordance with lines and grades indicated.

3.7.3 Protection

Completed concrete shall be protected from damage until accepted. The Contractor shall repair damaged concrete and clean concrete discolored during construction. Concrete that is damaged shall be removed and reconstructed for the entire length between regularly scheduled joints. Refinishing the damaged portion will not be acceptable. Removed damaged portions shall be disposed of as directed.

3.7.4 Protective Coating

Protective coating of linseed oil mixture shall be applied to the exposed-to-view concrete surface.

3.7.4.1 Application

Curing and backfilling operation shall be completed prior to applying two coats of protective coating. Concrete shall be surface dry and clean before each application. Coverage shall be by spray application at not more than for first application and not more than or second application, except that the number of applications and coverage for each application for commercially prepared mixture shall be in accordance with the manufacturer's instructions. Coated surfaces shall be protected from vehicular and pedestrian traffic until dry.

3.7.4.2 Precautions

Protective coating shall not be heated by direct application of flame or electrical heaters and shall be protected from exposure to open flame, sparks, and fire adjacent to open containers or applicators. Material shall not be applied at ambient or material temperatures lower than 10 degrees C.

3.8 FIELD QUALITY CONTROL

3.8.1 General Requirements

The Contractor shall perform the inspection and tests described and meet

the specified requirements for inspection details and frequency of testing. Based upon the results of these inspections and tests, the Contractor shall take the action and submit reports as required below, and any additional tests to insure that the requirements of these specifications are met.

3.8.2 Concrete Testing

3.8.2.1 Strength Testing

The Contractor shall provide molded concrete specimens for strength tests. Samples of concrete placed each day shall be taken not less than once a day nor less than once for every 250 cubic yards of concrete. The samples for strength tests shall be taken in accordance with ASTM C 172. Cylinders for acceptance shall be molded in conformance with ASTM C 31/C 31M by an approved testing laboratory. Each strength test result shall be the average of 2 test cylinders from the same concrete sample tested at 28 days, unless otherwise specified or approved. Concrete specified on the basis of compressive strength will be considered satisfactory if the averages of all sets of three consecutive strength test results equal or exceed the specified strength, and no individual strength test result falls below the specified strength by more than 500 psi.

3.8.2.2 Air Content

Air content shall be determined in accordance with ASTM C 173 or ASTM C 231. ASTM C 231 shall be used with concretes and mortars made with relatively dense natural aggregates. Two tests for air content shall be made on randomly selected batches of each class of concrete placed during each shift. Additional tests shall be made when excessive variation in concrete workability is reported by the placing foreman or the Government inspector. If results are out of tolerance, the placing foreman shall be notified and he shall take appropriate action to have the air content corrected at the plant. Additional tests for air content will be performed on each truckload of material until such time as the air content is within the tolerance specified.

3.8.2.3 Slump Test

Two slump tests shall be made on randomly selected batches of each class of concrete for every 250 cubic yards, or fraction thereof, of concrete placed during each shift. Additional tests shall be performed when excessive variation in the workability of the concrete is noted or when excessive crumbling or slumping is noted along the edges of slip-formed concrete.

3.8.3 Thickness Evaluation

The anticipated thickness of the concrete shall be determined prior to placement by passing a template through the formed section or by measuring the depth of opening of the extrusion template of the curb forming machine. If a slip form paver is used for sidewalk placement, the subgrade shall be true to grade prior to concrete placement and the thickness will be determined by measuring each edge of the completed slab.

3.8.4 Surface Evaluation

The finished surface of each category of the completed work shall be uniform in color and free of blemishes and form or tool marks.

3.9 SURFACE DEFICIENCIES AND CORRECTIONS

3.9.1 Thickness Deficiency

When measurements indicate that the completed concrete section is deficient in thickness by more than .25 inch the deficient section will be removed, between regularly scheduled joints, and replaced.

3.9.2 High Areas

In areas not meeting surface smoothness and plan grade requirements, high areas shall be reduced either by rubbing the freshly finished concrete with carborundum brick and water when the concrete is less than 36 hours old or by grinding the hardened concrete with an approved surface grinding machine after the concrete is 36 hours old or more. The area corrected by grinding the surface of the hardened concrete shall not exceed 5 percent of the area of any integral slab, and the depth of grinding shall not exceed .25 inch. Pavement areas requiring grade or surface smoothness corrections in excess of the limits specified above shall be removed and replaced.

3.9.3 Appearance

Exposed surfaces of the finished work will be inspected by the Government and any deficiencies in appearance will be identified. Areas which exhibit excessive cracking, discoloration, form marks, or tool marks or which are otherwise inconsistent with the overall appearances of the work shall be removed and replaced.

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SECTION 02821A

FENCING
02/02

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 392	(1996) Zinc-Coated Steel Chain-Link Fence Fabric
ASTM A 491	(1996) Aluminum-Coated Steel Chain-Link Fence Fabric
ASTM A 780	(2000) Repair of Damaged and Uncoated Areas of Hot-Dipped Galvanized Coatings
ASTM A 824	(1995) Metallic-Coated Steel Marcelled Tension Wire for Use With Chain Link Fence
ASTM C 94/C 94M	(2000e2) Ready-Mixed Concrete
ASTM F 1043	(2000) Strength and Protective Coatings on Metal Industrial Chain-Link Fence Framework
ASTM F 1083	(1997) Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures
ASTM F 1184	(1994) Industrial and Commercial Horizontal Slide Gates
ASTM F 900	(1994) Industrial and Commercial Swing Gates

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-07 Certificates

Chain Link Fence

Statement, signed by an official authorized to certify on behalf of the manufacturer, attesting that the chain link fence and component materials meet the specified requirements.

PART 2 PRODUCTS

2.1 FENCE FABRIC

Fence fabric shall conform to the following:

2.1.1 Chain Link Fence Fabric

ASTM A 392, Class 1, zinc-coated steel wire with minimum coating weight of 1.2 ounces of zinc per square foot of coated surface, or ASTM A 491, Type I, aluminum-coated steel wire. Fabric shall be fabricated of 9 gauge wire woven in 2 inch mesh. Fabric shall be twisted and barbed on the top selvage and knuckled on the bottom selvage. In sections of the fence required to use 3/4" aircraft cables, these sections of the fence are to be rated for vehicle stopping, 4500 pounds at 30 MPH. The aircraft cables, type 1, General Purpose Galvanized, Class 2, 6 by 19, are to be installed per document FS RR-W-410, that is at two separate cables, one at 30" above grade and the other at 35" above grade. The aircraft cables are to be attached to all of the fence posts using 1/2" "U" steel galvanized bolts and a 3/8" thick, 4.5" long, 1.5" wide, steel galvanized flat plate. At the ends sections of the cables, each cable is to be anchored into the ground at a 45 degree with the ground and a 3'x 3'x 1.5' concrete deadman anchor that has the top of the deadman and 3' deep in the ground. Tight tension of each of the aircraft cables shall be accomplished by using steel galvanized threaded 1.25" turnbuckles attached on one to swagged eye loop for connection to the cables and the other end of the turnbuckles attached to a galvanized threaded steel 1.25" rod, which travels into the ground and into two 4" x 4" x 0.25" anchor steel plates within the deadman anchors. See details of these aircraft cable anchorings in TM- 5-853-3, Chap. 2.

2.2 GATES

ASTM F 900 and/or ASTM F 1184. Gate shall be the type and swing shown. Gate frames shall conform to strength and coating requirements of ASTM F 1083 for Group IA, steel pipe, with external coating Type A, nominal pipe size (NPS) 1-1/2. Gate frames shall conform to strength and coating requirements of ASTM F 1043, for Group IC, steel pipe with external coating Type A or Type B, nominal pipe size (NPS) 1-1/2. Gate fabric shall be as specified for chain link fabric. Gate leaves more than 8 feet wide shall have either intermediate members and diagonal truss rods or shall have tubular members as necessary to provide rigid construction, free from sag or twist. Gate leaves less than 8 feet wide shall have truss rods or intermediate braces. Intermediate braces shall be provided on all gate frames with an electro-mechanical lock. Gate fabric shall be attached to the gate frame by method standard with the manufacturer except that welding will not be permitted. Latches, hinges, stops, keepers, rollers, and other hardware items shall be furnished as required for the operation of the gate. Latches shall be arranged for padlocking so that the padlock will be accessible from both sides of the gate. Stops shall be provided for holding the gates in the open position. For high security applications, each end member of gate frames shall be extended sufficiently above the top member to carry three strands of barbed wire in horizontal alignment with barbed wire strands on the fence.

2.3 POSTS

2.3.1 Metal Posts for Chain Link Fence

ASTM F 1083, zinc-coated. Group IA, with external coating Type A steel pipe. Group IC steel pipe, zinc-coated with external coating Type A or Type B and Group II , roll-formed steel sections, shall meet the strength and coating requirements of ASTM F 1043. Group III, ASTM F 1043 steel H-section may be used for line posts in lieu of line post shapes specified for the other classes. Sizes shall be as shown on the drawings. Line posts and terminal (corner, gate, and pull) posts selected shall be of the same designation throughout the fence. Gate post shall be for the gate type specified subject to the limitation specified in ASTM F 900 and/or ASTM F 1184.

2.4 BRACES AND RAILS

ASTM F 1083, zinc-coated, Group IA, steel pipe, size NPS 1-1/4. Group IC steel pipe, zinc-coated, shall meet the strength and coating requirements of ASTM F 1043. Group II, formed steel sections, size 1-21/32 inch, conforming to ASTM F 1043, may be used as braces and rails if Group II line posts are furnished.

2.5 WIRE

2.5.1 Tension Wire

Tension wire shall be Type I or Type II, Class 2 coating, in accordance with ASTM A 824.

2.6 CONCRETE

ASTM C 94/C 94M, using 3/4 inch maximum size aggregate, and having minimum compressive strength of 3000 psi at 28 days. Grout shall consist of one part portland cement to three parts clean, well-graded sand and the minimum amount of water to produce a workable mix.

PART 3 EXECUTION

3.1 INSTALLATION

Fence shall be installed to the lines and grades indicated. The area on either side of the fence line shall be cleared to the extent indicated. Line posts shall be spaced equidistant at intervals not exceeding 10 feet. Terminal (corner, gate, and pull) posts shall be set at abrupt changes in vertical and horizontal alignment. Fabric shall be continuous between terminal posts; however, runs between terminal posts shall not exceed 500 feet. Any damage to galvanized surfaces, including welding, shall be repaired with paint containing zinc dust in accordance with ASTM A 780.

3.2 EXCAVATION

Post holes shall be cleared of loose material. Waste material shall be spread where directed. The ground surface irregularities along the fence line shall be eliminated to the extent necessary to maintain a 1 inch clearance between the bottom of the fabric and finish grade.

3.3 GROUNDING

Fences shall be grounded on each side of all gates, at each corner, at the closest approach to each building located within 50 feet of the fence, and where the fence alignment changes more than 15 degrees. Grounding locations shall not exceed 650 feet. Each gate panel shall be bonded with a flexible bond strap to its gate post. Fences crossed by powerlines of 600 volts or more shall be grounded at or near the point of crossing and at distances not exceeding 150 feet on each side of crossing. Ground conductor shall consist of No. 8 AWG solid copper wire. Grounding electrodes shall be 3/4 inch by 10 foot long copper-clad steel rod. Electrodes shall be driven into the earth so that the top of the electrode is at least 6 inches below the grade. Where driving is impracticable, electrodes shall be buried a minimum of 12 inches deep and radially from the fence. The top of the electrode shall be not less than 2 feet or more than 8 feet from the fence. Ground conductor shall be clamped to the fence and electrodes with bronze grounding clamps to create electrical continuity between fence posts, fence fabric, and ground rods. After installation the total resistance of fence to ground shall not be greater than 25 ohms.

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08/03

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SECTION 02841

VEHICLE BARRIERS
08/03

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (1996) Structural Welding Code - Steel

1.2 GENERAL REQUIREMENTS

The Contractor shall be responsible for furnishing, installation, and field testing of each type of vehicle barrier and other equipment as specified, except for bollards which have a set diameter it must in all respects be identical to the unit tested and certified as defined in paragraph "BARRIER PERFORMANCE REQUIREMENTS." The design and structural materials of the vehicle barrier shall be the same as those used in the crash test of the barrier.

1.3 BARRIER PERFORMANCE REQUIREMENTS

Actual crash test shall be performed and data compiled by an approved independent testing agency at the manufacturer's expense. Barrier shall meet the requirements specified herein and shall not permit the test vehicle to vault or penetrate the barrier when tested to the following performance requirements:

a. Vehicle Crash gate shall withstand a 4500 pound vehicle at impact speed of 30 mph.

1.4 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-03 Product Data

Spare parts

SD-06 Test Reports

Vehicle barrier system

SD-07 Certificates

List of equipment

List of product installation

SD-10 Operation and Maintenance Data

Vehicle barrier,G

Submit data package in accordance with Section 01781, "Operation and Maintenance Data."

1.5 REQUIREMENTS

1.5.1 Required Data

After approval of the detail drawings, the Contractor shall submit spare parts data for each different item of materials and equipment used. The data shall include a complete list of parts and supplies, with current unit prices and source of supply.

1.5.2 Required Data

Submit a complete list of equipment and materials including industrial standards used, how they apply to the applicable component, manufacturer's descriptive and technical literature, and installation instructions. Submit list of product installation showing information necessary to document a minimum 1-year successful field operation performance history for each type of vehicle barrier installed.

1.5.3 Required Tests

Upon completion and testing of the installation and testing of vehicle barrier system, a test report shall be submitted in booklet form showing all field tests, including component adjustments and demonstration of compliance with the specified performance criteria. Each test report shall indicate the final position of controls.

1.5.4 Required Information

Submit vehicle barrier operation and maintenance data."

PART 2 PRODUCTS

2.1 MANUAL BEAM OR GATE

2.1.1 Manual Drop Arm Cable/Beam Crash Gate

The crash gate shall consist of two steel and/or concrete buttresses anchored into the ground and an above-grade gate assembly consisting of a heavy steel, concrete or aluminum structure. The stop strength rating of the crash gate shall be 4500 pounds at 30 mph and shall also satisfy the Manufacturer requirements of Dept. of State specification SD-STD-02.01 of April 1995. The crash gate shall be capable of being hinged from either side. The height of the gate shall be at 34 inches from the road surface to the center of the gate frame. The gate shall be capable of being manually rolled into place by one person to function as a swing gate. Hinge points of both buttresses shall each contain a locking pin with padlock acceptance for securing the crash gate in the closed position. Gate construction shall be such that the maximum spacing between the gate end posts and the crash protection bollards next to the gate shall be 4 feet.

2.2 MANUAL RETRACTABLE BOLLARDS

When in the raised position, the total retractable bollard heights shall be

no less than 30 inches above the roadway surface and shall be 8 inches wide. When in the lowered position, the retractable bollard shall extend no more than 5/8 inch above the roadway surface. Retractable bollards in the lowered position shall be capable of supporting a 32,000 pound axle load or a 16,000 pound wheel load. Design for this load shall be in accordance with AASHTO HB-16. Manual retractable bollards shall be capable of being raised and lowered utilizing a recessed handle on the top surface of the bollard, with a maximum force of 60 pounds. A recessed panel adjacent to the base of each bollard shall contain a spring actuated latching mechanism that automatically secures the bollard in either the full "UP" or full "DOWN" position. The panel shall have an access cover with provisions for a padlock to secure the access cover.

2.3 FINISH

All barrier surfaces shall be painted in accordance with requirements of Section 09900, "Paints and Coatings" or the manufacturer's recommendations.

PART 3 EXECUTION

3.1 ADDITIONAL BARRIER REQUIREMENTS

3.1.1 Foundation

The reinforced concrete foundation shall conform to Section 03300, "Cast-In-Place Concrete."

3.1.2 Welding

Welding shall be in accordance with AWS D1.1/D1.1M.

3.2 FIELD TESTING

Upon completion of construction, a field test shall be performed for each vehicle barrier. The Contracting Officer shall be notified at least 7 days prior to beginning of the field test. The Contractor shall furnish all equipment and make all necessary corrections and adjustments prior to tests witnessed by the Contracting Officer. Any conditions that interfere with the proper operation of the barrier discovered by the test shall be corrected at no additional cost to the Government. Adjustments and repairs shall be done by the Contractor under the direction of the Contracting Officer. After adjustments are made to assure correct functioning of components, applicable tests shall be completed (except for a year of environmental testing under normal use).

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SECTION 03300

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09/98

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SECTION 03300

CAST-IN-PLACE CONCRETE
09/98

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 301	(1996) Structural Concrete for Buildings

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 497	(1997) Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement
ASTM A 615/A 615M	(1996; Rev. A) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM C 31/C 31M	(1996) Making and Curing Concrete Test Specimens in the Field
ASTM C 39	(1996) Compressive Strength of Cylindrical Concrete Specimens
ASTM C 42	(1994) Obtaining and Testing Drilled Cores and Sawed Beams on Concrete
ASTM C 94	(1997) Ready-Mixed Concrete
ASTM C 143	(1990; Rev. A) Slump of Hydraulic Cement Concrete
ASTM C 172	(1997) Sampling Freshly Mixed Concrete
ASTM C 173	(1994; Rev. A) Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C 231	(1997) Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 309	(1997) Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 567	(1991) Unit Weight of Structural Lightweight Concrete
ASTM C 1107	(1997) Packaged Dry, Hydraulic-Cement Grout (Nonshrink)

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

1.2.1 SD-08 Manufacturer's Instructions

a. Liquid Membrane-Forming Compounds

1.2.2 SD-06 Test Reports

a. Compressive strength tests

1.2.3 SD-07 Certificates

a. Concrete

Provide the dry weight of cement, saturated surface-dry-weights of fine and coarse aggregate and quantities, type, and name of admixtures and of water (per cubic yard of concrete used in the manufacture of each batch of concrete. Certify the concrete is proportioned to provide concrete of quality and strength specified for its intended purpose.

1.3 DELIVERY

Do not deliver concrete until forms, reinforcement and embedded items are in place and ready for concrete placement.

PART 2 PRODUCTS

2.1 READY-MIXED CONCRETE

ASTM C 94, concrete shall have a 28-day compressive strength of 4000 psi. Slump shall be between 2 and 4 inches. Provide aggregate Size No.67 normal weight concrete.

2.2 REINFORCEMENT

2.2.1 Reinforcing Bars

ASTM A 615/A 615M.

2.2.2 Welded Wire Fabric

ASTM A 497, galvanized.

2.3 MATERIALS FOR CURING CONCRETE

2.3.1 Impervious Sheeting

Waterproof paper, clear or white polyethylene sheeting, or polyethylene-coated burlap.

2.3.2 Liquid Membrane-Forming Compounds

ASTM C 309, white-pigmented, Type 2, free of paraffin or petroleum.

2.4 MOISTURE BARRIER

Polyethylene sheeting, minimum 10 mil thickness, vapor permeance rating not exceeding 0.5 perms.

2.5 NONSHRINK GROUT

ASTM C 1107.

2.6 FORM MATERIALS

Provide metal, plywood, or hardboard forms capable of producing the required surface without adverse effect on concrete. Do not use form coating that adversely affects concrete surfaces or impairs subsequent applications to the concrete. Provide metal form ties, factory-fabricated, removable or snap-off type that will leave holes less than 1/4 inch deep and not more than one inch in diameter.

2.7 NONSLIP SURFACING MATERIAL

Provide nonslip surfacing material consisting of 55 percent, minimum, aluminum oxide or silicon-dioxide abrasive ceramically bonded to form a homogenous material sufficiently porous to give good bond with portland paste; or factory-graded emery material consisting of not less than 45 percent aluminum oxide and 25 percent ferric oxide. Provide well graded material, from particles retained on the No. 30 sieve to particles passing the No. 8 sieve.

PART 3 EXECUTION

3.1 FORMS

ACI 301.

3.2 PLACING REINFORCEMENT

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

3.3 SETTING MISCELLANEOUS MATERIAL

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

3.4 INSTALLATION OF MOISTURE BARRIER

Provide beneath the on-grade concrete floor slab. Lap 4 inches minimum, and seal laps and patches with pressure-sensitive adhesive or tape 2 inches wide, minimum.

3.5 CONCRETE PLACEMENT

Deliver concrete from mixer to forms continuously until approved unit of operation is completed. Provide scaffolding, ramps and walkways so that personnel and equipment are not supported by in-place reinforcement. Placing will not be permitted when sun, heat, wind, or limitations of facilities furnished by the Contractor prevent proper consolidation,

finishing and curing. Deposit concrete as close as possible to its final position in the forms. When a vertical drop greater than 8 feet is authorized, provide equipment to prevent segregation. Regulate depositing of concrete so that it will be consolidated in horizontal layers not more than 12 inches thick. Place slabs in one layer. Screed concrete to provide levels and profiles indicated.

3.6 CONSOLIDATION

Immediately after placing, consolidate each layer of concrete by internal vibrators, except for slabs 4 inches or less. Use vibrators adequate in effectiveness and number to properly consolidate the concrete; keep a spare vibrator at the jobsite during placing operations.

3.7 WEATHER LIMITATIONS

Use special protection measures as approved by Contracting Officer, when freezing temperatures are anticipated before expiration of the specified curing period. Temperature of concrete placed during warm weather shall not exceed 85 degrees F except where an approved retarder is used.

3.8 Omitted

3.9 SURFACE FINISHES

ACI 301 for repair and finish. Slope floors uniformly to drains where drains are provided.

3.9.1 Floated Finish

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

3.10 CURING AND PROTECTION

ACI 301. Preserve moisture, protect from temperature extremes, wind and rain, and from mechanical injury.

3.11 SETTING BASE PLATES AND BEARING PLATES

Clean and dampen concrete surface before grouting. Set plate or equipment base to line and elevation. Provide grout at least 3/4 inches thick. Surfaces in contact with grout shall be free of oil and grease.

3.12 FIELD QUALITY CONTROL

3.12.1 Sampling

ASTM C 172. Collect samples of fresh concrete to perform tests specified. ASTM C 31/C 31M for making test specimens.

3.12.2 Testing

3.12.2.1 Slump Tests

ASTM C 143. Take concrete samples during concrete placement. Perform tests at commencement of concrete placement, when test cylinders are made, and for each batch (minimum) or every 20 cubic yards (maximum) of concrete.

3.12.2.2 Temperature Tests

Test the concrete delivered and the concrete in the forms. Perform tests in hot or cold weather conditions (below 50 degrees F and above 80 degrees F) for each batch (minimum) or every 20 cubic yards (maximum) of concrete, until the specified temperature is obtained, and whenever test cylinders and slump tests are made.

3.12.2.3 Compressive Strength Tests

ASTM C 39. Make two test cylinders for each set of tests in accordance with ASTM C 31/C 31M. Precautions shall be taken to prevent evaporation and loss of water from the specimen. Test two cylinders at 28 days. Samples for strength tests of each mix design of concrete placed each day shall be taken not less than once a day, nor less than once for each 100 cubic yards of concrete, nor less than once for each 5000 square feet of surface area for slabs or walls. For the entire project, take no less than five sets of samples and perform strength tests for each mix design of concrete placed. Each strength test result shall be the average of two cylinders from the same concrete sample tested at 28 days. If the average of any three consecutive strength test results is less than f'c or if any strength test result falls below f'c by more than 500 psi, take a minimum of three ASTM C 42 core samples from the in-place work represented by the low test cylinder results and test. Concrete represented by core test shall be considered structurally adequate if the average of three cores is equal to at least 85 percent of f'c and if no single core is less than 75 percent of f'c. Locations represented by erratic core strengths shall be retested. Remove concrete not meeting strength criteria and provide new acceptable concrete.

3.12.2.4 Air Content

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

3.12.2.5 Unit Weight of Structural Lightweight Concrete

ASTM C 567. Determine unit weight of lightweight concrete.Perform test for every 20 cubic yards maximum.

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SECTION 09900

PAINTS AND COATINGS
02/02

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)

ACGIH Limit Values	(1991-1992) Threshold Limit Values (TLVs) for Chemical Substances and Physical Agents and Biological Exposure Indices (BEIs)
ACGIH Limit Values	Documentation of Threshold Limit Values and Biological Exposure Indices

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A13.1	Scheme for Identification of Piping Systems

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 235	Standard Specification for Mineral Spirits (Petroleum Spirits) (Hydrocarbon Dry Cleaning Solvent)
ASTM D 523	(1999) Standard Test Method for Specular Gloss
ASTM D 2092	(1995) Preparation of Zinc-Coated (Galvanized) Steel Surfaces for Painting
ASTM D 4263	(1983; R 1999) Indicating Moisture in Concrete by the Plastic Sheet Method
ASTM D 4444	(1998) Standard Test Methods for Use and Calibration of Hand-Held Moisture Meters
ASTM F 1869	(1998) Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910.1000	Air Contaminants

FEDERAL STANDARDS (FED-STD)

FED-STD-313	(Rev. C) Material Safety Data, Transportation Data and Disposal Data for Hazardous Materials Furnished to

Government Activities

MASTER PAINTERS INSTITUTE (MPI)

MPI 4	(2001) Interior/Exterior Latex Block Filler
MPI 7	(2001) Exterior Oil Wood Primer
MPI 8	(2001) Exterior Alkyd, Flat
MPI 9	(2001) Exterior Alkyd Enamel
MPI 10	(2001) Exterior Latex, Flat
MPI 11	(2001) Exterior Latex, Semi-Gloss
MPI 23	(2001) Surface Tolerant Metal Primer
MPI 39	(2001) Interior Latex-based Wood Primer
MPI 42	(2001) Latex Stucco and Masonry Textured Coating
MPI 44	Interior Latex, Gloss Level 2
MPI 45	(2001) Interior Primer Sealer
MPI 47	(2001) Interior Alkyd, Semi-Gloss
MPI 48	(2001) Interior Alkyd, Gloss
MPI 49	(2001) Interior Alkyd, Flat
MPI 50	(2001) Interior Latex Primer Sealer
MPI 51	(2001) Interior Alkyd, Eggshell
MPI 52	(2001) Interior Latex, Gloss Level 3
MPI 54	(2001) Interior Latex, Semi-Gloss
MPI 56	(2001) Interior Alkyd Dry Fog/Fall
MPI 57	(2001) Interior Oil Modified Clear Urethane, Satin
MPI 77	(2001) Epoxy Cold Cured, Gloss
MPI 79	(2001) Marine Alkyd Metal Primer
MPI 94	(2001) Exterior Alkyd, Semi-Gloss
MPI 95	(2001) Fast Drying Metal Primer
MPI 107	(2001) Rust Inhibitive Primer (Water-Based)
MPI 110	(2001) Interior/Exterior High Performance Acrylic

MPI 116	(2001) Epoxy Block Filler
MPI 119	(2001) Exterior Latex, High Gloss (acrylic)
MPI 138	(2001) High Performance Latex, White and Tints - MPI Gloss Level 2
MPI 139	(2001) High Performance Latex, White and Tints - MPI Gloss Level 3
MPI 140	(2001) High Performance Architectural Latex - Gloss Level 4
MPI 141	(2001) High Performance Semigloss Latex, White and Tints - Gloss Level 5

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-STD-101	(Rev. B) Color Code for Pipelines and for Compressed Gas Cylinders

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS SP01-01	(2001) Environmentally Preferable Product Specification for Architectural and Anti-Corrosive Paints

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC QP 1	(1989) Evaluating Qualifications of Painting Contractors (Field Application to Complex Structures)
SSPC PA 1	(2000) Shop, Field, and Maintenance Painting
SSPC Guide 3	(1995) Safety in Paint Application
SSPC VIS 1	(1989) Visual Standard for Abrasive Blast Cleaned Steel (Standard Reference Photographs)
SSPC VIS 3	(1993) Visual Standard for Power- and Hand-Tool Cleaned Steel (Standard Reference Photographs)
SSPC VIS 4	(2001) Guide and Reference Photographs for Steel Surfaces Prepared by Waterjetting
SSPC SP 1	(1982) Solvent Cleaning
SSPC SP 2	(1995) Hand Tool Cleaning
SSPC SP 3	(1995) Power Tool Cleaning
SSPC SP 6	(1994) Commercial Blast Cleaning
SSPC SP 7	(1994) Brush-Off Blast Cleaning

SSPC SP 10	(1994) Near-White Blast Cleaning
SSPC SP 12	(1995) Surface Preparation and Cleaning of Steel and Other Hard Materials by High-and Ultra high-Pressure Water Jetting Prior to Recoating
SSPC Paint 18	(1991) Chlorinated Rubber Intermediate Coat Paint

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

The current MPI, "Approved Product List" which lists paint by brand, label, product name and product code as of the date of contract award, will be used to determine compliance with the submittal requirements of this specification. The Contractor may choose to use a subsequent MPI "Approved Product List", however, only one list may be used for the entire contract and each coating system is to be from a single manufacturer. All coats on a particular substrate must be from a single manufacturer. No variation from the MPI Approved Products List is acceptable.

Samples of specified materials may be taken and tested for compliance with specification requirements.

In keeping with the intent of Executive Order 13101, "Greening the Government through Waste Prevention, Recycling, and Federal Acquisition", products certified by SCS as meeting SCS SP01-01 shall be given preferential consideration over registered products. Products that are registered shall be given preferential consideration over products not carrying any EPP designation.

SD-02 Shop Drawings

Piping identification

Submit color stencil codes

SD-03 Product Data

Coating; G,RE

Manufacturer's Technical Data Sheets

Sealant

SD-04 Samples

Color; G, RE

Submit manufacturer's samples of paint colors. Cross reference color samples to color scheme as indicated.

SD-07 Certificates

Applicator's qualifications

Qualification Testing laboratory for coatings

SD-08 Manufacturer's Instructions

Application instructions

Mixing

Detailed mixing instructions, minimum and maximum application temperature and humidity, potlife, and curing and drying times between coats.

Manufacturer's Material Safety Data Sheets

Submit manufacturer's Material Safety Data Sheets for coatings, solvents, and other potentially hazardous materials, as defined in FED-STD-313.

SD-10 Operation and Maintenance Data

Coatings:

Preprinted cleaning and maintenance instructions for all coating systems shall be provided.

1.3 APPLICATOR'S QUALIFICATIONS

1.3.1 Contractor Qualification

Submit the name, address, telephone number, FAX number, and e-mail address of the contractor that will be performing all surface preparation and coating application. Submit evidence that key personnel have successfully performed surface preparation and application of coatings on a minimum of three similar projects within the past three years. List information by individual and include the following:

a. Name of individual and proposed position for this work.

b. Information about each previous assignment including:

Position or responsibility

Employer (if other than the Contractor)

Name of facility owner

Mailing address, telephone number, and telex number (if non-US) of facility owner

Name of individual in facility owner's organization who can be contacted as a reference

Location, size and description of structure

Dates work was carried out

Description of work carried out on structure

1.3.2 SSPC QP 1 Certification

All contractors and subcontractors that perform surface preparation or coating application shall be certified by the Society for Protective Coatings (formerly Steel Structures Painting Council) (SSPC) to the requirements of SSPC QP 1 prior to contract award, and shall remain certified while accomplishing any surface preparation or coating application. The painting contractors and painting subcontractors must remain so certified for the duration of the project. If a contractor's or subcontractor's certification expires, the firm will not be allowed to perform any work until the certification is reissued. Requests for extension of time for any delay to the completion of the project due to an inactive certification will not be considered and liquidated damages will apply. Notify the Contracting Officer of any change in contractor certification status.

1.4 QUALITY ASSURANCE

1.4.1 Field Samples and Tests

The Contracting Officer may choose up to two coatings that have been delivered to the site to be tested at no cost to the Government. Take samples of each chosen product as specified in the paragraph "Sampling Procedures." Test each chosen product as specified in the paragraph "Testing Procedure." Products which do not conform, shall be removed from the job site and replaced with new products that confrom to the referenced specification. Testing of replacement products that failed initial testing shall be at no cost to the Government.

1.4.1.1 Sampling Procedure

The Contracting Officer will select paint at random from the products that have been delivered to the job site for sample testing. The Contractor shall provide one quart samples of the selected paint materials. The samples shall be taken in the presence of the Contracting Officer, and labeled, identifying each sample. Provide labels in accordance with the paragraph "Packaging, Labeling, and Storage" of this specification.

1.4.1.2 Testing Procedure

Provide Batch Quality Conformance Testing for specified products, as defined by and performed by MPI. As an alternative to Batch Quality Conformance Testing, the Contractor may provide Qualification Testing for specified products above to the appropriate MPI product specification, using the third-party laboratory approved under the paragraph "Qualification Testing" laboratory for coatings. The qualification testing lab report shall include the backup data and summary of the test results. The summary shall list all of the reference specification requirements and the result of each test. The summary shall clearly indicate whether the tested paint meets each test requirement. Note that Qualification Testing may take 4 to 6 weeks to perform, due to the extent of testing required.

Submit name, address, telephone number, FAX number, and e-mail address of the independent third party laboratory selected to perform testing of coating samples for compliance with specification requirements. Submit documentation that laboratory is regularly engaged in testing of paint samples for conformance with specifications, and that employees performing

testing are qualified. If the Contractor chooses MPI to perform the Batch Quality Conformance testing, the above submittal information is not required, only a letter is required from the Contractor stating that MPI will perform the testing.

1.5 REGULATORY REQUIREMENTS

1.5.1 Environmental Protection

In addition to requirements specified elsewhere for environmental protection, provide coating materials that conform to the restrictions of the local Air Pollution Control District and regional jurisdiction. Notify Contracting Officer of any paint specified herein which fails to conform.

1.5.2 Lead Content

Do not use coatings having a lead content over 0.06 percent by weight of nonvolatile content.

1.5.3 Chromate Content

Do not use coatings containing zinc-chromate or strontium-chromate.

1.5.4 Asbestos Content

Materials shall not contain asbestos.

1.5.5 Mercury Content

Materials shall not contain mercury or mercury compounds.

1.5.6 Silica

Abrasive blast media shall not contain free crystilline silica.

1.5.7 Human Carcinogens

Materials shall not contain ACGIH Limit Values and ACGIH Limit Values confirmed human carcinogens (A1) or suspected human carcinogens (A2).

1.6 PACKAGING, LABELING, AND STORAGE

Paints shall be in sealed containers that legibly show the contract specification number, designation name, formula or specification number, batch number, color, quantity, date of manufacture, manufacturer's formulation number, manufacturer's directions including any warnings and special precautions, and name and address of manufacturer. Pigmented paints shall be furnished in containers not larger than 5 gallons. Paints and thinners shall be stored in accordance with the manufacturer's written directions, and as a minimum, stored off the ground, under cover, with sufficient ventilation to prevent the buildup of flammable vapors, and at temperatures between 40 to 95 degrees F.

1.7 SAFETY AND HEALTH

Apply coating materials using safety methods and equipment in accordance with the following:

Work shall comply with applicable Federal, State, and local laws and regulations, and with the ACCIDENT PREVENTION PLAN. The Activity Hazard Analysis shall include analyses of the potential impact of painting operations on painting personnel and on others involved in and adjacent to the work zone.

1.7.1 Safety Methods Used During Coating Application

Comply with the requirements of SSPC Guide 3.

1.7.2 Toxic Materials

To protect personnel from overexposure to toxic materials, conform to the most stringent guidance of:

a. The applicable manufacturer's Material Safety Data Sheets (MSDS) or local regulation.

b. 29 CFR 1910.1000.

c. ACGIH Limit Values, threshold limit values.

1.8 ENVIRONMENTAL CONDITIONS

1.8.1 Coatings

Do not apply coating when air or substrate conditions are:

a. Less than 5 degrees F above dew point;

b. Below 50 degrees F or over 95 degrees F, unless specifically pre-approved by the Contracting Officer and the product manufacturer. Under no circumstances shall application conditions exceed manufacturer recommendations.

1.9 COLOR SELECTION

Colors of finish coats shall be as indicated or specified. Where not indicated or specified, colors shall be selected by the Contracting Officer. Manufacturers' names and color identification are used for the purpose of color identification only. Named products are acceptable for use only if they conform to specified requirements. Products of other manufacturers are acceptable if the colors approximate colors indicated and the product conforms to specified requirements.

Tint each coat progressively darker to enable confirmation of the number of coats.

1.10 LOCATION AND SURFACE TYPE TO BE PAINTED

1.10.1 Painting Included

Where a space or surface is indicated to be painted, include the following unless indicated otherwise.

a. Surfaces behind portable objects and surface mounted articles readily detachable by removal of fasteners, such as screws and bolts.

b. New factory finished surfaces that require identification or color coding and factory finished surfaces that are damaged during performance of the work.

c. Existing coated surfaces that are damaged during performance of the work.

1.10.1.1 Exterior Painting

Includes new surfaces, existing coated surfaces, and existing uncoated surfaces, of the buildings and appurtenances as indicated. Also included are existing coated surfaces made bare by cleaning operations.

1.10.1.2 Interior Painting

Includes new surfaces, existing uncoated surfaces, and existing coated surfaces of the building~~(~~(s~~)~~) and appurtenances as indicated and existing coated surfaces made bare by cleaning operations. Where a space or surface is indicated to be painted, include the following items, unless indicated otherwise.

a. Exposed columns, girders, beams, joists, and metal deck; and

b. Other contiguous surfaces.

1.10.2 Painting Excluded

Do not paint the following unless indicated otherwise.

a. Surfaces concealed and made inaccessible by panelboards, fixed ductwork, machinery, and equipment fixed in place.

b. Surfaces in concealed spaces. Concealed spaces are defined as enclosed spaces above suspended ceilings, furred spaces, attic spaces, crawl spaces, elevator shafts and chases.

c. Steel to be embedded in concrete.

d. Copper, stainless steel, aluminum, brass, and lead except existing coated surfaces.

e. Hardware, fittings, and other factory finished items.

1.10.3 Mechanical and Electrical Painting

Includes field coating of interior and exterior new surfaces.

a. Where a space or surface is indicated to be painted, include the following items unless indicated otherwise.

(1) Exposed piping, conduit, and ductwork;

(2) Supports, hangers, air grilles, and registers;

(3) Miscellaneous metalwork and insulation coverings.

1.10.4 Definitions and Abbreviations

1.10.4.1 Qualification Testing

Qualification testing is the performance of all test requirements listed in the product specification. This testing is accomplished by MPI to qualify each product for the MPI Approved Product List, and may also be accomplished by Contractor's third party testing lab if an alternative to Batch Quality Conformance Testing by MPI is desired.

1.10.4.2 Batch Quality Conformance Testing

Batch quality conformance testing determines that the product provided is the same as the product qualified to the appropriate product specification. This testing shall only be accomplished by MPI testing lab.

1.10.4.3 Coating

A film or thin layer applied to a base material called a substrate. A coating may be a metal, alloy, paint, or solid/liquid suspensions on various substrates (metals, plastics, wood, paper, leather, cloth, etc.). They may be applied by electrolysis, vapor deposition, vacuum, or mechanical means such as brushing, spraying, calendering, and roller coating. A coating may be applied for aesthetic or protective purposes or both. The term "coating" as used herein includes emulsions, enamels, stains, varnishes, sealers, epoxies, and other coatings, whether used as primer, intermediate, or finish coat. The terms paint and coating are used interchangeably.

1.10.4.4 DFT or dft

Dry film thickness, the film thickness of the fully cured, dry paint or coating.

1.10.4.5 DSD

Degree of Surface Degradation, the MPI system of defining degree of surface degradation. Five (5) levels are generically defined under the Assessment sections in the MPI Maintenance Repainting Manual.

1.10.4.6 EPP

Environmentally Preferred Products, a standard for determining environmental preferability in support of Executive Order 13101.

1.10.4.7 EXT

MPI short term designation for an exterior coating system.

1.10.4.8 INT

MPI short term designation for an interior coating system.

1.10.4.9 micron / microns

The metric measurement for 0.001 mm or one/one-thousandth of a millimeter.

1.10.4.10 mil / mils

The English measurement for 0.001 in or one/one-thousandth of an inch, equal to 25.4 microns or 0.0254 mm.

1.10.4.11 mm

The metric measurement for millimeter, 0.001 meter or one/one-thousandth of a meter.

1.10.4.12 MPI Gloss Levels

MPI system of defining gloss. Seven (7) gloss levels (G1 to G7) are generically defined under the Evaluation sections of the MPI Manuals. Traditionally, Flat refers to G1/G2, Eggshell refers to G3, Semigloss refers to G5, and Gloss refers to G6.

Gloss levels are defined by MPI as follows:

Gloss Level	Description	Units @ 60 degrees	Units @ 85 degrees
G1	Matte or Flat	0 to 5	10 max
G2	Velvet	0 to 10	10 to 35
G3	Eggshell	10 to 25	10 to 35
G4	Satin	20 to 35	35 min
G5	Semi-Gloss	35 to 70	
G6	Gloss	70 to 85	
G7	High Gloss		

Gloss is tested in accordance with ASTM D 523. Historically, the Government has used Flat (G1 / G2), Eggshell (G3), Semi-Gloss (G5), and Gloss (G6).

1.10.4.13 MPI System Number

The MPI coating system number in each Division found in either the MPI Architectural Painting Specification Manual or the Maintenance Repainting Manual and defined as an exterior (EXT/REX) or interior system (INT/RIN). The Division number follows the CSI Master Format.

1.10.4.14 Paint

See Coating definition.

1.10.4.15 REX

MPI short term designation for an exterior coating system used in repainting projects or over existing coating systems.

1.10.4.16 RIN

MPI short term designation for an interior coating system used in repainting projects or over existing coating systems.

PART 2 PRODUCTS

2.1 MATERIALS

Conform to the coating specifications and standards referenced in PART 3. Submit manufacturer's technical data sheets for specified coatings and solvents.

PART 3 EXECUTION

3.1 PROTECTION OF AREAS AND SPACES NOT TO BE PAINTED

Prior to surface preparation and coating applications, remove, mask, or otherwise protect, hardware, hardware accessories, machined surfaces, radiator covers, plates, lighting fixtures, public and private property, and other such items not to be coated that are in contact with surfaces to be coated. Following completion of painting, workmen skilled in the trades involved shall reinstall removed items. Restore surfaces contaminated by coating materials, to original condition and repair damaged items.

3.2 SURFACE PREPARATION

Remove dirt, splinters, loose particles, grease, oil, and other foreign matter and substances deleterious to coating performance as specified for each substrate before application of paint or surface treatments. Oil and grease shall be removed prior to mechanical cleaning. Cleaning shall be programmed so that dust and other contaminants will not fall on wet, newly painted surfaces. Exposed ferrous metals such as nail heads on or in contact with surfaces to be painted with water-thinned paints, shall be spot-primmed with a suitable corrosion-inhibitive primer capable of preventing flash rusting and compatible with the coating specified for the adjacent areas.

3.3 PREPARATION OF METAL SURFACES

3.3.1 Existing and New Ferrous Surfaces

a. Ferrous Surfaces including Shop-coated Surfaces and Small Areas That Contain Rust, Mill Scale and Other Foreign Substances: Solvent clean or detergent wash in accordance with SSPC SP 1 to remove oil and grease. Where shop coat is missing or damaged, clean according to SSPC SP 2, SSPC SP 3, SSPC SP 6, or SSPC SP 10. Water jetting to SSPC SP 12 WJ-4 may be used to remove loose coating and other loose materials. Use inhibitor as recommended by coating manufacturer to prevent premature rusting. Shop-coated ferrous surfaces shall be protected from corrosion by treating and touching up corroded areas immediately upon detection.

b. Surfaces With More Than 20 Percent Rust, Mill Scale, and Other Foreign Substances: Clean entire surface in accordance with SSPC SP 6/SSPC SP 12 WJ-3 or SSPC SP 10/SSPC SP 12 WJ-2.

3.3.2 Final Ferrous Surface Condition:

For tool cleaned surfaces, the requirements are stated in SSPC SP 2 and SSPC SP 3. As a visual reference, cleaned surfaces shall be similar to photographs in SSPC VIS 3.

For abrasive blast cleaned surfaces, the requirements are stated in SSPC SP 7, SSPC SP 6, and SSPC SP 10. As a visual reference, cleaned surfaces shall be similar to photographs in SSPC VIS 1.

For waterjet cleaned surfaces, the requirements are stated in SSPC SP 12. As a visual reference, cleaned surfaces shall be similar to photographs in SSPC VIS 4.

3.3.3 Galvanized Surfaces

a. New or Existing Galvanized Surfaces With Only Dirt and Zinc Oxidation Products: Clean with solvent, steam, or non-alkaline detergent solution in accordance with SSPC SP 1. If the galvanized metal has been passivated or stabilized, the coating shall be completely removed by brush-off abrasive blast. New galvanized steel to be coated shall not be "passivated" or "stabilized" If the absence of hexavalent stain inhibitors is not documented, test as described in ASTM D 2092, Appendix X2, and remove by one of the methods described therein.

b. Galvanized with Slight Coating Deterioration or with Little or No Rusting: Water jetting to SSPC SP 12 WJ3 to remove loose coating from surfaces with less than 20 percent coating deterioration and no blistering, peeling, or cracking. Use inhibitor as recommended by the coating manufacturer to prevent rusting.

3.3.4 Non-Ferrous Metallic Surfaces

Aluminum and aluminum-alloy, lead, copper, and other nonferrous metal surfaces.

a. Surface Cleaning: Solvent clean in accordance with SSPC SP 1 and wash with mild non-alkaline detergent to remove dirt and water soluble contaminants.

3.3.5 Terne-Coated Metal Surfaces

Solvent clean surfaces with mineral spirits, ASTM D 235. Wipe dry with clean, dry cloths.

3.3.6 Existing Surfaces with a Bituminous or Mastic-Type Coating

Remove chalk, mildew, and other loose material by washing with a solution of 1/2 cup trisodium phosphate, 1/4 cup household detergent, one quart 5 percent sodium hypochlorite solution and 3 quarts of warm water.

3.4 PREPARATION OF CONCRETE AND CEMENTITIOUS SURFACE

3.4.1 Concrete and Masonry

a. Curing: Concrete, stucco and masonry surfaces shall be allowed to cure at least 30 days before painting, except concrete slab on grade, which shall be allowed to cure 90 days before painting.

b. Surface Cleaning: Remove the following deleterious substances.

(1) Dirt, Grease, and Oil: Wash new surfaces with a solution composed of 1/2 cup trisodium phosphate, 1/4 cuphousehold detergent, and 4 quarts of warm water. Then rinse thoroughly

with fresh water. For large areas, water blasting may be used.

(2) Fungus and Mold: Wash new surfaces with a solution composed of 1/2 cup trisodium phosphate, 1/4 cup household detergent, 1 quart 5 percent sodium hypochlorite solution and 3 quarts of warm water. Rinse thoroughly with fresh water.

(3) Paint and Loose Particles: Remove by wire brushing.

(4) Efflorescence: Remove by scraping or wire brushing followed by washing with a 5 to 10 percent by weight aqueous solution of hydrochloric (muriatic) acid. Do not allow acid to remain on the surface for more than five minutes before rinsing with fresh water. Do not acid clean more than 4 square feet of surface, per workman, at one time.

~~[~~(5) Removal of Existing Coatings: For surfaces to receive textured coating MPI 42, remove existing coatings including soundly adhered coatings if recommended by textured coating manufacturer.~~]~~

c. Cosmetic Repair of Minor Defects: Repair or fill mortar joints and minor defects, including but not limited to spalls, in accordance with manufacturer's recommendations and prior to coating application.

d. Allowable Moisture Content: Latex coatings may be applied to damp surfaces, but not to surfaces with droplets of water. Do not apply epoxies to damp vertical surfaces as determined by ASTM D 4263 or horizontal surfaces that exceed 3 lbs of moisture per 1000 square feet in 24 hours as determined by ASTM F 1869. In all cases follow manufacturers recommendations. Allow surfaces to cure a minimum of 30 days before painting.

3.4.2 Gypsum Board, Plaster, and Stucco

a. Surface Cleaning: Plaster and stucco shall be clean and free from loose matter; gypsum board shall be dry. Remove loose dirt and dust by brushing with a soft brush, rubbing with a dry cloth, or vacuum-cleaning prior to application of the first coat material. A damp cloth or sponge may be used if paint will be water-based.

b. Repair of Minor Defects: Prior to painting, repair joints, cracks, holes, surface irregularities, and other minor defects with patching plaster or spackling compound and sand smooth.

c. Allowable Moisture Content: Latex coatings may be applied to damp surfaces, but not surfaces with droplets of water. Do not apply epoxies to damp surfaces as determined by ASTM D 4263. New plaster to be coated shall have a maximum moisture content of 8 percent, when measured in accordance with ASTM D 4444, Method A, unless otherwise authorized. In addition to moisture content requirements, allow new plaster to age a minimum of 30 days before preparation for painting.

3.5 PREPARATION OF WOOD AND PLYWOOD SURFACES

3.5.1 New Plywood and Wood Surfaces, Except Floors:

a. Wood surfaces shall be cleaned of foreign matter.

   Surface Cleaning: Surfaces shall be free from dust and other deleterious substances and in a condition approved by the Contracting Officer prior to receiving paint or other finish. Do not use water to clean uncoated wood.

b. Moisture content of the wood shall not exceed 12 percent as measured by a moisture meter in accordance with ASTM D 4444, Method A, unless otherwise authorized.

c. Wood surfaces adjacent to surfaces to receive water-thinned paints shall be primed and/or touched up before applying water-thinned paints.

d. Cracks and Nailheads: Set and putty stop nailheads and putty cracks after the prime coat has dried.

e. Cosmetic Repair of Minor Defects:

   (1) Knots and Resinous Wood: Prior to application of coating, cover knots and stains with two or more coats of 3-pound-cut shellac varnish, plasticized with 5 ounces of castor oil per gallon. Scrape away existing coatings from knotty areas, and sand before treating. Prime before applying any putty over shellacked area.

   (2) Open Joints and Other Openings: Fill with whiting putty, linseed oil putty. Sand smooth after putty has dried.

   (3) Checking: Where checking of the wood is present, sand the surface, wipe and apply a coat of pigmented orange shellac. Allow to dry before paint is applied.

f. Prime Coat For New Exterior Surfaces: Prime coat before wood becomes dirty, warped, or weathered.

3.6 APPLICATION

3.6.1 Coating Application

Painting practices shall comply with applicable federal, state and local laws enacted to insure compliance with Federal Clean Air Standards. Apply coating materials in accordance with SSPC PA 1. SSPC PA 1 methods are applicable to all substrates, except as modified herein.

At the time of application, paint shall show no signs of deterioration. Uniform suspension of pigments shall be maintained during application.

Unless otherwise specified or recommended by the paint manufacturer, paint may be applied by brush, roller, or spray. Rollers for applying paints and enamels shall be of a type designed for the coating to be applied and the surface to be coated.

Paints, except water-thinned types, shall be applied only to surfaces that are completely free of moisture as determined by sight or touch.

Thoroughly work coating materials into joints, crevices, and open spaces. Special attention shall be given to insure that all edges, corners, crevices, welds, and rivets receive a film thickness equal to that of adjacent painted surfaces.

Each coat of paint shall be applied so dry film shall be of uniform thickness and free from runs, drops, ridges, waves, pinholes or other voids, laps, brush marks, and variations in color, texture, and finish. Hiding shall be complete.

Touch up damaged coatings before applying subsequent coats. Interior areas shall be broom clean and dust free before and during the application of coating material.

a. Drying Time: Allow time between coats, as recommended by the coating manufacturer, to permit thorough drying, but not to present topcoat adhesion problems. Provide each coat in specified condition to receive next coat.

b. Primers, and Intermediate Coats: Do not allow primers or intermediate coats to dry more than 30 days, or longer than recommended by manufacturer, before applying subsequent coats. Follow manufacturer's recommendations for surface preparation if primers or intermediate coats are allowed to dry longer than recommended by manufacturers of subsequent coatings. Each coat shall cover surface of preceding coat or surface completely, and there shall be a visually perceptible difference in shades of successive coats.

c. Finished Surfaces: Provide finished surfaces free from runs, drops, ridges, waves, laps, brush marks, and variations in colors.

d. Thermosetting Paints: Topcoats over thermosetting paints (epoxies and urethanes) should be applied within the overcoating window recommended by the manufacturer.

3.6.2 Mixing and Thinning of Paints

Reduce paints to proper consistency by adding fresh paint, except when thinning is mandatory to suit surface, temperature, weather conditions, application methods, or for the type of paint being used. Obtain written permission from the Contracting Officer to use thinners. The written permission shall include quantities and types of thinners to use.

When thinning is allowed, paints shall be thinned immediately prior to application with not more than 1 pint of suitable thinner per gallon. The use of thinner shall not relieve the Contractor from obtaining complete hiding, full film thickness, or required gloss. Thinning shall not cause the paint to exceed limits on volatile organic compounds. Paints of different manufacturers shall not be mixed.

3.6.3 Two-Component Systems

Two-component systems shall be mixed in accordance with manufacturer's instructions. Any thinning of the first coat to ensure proper penetration and sealing shall be as recommended by the manufacturer for each type of substrate.

3.6.4 Coating Systems

a. Systems by Substrates: Apply coatings that conform to the respective specifications listed in the following Tables:

Table

Division 3. Exterior Concrete Paint Table
Division 4. Exterior Concrete Masonry Units Paint Table
Division 5. Exterior Metal, Ferrous and Non-Ferrous Paint Table
Division 6. Exterior Wood; Dressed Lumber, Paneling, Decking, Shingles Paint Table
Division 3. Interior Concrete Paint Table
Division 4. Interior Concrete Masonry Units Paint Table
Division 5. Interior Metal, Ferrous and Non-Ferrous Paint Table
Division 6. Interior Wood Paint Table
Division 9: Interior Plaster, Gypsum Board, Textured Surfaces Paint Table

b. Minimum Dry Film Thickness (DFT): Apply paints, primers, varnishes, enamels, undercoats, and other coatings to a minimum dry film thickness of 1.5 mil each coat unless specified otherwise in the Tables. Coating thickness where specified, refers to the minimum dry film thickness.

c. Coatings for Surfaces Not Specified Otherwise: Coat surfaces which have not been specified, the same as surfaces having similar conditions of exposure.

d. Existing Surfaces Damaged During Performance of the Work, Including New Patches In Existing Surfaces: Coat surfaces with the following:

(1) One coat of primer.

(2) One coat of undercoat or intermediate coat.

(3) One topcoat to match adjacent surfaces.

e. Existing Coated Surfaces To Be Painted: Apply coatings conforming to the respective specifications listed in the Tables herein, except that pretreatments, sealers and fillers need not be provided on surfaces where existing coatings are soundly adhered and in good condition. Do not omit undercoats or primers.

3.7 COATING SYSTEMS FOR METAL

Apply coatings of Tables in Division 5 for Exterior and Interior.

a. Apply specified ferrous metal primer on the same day that surface is cleaned, to surfaces that meet all specified surface preparation requirements at time of application.

b. Inaccessible Surfaces: Prior to erection, use one coat of specified primer on metal surfaces that will be inaccessible after erection.

c. Shop-primed Surfaces: Touch up exposed substrates and damaged coatings to protect from rusting prior to applying field primer.

d. Surface Previously Coated with Epoxy or Urethane: Apply MPI 101, 1.5 mils DFT immediately prior to application of epoxy or urethane coatings.

e. Pipes and Tubing: The semitransparent film applied to some pipes and tubing at the mill is not to be considered a shop coat, but shall be overcoated with the specified ferrous-metal primer prior to application of finish coats.

f. Exposed Nails, Screws, Fasteners, and Miscellaneous Ferrous Surfaces. On surfaces to be coated with water thinned coatings, spot prime exposed nails and other ferrous metal with latex primer MPI 107.

3.8 COATING SYSTEMS FOR CONCRETE AND CEMENTITIOUS SUBSTRATES

Apply coatings of Tables in Division 3, 4 and 9 for Exterior and Interior.

3.9 COATING SYSTEMS FOR WOOD AND PLYWOOD

a. Apply coatings of Tables in Division 6 for Exterior and Interior.

b. Prior to erection, apply two coats of specified primer to treat and prime wood and plywood surfaces which will be inaccessible after erection.

c. Apply stains in accordance with manufacturer's printed instructions.

3.10 PIPING IDENTIFICATION

Piping Identification, Including Surfaces In Concealed Spaces: Provide in accordance with MIL-STD-101 or ANSI A13.1. Place stenciling in clearly visible locations. On piping not covered by MIL-STD-101 and ANSI A13.1, stencil approved names or code letters, in letters a minimum of 1/2 inch high for piping and a minimum of 2 inches high elsewhere. Stencil arrow-shaped markings on piping to indicate direction of flow using black stencil paint.

3.11 INSPECTION AND ACCEPTANCE

In addition to meeting previously specified requirements, demonstrate mobility of moving components, including swinging and sliding doors, cabinets, and windows with operable sash, for inspection by the Contracting Officer. Perform this demonstration after appropriate curing and drying times of coatings have elapsed and prior to invoicing for final payment.

3.12 PAINT TABLES

All DFT's are minimum values.

3.12.1 EXTERIOR PAINT TABLES

DIVISION 3: EXTERIOR CONCRETE PAINT TABLE

A. Concrete vertical surfaces, including undersides of balconies and soffits but excluding tops of slabs:

DIVISION 3: EXTERIOR CONCRETE PAINT TABLE

1. Latex

New; MPI EXT 3.1A-G2 (Flat) / Existing; MPI REX 3.1A-G2 (Flat)

Primer:	Intermediate:	Topcoat:
MPI 10	MPI 10	MPI 10

System DFT: 3.5 mils

New; MPI EXT 3.1A-G5 (Semigloss) / Existing; MPI EXT 3.1A-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 11	MPI 11	MPI 11

System DFT: 3.5 mils

New; MPI EXT 3.1A-G6 (Gloss) / Existing; MPI REX 3.1A-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 119	MPI 119	MPI 119

System DFT: 3.5 mils

Primer as recommended by manufacturer. Topcoat: Coating to match adjacent surfaces.

B. Concrete walls and bottom of swimming pools.

1. Chlorinated Rubber

New; / Existing;

Primer:	Intermediate:	Topcoat:
SSPC Paint 18	SSPC Paint 18	SSPC Paint 18

System DFT: Per Manufacturer

NOTE: Thin first coat (primer) with 1 part of approved thinner to 4 parts of paint by volume.

DIVISION 4: EXTERIOR CONCRETE MASONRY UNITS PAINT TABLE

A. Concrete masonry on uncoated surface:

1. Latex

New; MPI EXT 4.2A-G1 (Flat) / Existing; MPI REX 4.2A-G1 (Flat)

Block Filler:	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 10	MPI 10

System DFT: 11 mils

New; MPI EXT 4.2A-G5 (Semigloss) / Existing; MPI REX 4.2A-G5 (Semigloss)

Block Filler:	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 11	MPI 11

System DFT: 11 mils

New; MPI EXT 4.2A-G6 (Gloss) / Existing; MPI REX 4.2A-G6 (Gloss)

Block Filler:	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 119	MPI 119

System DFT: 11 mils

Topcoat: Coating to match adjacent surfaces.

DIVISION 5: EXTERIOR METAL, FERROUS AND NON-FERROUS PAINT TABLE

STEEL / FERROUS SURFACES

A. Steel that has been hand or power tool cleaned to SSPC SP 2 or SSPC SP 3

STEEL / FERROUS SURFACES

1. Alkyd
   New; MPI EXT 5.1Q-G5 (Semigloss) Existing; MPI REX 5.1D-G5

Primer:	Intermediate:	Topcoat:
MPI 23	MPI 94	MPI 94

   System DFT: 5.25 mils

   New; MPI EXT 5.1Q-G6 (Gloss) / Existing; MPI REX 5.1D-G6

Primer:	Intermediate:	Topcoat:
MPI 23	MPI 9	MPI 9

   System DFT: 5.25 mils

B. New Steel that has been blast-cleaned to SSPC SP 6:

2. Alkyd
   New; MPI EXT 5.1D-G5 (Semigloss) / Existing; MPI REX 5.1D-G5

Primer:	Intermediate:	Topcoat:
MPI 79	MPI 94	MPI 94

   System DFT: 5.25 mils

   New; MPI EXT 5.1D-G6 (Gloss) / Existing; MPI REX 5.1D-G6

Primer:	Intermediate:	Topcoat:
MPI 79	MPI 9	MPI 9

   System DFT: 5.25 mils

EXTERIOR SURFACES, OTHER METALS (NON-FERROUS)

C. Aluminum, aluminum alloy and other miscellaneous non-ferrous metal items not otherwise specified except hot metal surfaces, roof surfaces, and new prefinished equipment. Match surrounding finish:

1. Alkyd
   MPI EXT 5.4F-G1 (Flat)

Primer:	Intermediate:	Topcoat:
MPI 95	MPI 8	MPI 8

   System DFT: 5 mils

   MPI EXT 5.4F-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 95	MPI 94	MPI 94

   System DFT: 5 mils

   MPI EXT 5.4F-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 95	MPI 9	MPI 9

   System DFT: 5 mils

DIVISION 6: EXTERIOR WOOD; DRESSED LUMBER, PANELING, DECKING, SHINGLES PAINT TABLE

A. Wood and plywood, trim, not otherwise specified:

1. Alkyd
   MPI EXT 6.3B-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 7	MPI 94	MPI 94

   System DFT: 5 mils

DIVISION 6: EXTERIOR WOOD; DRESSED LUMBER, PANELING, DECKING, SHINGLES PAINT TABLE

MPI EXT 6.3B-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 7	MPI 9	MPI 9

System DFT: 5 mils

2. Latex

MPI EXT 6.3A-G1 (Flat)

Primer:	Intermediate:	Topcoat:
MPI 7	MPI 10	MPI 10

System DFT: 5 mils

MPI EXT 6.3A-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 7	MPI 11	MPI 11

System DFT: 5 mils

MPI EXT 6.3A-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 7	MPI 119	MPI 119

System DFT: 5 mils

3.12.2 INTERIOR PAINT TABLES

DIVISION 3: INTERIOR CONCRETE PAINT TABLE

A. Concrete, vertical surfaces, not specified otherwise:

1. Latex

~~New; MPI INT 3.1A-G2 (Flat) / Existing; MPI RIN 3.1A-G2 (Flat)~~

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 44	MPI 44

System DFT: 4 mils

New; MPI INT 3.1A-G3 (Eggshell) / Existing; MPI RIN 3.1A-G3 (Eggshell)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 52	MPI 52

System DFT: 4 mils

New; MPI INT 3.1A-G5 (Semigloss) / Existing; MPI RIN 3.1A-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 54	MPI 54

System DFT: 4 mils

B. Concrete ceilings, uncoated:

1. Latex Aggregate

MPI INT 3.1N

Primer:	Intermediate:	Topcoat:
N/A	N/A	MPI 42

System DFT: Per Manufacturer

Texture - Coarse. Surface preparation, number of coats, and primer in accordance with manufacturer's instructions. Topcoat: Coating to match adjacent surfaces.

C. Concrete in toilets, food-preparation, laundry areas, shower areas, not otherwise specified except floors:

DIVISION 3: INTERIOR CONCRETE PAINT TABLE

1. Waterborne Light Industrial Coating
   New; MPI INT 3.1L-G3(Eggshell) / Existing; MPI RIN 3.1C-G3(Eggshell)

Primer:	Intermediate:	Topcoat:
MPI 110-G3	MPI 110-G3	MPI 110-G3

   System DFT: 4.8 mils

   New; MPI INT 3.1L-G5(Semigloss) / Existing; MPI RIN 3.1C-G5(Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 110-G5	MPI 110-G5	MPI 110-G5

   System DFT: 4.8 mils

   New; MPI INT 3.1L-G6(Gloss) / Existing; MPI RIN 3.1C-G6(Gloss)

Primer:	Intermediate:	Topcoat:
MPI 110-G6	MPI 110-G6	MPI 110-G6

   System DFT: 4.8 mils

2. Alkyd
   New; MPI INT 3.1D-G3 (Eggshell) / Existing; RIN 3.1D-G3 (Eggshell)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 51	MPI 51

   System DFT: 4.5 mils

   MPI INT 3.1D-G5 (Semigloss) / Existing; RIN 3.1D-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 47	MPI 47

   System DFT: 4.5 mils

   MPI INT 3.1D-G6 (Gloss) / Existing; RIN 3.1D-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 48	MPI 48

   System DFT: 4.5 mils

3. Epoxy
   New; MPI INT 3.1F-G6 (Gloss) / Existing; MPI RIN 3.1E-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 77	MPI 77	MPI 77

   System DFT: 4 mils

   Note: Primer may be reduced for penetration per manufacturer's instructions.

DIVISION 4: INTERIOR CONCRETE MASONRY UNITS PAINT TABLE

A. Concrete masonry:

1. High Performance Architectural Latex
   MPI INT 4.2D-G2 (Flat)

Filler	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 138	MPI 138

   System DFT: 11 mils

   MPI INT 4.2D-G3 (Eggshell)

Filler	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 139	MPI 139

   System DFT: 11 mils

   MPI INT 4.2D-G4 (Satin)

DIVISION 4: INTERIOR CONCRETE MASONRY UNITS PAINT TABLE

Filler	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 140	MPI 140

System DFT: 11 mils

MPI INT 4.2D-G5 (Semigloss)

Filler	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 141	MPI 141

System DFT: 11 mils

Fill all holes in masonry surface

B. Concrete masonry units in toilets, food-preparation, laundry areas, shower areas, unless otherwise specified:

1. Waterborne Light Industrial Coating

MPI INT 4.2K-G3(Eggshell)

Filler:	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 110-G3	MPI 110-G3

System DFT: 11 mils

MPI INT 4.2K-G5(Semigloss)

Filler:	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 110-G5	MPI 110-G5

System DFT: 11 mils

MPI INT 4.2K-G6(Gloss)

Filler:	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 110-G6	MPI 110-G6

System DFT: 11 mils

Fill all holes in masonry surface]

2. Alkyd

MPI INT 4.2N-G3 (Eggshell)

Filler:	Primer:	Intermediate:	Topcoat:
MPI 4	MPI 50	MPI 51	MPI 51

System DFT: 12 mils

MPI INT 4.2N-G5 (Semigloss)

Filler:	Primer:	Intermediate:	Topcoat:
MPI 4	MPI 50	MPI 47	MPI 47

System DFT: 12 mils

MPI INT 4.2N-G6 (Gloss)

Filler:	Primer:	Intermediate:	Topcoat:
MPI 4	MPI 50	MPI 48	MPI 48

System DFT: 12 mils

Fill all holes in masonry surface]

3. Epoxy

MPI INT 4.2G-G6 (Gloss)

Filler:	Primer:	Intermediate:	Topcoat:
MPI 116	N/A	MPI 77	MPI 77

System DFT: 10 mils

Fill all holes in masonry surface

DIVISION 4: INTERIOR CONCRETE MASONRY UNITS PAINT TABLE

DIVISION 5: INTERIOR METAL, FERROUS AND NON-FERROUS PAINT TABLE

INTERIOR STEEL / FERROUS SURFACES

A. Metal, not otherwise specified except floors, hot metal surfaces, and new prefinished equipment:

1. High Performance Architectural Latex
   MPI INT 5.1R-G2 (Flat)
   Primer: Intermediate: Topcoat:
   MPI 79 MPI 138 MPI 138
   System DFT: 5 mils

   MPI INT 5.1R-G3 (Eggshell)
   Primer: Intermediate: Topcoat:
   MPI 79 MPI 139 MPI 139
   System DFT: 5 mils

   MPI INT 5.1R-G5 (Semigloss)
   Primer: Intermediate: Topcoat:
   MPI 79 MPI 141 MPI 141
   System DFT: 5 mils

2. Alkyd
   MPI INT 5.1E-G2 (Flat)
   Primer: Intermediate: Topcoat:
   MPI 79 MPI 49 MPI 49
   System DFT: 5.25 mils

   MPI INT 5.1E-G3 (Eggshell)
   Primer: Intermediate: Topcoat:
   MPI 79 MPI 51 MPI 51
   System DFT: 5.25 mils

   MPI INT 5.1E-G5 (Semigloss)
   Primer: Intermediate: Topcoat:
   MPI 79 MPI 47 MPI 47
   System DFT: 5.25 mils]

   MPI INT 5.1E-G6 (Gloss)
   Primer: Intermediate: Topcoat:
   MPI 79 MPI 48 MPI 48
   System DFT: 5.25 mils

B. Metal in toilets, food-preparation, laundry areas, shower areas not otherwise specified except floors, hot metal surfaces, and new prefinished equipment:

1. Alkyd
   MPI INT 5.1E-G3 (Eggshell)
   Primer: Intermediate: Topcoat:
   MPI 79 MPI 51 MPI 51
   System DFT: 5.25 mils

   MPI INT 5.1E-G5 (Semigloss)
   Primer: Intermediate: Topcoat:
   MPI 79 MPI 47 MPI 47

INTERIOR STEEL / FERROUS SURFACES
System DFT: 5.25 mils

MPI INT 5.1E-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 79	MPI 48	MPI 48

System DFT: 5.25 mils

2. Alkyd
MPI INT 5.1T-G3 (Eggshell) For hand tool cleaning

Primer:	Intermediate:	Topcoat:
MPI 23	MPI 51	MPI 51

System DFT: 5.25 mils

MPI INT 5.1T-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 23	MPI 47	MPI 47

System DFT: 5.25 mils

MPI INT 5.1T-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 23	MPI 48	MPI 48

System DFT: 5.25 mils

DIVISION 6: INTERIOR WOOD PAINT TABLE

A. Wood and plywood not otherwise specified:

1. High Performance Architectural Latex
MPI INT 6.4S-G3 (Eggshell)

Primer:	Intermediate:	Topcoat:
MPI 39	MPI 139	MPI 139

System DFT: 4.5 mils

MPI INT 6.4S-G4 (Satin)

Primer:	Intermediate:	Topcoat:
MPI 39	MPI 140	MPI 140

System DFT: 4.5 mils

MPI INT 6.4S-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 39	MPI 141	MPI 141

System DFT: 4.5 mils

2. Alkyd
MPI INT 6.4B-G3 (Eggshell)

Primer:	Intermediate:	Topcoat:
MPI 45	MPI 51	MPI 51

System DFT: 4.5 mils

MPI INT 6.4B-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 45	MPI 47	MPI 47

System DFT: 4.5 mils

MPI INT 6.4B-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 45	MPI 48	MPI 48

DIVISION 6: INTERIOR WOOD PAINT TABLE
System DFT: 4.5 mils

B. Wood surfaces in toilets, food-preparation, laundry areas, shower areas, not otherwise specified.:

1. Waterborne Light Industrial
MPI INT 6.3P-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 45	MPI 110-G5	MPI 110-G5

System DFT: 4.5 mils

MPI INT 6.3P-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 45	MPI 110-G6	MPI 110-G6

System DFT: 4.5 mils

2. Alkyd
MPI INT 6.3B-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 45	MPI 47	MPI 47

System DFT: 4.5 mils

MPI INT 6.3B-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 45	MPI 48	MPI 48

System DFT: 4.5 mils

C. Wood Doors; Natural Finish or Stained:

1. Natural finish, oil-modified polyurethane
New; MPI INT 6.3K-G4 / Existing; MPI RIN 6.3K-G4

Primer:	Intermediate:	Topcoat:
MPI 57	MPI 57	MPI 57

System DFT: 4 mils

New; MPI INT 6.3K-G6 (Gloss) / Existing; MPI RIN 6.3K-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 56	MPI 56	MPI 56

System DFT: 4 mils

Note: Sand between all coats per manufacturers recommendations.]

DIVISION 9: INTERIOR PLASTER, GYPSUM BOARD, TEXTURED SURFACES PAINT TABLE

A. Plaster and Wallboard not otherwise specified:

1. Latex
New; MPI INT 9.2A-G2 (Flat) / Existing; RIN 9.2A-G2 (Flat)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 44	MPI 44

System DFT: 4 mils

New; MPI INT 9.2A-G3 (Eggshell) / Existing; RIN 9.2A-G3 (Eggshell)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 52	MPI 52

System DFT: 4 mils

New; MPI INT 9.2A-G5 (Semigloss) / Existing; RIN 9.2A-G5 (Semigloss)

DIVISION 9: INTERIOR PLASTER, GYPSUM BOARD, TEXTURED SURFACES PAINT TABLE

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 54	MPI 54

System DFT: 4 mils

B. Plaster and Wallboard in toilets, food-preparation, laundry areas, shower areas, not otherwise specified.:

1. Waterborne Light Industrial Coating
   New; MPI INT 9.2L-G5(Semigloss) / Existing; MPI RIN 9.2L-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 110-G5	MPI 110-G5

   System DFT: 4 mils

2. Alkyd
   New; MPI INT 9.2C-G5 (Semigloss) / Existing; MPI RIN 9.2C-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 47	MPI 47

   System DFT: 4 mils

3. Epoxy
   New; MPI INT 9.2E-G6 (Gloss) / Existing; MPI RIN 9.2D-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 77	MPI 77

   System DFT: 4 mils

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SECTION 16110

ELECTRICAL WORK

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SECTION 16110

ELECTRICAL WORK
09/98

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C80.1	(1994) Rigid Steel Conduit - Zinc Coated

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 1	(1995) Hard-Drawn Copper Wire
ASTM B 8	(1995) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2002) National Electrical Code

UNDERWRITERS LABORATORIES INC. (UL)

UL 4	(1996; R 1996) Armored Cable
UL 6	(1997) Rigid Metal Conduit
UL 514B	(1997) Fittings for Conduit and Outlet Boxes
UL 1569	(1995; R 1997) Metal-Clad Cables

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

1.2.1 SD-03 Product Data

a. Wires and cables; G,RE

b. Wiring devices and wall plates; G,RE

c. Conduit and fittings

1.2.2 SD-06 Test Reports

a. 600-volt wiring test; G,RE

Submit written copies of test results.

PART 2 PRODUCTS

2.1 WIRES AND CABLES

Wires and cables shall meet requirements of NFPA 70 and UL for type of insulation, jacket, and conductor specified or indicated.

2.1.1 Feeder and Branch Circuits Conductors

Conductors No. 8 AWG and larger shall be stranded. Conductors No. 10 AWG and smaller shall be solid. Provide copper conductor for sizes No. 6 AWG and smaller. For No. 4 AWG and larger shall be either copper or aluminum. Provide 600 volts, Type THHN/THWN, XHHW insulation.

2.1.2 Remote Control and Signal Cable

Copper conductor; minimum size for Class 1 circuits, No. 14 AWG; for Class 2 low-energy circuits, No. 16 AWG; and for Class 3 low-energy circuits, No. 22 AWG. Provide 600 volt insulation, for Class 1; 300 volt insulation for Class 2 and 3; rated 60 degree C.

2.1.3 Bonding Conductors

ASTM B 1, solid bare copper for sizes No. 8 AWG and smaller; ASTM B 8, Class B, stranded bare copper for sizes No. 6 AWG and larger.

2.1.4 Metal-Clad Cable

UL 1569, NFPA 70, Type MC cable.

2.1.5 Armored Cable

UL 4, NFPA 70, Type AC cable.

2.2 CONDUIT AND FITTINGS

2.2.1 Conduit

ANSI C80.1, UL 6, rigid steel (zinc-coated).

2.2.2 Conduit Fittings

UL 514B, ferrous fittings for metal conduit shall be cadmium- or zinc-coated. Provide threaded-type fittings for rigid metal conduit.

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installation shall conform to requirements of NFPA 70.

3.1.1 Conduit Installation

Install conduit and the required support in accordance with the requirements of NFPA 70.

3.1.2 Restrictions Applicable to Aluminum Conduit

Do not install underground or encased in concrete or masonry. Do not use brass or bronze fittings.

3.1.3 Restrictions Applicable to EMT

Do not install underground, in concrete, outdoors, hazardous areas and areas subject to severe physical damage including but not limited to equipment rooms where moving or replacing equipment could physically damage the EMT.

3.1.4 Grounding Conductor

Provide bare or insulated, green equipment grounding conductor in feeder and branch circuits, including lighting circuits. Ground conductor shall be separate from electrical system neutral conductor. Provide bare or insulated, green conductor for grounding conductors installed in conduit or raceways.

3.1.5 Conductor Identification and Tagging

Conductor identification shall be provided within each enclosure where a tap, splice, or termination is made. Phase conductors of low voltage power circuits shall be identified by color coding.

a. Color coding shall be provided for service, feeder, branch, and ground conductors. Color shall be green for grounding conductors and white for neutrals; except where neutrals of more than one system are installed in the same raceway or box, other neutral shall be white with colored (not green) stripe. The color coding for 3-phase and single-phase low voltage systems shall be as follows:

   120/208-volt, 3-phase: Black(A), red(B), and blue(C).
   277/480-volt, 3-phase: Brown(A), orange(B), and yellow(C).
   120/240-volt, 1-phase: Black and red.

3.2 FIELD QUALITY CONTROL

Supply test equipment and personnel. Notify Contracting Officer 5 working days prior to each test.

3.2.1 600-Volt Wiring Test

Test wiring to verify that no short circuits or accidental grounds exist. Perform insulation resistance test on wiring No. 6 AWG and larger diameter using instruments which applies voltage of approximately 500 volts to provide direct reading of resistance. Minimum resistance shall be 250,000 ohms.

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DIVISION 16 - ELECTRICAL

SECTION 16524

EXTERIOR LIGHTING

09/99

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SECTION 16524

EXTERIOR LIGHTING
09/99

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO LTS2	(1985) Structural Supports for Highway Signs, Luminaires and Traffic Signals

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C2	(2002) National Electrical Safety Code
ANSI C136.14	(1988) Roadway Lighting Equipment - Enclosed Side-Mounted Luminaires for Horizontal-Burning High-Intensity-Discharge Lamps

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code

UNDERWRITERS LABORATORIES INC. (UL)

UL 773	(1995; R 1998) Plug-In, Locking Type Photocontrols for Use with Area Lighting
UL 1029	(1994; R 1997) High-Intensity-Discharge Lamp Ballasts
UL 1572	(1995; R 1999) High Intensity Discharge Lighting Fixtures

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-02 Shop Drawings

Installation details

SD-03 Product Data

Lighting fixtures

SD-06 Test Reports

Operational test

1.3 QUALITY ASSURANCE

1.3.1 Installation Details

Submit shop drawing showing mounting support for each fixtures. For pole mounted fixtures, include pole dimensions, wind load as determined in accordance with AASHTO LTS2, pole deflection, pole class and other applicable information.

PART 2 PRODUCTS

2.1 LIGHTING FIXTURES

Provide type and wattage as scheduled.

2.2 HIGH-INTENSITY-DISCHARGE (HID) LIGHTING FIXTURES

ANSI C136.14 or UL 1572.

2.2.1 HID Ballasts

UL 1029, and ANSI C82.4, designed to operate on system voltage to which they are connected and constructed so that open circuit operation will not reduce the average life. Provide single-lamp ballasts which shall have a minimum starting temperature of minus 30 degrees C.

2.2.2 HID Lamps

Provide type, wattage, and color of lamp as scheduled.

2.3 PHOTOCELL SWITCH

UL 773, hermetically sealed cadmium-sulfide cell rated, 60 Hz. Switch shall turn on below 3 footcandles and off at 3 to 10 footcandles. Provide a directional lens in front of the cell to prevent fixed light sources from creating a turnoff condition.

2.4 POLES

Provide poles designed for wind loading of 100 miles per hour in accordance with AASHTO LTS2. Poles shall be anchor-base type designed for use with underground supply conductors.

PART 3 EXECUTION

3.1 INSTALLATION

ANSI C2, NFPA 70, and to the requirements specified herein.

3.1.1 Pole Setting

Place backfill in the hole in 6-inch maximum layers and thoroughly tamp. Place surplus earth around the pole in conical shape and pack tightly to drain water away.

3.1.2 Photocell Switch Aiming

Aim switch according to manufacturer's recommendations.

3.1.3 Grounding

Ground noncurrent-carrying metal parts of lighting fixtures including metal poles, mounting arms, and brackets.

3.2 FIELD QUALITY CONTROL

Upon completion of installation, conduct an operational test to show that equipment operates in accordance with requirement of this section.

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SECTION 01005

GENERAL AND SPECIAL PROVISIONS

PART 1 SCOPE OF WORK

1.1 Asbestos Abatement

None.

1.2 Building Demolishion

Building demolition as required for the renovation of building.

1.3 Civil Work

Grading, site preparation,for new parking lots, driveways, site utilities, landscaping and sidewalks.

1.4 Architectural Work

Provide renovations of Building with new interior metal stud walls, drywall and painted finishes, new doors and metal frames, sheet vinyl floor and walls, raised floor systems, acoustical tile ceilings, and toilet partitions, and miscellaneous millwork as noted on drawings.

1.5 Mechanical Work

Provide new air handling equipment and associated ductwork with piping as indicated on drawings. Provide and install all noted plumbing systems/items and new fire suppression system.

1.6 Electrical Work

Provide fluorescent, ~~incandescent and metal halide~~ lighting fixtures, power receptacles, power for special outlets/disconnects, heating, ventilating, air conditioning equipment and all other power system requirements noted on drawings. Also lightning protection, fire alarm and communications, data and telephone systems shall be provided as indicated on drawings and specifications.

PART 2 PROJECT REQUIREMENTS

2.1 Certificates of Compliance and Material Submittals

The Contractor shall submit for approval all certificates of compliance and material submittals required in these technical provisions. Required submittals shall be submitted for approval not later than 30 days prior to the approval date needed to achieve compliance with the approved project schedule. Approval must be received from the Contracting Officer or his representative before incorporating the materials into the work. The Contractor shall provide a Submittal Control Sheet listing all required submittal forms (form 59-2-R) and a sample Submittal Register (Form 4288) will be provided at the Prework Conference.

2.2 Omitted

2.3 Quality Control

The Contractor shall provide the job superintendent's name and telephone number to the Construction Management Division of the PWBC; Building 3-1933, Butner Road; (910) 396-2308, prior to commencement of work. The Contractor shall furnish a daily Contract Quality Control (CQC)/Superintendent's work report to the Contracting Officer's Representative (COR). A sample CQC report form will be provided at the Prework Conference.

2.4 Excavation Permit

The Contractor shall have a completed and approved PWBC Excavation Permit in his possession prior to any excavation, to include sign or fence-post holes. The Contractor shall schedule an appointment to locate utility lines at least 24 hours prior to any excavation with the PWBC Maintenance Division; Building 3-1634, Butner Road; (910) 396-2772. A copy of the PWBC Excavation Permit will be provided at the Prework Conference. The Contractor shall also be responsible for coordination with the Information Technology Business Center (ITBC), Outside Plant Branch; Building 1-1434, Scott Street; (910) 396-8200, for locating communication lines prior to any excavation.

2.5 Disposal and Borrow Permits

2.5.1 Disposal Permits

A permit is required to use the installation land clearing and inert debris and demolition landfills. Landfill permits shall be processed with the Environmental Branch of PWBC Environmental & Natural Resources Division; ~~Building 3-1933, Butner Road;~~ (910) 396-3372/3341. Permits are issued for the life of the specific contract only. Only materials produced on the project for which the permits are issued may be disposed of in the land clearing and inert debris and demolition landfills. The Contractor shall keep a copy of the complete permit with the vehicle throughout the contract disposal operation. Copies of the disposal permit forms will be provided at the Prework Conerence. The land clearing and inert debris and demolition debris disposal site locations are shown on the drawings.

2.5.2 Borrow permits

A permit is required to use the Ft. Bragg borrow material pits. Borrow pit permits shall be processed with the PWBC Facility Maintenance Division; Building 3-1634, Butner Road; (910)432-6336. Permits are issued for the life of the specific contract only. Borrow materials may only be used on the project for which the permits are issued. The Contractor shall keep a copy of the completed permit with the vehicle throughout the contract borrow operation. Copies of the borrow peremit forms will be provided at the preworok Conference. The borrow pit location is shown on the drawings.

2.6 Haul Routes

The Contractor is required to use the haul routes shown on the contract drawings for transportation of borrow materials, construction debris, or demolition materials unless otherwise permitted in writing by the COR. When haul routes are not designated in the contract, the Contractor must obtain approval from the COR for the routes he intends to use. The axle

load of earth-hauling equipment operating on paved streets shall not exceed 12,000 pounds.

2.7 Utility Outages and Road Closures

Utility, road, and railroad closures require minimum 10 working days advance written notice and will be subject to COR approval. A sample utility outage/road closure request form will be provided at the Prework Conference. In the case of road closures, a sketch shall be provided showing the closure location and all necessary signs and barricades. Necessary signage, barricades, flagpersons, lights (including temporary traffic control lights), and markings for the safe movement of the public during construction shall be in accordance with the Manual on Uniform Traffic Control Devices, and shall be provided at no additional expense to the Government.

2.8 Availablity and Use of Utility Services

Utility services required on the job site for the accomplishmenet of the work will be furnished at no cost to the Contractor, however, the Government will make no connections or alterations to the existing utility systems for the Contractor. Utilities for offices and/or storage buildings or areas will be billed to the Contractor monthly and will not be furnished free of charge. The Contractor shall be responsible for installing meters or other connections at no cost to the Government. At the conclusion of the contract, the Contractor shall remove all temporary connections, distribution lines, meters and associated paraphrnalia unless otherwise directed by the Contracting Officer or his representative. Prior to installing any utility connections at an office/storage site, the plan will be approved by the COR. When utility meters are installed, the Contractor shall notify the (COR) for the initial meter reading. Failure to obtain this initial reading will result in the Contractor being charged for the entire amount on the meter.

2.9 As-Built Record Drawings

2.9.1 Master Prints

The Contractor shall be responsible for maintaining one set of master prints at the job-site on which he shall keep a careful and neat record of all deviations from the original contract drawings as the work progresses. The Contractor shall note all changes and corrections on these record drawings shall also include the actual location of all subsurface utility lines installed or encountered, and the type of materials used.

2.9.2 Certification

These marked-up/annotated prints shall be certified as to their correctness by the signature of an authorized representative of the Contractor and turned-over to the COR not later than 10 days after acceptance of the work by the Government.

PART 3 SPECIAL PROVISIONS:

3.1 Occupancy

The adjacent facilities will be occupied. Contractor is responsible for providing such covering, shields, and barricades as are required to protect the facility occupants.

3.2 Special Work Constraints

3.2.1 Time Constraints

Work is to be completed between the hours of 7:00 AM to 4:00 PM, Monday thru Friday, no government holidays. Work may be terminated at any time for special closure of the site.

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SECTION 01330

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09/00

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-- End of Section Table of Contents --

SECTION 01330

SUBMITTAL PROCEDURES
09/00

PART 1 GENERAL

1.1 SUBMITTAL IDENTIFICATION

Submittals required are identified by SD numbers and titles as follows:

SD-01 Preconstruction Submittals

SD-02 Shop Drawings

SD-03 Product Data

SD-04 Samples

SD-05 Design Data

SD-06 Test Reports

SD-07 Certificates

SD-08 Manufacturer's Instructions

SD-09 Manufacturer's Field Reports

SD-10 Operation and Maintenance Data

SD-11 Closeout Submittals

1.2 SUBMITTAL CLASSIFICATION

Submittals are classified as follows:

1.2.1 Government Approved

Government approval is required for extensions of design, critical materials, deviations, equipment whose compatibility with the entire system must be checked, and other items as designated by the Contracting Officer. Within the terms of the Contract Clause entitled "Specifications and Drawings for Construction," they are considered to be "shop drawings."

1.2.2 Information Only

All submittals not requiring Government approval will be for information only. They are not considered to be "shop drawings" within the terms of the Contract Clause referred to above.

1.3 APPROVED SUBMITTALS

The Contracting Officer's approval of submittals shall not be construed as a complete check, but will indicate only that the general method of construction, materials, detailing and other information are satisfactory. Approval will not relieve the Contractor of the responsibility for any error which may exist, as the Contractor under the Contractor Quality Control (CQC) requirements of this contract is responsible for dimensions,

the design of adequate connections and details, and the satisfactory construction of all work. After submittals have been approved by the Contracting Officer, no resubmittal for the purpose of substituting materials or equipment will be considered unless accompanied by an explanation of why a substitution is necessary.

1.4 DISAPPROVED SUBMITTALS

The Contractor shall make all corrections required by the Contracting Officer and promptly furnish a corrected submittal in the form and number of copies specified for the initial submittal. If the Contractor considers any correction indicated on the submittals to constitute a change to the contract, a notice in accordance with the Contract Clause "Changes" shall be given promptly to the Contracting Officer.

1.5 WITHHOLDING OF PAYMENT

Payment for materials incorporated in the work will not be made if required approvals have not been obtained.

PART 2 PRODUCTS (Not used)

PART 3 EXECUTION

3.1 GENERAL

The Contractor shall make submittals as required by the specifications. The Contracting Officer may request submittals in addition to those specified when deemed necessary to adequately describe the work covered in the respective sections. Units of weights and measures used on all submittals shall be the same as those used in the contract drawings. Each submittal shall be complete and in sufficient detail to allow ready determination of compliance with contract requirements. Prior to submittal, all items shall be checked and approved by the Contractor's Quality Control (CQC) System Manager and each item shall be stamped, signed, and dated by the CQC System Manager indicating action taken. Proposed deviations from the contract requirements shall be clearly identified. Submittals shall include items such as: Contractor's, manufacturer's, or fabricator's drawings; descriptive literature including (but not limited to) catalog cuts, diagrams, operating charts or curves; test reports; test cylinders; samples; O&M manuals (including parts list); certifications; warranties; and other such required submittals. Submittals requiring Government approval shall be scheduled and made prior to the acquisition of the material or equipment covered thereby. Samples remaining upon completion of the work shall be picked up and disposed of in accordance with manufacturer's Material Safety Data Sheets (MSDS) and in compliance with existing laws and regulations.

3.2 SUBMITTAL REGISTER

At the end of this section is a submittal register showing items of equipment and materials for which submittals are required by the specifications; this list may not be all inclusive and additional submittals may be required. Contractor will also be given the submittal register files, containing the computerized ENG Form and instructions on the use of the files. These submittal register files will be furnished on a separate diskette. Columns "c" through "f" have been completed by the Government; the Contractor shall complete columns "a", "b" and "g" through "r" and submit the forms (hard copy plus associated electronic file) to the

Contracting Officer for approval within 30 calendar days after Notice to Proceed. The Contractor shall keep this diskette up-to-date and shall submit it to the Government together with the monthly payment request. The approved submittal register will become the scheduling document and will be used to control submittals throughout the life of the contract. The submittal register and the progress schedules shall be coordinated.

3.3 SCHEDULING

Submittals covering component items forming a system or items that are interrelated shall be scheduled to be coordinated and submitted concurrently. Certifications to be submitted with the pertinent drawings shall be so scheduled. Adequate time (a minimum of 21 calendar days exclusive of mailing time) shall be allowed and shown on the register for review and approval. No delay damages or time extensions will be allowed for time lost in late submittals.

3.4 TRANSMITTAL FORM (ENG FORM 4025)

The sample transmittal form (ENG Form 4025) attached to this section shall be used for submitting both Government approved and information only submittals in accordance with the instructions on the reverse side of the form. These forms are included in the RMS-QC software that the Contractor is required to use for this contract. This form shall be properly completed by filling out all the heading blank spaces and identifying each item submitted. Special care shall be exercised to ensure proper listing of the specification paragraph and/or sheet number of the contract drawings pertinent to the data submitted for each item.

3.5 SUBMITTAL PROCEDURE

Submittals shall be made as follows:

3.5.1 Deviations

For submittals which include proposed deviations requested by the Contractor, the column "variation" of ENG Form 4025 shall be checked. The Contractor shall set forth in writing the reason for any deviations and annotate such deviations on the submittal. The Government reserves the right to rescind inadvertent approval of submittals containing unnoted deviations.

3.6 CONTROL OF SUBMITTALS

The Contractor shall carefully control his procurement operations to ensure that each individual submittal is made on or before the Contractor scheduled submittal date shown on the approved "Submittal Register."

3.7 GOVERNMENT APPROVED SUBMITTALS

Upon completion of review of submittals requiring Government approval, the submittals will be identified as having received approval by being so stamped and dated. Two copies of the submittal will be retained by the Contracting Officer and three copies of the submittal will be returned to the Contractor.

3.8 INFORMATION ONLY SUBMITTALS

Normally submittals for information only will not be returned. Approval of

the Contracting Officer is not required on information only submittals. The Government reserves the right to require the Contractor to resubmit any item found not to comply with the contract. This does not relieve the Contractor from the obligation to furnish material conforming to the plans and specifications; will not prevent the Contracting Officer from requiring removal and replacement of nonconforming material incorporated in the work; and does not relieve the Contractor of the requirement to furnish samples for testing by the Government laboratory or for check testing by the Government in those instances where the technical specifications so prescribe.

3.9 STAMPS

Stamps used by the Contractor on the submittal data to certify that the submittal meets contract requirements shall be similar to the following:

CONTRACTOR

(Firm Name)

_____ Approved

_____ Approved with corrections as noted on submittal data and/or attached sheets(s).

SIGNATURE: _____

TITLE: _____

DATE: _____

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SECTION 01355A

ENVIRONMENTAL PROTECTION

02/02

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SECTION 01355A

ENVIRONMENTAL PROTECTION
02/02

PART 1 GENERAL

1.1 REFERENCES

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

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

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

U.S. ARMY CORPS OF ENGINEERS (USACE)

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

1.2 DEFINITIONS

1.2.1 Environmental Pollution and Damage

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

1.2.2 Environmental Protection

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

1.2.3 Contractor Generated Hazardous Waste

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

1.2.4 Project Pesticide Coordinator

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

1.2.5 Land Application for Discharge Water

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

1.2.6 Pesticide

Pesticide is defined as any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest, or intended for use as a plant regulator, defoliant or desiccant.

1.2.7 Pests

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

1.2.8 Surface Discharge

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

1.2.9 Waters of the United States

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

1.2.10 Wetlands

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

1.3 GENERAL REQUIREMENTS

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

1.4 SUBCONTRACTORS

The Contractor shall ensure compliance with this section by subcontractors.

1.5 PAYMENT

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

1.6 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Environmental Protection Plan; G

The environmental protection plan.

1.7 ENVIRONMENTAL PROTECTION PLAN

Prior to commencing construction activities or delivery of materials to the site, the Contractor shall submit an Environmental Protection Plan for review and approval by the Contracting Officer. The purpose of the

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

1.7.1 Compliance

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

1.7.2 Contents

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

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

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

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

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

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

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

g. Traffic control plans including measures to reduce erosion of temporary roadbeds by construction traffic, especially during wet

weather. Plan shall include measures to minimize the amount of mud transported onto paved public roads by vehicles or runoff.

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

i. Drawing showing the location of borrow areas.

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

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

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

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

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

5. The names and locations of suppliers of containment materials and locations of additional fuel oil recovery, cleanup, restoration, and material-placement equipment available in case of an unforeseen spill emergency.

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

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

October). The report shall indicate the total amount of waste generated and total amount of waste diverted in cubic yards or tons along with the percent that was diverted.

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

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

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

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

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

q. A pesticide treatment plan shall be included and updated, as information becomes available. The plan shall include: sequence of treatment, dates, times, locations, pesticide trade name, EPA registration numbers, authorized uses, chemical composition, formulation, original and applied concentration, application rates of active ingredient (i.e. pounds of active ingredient applied), equipment

used for application and calibration of equipment. The Contractor is responsible for Federal, State, Regional and Local pest management record keeping and reporting requirements as well as any additional Project Office specific requirements.

1.7.3 Appendix

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

1.8 PROTECTION FEATURES

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

1.9 ENVIRONMENTAL ASSESSMENT OF CONTRACT DEVIATIONS

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

1.10 NOTIFICATION

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

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 ENVIRONMENTAL PERMITS AND COMMITMENTS

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

3.2 LAND RESOURCES

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

3.2.1 Work Area Limits

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

3.2.2 Landscape

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

3.2.3 Erosion and Sediment Controls

The Contractor shall be responsible for providing erosion and sediment control measures in accordance with Federal, State, and local laws and regulations. The erosion and sediment controls selected and maintained by the Contractor shall be such that water quality standards are not violated as a result of the Contractor's construction activities. The area of bare soil exposed at any one time by construction operations should be kept to a minimum. The Contractor shall construct or install temporary and permanent erosion and sediment control best management practices (BMPs) as indicated on the drawings. BMPs may include, but not be limited to, vegetation cover, stream bank stabilization, slope stabilization, silt fences, construction of terraces, interceptor channels, sediment traps, inlet and outfall protection, diversion channels, and sedimentation basins. Any

temporary measures shall be removed after the area has been stabilized.

3.2.4 Contractor Facilities and Work Areas

The Contractor's field offices, staging areas, stockpile storage, and temporary buildings shall be placed in areas designated on the drawings or as directed by the Contracting Officer. Temporary movement or relocation of Contractor facilities shall be made only when approved. Erosion and sediment controls shall be provided for on-site borrow and spoil areas to prevent sediment from entering nearby waters. Temporary excavation and embankments for plant and/or work areas shall be controlled to protect adjacent areas.

3.3 WATER RESOURCES

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

3.3.1 Cofferdams, Diversions, and Dewatering Operations

Construction operations for dewatering, removal of cofferdams, tailrace excavation, and tunnel closure shall be controlled at all times to maintain compliance with existing State water quality standards and designated uses of the surface water body. The Contractor shall comply with the State water quality standards and anti-degradation provisions and the Clean Water Act Section 404.

3.3.2 Stream Crossings

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

3.3.3 Wetlands

The Contractor shall not enter, disturb, destroy, or allow discharge of contaminants into any wetlands, except as authorized herein. The Contractor shall be responsible for the protection of wetlands shown on the drawings in accordance with paragraph ENVIRONMENTAL PERMITS, REVIEWS, AND APPROVALS. Authorization to enter specific wetlands identified shall not relieve the Contractor from any obligation to protect other wetlands within, adjacent to, or in the vicinity of the construction site and associated boundaries.

3.4 AIR RESOURCES

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

3.4.1 Particulates

Dust particles; aerosols and gaseous by-products from construction

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

3.4.2 Odors

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

3.4.3 Sound Intrusions

The Contractor shall keep construction activities under surveillance and control to minimize environment damage by noise. The Contractor shall comply with the provisions of the State rules.

3.4.4 Burning

Burning shall be prohibited on the Government premises.

3.5 CHEMICAL MATERIALS MANAGEMENT AND WASTE DISPOSAL

Disposal of wastes shall be as directed below, unless otherwise specified in other sections and/or shown on the drawings.

3.5.1 Solid Wastes

Solid wastes (excluding clearing debris) shall be placed in containers which are emptied on a regular schedule. Handling, storage, and disposal shall be conducted to prevent contamination. Segregation measures shall be employed so that no hazardous or toxic waste will become co-mingled with solid waste. Waste materials shall be hauled to the Government landfill site shown on the drawings. The Contractor shall comply with site procedures, Federal, State, and local laws and regulations pertaining to the use of landfill areas.

3.5.2 Chemicals and Chemical Wastes

Chemicals shall be dispensed ensuring no spillage to the ground or water. Periodic inspections of dispensing areas to identify leakage and initiate corrective action shall be performed and documented. This documentation will be periodically reviewed by the Government. Chemical waste shall be collected in corrosion resistant, compatible containers. Collection drums shall be monitored and removed to a staging or storage area when contents are within 6 inches of the top. Wastes shall be classified, managed, stored, and disposed of in accordance with Federal, State, and local laws

and regulations.

3.5.3 Contractor Generated Hazardous Wastes/Excess Hazardous Materials

Hazardous wastes are defined in 40 CFR 261, or are as defined by applicable State and local regulations. Hazardous materials are defined in 49 CFR 171 - 178. The Contractor shall, at a minimum, manage and store hazardous waste in compliance with 40 CFR 262 and shall manage and store hazardous waste in accordance with the Installation hazardous waste management plan. The Contractor shall take sufficient measures to prevent spillage of hazardous and toxic materials during dispensing. The Contractor shall segregate hazardous waste from other materials and wastes, shall protect it from the weather by placing it in a safe covered location, and shall take precautionary measures such as berming or other appropriate measures against accidental spillage. The Contractor shall be responsible for storage, describing, packaging, labeling, marking, and placarding of hazardous waste and hazardous material in accordance with 49 CFR 171 - 178, State, and local laws and regulations. The Contractor shall transport Contractor generated hazardous waste off Government property within 60 days in accordance with the Environmental Protection Agency and the Department of Transportation laws and regulations. The Contractor shall dispose of hazardous waste in compliance with Federal, State and local laws and regulations. Spills of hazardous or toxic materials shall be immediately reported to the Contracting Officer. Cleanup and cleanup costs due to spills shall be the Contractor's responsibility. The disposition of Contractor generated hazardous waste and excess hazardous materials are the Contractor's responsibility.

3.5.4 Fuel and Lubricants

Storage, fueling and lubrication of equipment and motor vehicles shall be conducted in a manner that affords the maximum protection against spill and evaporation. Fuel, lubricants and oil shall be managed and stored in accordance with all Federal, State, Regional, and local laws and regulations. Used lubricants and used oil to be discarded shall be stored in marked corrosion-resistant containers and recycled or disposed in accordance with 40 CFR 279, State, and local laws and regulations. Storage of fuel on the project site shall be accordance with all Federal, State, and local laws and regulations.

3.5.5 Waste Water

Disposal of waste water shall be as specified below.

a. Waste water from construction activities, such as onsite material processing, concrete curing, foundation and concrete clean-up, water used in concrete trucks, forms, etc. shall not be allowed to enter water ways or to be discharged prior to being treated to remove pollutants. The Contractor shall dispose of the construction related waste water off-Government property in accordance with all Federal, State, Regional and Local laws and regulations.

b. For discharge of ground water, the Contractor shall obtain a State or Federal permit specific for pumping and discharging ground water prior to surface discharging.

c. Water generated from the flushing of lines after disinfection or disinfection in conjunction with hydrostatic testing and/or

hydrostatic testing shall be discharged into the sanitary sewer with prior approval and/or notification to the Waste Water Treatment Plant's Operator.

3.6 RECYCLING AND WASTE MINIMIZATION

The Contractor shall participate in State and local government sponsored recycling programs.

3.7 NON-HAZARDOUS SOLID WASTE DIVERSION REPORT

The Contractor shall maintain an inventory of non-hazardous solid waste diversion and disposal of construction and demolition debris. The Contractor shall submit a report to the Contracting Officer on the first working day after each fiscal year quarter, starting the first quarter that non-hazardous solid waste has been generated. The following shall be included in the report:

a. Construction and Demolition (C&D) Debris Disposed in cubic yards or tons, as appropriate.

b. Construction and Demolition (C&D) Debris Recycled in cubic yards or tons, as appropriate.

c. Total C&D Debris Generated in cubic yards or tons, as appropriate.

d. Waste Sent to Waste-To-Energy Incineration Plant (This amount should not be included in the recycled amount) in cubic yards or tons, as appropriate.

3.8 HISTORICAL, ARCHAEOLOGICAL, AND CULTURAL RESOURCES

If during excavation or other construction activities any previously unidentified or unanticipated historical, archaeological, and cultural resources are discovered or found, all activities that may damage or alter such resources shall be temporarily suspended. Resources covered by this paragraph include but are not limited to: any human skeletal remains or burials; artifacts; shell, midden, bone, charcoal, or other deposits; rock or coral alignments, pavings, wall, or other constructed features; and any indication of agricultural or other human activities. Upon such discovery or find, the Contractor shall immediately notify the Contracting Officer so that the appropriate authorities may be notified and a determination made as to their significance and what, if any, special disposition of the finds should be made. The Contractor shall cease all activities that may result in impact to or the destruction of these resources. The Contractor shall secure the area and prevent employees or other persons from trespassing on, removing, or otherwise disturbing such resources.

3.9 BIOLOGICAL RESOURCES

The Contractor shall minimize interference with, disturbance to, and damage to fish, wildlife, and plants including their habitat. The Contractor shall be responsible for the protection of threatened and endangered animal and plant species including their habitat in accordance with Federal, State, Regional, and local laws and regulations.

3.10 INTEGRATED PEST MANAGEMENT

In order to minimize impacts to existing fauna and flora, the Contractor,

through the Contracting Officer, shall coordinate with the Project Pesticide Coordinator (PPC) at the earliest possible time prior to pesticide application. The Contractor shall discuss integrated pest management strategies with the PPC and receive concurrence from the PPC through the COR prior to the application of any pesticide associated with these specifications. Project Office Pest Management personnel shall be given the opportunity to be present at all meetings concerning treatment measures for pest or disease control and during application of the pesticide. The use and management of pesticides are regulated under 40 CFR 152 - 186.

3.10.1 Pesticide Delivery and Storage

Pesticides shall be delivered to the site in the original, unopened containers bearing legible labels indicating the EPA registration number and the manufacturer's registered uses. Pesticides shall be stored according to manufacturer's instructions and under lock and key when unattended.

3.10.2 Qualifications

For the application of pesticides, the Contractor shall use the services of a subcontractor whose principal business is pest control. The subcontractor shall be licensed and certified in the state where the work is to be performed.

3.10.3 Pesticide Handling Requirements

The Contractor shall formulate, treat with, and dispose of pesticides and associated containers in accordance with label directions and shall use the clothing and personal protective equipment specified on the labeling for use during all phases of the application. Material Safety Data Sheets (MSDS)shall be available for all pesticide products.

3.10.4 Application

Pesticides shall be applied by a State Certified Pesticide Applicator in accordance with EPA label restrictions and recommendation. The Certified Applicator shall wear clothing and personal protective equipment as specified on the pesticide label. Water used for formulating shall only come from locations designated by the Contracting Officer. The Contractor shall not allow the equipment to overflow. Prior to application of pesticide, all equipment shall be inspected for leaks, clogging, wear, or damage and shall be repaired prior to being used.

3.11 PREVIOUSLY USED EQUIPMENT

The Contractor shall clean all previously used construction equipment prior to bringing it onto the project site. The Contractor shall ensure that the equipment is free from soil residuals, egg deposits from plant pests, noxious weeds, and plant seeds. The Contractor shall consult with the USDA jurisdictional office for additional cleaning requirements.

3.12 MAINTENANCE OF POLLUTION FACILITIES

The Contractor shall maintain permanent and temporary pollution control facilities and devices for the duration of the contract or for that length of time construction activities create the particular pollutant.

3.13 MILITARY MUNITIONS

In the event the Contractor discovers or uncovers military munitions as defined in 40 CFR 260, the Contractor shall immediately stop work in that area and immediately inform the Contracting Officer.

3.14 TRAINING OF CONTRACTOR PERSONNEL

The Contractor's personnel shall be trained in all phases of environmental protection and pollution control. The Contractor shall conduct environmental protection/pollution control meetings for all Contractor personnel prior to commencing construction activities. Additional meetings shall be conducted for new personnel and when site conditions change. The training and meeting agenda shall include: methods of detecting and avoiding pollution; familiarization with statutory and contractual pollution standards; installation and care of devices, vegetative covers, and instruments required for monitoring purposes to ensure adequate and continuous environmental protection/pollution control; anticipated hazardous or toxic chemicals or wastes, and other regulated contaminants; recognition and protection of archaeological sites, artifacts, wetlands, and endangered species and their habitat that are known to be in the area.

3.15 POST CONSTRUCTION CLEANUP

The Contractor shall clean up all areas used for construction in accordance with Contract Clause: "Cleaning Up". The Contractor shall, unless otherwise instructed in writing by the Contracting Officer, obliterate all signs of temporary construction facilities such as haul roads, work area, structures, foundations of temporary structures, stockpiles of excess or waste materials, and other vestiges of construction prior to final acceptance of the work. The disturbed area shall be graded, filled and the entire area seeded unless otherwise indicated.

-- End of Section --

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SECTION 01451A

CONTRACTOR QUALITY CONTROL
01/03

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM D 3740	(2001) Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
ASTM E 329	(2000b) Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction

1.2 PAYMENT

Separate payment will not be made for providing and maintaining an effective Quality Control program, and all costs associated therewith shall be included in the applicable unit prices or lump-sum prices contained in the Bidding Schedule.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

The Contractor is responsible for quality control and shall establish and maintain an effective quality control system in compliance with the Contract Clause titled "Inspection of Construction." The quality control system shall consist of plans, procedures, and organization necessary to produce an end product which complies with the contract requirements. The system shall cover all construction operations, both onsite and offsite, and shall be keyed to the proposed construction sequence. The site project superintendent will be held responsible for the quality of work on the job and is subject to removal by the Contracting Officer for non-compliance with the quality requirements specified in the contract. The site project superintendent in this context shall be the highest level manager responsible for the overall construction activities at the site, including quality and production. The site project superintendent shall maintain a physical presence at the site at all times, except as otherwise acceptable to the Contracting Officer, and shall be responsible for all construction and construction related activities at the site.

3.2 QUALITY CONTROL PLAN

The Contractor shall furnish for review by the Government, not later than

14 days after receipt of notice to proceed, the Contractor Quality Control (CQC) Plan proposed to implement the requirements of the Contract Clause titled "Inspection of Construction." The plan shall identify personnel, procedures, control, instructions, tests, records, and forms to be used. The Government will consider an interim plan for the first 60 days of operation. Construction will be permitted to begin only after acceptance of the CQC Plan or acceptance of an interim plan applicable to the particular feature of work to be started. Work outside of the features of work included in an accepted interim plan will not be permitted to begin until acceptance of a CQC Plan or another interim plan containing the additional features of work to be started.

3.2.1 Content of the CQC Plan

The CQC Plan shall include, as a minimum, the following to cover all construction operations, both onsite and offsite, including work by subcontractors, fabricators, suppliers, and purchasing agents:

a. A description of the quality control organization, including a chart showing lines of authority and acknowledgment that the CQC staff shall implement the three phase control system for all aspects of the work specified. The staff shall include a CQC System Manager who shall report to the project superintendent.

b. The name, qualifications (in resume format), duties, responsibilities, and authorities of each person assigned a CQC function.

c. A copy of the letter to the CQC System Manager signed by an authorized official of the firm which describes the responsibilities and delegates sufficient authorities to adequately perform the functions of the CQC System Manager, including authority to stop work which is not in compliance with the contract. The CQC System Manager shall issue letters of direction to all other various quality control representatives outlining duties, authorities, and responsibilities. Copies of these letters shall also be furnished to the Government.

d. Procedures for scheduling, reviewing, certifying, and managing submittals, including those of subcontractors, offsite fabricators, suppliers, and purchasing agents. These procedures shall be in accordance with Section 01330 SUBMITTAL PROCEDURES.

e. Control, verification, and acceptance testing procedures for each specific test to include the test name, specification paragraph requiring test, feature of work to be tested, test frequency, and person responsible for each test. (Laboratory facilities approved by the Contracting Officer shall be used.)

f. Procedures for tracking preparatory, initial, and follow-up control phases and control, verification, and acceptance tests including documentation.

g. Procedures for tracking construction deficiencies from identification through acceptable corrective action. These procedures shall establish verification that identified deficiencies have been corrected.

h. Reporting procedures, including proposed reporting formats.

i. A list of the definable features of work. A definable feature of work is a task which is separate and distinct from other tasks, has separate control requirements, and may be identified by different trades or disciplines, or it may be work by the same trade in a different environment. Although each section of the specifications may generally be considered as a definable feature of work, there are frequently more than one definable features under a particular section. This list will be agreed upon during the coordination meeting.

3.2.2 Acceptance of Plan

Acceptance of the Contractor's plan is required prior to the start of construction. Acceptance is conditional and will be predicated on satisfactory performance during the construction. The Government reserves the right to require the Contractor to make changes in his CQC Plan and operations including removal of personnel, as necessary, to obtain the quality specified.

3.2.3 Notification of Changes

After acceptance of the CQC Plan, the Contractor shall notify the Contracting Officer in writing of any proposed change. Proposed changes are subject to acceptance by the Contracting Officer.

3.3 COORDINATION MEETING

After the Preconstruction Conference, before start of construction, and prior to acceptance by the Government of the CQC Plan, the Contractor shall meet with the Contracting Officer or Authorized Representative and discuss the Contractor's quality control system. The CQC Plan shall be submitted for review a minimum of 7 calendar days prior to the Coordination Meeting. During the meeting, a mutual understanding of the system details shall be developed, including the forms for recording the CQC operations, control activities, testing, administration of the system for both onsite and offsite work, and the interrelationship of Contractor's Management and control with the Government's Quality Assurance. Minutes of the meeting shall be prepared by the Government and signed by both the Contractor and the Contracting Officer. The minutes shall become a part of the contract file. There may be occasions when subsequent conferences will be called by either party to reconfirm mutual understandings and/or address deficiencies in the CQC system or procedures which may require corrective action by the Contractor.

3.4 QUALITY CONTROL ORGANIZATION

3.4.1 Personnel Requirements

The requirements for the CQC organization are a CQC System Manager and sufficient number of additional qualified personnel to ensure safety and contract compliance. The Safety and Health Manager shall receive direction and authority from the CQC System Manager and shall serve as a member of the CQC staff. Personnel identified in the technical provisions as requiring specialized skills to assure the required work is being performed properly will also be included as part of the CQC organization. The Contractor's CQC staff shall maintain a presence at the site at all times during progress of the work and have complete authority and responsibility to take any action necessary to ensure contract compliance. The CQC staff

shall be subject to acceptance by the Contracting Officer. The Contractor shall provide adequate office space, filing systems and other resources as necessary to maintain an effective and fully functional CQC organization. Complete records of all letters, material submittals, shop drawing submittals, schedules and all other project documentation shall be promptly furnished to the CQC organization by the Contractor. The CQC organization shall be responsible to maintain these documents and records at the site at all times, except as otherwise acceptable to the Contracting Officer.

3.4.2 CQC System Manager

The Contractor shall identify as CQC System Manager an individual within the onsite work organization who shall be responsible for overall management of CQC and have the authority to act in all CQC matters for the Contractor. The CQC System Manager shall be a graduate engineer, graduate architect, or a graduate of construction management, ~~with~~or have a minimum of ~~8~~10 years construction experience on construction similar to this contract ~~or a construction person with a minimum of 10 years in related work~~. This CQC System Manager shall be on the site at all times during construction and shall be employed by the prime Contractor. The CQC System Manager shall be assigned no other duties. An alternate for the CQC System Manager shall be identified in the plan to serve in the event of the System Manager's absence. The requirements for the alternate shall be the same as for the designated CQC System Manager.

3.4.3 CQC Personnel

In addition to CQC personnel specified elsewhere in the contract, the Contractor shall provide as part of the CQC organization specialized personnel to assist the CQC System Manager for the following areas: electrical, mechanical, structural and submittals clerk. These individuals shall be directly employed by the prime Contractor and may not be employed by a supplier or sub-contractor on this project; be responsible to the CQC System Manager; be physically present at the construction site during work on their areas of responsibility; have the necessary education and/or experience in accordance with the experience matrix listed herein. These individuals shall have no other duties other than quality control and shall be physically present at the construction site during work on their areas of responsibility, or no later than 60 days after notice to proceed whichever is earlier.

Experience Matrix

	Area	Qualifications
a.	Mechanical	Graduate Mechanical Engineer with 8 yrs experience or person with 12 yrs related experience
b.	Electrical	Graduate Electrical Engineer with 8 yrs related experience or person with 12 yrs related experience
c.	Structural	Graduate Structural Engineer with 6 yrs

Experience Matrix

Area	Qualifications
	experience or person with 12 yrs related experience
d. Submittals	Submittal Clerk with 1 yr experience

3.5 SUBMITTALS AND DELIVERABLES

Submittals, if needed, shall be made as specified in Section 01330 SUBMITTAL PROCEDURES. The CQC organization shall be responsible for certifying that all submittals and deliverables are in compliance with the contract requirements.

3.6 CONTROL

Contractor Quality Control is the means by which the Contractor ensures that the construction, to include that of subcontractors and suppliers, complies with the requirements of the contract. At least three phases of control shall be conducted by the CQC System Manager for each definable feature of the construction work as follows:

3.6.1 Preparatory Phase

This phase shall be performed prior to beginning work on each definable feature of work, after all required plans/documents/materials are approved/accepted, and after copies are at the work site. This phase shall include:

a. A review of each paragraph of applicable specifications, reference codes, and standards. A copy of those sections of referenced codes and standards applicable to that portion of the work to be accomplished in the field shall be made available by the Contractor at the preparatory inspection. These copies shall be maintained in the field and available for use by Government personnel until final acceptance of the work.

b. A review of the contract drawings.

c. A check to assure that all materials and/or equipment have been tested, submitted, and approved.

d. Review of provisions that have been made to provide required control inspection and testing.

e. Examination of the work area to assure that all required preliminary work has been completed and is in compliance with the contract.

f. A physical examination of required materials, equipment, and sample work to assure that they are on hand, conform to approved shop drawings or submitted data, and are properly stored.

g. A review of the appropriate activity hazard analysis to assure safety requirements are met.

h. Discussion of procedures for controlling quality of the work including repetitive deficiencies. Document construction tolerances and workmanship standards for that feature of work.

i. A check to ensure that the portion of the plan for the work to be performed has been accepted by the Contracting Officer.

j. Discussion of the initial control phase.

k. The Government shall be notified at least 24 hours in advance of beginning the preparatory control phase. This phase shall include a meeting conducted by the CQC System Manager and attended by the superintendent, other CQC personnel (as applicable), and the foreman responsible for the definable feature. The results of the preparatory phase actions shall be documented by separate minutes prepared by the CQC System Manager and attached to the daily CQC report. The Contractor shall instruct applicable workers as to the acceptable level of workmanship required in order to meet contract specifications.

3.6.2 Initial Phase

This phase shall be accomplished at the beginning of a definable feature of work. The following shall be accomplished:

a. A check of work to ensure that it is in full compliance with contract requirements. Review minutes of the preparatory meeting.

b. Verify adequacy of controls to ensure full contract compliance. Verify required control inspection and testing.

c. Establish level of workmanship and verify that it meets minimum acceptable workmanship standards. Compare with required sample panels as appropriate.

d. Resolve all differences.

e. Check safety to include compliance with and upgrading of the safety plan and activity hazard analysis. Review the activity analysis with each worker.

f. The Government shall be notified at least ~~[_____]~~48 hours in advance of beginning the initial phase. Separate minutes of this phase shall be prepared by the CQC System Manager and attached to the daily CQC report. Exact location of initial phase shall be indicated for future reference and comparison with follow-up phases.

g. The initial phase should be repeated for each new crew to work onsite, or any time acceptable specified quality standards are not being met.

3.6.3 Follow-up Phase

Daily checks shall be performed to assure control activities, including control testing, are providing continued compliance with contract requirements, until completion of the particular feature of work. The checks shall be made a matter of record in the CQC documentation. Final

follow-up checks shall be conducted and all deficiencies corrected prior to the start of additional features of work which may be affected by the deficient work. The Contractor shall not build upon nor conceal non-conforming work.

3.6.4 Additional Preparatory and Initial Phases

Additional preparatory and initial phases shall be conducted on the same definable features of work if: the quality of on-going work is unacceptable; if there are changes in the applicable CQC staff, onsite production supervision or work crew; if work on a definable feature is resumed after a substantial period of inactivity; or if other problems develop.

3.7 TESTS

3.7.1 Testing Procedure

The Contractor shall perform specified or required tests to verify that control measures are adequate to provide a product which conforms to contract requirements. Upon request, the Contractor shall furnish to the Government duplicate samples of test specimens for possible testing by the Government. Testing includes operation and/or acceptance tests when specified. The Contractor shall procure the services of a Corps of Engineers approved testing laboratory or establish an approved testing laboratory at the project site. The Contractor shall perform the following activities and record and provide the following data:

a. Verify that testing procedures comply with contract requirements.

b. Verify that facilities and testing equipment are available and comply with testing standards.

c. Check test instrument calibration data against certified standards.

d. Verify that recording forms and test identification control number system, including all of the test documentation requirements, have been prepared.

e. Results of all tests taken, both passing and failing tests, shall be recorded on the CQC report for the date taken. Specification paragraph reference, location where tests were taken, and the sequential control number identifying the test shall be given. If approved by the Contracting Officer, actual test reports may be submitted later with a reference to the test number and date taken. An information copy of tests performed by an offsite or commercial test facility shall be provided directly to the Contracting Officer. Failure to submit timely test reports as stated may result in nonpayment for related work performed and disapproval of the test facility for this contract.

3.7.2 Testing Laboratories

3.7.2.1 Capability Check

The Government reserves the right to check laboratory equipment in the proposed laboratory for compliance with the standards set forth in the contract specifications and to check the laboratory technician's testing procedures and techniques. Laboratories utilized for testing soils,

concrete, asphalt, and steel shall meet criteria detailed in ASTM D 3740 and ASTM E 329.

3.7.2.2 Capability Recheck

If the selected laboratory fails the capability check, the Contractor will be assessed a charge of $100 to reimburse the Government for each succeeding recheck of the laboratory or the checking of a subsequently selected laboratory. Such costs will be deducted from the contract amount due the Contractor.

3.7.3 Onsite Laboratory

The Government reserves the right to utilize the Contractor's control testing laboratory and equipment to make assurance tests, and to check the Contractor's testing procedures, techniques, and test results at no additional cost to the Government.

3.7.4 Furnishing or Transportation of Samples for Testing

Costs incidental to the transportation of samples or materials shall be borne by the Contractor. Samples of materials for test verification and acceptance testing by the Government shall be delivered to the Corps of Engineers Division Laboratory. Coordination for each specific test, exact delivery location, and dates will be made through the Area Office.

3.8 COMPLETION INSPECTION

3.8.1 Punch-Out Inspection

Near the end of the work, or any increment of the work established by a time stated in the SPECIAL CONTRACT REQUIREMENTS Clause, "Commencement, Prosecution, and Completion of Work", or by the specifications, the CQC Manager shall conduct an inspection of the work. A punch list of items which do not conform to the approved drawings and specifications shall be prepared and included in the CQC documentation, as required by paragraph DOCUMENTATION. The list of deficiencies shall include the estimated date by which the deficiencies will be corrected. The CQC System Manager or staff shall make a second inspection to ascertain that all deficiencies have been corrected. Once this is accomplished, the Contractor shall notify the Government that the facility is ready for the Government Pre-Final inspection.

3.8.2 Pre-Final Inspection

The Government will perform the pre-final inspection to verify that the facility is complete and ready to be occupied. A Government Pre-Final Punch List may be developed as a result of this inspection. The Contractor's CQC System Manager shall ensure that all items on this list have been corrected before notifying the Government, so that a Final inspection with the customer can be scheduled. Any items noted on the Pre-Final inspection shall be corrected in a timely manner. These inspections and any deficiency corrections required by this paragraph shall be accomplished within the time slated for completion of the entire work or any particular increment of the work if the project is divided into increments by separate completion dates.

3.8.3 Final Acceptance Inspection

The Contractor's Quality Control Inspection personnel, plus the superintendent or other primary management person, and the Contracting Officer's Representative shall be in attendance at the final acceptance inspection. Additional Government personnel including, but not limited to, those from Base/Post Civil Facility Engineer user groups, and major commands may also be in attendance. The final acceptance inspection will be formally scheduled by the Contracting Officer based upon results of the Pre-Final inspection. Notice shall be given to the Contracting Officer at least 14 days prior to the final acceptance inspection and shall include the Contractor's assurance that all specific items previously identified to the Contractor as being unacceptable, along with all remaining work performed under the contract, will be complete and acceptable by the date scheduled for the final acceptance inspection. Failure of the Contractor to have all contract work acceptably complete for this inspection will be cause for the Contracting Officer to bill the Contractor for the Government's additional inspection cost in accordance with the contract clause titled "Inspection of Construction".

3.9 DOCUMENTATION

The Contractor shall maintain current records providing factual evidence that required quality control activities and/or tests have been performed. These records shall include the work of subcontractors and suppliers and shall be on an acceptable form that includes, as a minimum, the following information:

a. Contractor/subcontractor and their area of responsibility.

b. Operating plant/equipment with hours worked, idle, or down for repair.

c. Work performed each day, giving location, description, and by whom. When Network Analysis (NAS) is used, identify each phase of work performed each day by NAS activity number.

d. Test and/or control activities performed with results and references to specifications/drawings requirements. The control phase shall be identified (Preparatory, Initial, Follow-up). List of deficiencies noted, along with corrective action.

e. Quantity of materials received at the site with statement as to acceptability, storage, and reference to specifications/drawings requirements.

f. Submittals and deliverables reviewed, with contract reference, by whom, and action taken.

g. Offsite surveillance activities, including actions taken.

h. Job safety evaluations stating what was checked, results, and instructions or corrective actions.

i. Instructions given/received and conflicts in plans and/or specifications.

j. Contractor's verification statement.

These records shall indicate a description of trades working on the project; the number of personnel working; weather conditions encountered; and any delays encountered. These records shall cover both conforming and deficient features and shall include a statement that equipment and materials incorporated in the work and workmanship comply with the contract. The original and one copy of these records in report form shall be furnished to the Government daily within 24 hours after the date covered by the report, except that reports need not be submitted for days on which no work is performed. As a minimum, one report shall be prepared and submitted for every 7 days of no work and on the last day of a no work period. All calendar days shall be accounted for throughout the life of the contract. The first report following a day of no work shall be for that day only. Reports shall be signed and dated by the CQC System Manager. The report from the CQC System Manager shall include copies of test reports and copies of reports prepared by all subordinate quality control personnel.

3.10 SAMPLE FORMS

Sample forms enclosed at the end of this section.

3.11 NOTIFICATION OF NONCOMPLIANCE

The Contracting Officer will notify the Contractor of any detected noncompliance with the foregoing requirements. The Contractor shall take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the work site, shall be deemed sufficient for the purpose of notification. If the Contractor fails or refuses to comply promptly, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to such stop orders shall be made the subject of claim for extension of time or for excess costs or damages by the Contractor.

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SECTION 01500A

TEMPORARY CONSTRUCTION FACILITIES
02/97

1.1 GENERAL REQUIREMENTS

1.1.1 Site Plan

The Contractor shall prepare a site plan indicating the proposed location and dimensions of any area to be fenced and used by the Contractor, the number of trailers to be used, avenues of ingress/egress to the fenced area and details of the fence installation. This plan shall be submitted to the Government for approval. Any areas which may have to be graveled to prevent the tracking of mud shall also be identified. The Contractor shall also indicate if the use of a supplemental or other staging area is desired.

1.1.2 Identification of Employees

The Contractor shall be responsible for furnishing to each employee, and for requiring each employee engaged on the work to display, identification as approved and directed by the Contracting Officer. Prescribed identification shall immediately be delivered to the Contracting Officer for cancellation upon release of any employee. When required, the Contractor shall obtain and provide fingerprints of persons employed on the project. Contractor and subcontractor personnel shall wear identifying markings on hard hats clearly identifying the company employee's.

1.1.3 Employee Parking

Contractor employees shall park privately owned vehicles in an area designated by the Contracting Officer. This area will be within reasonable walking distance of the construction site. Contractor employee parking shall not interfere with existing and established parking requirements of the military installation.

1.2 AVAILABILITY AND USE OF UTILITY SERVICES

1.2.1 Payment for Utility Services

The Government will make all reasonably required utilities available to the Contractor from existing outlets and supplies, as specified in the contract. Unless otherwise provided in the contract, the amount of each utility service consumed shall be charged to or paid for by the Contractor at prevailing rates charged to the Government or, where the utility is produced by the Government, at reasonable rates determined by the Contracting Officer. The Contractor shall carefully conserve any utilities furnished without charge.

1.2.2 Meters and Temporary Connections

The Contractor, at its expense and in a manner satisfactory to the Contracting Officer, shall provide and maintain necessary temporary connections, distribution lines, and meter bases (Government will provide meters) required to measure the amount of each utility used for the purpose of determining charges. The Contractor shall notify the Contracting Officer, in writing, 5 working days before final electrical connection is desired so that a utilities contract can be established. The Government

will provide a meter and make the final hot connection after inspection and approval of the Contractor's temporary wiring installation. The Contractor shall not make the final electrical connection.

1.2.3 Advance Deposit

An advance deposit for utilities consisting of an estimated month's usage or a minimum of $50.00 will be required. The last monthly bills for the fiscal year will normally be offset by the deposit and adjustments will be billed or returned as appropriate. Services to be rendered for the next fiscal year, beginning 1 October, will require a new deposit. Notification of the due date for this deposit will be mailed to the Contractor prior to the end of the current fiscal year.

1.2.4 Final Meter Reading

Before completion of the work and final acceptance of the work by the Government, the Contractor shall notify the Contracting Officer, in writing, 5 working days before termination is desired. The Government will take a final meter reading, disconnect service, and remove the meters. The Contractor shall then remove all the temporary distribution lines, meter bases, and associated paraphernalia. The Contractor shall pay all outstanding utility bills before final acceptance of the work by the Government.

1.2.5 Sanitation

The Contractor shall provide and maintain within the construction area minimum field-type sanitary facilities approved by the Contracting Officer. Government toilet facilities will not be available to Contractor's personnel.

1.2.6 Telephone

The Contractor shall make arrangements and pay all costs for telephone facilities desired.

1.3 BULLETIN BOARD, PROJECT SIGN, AND PROJECT SAFETY SIGN

1.3.1 Bulletin Board

Immediately upon beginning of work, the Contractor shall provide a weatherproof glass-covered bulletin board not less than 36 by 48 inches in size for displaying the Equal Employment Opportunity poster, a copy of the wage decision contained in the contract, Wage Rate Information poster, and other information approved by the Contracting Officer. The bulletin board shall be located at the project site in a conspicuous place easily accessible to all employees, as approved by the Contracting Officer. Legible copies of the aforementioned data shall be displayed until work is completed. Upon completion of work the bulletin board shall be removed by and remain the property of the Contractor.

1.3.2 Project and Safety Signs

The requirements for the signs, their content, and location shall be as shown on the drawings. The signs shall be erected within 15 days after receipt of the notice to proceed. The data required by the safety sign shall be corrected daily, with light colored metallic or non-metallic numerals. Upon completion of the project, the signs shall be removed from

the site.

1.4 PROTECTION AND MAINTENANCE OF TRAFFIC

During construction the Contractor shall provide access and temporary relocated roads as necessary to maintain traffic. The Contractor shall maintain and protect traffic on all affected roads during the construction period except as otherwise specifically directed by the Contracting Officer. Measures for the protection and diversion of traffic, including the provision of watchmen and flagmen, erection of barricades, placing of lights around and in front of equipment and the work, and the erection and maintenance of adequate warning, danger, and direction signs, shall be as required by the State and local authorities having jurisdiction. The traveling public shall be protected from damage to person and property. The Contractor's traffic on roads selected for hauling material to and from the site shall interfere as little as possible with public traffic. The Contractor shall investigate the adequacy of existing roads and the allowable load limit on these roads. The Contractor shall be responsible for the repair of any damage to roads caused by construction operations.

1.4.1 Haul Roads

The Contractor shall, at its own expense, construct access and haul roads necessary for proper prosecution of the work under this contract. Haul roads shall be constructed with suitable grades and widths; sharp curves, blind corners, and dangerous cross traffic shall be avoided. The Contractor shall provide necessary lighting, signs, barricades, and distinctive markings for the safe movement of traffic. The method of dust control, although optional, shall be adequate to ensure safe operation at all times. Location, grade, width, and alignment of construction and hauling roads shall be subject to approval by the Contracting Officer. Lighting shall be adequate to assure full and clear visibility for full width of haul road and work areas during any night work operations. Upon completion of the work, haul roads designated by the Contracting Officer shall be removed.Text

1.4.2 Barricades

The Contractor shall erect and maintain temporary barricades to limit public access to hazardous areas. Such barricades shall be required whenever safe public access to paved areas such as roads, parking areas or sidewalks is prevented by construction activities or as otherwise necessary to ensure the safety of both pedestrian and vehicular traffic. Barricades shall be securely placed, clearly visible with adequate illumination to provide sufficient visual warning of the hazard during both day and night.

1.5 CONTRACTOR'S TEMPORARY FACILITIES

1.5.1 Administrative Field Offices

The Contractor shall provide and maintain administrative field office facilities within the construction area at the designated site. Government office and warehouse facilities will not be available to the Contractor's personnel.

1.5.2 Storage Area

The Contractor shall construct a temporary 6 foot high chain link fence around trailers and materials. The fence shall include plastic strip

inserts, colored green, so that visibility through the fence is obstructed. Fence posts may be driven, in lieu of concrete bases, where soil conditions permit. Trailers, materials, or equipment shall not be placed or stored outside the fenced area unless such trailers, materials, or equipment are assigned a separate and distinct storage area by the Contracting Officer away from the vicinity of the construction site but within the military boundaries. Trailers, equipment, or materials shall not be open to public view with the exception of those items which are in support of ongoing work on any given day. Materials shall not be stockpiled outside the fence in preparation for the next day's work. Mobile equipment, such as tractors, wheeled lifting equipment, cranes, trucks, and like equipment, shall be parked within the fenced area at the end of each work day.

1.5.3 Supplemental Storage Area

Upon Contractor's request, the Contracting Officer will designate another or supplemental area for the Contractor's use and storage of trailers, equipment, and materials. This area may not be in close proximity of the construction site but shall be within the military boundaries. Fencing of materials or equipment will not be required at this site; however, the Contractor shall be responsible for cleanliness and orderliness of the area used and for the security of any material or equipment stored in this area. Utilities will not be provided to this area by the Government.

1.5.4 Appearance of Trailers

Trailers utilized by the Contractor for administrative or material storage purposes shall present a clean and neat exterior appearance and shall be in a state of good repair. Trailers which, in the opinion of the Contracting Officer, require exterior painting or maintenance will not be allowed on the military property.

1.5.5 Maintenance of Storage Area

Fencing shall be kept in a state of good repair and proper alignment. Should the Contractor elect to traverse, with construction equipment or other vehicles, grassed or unpaved areas which are not established roadways, such areas shall be covered with a layer of gravel as necessary to prevent rutting and the tracking of mud onto paved or established roadways; gravel gradation shall be at the Contractor's discretion. Grass located within the boundaries of the construction site shall be mowed for the duration of the project. Grass and vegetation along fences, buildings, under trailers, and in areas not accessible to mowers shall be edged or trimmed neatly.

1.5.6 New Building

In the event a new building is constructed for the temporary project field office, it shall be a minimum 12 feet in width, 16 feet in length and have a minimum of 7 feet headroom. It shall be equipped with approved electrical wiring, at least one double convenience outlet and the required switches and fuses to provide 110-120 volt power. It shall be provided with a work table with stool, desk with chair, two additional chairs, and one legal size file cabinet that can be locked. The building shall be waterproof, shall be supplied with heater, shall have a minimum of two doors, electric lights, a telephone, a battery operated smoke detector alarm, a sufficient number of adjustable windows for adequate light and ventilation, and a supply of approved drinking water. Approved sanitary

facilities shall be furnished. The windows and doors shall be screened and the doors provided with dead bolt type locking devices or a padlock and heavy duty hasp bolted to the door. Door hinge pins shall be non-removable. The windows shall be arranged to open and to be securely fastened from the inside. Glass panels in windows shall be protected by bars or heavy mesh screens to prevent easy access to the building through these panels. In warm weather, air conditioning capable of maintaining the office at 50 percent relative humidity and a room temperature 20 degrees F below the outside temperature when the outside temperature is 95 degrees F, shall be furnished. Any new building erected for a temporary field office shall be maintained by the Contractor during the life of the contract and upon completion and acceptance of the work shall become the property of the Contractor and shall be removed from the site. All charges for telephone service for the temporary field office shall be borne by the Contractor, including long distance charges up to a maximum of $75.00 per month.

1.5.7 Security Provisions

Adequate outside security lighting shall be provided at the Contractor's temporary facilities. The Contractor shall be responsible for the security of its own equipment; in addition, the Contractor shall notify the appropriate law enforcement agency requesting periodic security checks of the temporary project field office.

1.6 PLANT COMMUNICATION

Whenever the Contractor has the individual elements of its plant so located that operation by normal voice between these elements is not satisfactory, the Contractor shall install a satisfactory means of communication, such as telephone or other suitable devices. The devices shall be made available for use by Government personnel.

1.7 TEMPORARY PROJECT SAFETY FENCING

As soon as practicable, but not later than 15 days after the date established for commencement of work, the Contractor shall furnish and erect temporary project safety fencing at the work site. The safety fencing shall be a high visibility orange colored, high density polyethylene grid or approved equal, a minimum of 42 inches high, supported and tightly secured to steel posts located on maximum 10 foot centers, constructed at the approved location. The safety fencing shall be maintained by the Contractor during the life of the contract and, upon completion and acceptance of the work, shall become the property of the Contractor and shall be removed from the work site.

1.8 CLEANUP

Construction debris, waste materials, packaging material and the like shall be removed from the work site daily. Any dirt or mud which is tracked onto paved or surfaced roadways shall be cleaned away. Materials resulting from demolition activities which are salvageable shall be stored within the fenced area described above or at the supplemental storage area. Stored material not in trailers, whether new or salvaged, shall be neatly stacked when stored.

1.9 RESTORATION OF STORAGE AREA

Upon completion of the project and after removal of trailers, materials,

and equipment from within the fenced area, the fence shall be removed and will become the property of the Contractor. Areas used by the Contractor for the storage of equipment or material, or other use, shall be restored to the original or better condition. Gravel used to traverse grassed areas shall be removed and the area restored to its original condition, including top soil and seeding as necessary.

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SECTION 01780A

CLOSEOUT SUBMITTALS
05/02

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

As-Built Drawings; G

Drawings showing final as-built conditions of the project. ~~I~~The final CADD as-built drawings shall consist of one set of electronic CADD drawing files in the specified format, one set of mylar drawings, and one set of the approved working as-built drawings.

SD-03 Product Data

As-Built Record of Equipment and Materials

Two copies of the record listing the as-built materials and equipment incorporated into the construction of the project.

Warranty Management Plan

One set of the warranty management plan containing information relevant to the warranty of materials and equipment incorporated into the construction project, including the starting date of warranty of construction. The Contractor shall furnish with each warranty the name, address, and telephone number of each of the guarantor's representatives nearest to the project location.

Warranty Tags

Two record copies of the warranty tags showing the layout and design.

Final Cleaning

Two copies of the listing of completed final clean-up items.

1.2 PROJECT RECORD DOCUMENTS

1.2.1 As-Built Drawings

This paragraph covers as-built drawings complete, as a requirement of the contract. The terms "drawings," "contract drawings," "drawing files," "working as-built drawings" and "final as-built drawings" refer to contract drawings which are revised to be used for final as-built drawings.

1.2.1.1 Government Furnished Materials

One set of electronic CADD files in the specified software and format revised to reflect all bid amendments will be provided by the Government at the preconstruction conference for projects requiring CADD file as-built drawings.

1.2.1.2 Working As-Built and Final As-Built Drawings

The Contractor shall revise 2 sets of paper drawings by red-line process to show the as-built conditions during the prosecution of the project. These working as-built marked drawings shall be kept current on a weekly basis and at least one set shall be available on the jobsite at all times. Changes from the contract plans which are made in the work or additional information which might be uncovered in the course of construction shall be accurately and neatly recorded as they occur by means of details and notes. Final as-built drawings shall be prepared after the completion of each definable feature of work as listed in the Contractor Quality Control Plan (Foundations, Utilities, Structural Steel, etc., as appropriate for the project). The working as-built marked prints and final as-built drawings will be jointly reviewed for accuracy and completeness by the Contracting Officer and the Contractor prior to submission of each monthly pay estimate. If the Contractor fails to maintain the working and final as-built drawings as specified herein, the Contracting Officer will deduct from the monthly progress payment an amount representing the estimated cost of maintaining the as-built drawings. This monthly deduction will continue until an agreement can be reached between the Contracting Officer and the Contractor regarding the accuracy and completeness of updated drawings. The working and final as-built drawings shall show, but shall not be limited to, the following information:

a. The actual location, kinds and sizes of all sub-surface utility lines. In order that the location of these lines and appurtenances may be determined in the event the surface openings or indicators become covered over or obscured, the as-built drawings shall show, by offset dimensions to two permanently fixed surface features, the end of each run including each change in direction. Valves, splice boxes and similar appurtenances shall be located by dimensioning along the utility run from a reference point. The average depth below the surface of each run shall also be recorded.

b. The location and dimensions of any changes within the building structure.

c. Correct grade, elevations, cross section, or alignment of roads, earthwork, structures or utilities if any changes were made from contract plans.

d. Changes in details of design or additional information obtained from working drawings specified to be prepared and/or furnished by the Contractor; including but not limited to fabrication, erection, installation plans and placing details, pipe sizes, insulation material, dimensions of equipment foundations, etc.

e. The topography, invert elevations and grades of drainage installed or affected as part of the project construction.

f. Changes or modifications which result from the final inspection.

g. Where contract drawings or specifications present options, only the option selected for construction shall be shown on the final as-built prints.

h. If borrow material for this project is from sources on Government property, or if Government property is used as a spoil area, the Contractor shall furnish a contour map of the final borrow pit/spoil area elevations.

i. Systems designed or enhanced by the Contractor, such as HVAC controls, fire alarm, fire sprinkler, and irrigation systems.

j. Modifications (change order price shall include the Contractor's cost to change working and final as-built drawings to reflect modifications) and compliance with the following procedures.

(1) Directions in the modification for posting descriptive changes shall be followed.

(2) A Modification Circle shall be placed at the location of each deletion.

(3) For new details or sections which are added to a drawing, a Modification Circle shall be placed by the detail or section title.

(4) For minor changes, a Modification Circle shall be placed by the area changed on the drawing (each location).

(5) For major changes to a drawing, a Modification Circle shall be placed by the title of the affected plan, section, or detail at each location.

(6) For changes to schedules or drawings, a Modification Circle shall be placed either by the schedule heading or by the change in the schedule.

(7) The Modification Circle size shall be 1/2 inch diameter unless the area where the circle is to be placed is crowded. Smaller size circle shall be used for crowded areas.

1.2.1.3 Drawing Preparation

The as-built drawings shall be modified as may be necessary to correctly show the features of the project as it has been constructed by bringing the contract set into agreement with approved working as-built prints, and adding such additional drawings as may be necessary. These working as-built marked prints shall be neat, legible and accurate. These drawings are part of the permanent records of this project and shall be returned to the Contracting Officer after approval by the Government. Any drawings damaged or lost by the Contractor shall be satisfactorily replaced by the Contractor at no expense to the Government.

1.2.1.4 Computer Aided Design and Drafting (CADD) Drawings

Only personnel proficient in the preparation of CADD drawings shall be employed to modify the contract drawings or prepare additional new drawings. Additions and corrections to the contract drawings shall be equal in quality and detail to that of the originals. Line colors, line weights, lettering, layering conventions, and symbols shall be the same as the original line colors, line weights, lettering, layering conventions,

and symbols. If additional drawings are required, they shall be prepared using the specified electronic file format applying the same graphic standards specified for original drawings. The title block and drawing border to be used for any new final as-built drawings shall be identical to that used on the contract drawings. Additions and corrections to the contract drawings shall be accomplished using CADD files. The Contractor will be furnished "as-designed" drawings in AutoCad Release or Microstation format and shall return completed as built drawings in same format as government provided. The electronic files will be supplied on compact disc, read-only memory (CD-ROM). The Contractor shall be responsible for providing all program files and hardware necessary to prepare final as-built drawings. The Contracting Officer will review final as-built drawings for accuracy and the Contractor shall make required corrections, changes, additions, and deletions.

a. CADD colors shall be the "base" colors of red, green, and blue. Color code for changes shall be as follows:

(1) Deletions (red) - Deleted graphic items (lines) shall be colored red with red lettering in notes and leaders.

(2) Additions (Green) - Added items shall be drawn in green with green lettering in notes and leaders.

(3) Special (Blue) - Items requiring special information, coordination, or special detailing or detailing notes shall be in blue.

b. The Contract Drawing files shall be renamed in a manner related to the contract number (i.e., 98-C-10.DGN/DWG) as instructed in the Pre-Construction conference. Marked-up changes shall be made only to those renamed files. All changes shall be made on the layer/level as the original item. There shall be no deletions of existing lines; existing lines shall be over struck in red. Additions shall be in green with line weights the same as the drawing. Special notes shall be in blue on layer #63.

c. When final revisions have been completed, the cover sheet drawing shall show the wording "RECORD DRAWING AS-BUILT" followed by the name of the Contractor in letters at least 3/16 inch high. All other contract drawings shall be marked either "AS-Built" drawing denoting no revisions on the sheet or "Revised As-Built" denoting one or more revisions. Original contract drawings shall be dated in the revision block.

d. Within 10 days after Government approval of all of the working as-built drawings for a phase of work, the Contractor shall prepare the final CADD as-built drawings for that phase of work and submit two sets of blue-lined prints of these drawings for Government review and approval. The Government will promptly return one set of prints annotated with any necessary corrections. Within 7 days the Contractor shall revise the CADD files accordingly at no additional cost and submit one set of final prints for the completed phase of work to the Government. Within 10 days of substantial completion of all phases of work, the Contractor shall submit the final as-built drawing package for the entire project. The submittal shall consist of one set of electronic files on compact disc, read-only memory (CD-ROM), two sets of blue-line prints and one set of the approved working as-built drawings. They shall be complete in all details and identical in form and function to the contract drawing files supplied by the Government. Any transactions or adjustments necessary to accomplish

this is the responsibility of the Contractor. The Government reserves the right to reject any drawing files it deems incompatible with the customer's CADD system. Paper prints, drawing files and storage media submitted will become the property of the Government upon final approval. Failure to submit final as-built drawing files and marked prints as specified shall be cause for withholding any payment due the Contractor under this contract. Approval and acceptance of final as-built drawings shall be accomplished before final payment is made to the Contractor.

1.2.1.5 Manually Prepared Drawings

Manually prepared drawings shall not be accepted.

1.2.1.6 Payment

No separate payment will be made for as-built drawings required under this contract, and all costs accrued in connection with such drawings shall be considered a subsidiary obligation of the Contractor.

1.2.2 As-Built Record of Equipment and Materials

The Contractor shall furnish one copy of preliminary record of equipment and materials used on the project 15 days prior to final inspection. This preliminary submittal will be reviewed and returned 2 days after final inspection with Government comments. Two sets of final record of equipment and materials shall be submitted 10 days after final inspection. The designations shall be keyed to the related area depicted on the contract drawings. The record shall list the following data:

RECORD OF DESIGNATED EQUIPMENT AND MATERIALS DATA

Description	Specification Section	Manufacturer and Catalog, Model, and Serial Number	Composition and Size	Where Used

1.2.3 Final Approved Shop Drawings

The Contractor shall furnish final approved project shop drawings 30 days after transfer of the completed facility.

1.2.4 Construction Contract Specifications

The Contractor shall furnish final as-built construction contract specifications, including modifications thereto, 30 days after transfer of the completed facility.

1.2.5 Real Property Equipment

The Contractor shall furnish a list of installed equipment furnished under this contract. The list shall include all information usually listed on manufacturer's name plate. The "EQUIPMENT-IN-PLACE LIST" shall include, as applicable, the following for each piece of equipment installed: description of item, location (by room number), model number, serial number, capacity, name and address of manufacturer, name and address of equipment supplier, condition, spare parts list, manufacturer's catalog, and warranty. A draft list shall be furnished at time of transfer. The final list shall be furnished 30 days after transfer of the completed facility.

1.3 WARRANTY MANAGEMENT

1.3.1 Warranty Management Plan

The Contractor shall develop a warranty management plan which shall contain information relevant to the clause Warranty of Construction. At least 30 days before the planned pre-warranty conference, the Contractor shall submit the warranty management plan for Government approval. The warranty management plan shall include all required actions and documents to assure that the Government receives all warranties to which it is entitled. The plan shall be in narrative form and contain sufficient detail to render it suitable for use by future maintenance and repair personnel, whether tradesmen, or of engineering background, not necessarily familiar with this contract. The term "status" as indicated below shall include due date and whether item has been submitted or was accomplished. Warranty information made available during the construction phase shall be submitted to the Contracting Officer for approval prior to each monthly pay estimate. Approved information shall be assembled in a binder and shall be turned over to the Government upon acceptance of the work. The construction warranty period shall begin on the date of project acceptance and shall continue for the full product warranty period. A joint 4 month and 9 month warranty inspection shall be conducted, measured from time of acceptance, by the Contractor, Contracting Officer and the Customer Representative. Information contained in the warranty management plan shall include, but shall not be limited to, the following:

a. Roles and responsibilities of all personnel associated with the warranty process, including points of contact and telephone numbers within the organizations of the Contractors, subcontractors, manufacturers or suppliers involved.

b. Listing and status of delivery of all Certificates of Warranty for extended warranty items, to include roofs, HVAC balancing, pumps, motors, transformers, and for all commissioned systems such as fire protection and alarm systems, sprinkler systems, lightning protection systems, etc.

c. A list for each warranted equipment, item, feature of construction or system indicating:

1. Name of item.
2. Model and serial numbers.
3. Location where installed.
4. Name and phone numbers of manufacturers or suppliers.
5. Names, addresses and telephone numbers of sources of spare parts.
6. Warranties and terms of warranty. This shall include one-year overall warranty of construction. Items which have extended warranties shall be indicated with separate warranty expiration dates.
7. Cross-reference to warranty certificates as applicable.
8. Starting point and duration of warranty period.
9. Summary of maintenance procedures required to continue the warranty in force.
10. Cross-reference to specific pertinent Operation and Maintenance manuals.
11. Organization, names and phone numbers of persons to call for warranty service.
12. Typical response time and repair time expected for various

warranted equipment.

d. The Contractor's plans for attendance at the 4 and 9 month post-construction warranty inspections conducted by the Government.

e. Procedure and status of tagging of all equipment covered by extended warranties.

f. Copies of instructions to be posted near selected pieces of equipment where operation is critical for warranty and/or safety reasons.

1.3.2 Performance Bond

The Contractor's Performance Bond shall remain effective throughout the construction period.

a. In the event the Contractor fails to commence and diligently pursue any construction warranty work required, the Contracting Officer will have the work performed by others, and after completion of the work, will charge the remaining construction warranty funds of expenses incurred by the Government while performing the work, including, but not limited to administrative expenses.

b. In the event sufficient funds are not available to cover the construction warranty work performed by the Government at the Contractor's expense, the Contracting Officer will have the right to recoup expenses from the bonding company.

c. Following oral or written notification of required construction warranty repair work, the Contractor shall respond in a timely manner. Written verification will follow oral instructions. Failure of the Contractor to respond will be cause for the Contracting Officer to proceed against the Contractor.

1.3.3 Pre-Warranty Conference

Prior to contract completion, and at a time designated by the Contracting Officer, the Contractor shall meet with the Contracting Officer to develop a mutual understanding with respect to the requirements of this section. Communication procedures for Contractor notification of construction warranty defects, priorities with respect to the type of defect, reasonable time required for Contractor response, and other details deemed necessary by the Contracting Officer for the execution of the construction warranty shall be established/reviewed at this meeting. In connection with these requirements and at the time of the Contractor's quality control completion inspection, the Contractor shall furnish the name, telephone number and address of a licensed and bonded company which is authorized to initiate and pursue construction warranty work action on behalf of the Contractor. This point of contact will be located within the local service area of the warranted construction, shall be continuously available, and shall be responsive to Government inquiry on warranty work action and status. This requirement does not relieve the Contractor of any of its responsibilities in connection with other portions of this provision.

1.3.4 Contractor's Response to Construction Warranty Service Requirements

Following oral or written notification by the Contracting Officer, the Contractor shall respond to construction warranty service requirements in accordance with the "Construction Warranty Service Priority List" and the

three categories of priorities listed below. The Contractor shall submit a report on any warranty item that has been repaired during the warranty period. The report shall include the cause of the problem, date reported, corrective action taken, and when the repair was completed. If the Contractor does not perform the construction warranty within the timeframes specified, the Government will perform the work and backcharge the construction warranty payment item established.

1.3.5 Warranty Tags

At the time of installation, each warranted item shall be tagged with a durable, oil and water resistant tag approved by the Contracting Officer. Each tag shall be attached with a copper wire and shall be sprayed with a silicone waterproof coating. The date of acceptance and the QC signature shall remain blank until project is accepted for beneficial occupancy. The tag shall show the following information.

a. Type of product/material_____.

b. Model number_____.

c. Serial number_____.

d. Contract number_____.

e. Warranty period_____from_____to_____.

f. Inspector's signature_____.

g. Construction Contractor_____.

Address_____.

Telephone number_____.

h. Warranty contact_____.

Address_____.

Telephone number_____.

i. Warranty response time priority code_____.

j. WARNING - PROJECT PERSONNEL TO PERFORM ONLY OPERATIONAL MAINTENANCE DURING THE WARRANTY PERIOD.

1.4 MECHANICAL TESTING, ADJUSTING, BALANCING, AND COMMISSIONING

Prior to final inspection and transfer of the completed facility; all reports, statements, certificates, and completed checklists for testing, adjusting, balancing, and commissioning of mechanical systems shall be submitted to and approved by the Contracting Officer as specified in applicable technical specification sections.

1.5 OPERATION AND MAINTENANCE MANUALS

Operation manuals and maintenance manuals shall be submitted as specified. Operation manuals and maintenance manuals provided in a common volume shall be clearly differentiated and shall be separately indexed.

1.6 FINAL CLEANING

The premises shall be left broom clean. Stains, foreign substances, and temporary labels shall be removed from surfaces. Carpet and soft surfaces shall be vacuumed. Equipment and fixtures shall be cleaned to a sanitary condition. Filters of operating equipment shall be replaced. Debris shall be removed from roofs, drainage systems, gutters, and downspouts. Paved areas shall be swept and landscaped areas shall be raked clean. The site shall have waste, surplus materials, and rubbish removed. The project area shall have temporary structures, barricades, project signs and construction facilities removed. A list of completed clean-up items shall be submitted on the day of final inspection.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

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SECTION 02220

DEMOLITION
05/02

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A10.6	(1990) Safety Requirements for Demolition Operations

AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI Guideline K	(1997) Containers for Recovered Fluorocarbon Refrigerants

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

40 CFR 61-SUBPART M	National Emission Standard for Asbestos
40 CFR 82	Protection of Stratospheric Ozone; Refrigerant Recycling

U.S. ARMY CORPS OF ENGINEERS (USACE)

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

1.2 GENERAL REQUIREMENTS

Do not begin demolition until authorization is received from the Contracting Officer. Remove rubbish and debris from the project site; do not allow accumulations inside or outside the buildings. The work includes demolition, salvage of identified items and materials, and removal of resulting rubbish and debris. Rubbish and debris shall be removed from Government property daily, unless otherwise directed, to avoid accumulation at the demolition site. Materials that cannot be removed daily shall be stored in areas specified by the Contracting Officer. In the interest of occupational safety and health, the work shall be performed in accordance with EM 385-1-1, Section 23, Demolition, and other applicable Sections.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-07 Certificates

Demolition plan; G

Notifications; G

Notification of Demolition and Renovation forms; G

Submit proposed salvage, demolition and removal procedures to the Contracting Officer for approval before work is started.

SD-11 Closeout Submittals

Receipts

1.4 REGULATORY AND SAFETY REQUIREMENTS

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

1.4.1 Notifications

Furnish timely notification of demolition and renovation projects to Federal, State, regional, and local authorities in accordance with 40 CFR 61-SUBPART M. Notify the State's environmental protection agency and the Contracting Officer in writing 10 working days prior to the commencement of work in accordance with 40 CFR 61-SUBPART M.

Complete and submit Notification of Demolition and Renovation forms to Federal and State authorities and Contracting Officer, postmarked or delievered at least ten working days prior to commencement of work, in accordance with 40 CFR 61-SUBPART M. Complete paragraphs I, II, III.B, III.C (if applicable), VIII, and IX thru XIX of form. Copy of form is attached at end of this section.

1.4.2 Receipts

Submit a shipping receipt or bill of lading for all containers of ozone depleting substance (ODS) shipped to the Defense Depot, Richmond, Virginia.

1.5 DUST AND DEBRIS CONTROL

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

1.6 PROTECTION

1.6.1 Traffic Control Signs

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

1.6.2 Existing Work

Before beginning any demolition work, the Contractor shall survey the site and examine the drawings and specifications to determine the extent of the work. The Contractor shall take necessary precautions to avoid damage to existing items to remain in place, to be reused, or to remain the property of the Government; any damaged items shall be repaired or replaced as approved by the Contracting Officer. The Contractor shall coordinate the work of this section with all other work and shall construct and maintain shoring, bracing, and supports as required. The Contractor shall ensure that structural elements are not overloaded and shall be responsible for increasing structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under this contract. Do not overload structural elements. Provide new supports and reinforcement for existing construction weakened by demolition or removal work. Repairs, reinforcement, or structural replacement must have Contracting Officer approval.

1.6.3 Weather Protection

For portions of the building to remain, protect building interior and materials and equipment from the weather at all times. Where removal of existing roofing is necessary to accomplish work, have materials and workmen ready to provide adequate and temporary covering of exposed areas so as to ensure effectiveness and to prevent displacement.

1.6.4 Trees

Trees within the project site which might be damaged during demolition, and which are indicated to be left in place, shall be protected by a 6 foot high fence. The fence shall be securely erected a minimum of 5 feet from the trunk of individual trees or follow the outer perimeter of branches or clumps of trees. Any tree designated to remain that is damaged during the work under this contract shall be replaced in kind or as approved by the Contracting Officer.

1.6.5 Facilities

Protect electrical and mechanical services and utilities. Where removal of existing utilities and pavement is specified or indicated, provide approved barricades, temporary covering of exposed areas, and temporary services or connections for electrical and mechanical utilities. Floors, roofs, walls, columns, pilasters, and other structural components that are designed and constructed to stand without lateral support or shoring, and are determined to be in stable condition, shall remain standing without additional bracing, shoring, of lateral support until demolished, unless directed otherwise by the Contracting Officer. The Contractor shall ensure that no elements determined to be unstable are left unsupported and shall be responsible for placing and securing bracing, shoring, or lateral supports as may be required as a result of any cutting, removal, or demolition work performed under this contract.

1.6.6 Protection of Personnel

During the demolition work the Contractor shall continuously evaluate the condition of the structure being demolished and take immediate action to protect all personnel working in and around the demolition site. No area, section, or component of floors, roofs, walls, columns, pilasters, or other structural element will be allowed to be left standing without sufficient

bracing, shoring, or lateral support to prevent collapse or failure while workmen remove debris or perform other work in the immediate area.

1.7 BURNING

The use of burning at the project site for the disposal of refuse and debris will not be permitted.

1.8 RELOCATIONS

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

1.9 Required Data

Demolition plan shall include procedures for careful removal and disposition of materials specified to be salvaged, coordination with other work in progress, a disconnection schedule of utility services, a detailed description of methods and equipment to be used for each operation and of the sequence of operations.

1.10 Environmental Protection

The work shall comply with the requirements of Section 01355 ENVIRONMENTAL PROTECTION.

1.11 USE OF EXPLOSIVES

Use of explosives will not be permitted.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 EXISTING FACILITIES TO BE REMOVED

3.1.1 Patching

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

a. Holes and depressions caused by previous physical damage or left as a result of removals in existing masonry walls to remain shall be completely filled with an approved masonry patching material, applied in accordance with the manufacturer's printed instructions.

b. Where existing partitions have been removed leaving damaged or missing resilient tile flooring, patch to match the existing floor tile.

c. Patch acoustic lay-in ceiling where partitions have been removed. The transition between the different ceiling heights shall be effected by continuing the higher ceiling level over to the first runner on the lower ceiling and closing the vertical opening with a painted sheet metal strip.

3.2 DISPOSITION OF MATERIAL

3.2.1 Title to Materials

Except where specified in other sections, all materials and equipment removed, and not reused, shall become the property of the Contractor and shall be removed from Government property. Title to materials resulting from demolition, and materials and equipment to be removed, is vested in the Contractor upon approval by the Contracting Officer of the Contractor's demolition and removal procedures, and authorization by the Contracting Officer to begin demolition. The Government will not be responsible for the condition or loss of, or damage to, such property after contract award. Materials and equipment shall not be viewed by prospective purchasers or sold on the site.

3.2.2 Salvaged Materials and Equipment

Remove materials and equipment that are indicated to be removed by the Contractor and that are to remain the property of the Government, and deliver to a storage site.

Contractor shall salvage items and material to the maximum extent possible.

Material salvaged for the Contractor shall be stored as approved by the Contracting Officer and shall be removed from Government property before completion of the contract. Material salvaged for the Contractor shall not be sold on the site.

Salvaged items to remain the property of the Government shall be removed in a manner to prevent damage, and packed or crated to protect the items from damage while in storage or during shipment. Items damaged during removal or storage shall be repaired or replaced to match existing items. Containers shall be properly identified as to contents.

3.2.2 Disposal of Ozone Depleting Substance (ODS)

Class I and Class II ODS are defined in Section, 602(a) and (b), of The Clean Air Act. Prevent discharge of Class I and Class II ODS to the atmosphere. Place recovered ODS in cylinders meeting ARI Guideline K suitable for the type ODS (filled to no more than 80 percent capacity) and provide appropriate labeling. Products, equipment and appliances containing ODS in a sealed, self-contained system (e.g. residential refrigerators and window air conditioners) shall be disposed of in accordance with 40 CFR 82.

3.2.3 Unsalvageable Material

Concrete, masonry, and other noncombustible material, except concrete permitted to remain in place, shall be disposed of in the disposal area located as noted within drawing package.

3.3 CLEANUP

Debris and rubbish shall be removed from basement and similar excavations. Debris shall be removed and transported in a manner that prevents spillage on streets or adjacent areas. Local regulations regarding hauling and disposal shall apply.

3.3.1 Debris and Rubbish

Debris and rubbish shall be removed from basement and similar excavations. Debris shall be removed and transported in a manner that prevents spillage on streets or adjacent areas. Local regulations regarding hauling and disposal shall apply.

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SECTION 02230

CLEARING AND GRUBBING
06/97

PART 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 the areas to be cleared.

1.1.2 Grubbing

Grubbing shall consist of the removal and disposal of stumps, roots larger than 3 inches in diameter, and matted roots from the designated grubbing areas.

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Materials Other Than Salable Timber;

Written permission to dispose of such products on private property shall be filed with the Contracting Officer.

PART 2 PRODUCTS (Not Applicable)

PART 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 Salable Timber

All felled timber from which saw logs, pulpwood, posts, poles, ties, mine props, or cordwood can be produced shall be considered as salable timber, and shall be trimmed of limbs and tops, sawed into salable lengths of 4 feet, and stockpiled at locations as directed. The disposal of the stockpiled timber will be by the Government.

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.

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SECTION 02300

EARTHWORK

12/97

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SECTION 02300

EARTHWORK
12/97

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN 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 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.
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; 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, SW, SP, SM. Satisfactory materials for grading shall be comprised of stones less than 8 inches, except for fill material for pavements which shall be comprised of stones less than 3 inches in any dimension.

1.2.2 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials are unsatisfactory. Unsatisfactory materials also include man-made fills; trash; refuse; backfills from previous construction; and material classified as satisfactory which contains root and other organic

matter or frozen material. The Contracting Officer shall be notified of any contaminated materials.

1.2.3 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 and ASTM D 422.

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 1557abbreviated as a percent of laboratory maximum density.

1.2.5 Topsoil

Material suitable for topsoils obtained from excavations is defined as soil suitable for growing vegetation.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Earthwork; G

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.

Procedure and location for disposal of unused satisfactory material. Blasting plan when blasting is permitted. Proposed source of borrow material.

SD-06 Test Reports

Testing; G

Within 24 hours of conclusion of physical tests, 5 copies of test results, including calibration curves and results of calibration tests.

SD-07 Certificates

Testing;

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

1.4 CLASSIFICATION OF EXCAVATION

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

1.4.1 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 unstratified masses, which cannot be removed without systematic drilling and firmly cemented conglomerate deposits possessing the characteristics of solid rock impossible to remove without systematic drilling. 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.

1.4.2 Common Excavation

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

1.5 BLASTING

Blasting will not be permitted.

1.6 UTILIZATION OF EXCAVATED MATERIALS

Unsatisfactory materials removed from excavations shall be disposed of in designated waste disposal or spoil areas. Satisfactory material removed from excavations shall be used, insofar as practicable, in the construction of fills, embankments, subgrades, shoulders, bedding (as backfill), and for similar purposes. No satisfactory excavated material shall be wasted without specific written authorization. Satisfactory material authorized to be wasted shall be disposed of in designated areas approved for surplus material storage or designated waste areas as directed. Newly designated waste areas on Government-controlled land shall be cleared and grubbed before disposal of waste material thereon. Coarse rock from excavations shall be stockpiled and used for constructing slopes or embankments adjacent to streams, or sides and bottoms of channels and for protecting against erosion. No excavated material shall be disposed of to obstruct the flow of any stream, endanger a partly finished structure, impair the efficiency or appearance of any structure, or be detrimental to the completed work in any way.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 STRIPPING OF TOPSOIL

Topsoil shall be stripped to a depth of 6 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 stockpiled in locations indicated.

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. Where pile foundations are to be used, the excavation of each pit shall be stopped at an elevation 1 foot above the base of the footing, as specified, before piles are driven. After the pile driving has been completed, loose and displaced material shall be removed and excavation completed, leaving a smooth, solid, undisturbed surface to receive the concrete or masonry.

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. 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

The Contractor shall notify the Contracting Officer sufficiently in advance of the opening of any excavation or borrow pit to permit elevations and measurements of the undisturbed ground surface to be taken. Except as otherwise permitted, borrow pits and other excavation areas shall be excavated providing adequate drainage. Overburden and other spoil material shall be transported to designated spoil areas or otherwise disposed of as directed. Borrow pits shall be neatly trimmed and drained after the excavation is completed. The Contractor shall ensure that excavation of any area, operation of borrow pits, or dumping of spoil material results in minimum detrimental effects on natural environmental conditions.

3.5 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 02630 STORM-DRAINAGE SYSTEM. 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 8"; 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 8" inchesin 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. Subgrade under parking areas will not be compacted to allow for proper drainage. 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 95 percent of laboratory maximum density.

3.9.2.1 Subgrade for Pavements

Subgrade for pavements shall not be compacted.

3.9.2.2 Subgrade for Shoulders

Subgrade for shoulders shall be compacted to at least 90 percentage laboratory maximum density for the 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 a thickness of 6 inches and graded to the elevations and slopes shown. Topsoil shall not be spread when frozen or excessively wet or dry. Material required for topsoil in excess of that produced by excavation within the grading limits shall be obtained from 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. 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 50.0 cubic yards stockpiled or in-place source material. Gradation of fill and backfill material shall be determined in accordance with ASTM C 136 or ASTM D 422.

3.13.2 In-Place Densities

a. One test per 1,500 square feet, or fraction thereof, of each lift of fill or backfill areas compacted by other than hand-operated machines.

b. One test per 1,500 square feet, or fraction thereof, of each lift of fill or backfill areas compacted by hand-operated machines.

c. One test per 500 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 2,500 square feet, or fraction thereof, of each lift of fill or backfill compacted by other than hand-operated machines.

b. One check test per lift for each 1,500 square feet, 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 25 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 --

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION
PSBC Dispatch Center Consolidation (E911)

CONTRACTOR

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(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
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			Joint Sealants - Field Molded	2.1.7														
			Sealants															
			Batching and Mixing Equipment	3.1.5.3														
			Conveying and Placing Concrete	3.2														
			Formwork	2.1.9														
			SD-06 Test Reports															
			Aggregates	2.1.2														
			Concrete Mixture Proportions	1.4.3														
			SD-07 Certificates															

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		03307A	Cementitious Materials	2.1.1														
			Aggregates	2.1.2														
		05500A	SD-02 Shop Drawings															
			Miscellaneous Metal Items															
		07600	SD-02 Shop Drawings															
			Covering on flat, sloped, or	3.1.21														
			curved surfaces															
			Expansion joints	3.1.22														
			Gravel stops and fascias	3.1.14														
			Splash pans															
			Flashing for roof drains	3.1.18														
			Counterflashing	3.1.11														
			Flashing at roof penetrations	3.1.23														
			Reglets	3.1.12														
			Scuppers	3.1.19														
			Copings	3.1.24														
			Drip edge	3.1.15														
			Eave flashing	3.1.20														
			SD-11 Closeout Submittals															
			Quality Control Plan	3.5														
		07840	SD-02 Shop Drawings															
			Firestopping Materials	2.1														
			SD-07 Certificates															
			Firestopping Materials	2.1														
			Installer Qualifications	1.5														
			Inspection	3.3														

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		07900A	SD-03 Product Data															
			Backing	2.1														
			Bond-Breaker	2.2														
			Sealant	2.5														
			SD-07 Certificates															
			Sealant	2.5														
		08110	SD-02 Shop Drawings															
			Doors	2.1														
			Doors	2.1														
			Frames	2.7														
			Frames	2.7														
			Accessories	2.5														
			SD-03 Product Data															
			Doors	2.1														
			Frames	2.7														
			Accessories	2.5														
		08210	SD-02 Shop Drawings															
			Wood Doors	1.2.1														
			SD-08 Manufacturer's Instructions															
			Fire Rated Doors	2.5														
			Fire Rated Doors	3.1.2														
		08702	SD-03 Product Data															
			Hardware and Accessories		G													
			SD-02 Shop Drawings															
			Hardware Devices		G													
			Hardware Schedule															

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		08702	Keying Schedule		G													
			Bitting List															
			SD-07 Certificates															
			Hardware and Accessories															
		09100	SD-02 Shop Drawings															
			Metal support systems	2.1														
		09250	SD-03 Product Data															
			Cementitious backer units	2.1.4														
			Water-Resistant Gypsum Backing	2.1.3														
			Board															
			Accessories	2.1.10														
			SD-07 Certificates															
			Asbestos Free Materials	2.1														
		09510	SD-02 Shop Drawings															
			Approved Detail Drawings	1.3														
			SD-03 Product Data															
			Acoustical Ceiling Systems	1.3.1														
			SD-04 Samples															
			Acoustical Units	2.1														
			SD-06 Test Reports															
			Fire Resistive Ceilings	1.3.1														
			Ceiling Attenuation Class and	1.3.2														
			Test															
			SD-07 Certificates															
			Acoustical Units	2.1														
		09650	SD-02 Shop Drawings															

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		09650	Tile Flooring	2.2	G													
			SD-03 Product Data															
			Tile Flooring	2.2														
			Adhesive for Vinyl Composition	2.2.6														
			Tile															
			Adhesive for Wall Base	2.2.7														
			SD-04 Samples															
			Tile Flooring	2.2														
			Wall Base	2.4														
			SD-06 Test Reports															
			Moisture Test	3.3														
			SD-08 Manufacturer's Instructions															
			Tile Flooring	2.2														
		09680A	SD-02 Shop Drawings															
			Installation	3.4														
			Molding	2.3														
			SD-03 Product Data															
			Carpet															
			Surface Preparation	3.1														
			Installation	3.4														
			Regulatory Requirements	1.3														
			SD-04 Samples															
			Carpet		G													
			Molding	2.3	G													
			SD-06 Test Reports															
			Moisture and Alkalinity Tests	3.2														

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		09680A	SD-07 Certificates															
			Carpet															
			Regulatory Requirements	1.3														
			SD-10 Operation and Maintenance															
			Data															
			Carpet															
			Cleaning and Protection	3.5														
		09900	SD-02 Shop Drawings															
			Piping identification	3.12														
			stencil	3.12														
			SD-03 Product Data															
			Coating	2.1	G													
			Manufacturer's Technical Data	2.1														
			Sheets															
			Sealant															
			SD-04 Samples															
			Color	1.9	G													
			SD-07 Certificates															
			Applicator's qualifications	1.3														
			Qualification Testing	1.4.1.2														
			SD-08 Manufacturer’s Instructions															
			Application instructions															
			Mixing	3.6.2														
			Manufacturer's Material Safety	1.7.2														
			Data Sheets															

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		09900	SD-10 Operation and Maintenance															
			Data															
			Coatings:	2.1														
		12320A	SD-02 Shop Drawings															
			Installation	3.1														
			SD-03 Product Data															
			Cabinets	2.1														
			Countertops and Backsplash	2.2														
			SD-04 Samples															
			Cabinets	2.1														
			Countertops and Backsplash	2.2														
			SD-06 Test Reports															
			Cabinets and Countertops															
		13851A	SD-02 Shop Drawings															
			Fire Alarm Reporting System	1.4.1	G													
			SD-03 Product Data															
			Storage Batteries	2.2	G													
			Voltage Drop															
			Special Tools and Spare Parts	2.7.4														
			Technical Data and Computer	1.4	G													
			Software															
			Training	3.6														
			Testing	3.5														
			SD-06 Test Reports															
			Testing	3.5														
			SD-07 Certificates															

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		13851A	Equipment	1.4.6														
			Qualifications	1.3.7														
			SD-10 Operation and Maintenance															
			Data															
			Technical Data and Computer	1.4	G													
			Software															
		15080A	SD-02 Shop Drawings															
			Mica Plates	3.2.2.4														
			SD-03 Product Data															
			General Materials	2.1														
			SD-04 Samples															
			Thermal Insulation Materials															
		15400	SD-03 Product Data															
			Pipe and fittings	2.1														
			Valves	2.2.4														
			Plumbing fixtures	2.4														
			Water heaters															
			Pipe hangers and supports	2.3.4														
			Pumps															
			Pressure gages	2.2.7														
			Water meters	2.2.5														
			Strainers	2.2.6														
			Drains	2.1.6														
			Water hammer arresters	2.2.10														
			Backflow preventers															
			Thermometers	2.2.8														

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		15400	SD-06 Test Reports															
			Disinfection	3.3														
			SD-10 Operation and Maintenance															
			Data															
			Water heaters															
			Pumps															
		15653	SD-03 Product Data															
			Air-Conditioning		G													
			Spare Parts Data															
			SD-02 Shop Drawings															
			Air-Conditioning															
			SD-08 Manufacturer's Instructions															
			Framed Instructions															
			SD-06 Test Reports															
			Tests	3.2														
			Demonstrations	3.5	G													
			Verification of Dimensions	1.4.1														
			System Performance Tests	3.2.														
			Air-Conditioning/Heat Pump															
			System															
			Service Organizations															
			Operation Manual															
			Maintenance Manual															
		15895	SD-02 Shop Drawings															
			Drawings	3.1.9	G													
			Installation	3.1	G													

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		15895	SD-03 Product Data															
			Components and Equipment	2.1	G													
			Test Procedures															
			Welding Procedures															
			Diagrams	3.1														
			Manufacturer's Exerience															
			Welded Joints	3.1.1.1														
			Performance Tests	3.7														
			Field Training	3.9														
			SD-06 Test Reports															
			Performance Tests	3.7														
			Testing, Adjusting, and Balancing	3.6	G													
			SD-07 Certificates															
			Bolts	2.5.2.2														
			SD-10 Operation and Maintenance															
			Data															
			Operating and Maintenance	3.9														
			Instructions															
		15990	SD-03 Product Data															
			TAB Related HVAC Submittals															
			SD-02 Shop Drawings															
			TAB Schematic Drawings and		G													
			Report Forms															
			SD-08 Manufacturer’s Instructions															
			TAB Procedures		G													
			SD-05 Design Data															

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		15990	Systems Readiness Check															
			TAB Execution															
			TAB Verification		G													
			SD-06 Test Reports															
			Design Review Report		G													
			Systems Readiness Check Report		G													
			TAB Report		G													
			TAB Verification Report		G													
			SD-07 Certificates															
			TAB Firm		G													
			TAB Specialist		G													
			Instrument Calibration															
			Ductwork Leak Testing															
		16264A	SD-03 Product Data															
			Equipment Performance		G													
			Sound Power Level		G													
			Generator Data		G													
			Power Factor Capability Curve															
			Heat Rejected to															
			Engine-Generator Space															
			Alarm Setpoints															
			Manufacturer's Catalog Data															
			Vibration-Isolation															
			SD-02 Shop Drawings															
			Layout and Shop Drawings															
			As-Built Drawings															

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		16264A	SD-08 Manufacturer's Instructions															
			Posted Data															
			Instructions															
			SD-06 Test Reports															
			Onsite Test															
			SD-07 Certificates															
			Component Manufacturer															
			Manufacturer/Assembler															
			Cooling System															
			Field Engineer															
			Welder Qualification															
			Installation Procedures															
			Torsional Vibration															
			Prototype Tests															
			Reliability and Durability															
			Emissions															
			Sound limitation															
			Site Visit															
			Flywheel Balance															
			Standards Compliance															
			Factory Tests															
			Functional Facilities															
		16265A	SD-02 Shop Drawings															
			UPS System	1.3.3.1	G													
			UPS System	1.9	G													
			Installation	3.1														

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		16265A	SD-03 Product Data															
			Performance Requirements	1.3.4	G													
			Spare Parts															
			Field Training	3.4	G													
			SD-06 Test Reports															
			Factory Testing	2.14														
			Field Supervision, Startup and	3.2														
			Testing															
		16410A	SD-02 Shop Drawings															
			Switches		G													
			Equipment	1.3.1														
			Installation	3.1														
			SD-03 Product Data															
			Material	1.3.1														
			Equipment	1.3.1														
			SD-06 Test Reports															
			Testing	2.4	G													
			SD-07 Certificates															
			Equipment	1.3.1														
			Material	1.3.1														
			Switching Equipment															
			SD-10 Operation and Maintenance															
			Data															
			Switching Equipment															
			Instructions	3.2														
		16415A	SD-03 Product Data															

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		16415A	Fault Current and Protective		G													
			Device Coordination Study															
			Manufacturer's Catalog		G													
			Material, Equipment, and Fixture		G													
			Lists															
			Installation Procedures															
			SD-02 Shop Drawings															
			Interior Electrical Equipment															
			As-Built Drawings															
			Onsite Test		G													
			SD-06 Test Reports															
			Factory Test Reports															
			Field Test Plan		G													
			Field Test Reports		G													
			SD-07 Certificates															
			Materials and Equipment															
		16475A	SD-03 Product Data															
			Fault Current Analysis	2.14	G	RE												
			Protective Device Coordination	2.14	G	RE												
			Study															
			Equipment	2.1														
			System Coordinator	1.4.1														
			Protective Relays	3.3.5														
			Installation	3.2														
			SD-06 Test Reports															
			Field Testing	3.3														

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ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION	MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
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SECTION 02370A

SOIL SURFACE EROSION CONTROL
01/03

PART 1 GENERAL

1.1 REFERENCES

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

U.S. DEPARTMENT OF AGRICULTURE (USDA)

AMS Seed Act	(1940; R 1988; R 1998) Federal Seed Act

ASTM INTERNATIONAL (ASTM) (ASTM)

ASTM D 977	(1998) Emulsified Asphalt
ASTM D 1560	(1992; R 2000) Resistance to Deformation and Cohesion of Bituminous Mixtures by Means of Hveem Apparatus
ASTM D 1682	(1959T; R 1975) Test for Breaking Load and Elongation of Textile Fabrics
ASTM D 1777	(1996) Thickness of Textile Materials
ASTM D 2028	(1997) Cutback Asphalt (Rapid-Curing Type)
ASTM D 2844	(1994) Resistance R-Value and Expansion Pressure of Compacted Soils
ASTM D 3776	(1996) Mass per Unit Area (Weight)of Fabric
ASTM D 3787	(2001) Bursting Strength of Textiles - Constant-Rate-of-Traverse (CRT), Ball Burst Test
ASTM D 3884	(2001e1) Abrasion Resistance of Textile Fabrics (Rotary Platform, Double Head Method)
ASTM D 4355	(1999) Deterioration of Geotextiles From Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus)
ASTM D 4491	(1999a) Water Permeability of Geotextiles by Permittivity
ASTM D 4533	(1991; R 1996) Trapezoidal Tearing Strength of Geotextiles
ASTM D 4595	(1986; R 2001) Tensile Properties of

	Geotextiles by the Wide-Width Strip Method
ASTM D 4632	(1991; R 1996) Grab Breaking Load and Elongation of Geotextiles
ASTM D 4751	(1999a) Determining Apparent Opening Size of a Geotextile
ASTM D 4833	(2000) Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
ASTM D 5035	(1995) Breaking Force and Elongation of Textile Fabrics (Strip Method)

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

Seed Establishment Period;

Calendar time period for the seed establishment period. When there is more than one seed establishment period, the boundaries of the seeded area covered for each period shall be described.

Maintenance Record;

Record of maintenance work performed, of measurements and findings for product failure, recommendations for repair, and products replaced.

SD-03 Product Data

Geotextile Fabrics;

A listing of equipment to be used for the application of erosion control materials.

Erosion Control Blankets;

Condition of finish grade status prior to installation; location of underground utilities and facilities.

SD-04 Samples

Materials; FI0

a. Geotextile fabrics; 6 inch square.

b. Erosion control blankets; 6 inch square.

SD-06 Test Reports

Geotextile Fabrics;

Erosion Control Blankets;
Sod;
Classification, botanical name, common name, percent pure live seed, minimum percent germination and hard seed, maximum percent weed seed content, and date tested.

1.3 DESCRIPTION OF WORK

The work shall consist of furnishing and installing soil surface erosion control materials, including fine grading, blanketing, stapling, mulching and miscellaneous related work, within project limits and in areas outside the project limits where the soil surface is disturbed from work under this contract at the designated locations. This work shall include all necessary materials, labor, supervision and equipment for installation of a complete system. This section shall be coordinated with the requirements of Section 02300A EARTHWORK and Section 02922A SODDING.

1.4 DELIVERY, INSPECTION, STORAGE, AND HANDLING

Materials shall be stored in designated areas and as recommended by the manufacturer protected from the elements, direct exposure, and damage. Containers shall not be dropped from trucks. Material shall be free of defects that would void required performance or warranty. Geosynthetic binders and synthetic soil binders shall be delivered in the manufacturer's original sealed containers and stored in a secure area.

a. Erosion control blankets and geotextile fabric shall be furnished in rolls with suitable wrapping to protect against moisture and extended ultraviolet exposure prior to placement. Erosion control blanket and geotextile fabric rolls shall be labeled to provide identification sufficient for inventory and quality control purposes.

b. All synthetic grids, synthetic sheets, and articulating cellular concrete block grids shall be sound and free of defects that would interfere with the proper placing of the block or impair the strength or permanence of the construction. Minor cracks in synthetic grids and concrete cellular block, incidental to the usual methods of manufacture, or resulting from standard methods of handling in shipment and delivery, shall not be deemed grounds for rejection.

c. Seed shall be inspected upon arrival at the jobsite for conformity to species and quality. Seed that is wet, moldy, or bears a test date five months or older, shall be rejected.

1.5 SUBSTITUTIONS

Substitutions will not be allowed without written request and approval from the Contracting Officer.

1.6 TIME LIMITATIONS

Backfilling the openings in synthetic grid systems and articulating cellular concrete block systems shall be completed a maximum 7 days after placement to protect the material from ultraviolet radiation.

1.7 WARRANTY

Erosion control material shall have a warranty for use and durable condition for project specific installations. Temporary erosion control materials shall carry a minimum eighteen month warranty. Permanent erosion control materials shall carry a minimum three year warranty.

PART 2 PRODUCTS

2.1 BINDERS

2.1.1 Synthetic Soil Binders

Calcium chloride, or other standard manufacturer's spray on adhesives designed for dust suppression.

2.1.2 Geosynthetic Binders

Geosynthetic binders shall be manufactured in accordance with ASTM D 1560, ASTM D 2844; and shall be referred to as products manufactured for use as modified emulsions for the purpose of erosion control and soil stabilization. Emulsions shall be manufactured from all natural materials and provide a hard durable finish.

2.2 MULCH

Mulch shall be free from weeds, mold, and other deleterious materials. Mulch materials shall be native to the region.

2.2.1 Straw

Straw shall be stalks from oats, wheat, rye, barley, or rice, furnished in air-dry condition and with a consistency for placing with commercial mulch-blowing equipment.

2.2.2 Hay

Hay shall be native hay, sudan-grass hay, broomsedge hay, or other herbaceous mowings, furnished in an air-dry condition suitable for placing with commercial mulch-blowing equipment.

2.2.3 Wood Cellulose Fiber

Wood cellulose fiber shall not contain any growth or germination-inhibiting factors and shall be dyed an appropriate color to facilitate placement during application. Composition on air-dry weight basis: a minimum 9 to a maximum 15 percent moisture, and between a minimum 4.5 to a maximum 6.0 pH.

2.2.4 Paper Fiber

Paper fiber mulch shall be recycled news print that is shredded for the purpose of mulching seed.

2.2.5 Shredded Bark

Locally shredded material shall be treated to retard the growth of mold and fungi.

2.2.6 Wood By-Products

Wood locally chipped or ground bark shall be treated to retard the growth of mold and fungi. Gradation: A maximum 2 inch wide by 4 inch long.

2.2.7 Coir

Coir shall be manufactured from 100 percent coconut fiber cured in fresh water for a minimum of 6 months.

2.2.8 Asphalt Adhesive

Asphalt adhesive shall conform to the following: Emulsified asphalt, conforming to ASTM D 977, Grade SS-1; and cutback asphalt, conforming to ASTM D 2028, Designation RC-70.

2.2.9 Mulch Control Netting

Mulch control netting may be constructed of lightweight recycled plastic, cotton, or paper or organic fiber. The recycled plastic shall be a woven or nonwoven polypropylene, nylon, or polyester containing stabilizers and/or inhibitors to make the fabric resistant to deterioration from UV, and with the following properties:

a. Minimum grab tensile strength (TF 25 #1/ASTM D 4632), 180 pounds.

b. Minimum Puncture (TF 25 #4/ASTM D 3787), 75 psi in the weakest direction.

c. Apparent opening sieve size of a minimum 40 and maximum 80 (U.S. Sieve Size)..

d. Minimum Trapezoidal tear strength (TF 25 #2/ASTM D 4533), 50 pounds.

2.3 GEOTEXTILE FABRICS

Geotextile fabrics shall be woven of polypropylene filaments formed into a stable network so that the filaments retain their relative position to each other. Sewn seams shall have strength equal to or greater than the geotextile itself. Fabric shall be installed to withstand maximum velocity flows as recommended by the manufacturer. The geotextile shall conform to the following minimum average roll values:

Property	Performance	Test Method
Weight		ASTM D 3776
Thickness		ASTM D 1777
Permeability		ASTM D 4491
Abrasion Resistance, Type (percent strength retained)	58 percent X 81 percent	ASTM D 3884
Tensile Grab Strength	1,467 N X 1, 933 N	ASTM D 4632
Grab Elongation	15percent X 20percent	ASTM D 4632
Burst Strength	5,510 kN/m^2	ASTM D 3787
Puncture Strength	733 N	ASTM D 4833
Trapezoid Tear	533 N X 533 N	ASTM D 4533
Apparent Opening Size	40 US Std Sieve	ASTM D 4751

Property	Performance	Test Method
UV Resistance @ 500 hrs	90 percent	ASTM D 4355

2.4 EROSION CONTROL BLANKETS

2.4.1 Erosion Control Blankets Type I

Type I blankets shall be used for erosion control and vegetation establishment on roadside embankments, abutments, berms, shoulders, and median swales where natural vegetation will provide long term stabilization. Erosion control blankets shall be a machine-produced mat of 100% straw. The blanket shall be of consistent thickness with the straw evenly distributed over the entire area of the mat. The blanket shall be covered on the top side with a photodegradable polypropylene netting having an approximate 1/2 by 1/2 inch mesh and be sewn together on a maximum 1.5 inch centers with degradable thread. The erosion control blanket shall have the following properties:

Material Content

Straw	100 percent with approximately ..50 lb/yd^2 weight
Netting	One side only, lightweight photodegradable with approximately 1.64 lb/1,000 ft^2 weight.
Thread	Degradable

Note 1: Photodegradable life a minimum of 2 months with a minimum 90 percent light penetration. Apply to slopes up to a maximum 3:1 gradient.

2.4.2 Erosion Control Blankets Type II

Erosion control blankets shall be a machine-produced mat of 100 percent straw. The blanket shall be of consistent thickness with the straw evenly distributed over the entire area of the mat. The blanket shall be covered on the top side with a polypropylene netting having an approximate 1/2 by 1/2 inch mesh with photodegradable accelerators to provide breakdown of the netting within approximately 45 days,depending upon geographic location and elevation. The blanket shall be sewn together on a maximum 1.5 inch centers with degradable thread. The erosion control blanket shall have the following properties:

Material Content

Straw	100 percent with approximately .50 lb/yd^2 weight.
Netting	One side only, photodegradable with photo accelerators and approximately 1.64 lb/1,000 ft^2 weight.
Thread	Degradable

NOTE: Photodegradable life a minimum of 10 months with a minimum 90 percent light penetration. Apply to slopes up to a maximum 3:1

Material Content
gradient.

2.4.3 Erosion Control Blankets Type III

Type III blankets shall be used for erosion control and vegetation establishment on roadside embankments, abutments, berms, shoulders, and median swales where natural vegetation will provide long term stabilization. Erosion control blanket shall be a machine-produced mat consisting of 70 percent straw and 30 percent coconut fiber. The blanket shall be of consistent thickness with the straw and coconut fiber evenly distributed over the entire area of the mat. The blanket shall be covered on the top side with heavyweight photodegradable polypropylene netting having UV additives to delay breakdown and an approximate 5/8 by 5/8 inch mesh, and on the bottom side with a lightweight photodegradable polypropylene netting with an approximate 1/2 inch by 1/2 inch mesh. The blanket shall be sewn together on 1.5 inch centers with degradable thread. The erosion control blanket shall have the following properties:

Material Content	
Straw	70 percent by approximately .35 lb/yd^2.
Coconut Fiber	30 percent by approximately .15 lb/yd^2 weight.
Netting	Top side heavyweight photodegradable with UV additives and approximately 3 lb/1,000 ft^2 weight Bottom side lightweight photodegradable with approximately 1.64 lb/1,000 ft^2 weight.

NOTE: Photodegradable life a minimum of 10 months with a minimum 90 percent light penetration. Apply to slopes with a gradient less than 1.5:1.

2.4.4 Erosion Control Blankets Type IV

Erosion control blanket shall be a machine-produced mat of 100 percent straw. The blanket shall be of consistent thickness with the straw evenly distributed over the entire area of the mat. The blanket shall be covered on the top and bottom sides with lightweight photodegradable polypropylene netting having an approximate 1/2 by 1/2 inch mesh. The blanket shall be sewn together on 1.5 inch centers with degradable thread. The erosion control blanket shall have the following properties:

Material Content	
Straw	100 percent with approximately .5 lb/yd^2 weight.
Netting	Both sides lightweight photodegradable with approximately 1.64 lb/1,000 ft^2 weight.

Material Content

Thread	Degradable

NOTE: Photodegradable life a minimum of 2 months with a minimum 90 percent light penetration. Apply to slopes with a gradient of less than 1.5:1.

2.4.5 Erosion Control Blankets Type V

Erosion control blanket shall be a machine-produced mat of 100 percent straw. The blanket shall be of consistent thickness with the straw evenly distributed over the entire area of the mat. The blanket shall be covered on the top side with polypropylene netting having an approximate 1/2 by 1/2 inch mesh with photodegradable accelerators to provide breakdown of the netting within approximately 45 days, depending upon geographic location and elevation. The bottom shall be covered with a polypropylene netting having an approximate 1/2 by 1/2 inch mesh with photo accelerators. The blanket shall be sewn together on 1.5 inch centers with degradable thread. The erosion control blanket shall have the following properties:

Material Content

Straw	100 percent with approximately .5 lb/yd^2 weight.
Netting	Top side lightweight photodegradable with photo accelerators with approximately 1.64 lb/1,000 ft^2 weight.
Thread	Bottom side lightweight photodegradable with photo accelerators and approximately 1.64 lb/1,000 ft^2 weight.

NOTE: Photodegradable life a minimum of 10 months with a minimum 90 percent light penetration. Apply to slopes up to a maximum 2:1 gradient.

2.4.6 Erosion Control Blankets Type VI

Erosion control blanket shall be a machine-produced 100% biodegradable mat with a 100 percent straw fiber matrix. The blanket shall be of consistent thickness with the straw fiber evenly distributed over the entire area of the mat. The blanket shall be covered on the top side with a 100 percent biodegradable woven natural organic fiber netting. The netting shall consist of machine directional strands formed from two intertwined yarns with cross directional strands interwoven through the twisted machine strands (commonly referred to as a Leno weave) to form an approximate 1/2 by 1/2 inch mesh. The blanket shall be sewn together with biodegradable thread on 1.5 inch centers. The erosion control blanket shall have the following properties:

Material Content

Matrix	100 percent straw fiber with approximately .50 lb/yd^2 weight

Material Content

Netting	One side only, Leno woven 100% biodegradable natural organic fiber
Weight	approximately 9.3 lb/1,000 ft2.
Thread	Biodegradable

NOTE: Photodegradable life a minimum of 10 months with a minimum 90 Percent light penetration. Apply to slopes up to a maximum 2:1 gradient.

2.4.7 Erosion Control Blankets Type VII

Erosion control blanket shall be a machine-produced 100 percent biodegradable mat with an herbaceous straw fiber matrix. The blanket shall be of consistent thickness with the straw evenly distributed over the entire area of the mat. The blanket shall be covered on the top and bottom sides with 100 percent biodegradable woven natural fiber netting. The netting shall consist of machine directional strands formed from two intertwined yarns with cross directional strands interwoven through the twisted machine strands (commonly referred to as a Leno weave) to form an approximate 1/2 by 1/2 inch mesh. The blanket shall be sewn together with biodegradable thread on 1.5 inch centers. The blanket shall have the following properties:

Material Content

Straw	100 percent straw fiber with approximately .5 lb/yd^2 weight.
Netting	Top and bottom sides,Leno woven 100% biodegradable natural organic fiber with approximately 9.3 lb/1,000ft^2 weight.
Thread	Biodegradable

Note: Photodegradable life a minimum of 18 months with a minimum 90 percent light penetration. Apply to slopes up to a maximum 1.5:1 gradient.

2.4.8 Erosion Control Blankets Type VIII

Erosion control blanket shall be a machine-produced 100 percent biodegradable mat with a 70 percent herbaceous straw and 30 percent coconut fiber blend matrix. The blanket shall be of consistent thickness with the straw and coconut fiber evenly distributed over the entire area of the mat. The blanket shall be covered on the top and bottom sides with 100 percent biodegradable woven natural organic fiber netting. The netting shall consist of machine directional strands formed from two intertwined yarns with cross directional strands interwoven through the twisted machine strands (commonly referred to as a Leno weave) to form an approximate 1/2 by 1/2 inch mesh. The blanket shall be sewn together with biodegradable thread on 1.5 inch centers. Straw/Coconut fiber erosion control blanket shall have the following properties:

Material Content

Matrix	70 percent straw fiber with approximately ..35 lb/yd^2 weight. 30 percent coconut fiber cured in fresh water with approximately ..15 lb/yd^2 weight.
Netting	Both sides woven 100% biodegradable natural organic fiber with approximately 9.3 lbs/1,000 ft^2 weight.
Thread	Biodegradable

NOTE: Photodegradable life a minimum of 24 months with a minimum 90 percent light penetration. Apply to slopes up to a maximum 1.5:1 gradient.

2.4.9 Erosion Control Blankets Type IX (Turf Reinforcement Mat)

Permanent erosion control/turf reinforcement mat is constructed of 100 percent coconut fiber stitch bonded between a heavy duty UV stabilized bottom net, and a heavy duty UV stabilized cuspated (crimped) middle netting overlaid with a heavy duty UV stabilized top net. The cuspated netting forms prominent closely spaced ridges across the entire width of the mat. The three nettings are stitched together on 1.5 inch centers with UV stabilized polypropylene thread to form a permanent three dimensional structure. The following list contains further physical properties of the turf erosion control mat.

Property	Test Method	Value	Units
Ground Cover	Image Analysis	93	percent
Thickness	ASTM D 1777		0.63 in
Mass Per Unit Area	ASTM D 3776		0.92 lb/sy
Tensile Strength	ASTM D 5035		480 lb/ft
Elongation	ASTM D 5035		percent
Tensile Strength	ASTM D 5035		960 lb/ft
Elongation	ASTM D 5035	31	percent
Tensile Strength	ASTM D 1682		177 lbs
Elongation	ASTM D 1682	22	percent
Resiliency	ASTM D 1777	greater than 80	percent
UV Stability*	ASTM D 4355		151 lbs
		86	percent
Color(permanent net)		UV Black	
Porosity(permanent net)Calculated		greater than 95	percent
Minimum Filament Measured Diameter (permanent net)			0.03 in

NOTE 1: *ASTM D 1682 Tensile Strength and percent Strength Retention of material after 1000 hours of exposure in Xenon-Arc Weatherometer

NOTE 2: Photodegradable life a minimum of 36 months with a minimum 90 percent light penetration. Apply to slopes up to a maximum 1:1 gradient.

2.4.10 Erosion Control Blankets Type X (Turf Reinforcement Mat)

Permanent erosion control/turf reinforcement mat shall be constructed of 100 percent UV stabilized high denier polypropylene fiber sewn between a black UV stabilized 1/2 inch mesh polypropylene netting on the top 5 lbs/1000 square ft and a black UV stabilized 5/8 inch mesh polypropylene netting on the bottom 3 lbs/1000 square ft with polypropylene thread. The mat shall be resistant to photo and chemical degradation. The following list contains further physical properties of the turf reinforcement mat.

Property	Test Method	Value	Units
Thickness	ASTM D 1777		0.56 in
Resiliency	100 PSI-3 cycles	94	percent
Mass Per Unit Area	ASTM D 3776		11.2 oz/sq yd
Tensile Strength	ASTM D 4632		35.2 lbs
Elongation	ASTM D 4632	25.5	percent
Tensile Strength	ASTM D 4595	259.2	lbs/ft
Elongation	ASTM D 4595	20.9	percent
Tensile Strength	ASTM D 5035		300 lbs/ft
Elongation	ASTM D 5035	51	percent
Tensile Strength	ASTM D 1682		89 lbs
Elongation	ASTM D 1682	21	percent
UV Stability*	ASTM D 4355		81* lbs
		90*	percent

NOTE 1: *ASTM D 1682 Tensile Strength and percent Strength Retention of material after 1000 hours of exposure in Xenon-Arc Weatherometer.

NOTE 2: Photodegradable life a minimum of 36 months with a minimum 90 percent light penetration. Apply to slopes up to a maximum 1:1 gradient.

2.4.11 Seed

2.4.11.1 Seed Classification

State-approved sod of the latest season's crop shall be provided bearing the producer's guaranteed analysis for percentages of mixture, purity, germination, hard seed, weed seed content, and inert material. Labels shall be in conformance with AMS Seed Act and applicable state seed laws. The Contractor shall submit the Seed Establishment Period information as specified in the Submittals paragraph.

2.4.11.2 Permanent Sod Species and Mixtures

Permanent sod species and mixtures shall be proportioned by weight in accordance with Section 02922A, "Sodding".

2.4.11.3 Quality

Weed shall be a maximum 1 percent by weight of the total mixture.

2.4.12 Staples

Staples shall be as recommended by the manufacturer.

2.5 CRUSHED ROCK

Crushed rock shall be crushed run between a minimum 3 inches and a maximum 6 inches.

2.6 GRAVEL

Gravel shall be river run between a minimum 1 inches and a maximum 3 inches. Contractor shall submit sieve test results for both gravel and SAND.

2.7 WATER

Unless otherwise directed, water shall be the responsibility of the Contractor. Water shall be potable or supplied by an existing irrigation system.

PART 3 EXECUTION

3.1 CONDITIONS

The Contractor shall submit a construction work sequence schedule, with the approved erosion control plan a minimum of 30 days prior to start of construction. The work schedule shall coordinate the timing of land disturbing activities with the provision of erosion control measures. Erosion control operations shall be performed under favorable weather conditions; when excessive moisture, frozen ground or other unsatisfactory conditions prevail, the work shall be stopped as directed. When special conditions warrant a variance to earthwork operations, a revised construction schedule shall be submitted for approval. Erosion control materials shall not be applied in adverse weather conditions which could affect their performance.

3.1.1 Finished Grade

The Contractor shall verify that finished grades are as indicated on the drawings; finish grading and compaction shall be completed in accordance with Section 02300A EARTHWORK, prior to the commencement of the work. The location of underground utilities and facilities in the area of the work shall be verified and marked. Damage to underground utilities and facilities shall be repaired at the Contractor's expense.

3.1.2 Placement of Erosion Control Blankets

Before placing the erosion control blankets, ensure the subgrade has been graded smooth; has no depressed, void areas; is free from obstructions, such as tree roots, projecting stones or other foreign matter. Vehicles shall not be permitted directly on the blankets.

3.2 SITE PREPARATION

3.2.1 Layout

Erosion control material locations may be adjusted to meet field conditions. When soil tests result in unacceptable particle sizes, a shop drawing shall be submitted indicating the corrective measures.

3.2.2 Protecting Existing Vegetation

When there are established lawns in the work area, the turf shall be

covered and/or protected or replaced after construction operations. Existing trees, shrubs, and plant beds that are to be preserved shall be barricaded along the dripline. Damage to existing trees shall be mitigated by the Contractor at no additional cost to the Government. Damage shall be assessed by a state certified arborist or other approved professional using the National Arborist Association's tree valuation guideline.

3.3 INSTALLATION

3.3.1 Mulch Installation

Mulch shall be installed in the areas indicated.

3.3.2 Erosion Control Blankets

a. Erosion control blankets shall be installed as indicated and in accordance with manufacturer's recommendations. The extent of erosion control blankets shall be as shown on drawings.

b. Erosion control blankets shall be oriented in vertical strips and anchored with staples, as indicated. Adjacent strips shall be abutted to allow for installation of a common row of staples. Horizontal joints between erosion control blankets shall be overlapped sufficiently to accommodate a common row of staples with the uphill end on top.

c. Where exposed to overland sheet flow, a trench shall be located at the uphill termination. The erosion control blanket shall be stapled to the bottom of the trench. Backfill and compact the trench as required.

d. Where terminating in a channel containing an installed blanket, the erosion control blanket shall overlap installed blanket sufficiently to accommodate a common row of staples.

3.4 CLEAN-UP

Excess material, debris, and waste materials shall be disposed offsite at an approved landfill or recycling center. Adjacent paved areas shall be cleared. Immediately upon completion of the installation in an area, the area shall be protected against traffic or other use by erecting barricades and providing signage as required, or as directed.

3.5 WATERING SOD

Water shall be applied to supplement rainfall at a sufficient rate to ensure moist soil conditions to a minimum 1 inch depth. Run-off and puddling shall be prevented. Watering trucks shall not be driven over turf areas, unless otherwise directed. Watering of other adjacent areas or plant material shall be prevented.

3.6 MAINTENANCE RECORD

A record shall be furnished describing the maintenance work performed, record of measurements and findings for product failure, recommendations for repair, and products replaced.

3.6.1 Maintenance

Maintenance shall include eradicating weeds; protecting embankments and ditches from surface erosion; maintaining the performance of the erosion control materials and mulch; protecting installed areas from traffic.

3.6.1.1 Maintenance Instructions

Written instructions containing drawings and other necessary information shall be furnished, describing the care of the installed material; including, when and where maintenance should occur, and the procedures for material replacement.

3.6.1.2 Patching and Replacement

Unless otherwise directed, material shall be placed, seamed or patched as recommended by the manufacturer. Material not meeting the required performance as a result of placement, seaming or patching shall be removed from the site. The Contractor shall replace the unacceptable material at no additional cost to the Government.

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DIVISION 02 - SITE CONSTRUCTION

SECTION 02630

STORM-DRAINAGE SYSTEM

03/00

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SECTION 02630

STORM-DRAINAGE SYSTEM
03/00

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 198	(1998) Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 536	(1999el) Ductile Iron Castings
ASTM C 32	(1999el) Sewer and Manhole Brick (Made from Clay or Shale)
ASTM C 55	(1999) Concrete Brick
ASTM C 62	(1997a) Building Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C 76	(1999) Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C 139	(1999) Concrete Masonry Units for Construction of Catch Basins and Manholes
ASTM C 270	(1997) Mortar for Unit Masonry
ASTM C 443	(1998) Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
ASTM C 478	(1997) Precast Reinforced Concrete Manhole Sections
ASTM C 924	(1998) Concrete Pipe Sewer Lines by Low-Pressure Air Test Method
ASTM C 1103	(1994) Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
ASTM D 1056	(1998) Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D 1171	(1994) Rubber Deterioration - Surface Ozone Cracking Outdoors or Chamber (Triangular Specimens)

ASTM D 1557	(1998) Laboratory Compaction Characteristics of Soil Using Modified Effort 2,700 kN-m/cu.m.
ASTM D 1752	(1984; R 1996el) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D 2167	(1994) Density and Unit Weight of Soil in Place by the Rubber Balloon Method

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Placing Pipe; G

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery and Storage

Materials delivered to site shall be inspected for damage, unloaded, and stored with a minimum of handling. Materials shall not be stored directly on the ground. The inside of pipes and fittings shall be kept free of dirt and debris. Before, during, and after installation, plastic pipe and fittings shall be protected from any environment that would result in damage or deterioration to the material. The Contractor shall have a copy of the manufacturer's instructions available at the construction site at all times and shall follow these instructions unless directed otherwise by the Contracting Officer.

1.3.2 Handling

Materials shall be handled in a manner that ensures delivery to the trench in sound, undamaged condition. Pipe shall be carried to the trench, not dragged.

PART 2 PRODUCTS

2.1 PIPE FOR CULVERTS AND STORM DRAINS

Pipe for culverts and storm drains shall be of the sizes indicated and shall conform to the requirements specified.

2.1.1 Concrete Pipe

ASTM C 76, Class III.

2.2 DRAINAGE STRUCTURES

2.2.1 Flared End Sections

Sections shall be of a standard design fabricated from zinc coated steel sheets meeting requirements of ASTM A 929/A 929M.

2.3 MISCELLANEOUS MATERIALS

2.3.1 Concrete

Unless otherwise specified, concrete and reinforced concrete shall conform to the requirements for 4000 psi concrete under Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. The concrete mixture shall have air content by volume of concrete, based on measurements made immediately after discharge from the mixer, of 5 to 7 percent when maximum size of coarse aggregate exceeds 37.5 mm. Air content shall be determined in accordance with ASTM C 231. The concrete covering over steel reinforcing shall not be less than 1 inch thick for covers and not less than 1.5 inches thick for walls and flooring. Concrete covering deposited directly against the ground shall have a thickness of at least 3 inches between steel and ground. Expansion-joint filler material shall conform to ASTM D 1751, or ASTM D 1752, or shall be resin-impregnated fiberboard conforming to the physical requirements of ASTM D 1752.

2.3.2 Mortar

Mortar for pipe joints, connections to other drainage structures, and brick or block construction shall conform to ASTM C 270, Type M, except that the maximum placement time shall be 1 hour. The quantity of water in the mixture shall be sufficient to produce a stiff workable mortar but in no case shall exceed 6 gallons of water per sack of cement. Water shall be clean and free of harmful acids, alkalies, and organic impurities. The mortar shall be used within 30 minutes after the ingredients are mixed with water. The inside of the joint shall be wiped clean and finished smooth. The mortar head on the outside shall be protected from air and sun with a proper covering until satisfactorily cured.

2.3.3 Precast Concrete Segmental Blocks

Precast concrete segmental block shall conform to ASTM C 139, not more than thick, not less than 8 inches long, and of such shape that joints can be sealed effectively and bonded with cement mortar.

2.3.4 Brick

Brick shall conform to ASTM C 62, Grade SW; ASTM C 55, Grade S-I or S-II; or ASTM C 32, Grade MS. Mortar for jointing and plastering shall consist of one part portland cement and two parts fine sand. Lime may be added to the mortar in a quantity not more than 25 percent of the volume of cement. The joints shall be filled completely and shall be smooth and free from surplus mortar on the inside of the structure. Brick structures shall be plastered with 5 inches of mortar over the entire outside surface of the walls. For square or rectangular structures, brick shall be laid in stretcher courses with a header course every sixth course. For round structures, brick shall be laid radially with every sixth course a stretcher course.

2.3.5 Precast Reinforced Concrete Manholes

Precast reinforced concrete manholes shall conform to ASTM C 478. Joints between precast concrete risers and tops shall be made with flexible watertight, rubber-type gaskets meeting the requirements of paragraph JOINTS.

2.3.6 Frame and Cover for Gratings

Frame and cover for gratings shall be cast gray iron, ASTM A 48, Class 35B; cast ductile iron, ASTM A 536, Grade 65-45-12; or cast aluminum, ASTM B 26/B 26M, Alloy 356.OT6. Weight, shape, size, and waterway openings for grates and curb inlets shall be as indicated on the plans.

2.3.7 Joints

2.3.7.1 Flexible Watertight Joints

a. Materials: Flexible watertight joints shall be made with plastic or rubber-type gaskets for concrete pipe and with factory-fabricated resilient materials for clay pipe. The design of joints and the physical requirements for plastic gaskets shall conform to AASHTO M 198, and rubber-type gaskets shall conform to ASTM C 443. Factory-fabricated resilient joint materials shall conform to ASTM C 425. Gaskets shall have not more than one factory-fabricated splice, except that two factory-fabricated splices of the rubber-type gasket are permitted if the nominal diameter of the pipe being gasketed exceeds 53 inches.

b. Test Requirements: Watertight joints shall be tested and shall meet test requirements of paragraph HYDROSTATIC TEST ON WATERTIGHT JOINTS. Rubber gaskets shall comply with the oil resistant gasket requirements of ASTM C 443. Certified copies of test results shall be delivered to the Contracting Officer before gaskets or jointing materials are installed. Alternate types of watertight joint may be furnished, if specifically approved.

2.3.7.2 Flexible Watertight, Gasketed Joints

a. Gaskets: When infiltration or exfiltration is a concern for pipe lines, the couplings may be required to have gaskets. The closed-cell expanded rubber gaskets shall be a continuous band approximately 7 inches wide and approximately .5 inch thick, meeting the requirements of ASTM D 1056, Type 2 A1 and shall have a quality retention rating of not less than 70 percent when tested for weather resistance by ozone chamber exposure, Method B of ASTM D 1171. Rubber O-ring gaskets shall be .75 inch in diameter for pipe diameters of 35.5 inches or smaller and .75 inch in diameter for larger pipe having .5 inch deep end corrugation. Rubber O-ring gaskets shall be 1.5 inches in diameter for pipe having 1 inch deep end corrugations. O-rings shall meet the requirements of AASHTO M 198 or ASTM C 443. Flexible plastic gaskets shall conform to requirements of AASHTO M 198, Type B.

2.4 STEEL LADDER

Steel ladder shall be provided where the depth of the manhole exceeds 4 meters. These ladders shall be not less than 16 inches in width, with .75 inch diameter rungs spaced 12 inches apart. The two stringers shall be a

minimum .25 inch thick and 2.5 inches wide. Ladders and inserts shall be galvanized after fabrication in conformance with ASTM A 123/A 123M.

2.5 RESILIENT CONNECTORS

Flexible, watertight connectors used for connecting pipe to manholes and inlets shall conform to ASTM C 923.

2.6 HYDROSTATIC TEST ON WATERTIGHT JOINTS

2.6.1 Concrete

A hydrostatic test shall be made on the watertight joint types as proposed. Only one sample joint of each type needs testing; however, if the sample joint fails because of faulty design or workmanship, an additional sample joint may be tested. During the test period, gaskets or other jointing material shall be protected from extreme temperatures which might adversely affect the performance of such materials. Performance requirements for joints in reinforced and nonreinforced concrete pipe shall conform to AASHTO M 198 or ASTM C 443.

PART 3 EXECUTION

3.1 EXCAVATION FOR PIPE CULVERTS, STORM DRAINS, AND DRAINAGE STRUCTURES

Excavation of trenches, and for appurtenances and backfilling for culverts and storm drains, shall be in accordance with the applicable portions of Section 02316 "Excavation, Trenching, and Backfilling for Utilities Systems" and the requirements specified below.

3.1.1 Trenching

The width of trenches at any point below the top of the pipe shall be not greater than the outside diameter of the pipe plus 12 inches to permit satisfactory jointing and thorough tamping of the bedding material under and around the pipe. Sheeting and bracing, where required, shall be placed within the trench width as specified. Contractor shall not overexcavate. Where trench widths are exceeded, redesign with a resultant increase in cost of stronger pipe or special installation procedures will be necessary. Cost of this redesign and increased cost of pipe or installation shall be borne by the Contractor without additional cost to the Government.

3.1.2 Removal of Unstable Material

Where wet or otherwise unstable soil incapable of properly supporting the pipe, as determined by the Contracting Officer, is unexpectedly encountered in the bottom of a trench, such material shall be removed to the depth required and replaced to the proper grade with select granular material, compacted as provided in paragraph BACKFILLING. When removal of unstable material is due to the fault or neglect of the Contractor in his performance of shoring and sheeting, water removal, or other specified requirements, such removal and replacement shall be performed at no additional cost to the government.

3.2 BEDDING

The bedding surface for the pipe shall provide a firm foundation of uniform density throughout the entire length of the pipe.

3.2.1 Concrete Pipe Requirements

When no bedding class is specified or detailed on the drawings, concrete pipe shall be bedded in a soil foundation accurately shaped and rounded to conform to the lowest one-fourth of the outside portion of circular pipe or to the lower curved portion of pipe arch for the entire length of the pipe or pipe arch. When necessary, the bedding shall be tamped. Bell holes and depressions for joints shall be not more than the length, depth, and width required for properly making the particular type of joint.

3.3 PLACING PIPE

Each pipe shall be thoroughly examined before being laid; defective or damaged pipe shall not be used. Plastic pipe shall be protected from exposure to direct sunlight prior to laying, if necessary to maintain adequate pipe stiffness and meet installation deflection requirements. Pipelines shall be laid to the grades and alignment indicated. Proper facilities shall be provided for lowering sections of pipe into trenches. Lifting lugs in vertically elongated metal pipe shall be placed in the same vertical plane as the major axis of the pipe. Pipe shall not be laid in water, and pipe shall not be laid when trench conditions or weather are unsuitable for such work. Diversion of drainage or dewatering of trenches during construction shall be provided as necessary.

3.3.1 Concrete

Laying shall proceed upgrade with spigot ends of bell-and-spigot pipe and tongue ends of tongue-and-groove pipe pointing in the direction of the flow.

3.4 JOINTING

3.4.1 Concrete

3.4.1.1 Cement-Mortar Bell-and-Spigot Joint

The first pipe shall be bedded to the established gradeline, with the bell end placed upstream. The interior surface of the bell shall be thoroughly cleaned with a wet brush and the lower portion of the bell filled with mortar as required to bring inner surfaces of abutting pipes flush and even. The spigot end of each subsequent pipe shall be cleaned with a wet brush and uniformly matched into a bell so that sections are closely fitted. After each section is laid, the remainder of the joint shall be filled with mortar, and a bead shall be formed around the outside of the joint with sufficient additional mortar. If mortar is not sufficiently stiff to prevent appreciable slump before setting, the outside of the joint shall be wrapped or bandaged with cheesecloth to hold mortar in place.

3.4.1.2 Plastic Sealing Compound Joints for Tongue-and-Grooved Pipe

Sealing compounds shall follow the recommendation of the particular manufacturer in regard to special installation requirements. Surfaces to receive lubricants, primers, or adhesives shall be dry and clean. Sealing compounds shall be affixed to the pipe not more than 3 hours prior to installation of the pipe, and shall be protected from the sun, blowing dust, and other deleterious agents at all times. Sealing compounds shall be inspected before installation of the pipe, and any loose or improperly affixed sealing compound shall be removed and replaced. The pipe shall be aligned with the previously installed pipe, and the joint pulled together. If, while making the joint with mastic-type sealant, a slight protrusion of

the material is not visible along the entire inner and outer circumference of the joint when the joint is pulled up, the pipe shall be removed and the joint remade. After the joint is made, all inner protrusions shall be cut off flush with the inner surface of the pipe. If nonmastic-type sealant material is used, the "Squeeze-Out" requirement above will be waived.

3.4.1.3 Flexible Watertight Joints

Gaskets and jointing materials shall be as recommended by the particular manufacturer in regard to use of lubricants, cements, adhesives, and other special installation requirements. Surfaces to receive lubricants, cements, or adhesives shall be clean and dry. Gaskets and jointing materials shall be affixed to the pipe not more than 24 hours prior to the installation of the pipe, and shall be protected from the sun, blowing dust, and other deleterious agents at all times. Gaskets and jointing materials shall be inspected before installing the pipe; any loose or improperly affixed gaskets and jointing materials shall be removed and replaced. The pipe shall be aligned with the previously installed pipe, and the joint pushed home. If, while the joint is being made the gasket becomes visibly dislocated the pipe shall be removed and the joint remade.

3.5 DRAINAGE STRUCTURES

3.5.1 Manholes and Inlets

Construction shall be of reinforced concrete, plain concrete, brick, precast reinforced concrete, precast concrete segmental blocks, prefabricated corrugated metal, or bituminous coated corrugated metal; complete with frames and covers or gratings; and with fixed galvanized steel ladders or fitted with precast step inserts for precast structures where indicated. Pipe studs and junction chambers of prefabricated corrugated metal manholes shall be fully bituminous-coated and paved when the connecting branch lines are so treated. Pipe connections to concrete manholes and inlets shall be made with flexible, watertight connectors.

3.5.2 Walls and Headwalls

Construction shall be as indicated.

3.6 STEEL LADDER INSTALLATION

Ladder shall be adequately anchored to the wall by means of steel inserts spaced not more than6.5 feet vertically, and shall be installed to provide at least 6 inchesof space between the wall and the rungs. The wall along the line of the ladder shall be vertical for its entire length.

3.7 BACKFILLING

3.7.1 Backfilling Pipe in Trenches

After the pipe has been properly bedded, selected material from excavation or borrow, at a moisture content that will facilitate compaction, shall be placed along both sides of pipe in layers not exceeding 6 inches in compacted depth. The backfill shall be brought up evenly on both sides of pipe for the full length of pipe. The fill shall be thoroughly compacted under the haunches of the pipe. Each layer shall be thoroughly compacted with mechanical tampers or rammers. This method of filling and compacting shall continue until the fill has reached an elevation of at least 12 inches above the top of the pipe. The remainder of the trench shall be

backfilled and compacted by spreading and rolling or compacted by mechanical rammers or tampers in layers not exceeding 12 inches. Tests for density shall be made as necessary to ensure conformance to the compaction requirements specified below. Where it is necessary, in the opinion of the Contracting Officer, that sheeting or portions of bracing used be left in place, the contract will be adjusted accordingly. Untreated sheeting shall not be left in place beneath structures or pavements.

3.7.2 Backfilling Pipe in Fill Sections

For pipe placed in fill sections, backfill material and the placement and compaction procedures shall be as specified below. The fill material shall be uniformly spread in layers longitudinally on both sides of the pipe, not exceeding 6 inches in compacted depth, and shall be compacted by rolling parallel with pipe or by mechanical tamping or ramming. Prior to commencing normal filling operations, the crown width of the fill at a height of 12 inches above the top of the pipe shall extend a distance of not less than twice the outside pipe diameter on each side of the pipe or 4 meters, whichever is less. After the backfill has reached at least 12 inches above the top of the pipe, the remainder of the fill shall be placed and thoroughly compacted in layers not exceeding 12 inches.

3.7.3 Movement of Construction Machinery

When compacting by rolling or operating heavy equipment parallel with the pipe, displacement of or injury to the pipe shall be avoided. Movement of construction machinery over a culvert or storm drain at any stage of construction shall be at the Contractor's risk. Any damaged pipe shall be repaired or replaced.

3.7.4 Compaction

3.7.4.1 General Requirements

Cohesionless materials include gravels, gravel-sand mixtures, sands, and gravelly sands. Cohesive materials include clayey and silty gravels, gravel-silt mixtures, clayey and silty sands, sand-clay mixtures, clays, silts, and very fine sands. When results of compaction tests for moisture-density relations are recorded on graphs, cohesionless soils will show straight lines or reverse-shaped moisture-density curves, and cohesive soils will show normal moisture-density curves.

3.7.4.2 Minimum Density

Backfill over and around the pipe and backfill around and adjacent to drainage structures shall be compacted at the approved moisture content to the following applicable minimum density, which will be determined as specified below.

a. Under airfield and heliport pavements, paved roads, streets, parking areas, and similar-use pavements including adjacent shoulder areas, the density shall be not less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless material, up to the elevation where requirements for pavement subgrade materials and compaction shall control.

b. Under unpaved or turfed traffic areas, density shall not be less than 90 percent of maximum density for cohesive material and 95

percent of maximum density for cohesionless material.

c. Under nontraffic areas, density shall be not less than that of the surrounding material.

3.7.5 Determination of Density

Testing shall be the responsibility of the Contractor and performed at no additional cost to the Government. Testing shall be performed by an approved commercial testing laboratory or by the Contractor subject to approval. Tests shall be performed in sufficient number to ensure that specified density is being obtained. Laboratory tests for moisture-density relations shall be made in accordance with ASTM D 1557 except that mechanical tampers may be used provided the results are correlated with those obtained with the specified hand tamper. Field density tests shall be determined in accordance with ASTM D 2167. Test results shall be furnished the Contracting Officer. The calibration checks of both the density and moisture gauges shall be made at the beginning of a job on each different type of material encountered and at intervals as directed.

3.8 PIPELINE TESTING

Lines shall be tested for leakage by low pressure air or water testing or exfiltration tests, as appropriate. Low pressure air testing for vitrified clay pipes shall conform to ASTM C 828. Low pressure air testing for concrete pipes shall conform to ASTM C 924. Low pressure air testing for plastic pipe shall conform to ASTM F 1417. Low pressure air testing procedures for other pipe materials shall use the pressures and testing times prescribed in ASTM C 828 or ASTM C 924, after consultation with the pipe manufacturer. Testing of individual joints for leakage by low pressure air or water shall conform to ASTM C 1103. Prior to exfiltration tests, the trench shall be backfilled up to at least the lower half of the pipe. If required, sufficient additional backfill shall be placed to prevent pipe movement during testing, leaving the joints uncovered to permit inspection. Visible leaks encountered shall be corrected regardless of leakage test results. When the water table is 24 inches or more above the top of the pipe at the upper end of the pipeline section to be tested, infiltration shall be measured using a suitable weir or other device acceptable to the Contracting Officer. An exfiltration test shall be made by filling the line to be tested with water so that a head of at least is provided above both the water table and the top of the pipe at the upper end of the pipeline to be tested. The filled line shall be allowed to stand until the pipe has reached its maximum absorption, but not less than 4 hours. After absorption, the head shall be reestablished. The amount of water required to maintain this water level during a 2-hour test period shall be measured. Leakage as measured by the exfiltration test shall not exceed 0.2 gallons per inch in diameter per 100 feet0.2 gallons per inch in diameter per 100 feet of pipeline per hour. When leakage exceeds the maximum amount specified, satisfactory correction shall be made and retesting accomplished. Testing, correcting, and retesting shall be made at no additional cost to the Government.

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SECTION 02770

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03/98

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SECTION 02770

CONCRETE SIDEWALKS AND CURBS AND GUTTERS
03/98

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 182	(1991) Burlap Cloth Made from Jute or Kenaf

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 185	(1997) Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM A 615/A 615M	(1996a) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 616/A 616M	(1996a) 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 C 31/C 31M	(1996) Making and Curing Concrete Test Specimens in the Field
ASTM C 143	(1990a) Slump of Hydraulic Cement Concrete
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 231	(1997) Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 309	(1997) Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 920	(1995) Elastomeric Joint Sealants
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 1996) Preformed Sponge Rubber and

	Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D 3405	(1996) Joint Sealants, Hot-Applied, for Concrete and Asphalt Pavements

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Concrete.

Copies of certified delivery tickets for all concrete used in the construction.

SD-06 Test Reports

Field Quality Control.

Copies of all test reports within 24 hours of completion of the test.

1.3 WEATHER LIMITATIONS

1.3.1 Placing During Cold Weather

Concrete placement shall not take place when the air temperature reaches 5 degrees C and is falling, or is already below that point. Placement may begin when the air temperature reaches 2 degrees C and is rising, or is already above 5 degrees C. Provisions shall be made to protect the concrete from freezing during the specified curing period. If necessary to place concrete when the temperature of the air, aggregates, or water is below 35 degrees F, placement and protection shall be approved in writing. Approval will be contingent upon full conformance with the following provisions. The underlying material shall be prepared and protected so that it is entirely free of frost when the concrete is deposited. Mixing water and aggregates shall be heated as necessary to result in the temperature of the in-place concrete being between 10 and 30 degrees C. Methods and equipment for heating shall be approved. The aggregates shall be free of ice, snow, and frozen lumps before entering the mixer. Covering and other means shall be provided for maintaining the concrete at a temperature of at least 10 degrees for not less than 72 hours after placing, and at a temperature above freezing for the remainder of the curing period.

1.3.2 Placing During Warm Weather

The temperature of the concrete as placed shall not exceed 30 degrees C except where an approved retarder is used. The mixing water and/or aggregates shall be cooled, if necessary, to maintain a satisfactory placing temperature. The placing temperature shall not exceed 37 degrees C at any time.

1.4 PLANT, EQUIPMENT, MACHINES, AND TOOLS

1.4.1 General Requirements

Plant, equipment, machines, and tools used in the work shall be subject to approval and shall be maintained in a satisfactory working condition at all times. The equipment shall have the capability of producing the required product, meeting grade controls, thickness control and smoothness requirements as specified. Use of the equipment shall be discontinued if it produces unsatisfactory results. The Contracting Officer shall have access at all times to the plant and equipment to ensure proper operation and compliance with specifications.

1.4.2 Slip Form Equipment

Slip form paver or curb forming machine, will be approved based on trial use on the job and shall be self-propelled, automatically controlled, crawler mounted, and capable of spreading, consolidating, and shaping the plastic concrete to the desired cross section in 1 pass.

PART 2 PRODUCTS

2.1 CONCRETE

Concrete shall conform to the applicable requirements of Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE except as otherwise specified. Concrete shall have a minimum compressive strength of 3500 psi3500 psi at 28 days. Maximum size of aggregate shall be 1.5 inches.

2.1.1 Air Content

Mixtures shall have air content by volume of concrete of 5 to 7 percent, based on measurements made immediately after discharge from the mixer.

2.1.2 Slump

The concrete slump shall be 2 inches plus or minus 1 inch where determined in accordance with ASTM C 143.

2.1.3 Reinforcement Steel

Reinforcement bars shall conform to ASTM A 615/A 615M, ASTM A 616/A 616M, or ASTM A 617/A 617M. Wire mesh reinforcement shall conform to ASTM A 185.

2.2 CONCRETE CURING MATERIALS

2.2.1 Impervious Sheet Materials

Impervious sheet materials shall conform to ASTM C 171, type optional, except that polyethylene film, if used, shall be white opaque.

2.2.2 Burlap

Burlap shall conform to AASHTO M 182.

2.2.3 White Pigmented Membrane-Forming Curing Compound

White pigmented membrane-forming curing compound shall conform to ASTM C 309, Type 2.

2.3 CONCRETE PROTECTION MATERIALS

Concrete protection materials shall be a linseed oil mixture of equal parts, by volume, of linseed oil and either mineral spirits, naphtha, or turpentine. At the option of the contractor, commercially prepared linseed oil mixtures, formulated specifically for application to concrete to provide protection against the action of deicing chemicals may be used, except that emulsified mixtures are not acceptable.

2.4 JOINT FILLER STRIPS

2.4.1 Contraction Joint Filler for Curb and Gutter

Contraction joint filler for curb and gutter shall consist of hard-pressed fiberboard.

2.4.2 Expansion Joint Filler, Premolded

Expansion joint filler, premolded, shall conform to ASTM D 1751 or ASTM D 1752, 9 mm thick, unless otherwise indicated.

2.5 JOINT SEALANTS

2.5.1 Joint Sealant, Cold-Applied

Joint sealant, cold-applied shall conform to ASTM C 920.

2.5.2 Joint Sealant, Hot-Poured

Joint sealant, hot-poured shall conform to ASTM D 3405.

2.6 FORM WORK

Form work shall be designed and constructed to ensure that the finished concrete will conform accurately to the indicated dimensions, lines, and elevations, and within the tolerances specified. Forms shall be of wood or steel, straight, of sufficient strength to resist springing during depositing and consolidating concrete. Wood forms shall be surfaced plank, 2 inches nominal thickness, straight and free from warp, twist, loose knots, splits or other defects. Wood forms shall have a nominal length of 10 feet. Radius bends may be formed with .75 inch boards, laminated to the required thickness. Steel forms shall be channel-formed sections with a flat top surface and with welded braces at each end and at not less than two intermediate points. Ends of steel forms shall be interlocking and self-aligning. Steel forms shall include flexible forms for radius forming, corner forms, form spreaders, and fillers. Steel forms shall have a nominal length of 10 feet with a minimum of 3 welded stake pockets per form. Stake pins shall be solid steel rods with chamfered heads and pointed tips designed for use with steel forms.

2.6.1 Sidewalk Forms

Sidewalk forms shall be of a height equal to the full depth of the finished sidewalk.

2.6.2 Curb and Gutter Forms

Curb and gutter outside forms shall have a height equal to the full depth

of the curb or gutter. The inside form of curb shall have batter as indicated and shall be securely fastened to and supported by the outside form. Rigid forms shall be provided for curb returns, except that benders or thin plank forms may be used for curb or curb returns with a radius of 10 feet or more, where grade changes occur in the return, or where the central angle is such that a rigid form with a central angle of 90 degrees cannot be used. Back forms for curb returns may be made of 1.5 inches benders, for the full height of the curb, cleated together. In lieu of inside forms for curbs, a curb "mule" may be used for forming and finishing this surface, provided the results are approved.

PART 3 EXECUTION

3.1 SUBGRADE PREPARATION

The subgrade shall be constructed to the specified grade and cross section prior to concrete placement. Subgrade shall be placed and compacted as directed.

3.1.1 Sidewalk Subgrade

The subgrade shall be tested for grade and cross section with a template extending the full width of the sidewalk and supported between side forms.

3.1.2 Curb and Gutter Subgrade

The subgrade shall be tested for grade and cross section by means of a template extending the full width of the curb and gutter. The subgrade shall be of materials equal in bearing quality to the subgrade under the adjacent pavement.

3.1.3 Maintenance of Subgrade

The subgrade shall be maintained in a smooth, compacted condition in conformity with the required section and established grade until the concrete is placed. The subgrade shall be in a moist condition when concrete is placed. The subgrade shall be prepared and protected to produce a subgrade free from frost when the concrete is deposited.

3.2 FORM SETTING

Forms shall be set to the indicated alignment, grade and dimensions. Forms shall be held rigidly in place by a minimum of 3 stakes per form placed at intervals not to exceed 4 feet. Corners, deep sections, and radius bends shall have additional stakes and braces, as required. Clamps, spreaders, and braces shall be used where required to ensure rigidity in the forms. Forms shall be removed without injuring the concrete. Bars or heavy tools shall not be used against the concrete in removing the forms. Any concrete found defective after form removal shall be promptly and satisfactorily repaired. Forms shall be cleaned and coated with form oil each time before concrete is placed. Wood forms may, instead, be thoroughly wetted with water before concrete is placed, except that with probable freezing temperatures, oiling is mandatory.

3.2.1 Sidewalks

Forms for sidewalks shall be set with the upper edge true to line and grade with an allowable tolerance of in any .1 inch long section. After forms are set, grade and alignment shall be checked with a .1 inch straightedge.

Forms shall have a transverse slope as indicated with the low side adjacent to the roadway. Side forms shall not be removed for 12 hours after finishing has been completed.

3.2.2 Curbs and Gutters

The forms of the front of the curb shall be removed not less than 2 hours nor more than 6 hours after the concrete has been placed. Forms back of curb shall remain in place until the face and top of the curb have been finished, as specified for concrete finishing. Gutter forms shall not be removed while the concrete is sufficiently plastic to slump in any direction.

3.3 SIDEWALK CONCRETE PLACEMENT AND FINISHING

3.3.1 Formed Sidewalks

Concrete shall be placed in the forms in one layer. When consolidated and finished, the sidewalks shall be of the thickness indicated. After concrete has been placed in the forms, a strike-off guided by side forms shall be used to bring the surface to proper section to be compacted. The concrete shall be consolidated with an approved vibrator, and the surface shall be finished to grade with a strike off.

3.3.2 Concrete Finishing

After straightedging, when most of the water sheen has disappeared, and just before the concrete hardens, the surface shall be finished with a wood float or darby to a smooth and uniformly fine granular or sandy texture free of waves, irregularities, or tool marks. A scored surface shall be produced by brooming with a fiber-bristle brush in a direction transverse to that of the traffic, followed by edging.

3.3.3 Edge and Joint Finishing

All slab edges, including those at formed joints, shall be finished with an edger having a radius of .1 inch. Transverse joint shall be edged before brooming, and the brooming shall eliminate the flat surface left by the surface face of the edger. Corners and edges which have crumbled and areas which lack sufficient mortar for proper finishing shall be cleaned and filled solidly with a properly proportioned mortar mixture and then finished.

3.3.4 Surface and Thickness Tolerances

Finished surfaces shall not vary more than .3 inch from the testing edge of a .1 inch straightedge. Permissible deficiency in section thickness will be up to .25 inch.

3.4 CURB AND GUTTER CONCRETE PLACEMENT AND FINISHING

3.4.1 Formed Curb and Gutter

Concrete shall be placed to the section required in a single lift. Consolidation shall be achieved by using approved mechanical vibrators. Curve shaped gutters shall be finished with a standard curb "mule".

3.4.2 Curb and Gutter Finishing

Approved slipformed curb and gutter machines may be used in lieu of hand placement.

3.4.3 Concrete Finishing

Exposed surfaces shall be floated and finished with a smooth wood float until true to grade and section and uniform in texture. Floated surfaces shall then be brushed with a fine-hair brush with longitudinal strokes. The edges of the gutter and top of the curb shall be rounded with an edging tool to a radius of .5 inch. Immediately after removing the front curb form, the face of the curb shall be rubbed with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. The front curb surface, while still wet, shall be brushed in the same manner as the gutter and curb top. The top surface of gutter and entrance shall be finished to grade with a wood float.

3.4.4 Joint Finishing

Curb edges at formed joints shall be finished as indicated.

3.4.5 Surface and Thickness Tolerances

Finished surfaces shall not vary more than .25 inch from the testing edge of a .1 inch straightedge. Permissible deficiency in section thickness will be up to .25 inch.

3.5 SIDEWALK JOINTS

Sidewalk joints shall be constructed to divide the surface into rectangular areas. Transverse contraction joints shall be spaced at a distance equal to the sidewalk width or 5 feet on centers, whichever is less, and shall be continuous across the slab. Longitudinal contraction joints shall be constructed along the centerline of all sidewalks 10 feet or more in width. Transverse expansion joints shall be installed at sidewalk returns and opposite expansion joints in adjoining curbs. Where the sidewalk is not in contact with the curb, transverse expansion joints shall be installed as indicated. Expansion joints shall be formed about structures and features which project through or into the sidewalk pavement, using joint filler of the type, thickness, and width indicated.

3.5.1 Sidewalk Contraction Joints

The contraction joints shall be formed in the fresh concrete by cutting a groove in the top portion of the slab to a depth of at least one-fourth of the sidewalk slab thickness, using a jointer to cut the groove, or by sawing a groove in the hardened concrete with a power-driven saw, unless otherwise approved. Sawed joints shall be constructed by sawing a groove in the concrete with a .1 inch blade to the depth indicated. An ample supply of saw blades shall be available on the job before concrete placement is started, and at least one standby sawing unit in good working order shall be available at the jobsite at all times during the sawing operations.

3.5.2 Sidewalk Expansion Joints

Expansion joints shall be formed with .5 inchjoint filler strips. Joint filler shall be placed with top edge .25 inch below the surface and shall

be held in place with steel pins or other devices to prevent warping of the filler during floating and finishing. Immediately after finishing operations are completed, joint edges shall be rounded with an edging tool having a radius of .1 inch, and concrete over the joint filler shall be removed. At the end of the curing period, expansion joints shall be cleaned and filled with joint sealant.

3.5.3 Reinforcement Steel Placement

Reinforcement steel shall be accurately and securely fastened in place with suitable supports and ties before the concrete is placed.

3.6 CURB AND GUTTER JOINTS

Curb and gutter joints shall be constructed at right angles to the line of curb and gutter.

3.6.1 Contraction Joints

Contraction joints shall be constructed directly opposite contraction joints in abutting portland cement concrete pavements and spaced so that monolithic sections between curb returns will not be less than 5 feet nor greater than 15 feet in length. Contraction joints shall be constructed by means of .1 inch thick separators and of a section conforming to the cross section of the curb and gutter. Separators shall be removed as soon as practicable after concrete has set sufficiently to preserve the width and shape of the joint and prior to finishing.

3.6.2 Expansion Joints

Expansion joints shall be formed by means of preformed expansion joint filler material cut and shaped to the cross section of curb and gutter. Expansion joints shall be provided in curb and gutter directly opposite expansion joints of abutting portland cement concrete pavement, and shall be of the same type and thickness as joints in the pavement. Where curb and gutter do not abut portland cement concrete pavement, expansion joints at least .5 inch in width shall be provided at intervals not exceeding 39.5 feet. Expansion joints shall be provided in nonreinforced concrete gutter at locations indicated. Expansion joints shall be sealed immediately following curing of the concrete or as soon thereafter as weather conditions permit. Expansion joints and the top 1 inchdepth of curb and gutter contraction-joints shall be sealed with joint sealant. The joint opening shall be thoroughly cleaned before the sealing material is placed. Sealing material shall not be spilled on exposed surfaces of the concrete. Concrete at the joint shall be surface dry and atmospheric and concrete temperatures shall be above 10 degrees C at the time of application of joint sealing material. Excess material on exposed surfaces of the concrete shall be removed immediately and concrete surfaces cleaned.

3.7 CURING AND PROTECTION

3.7.1 General Requirements

Concrete shall be protected against loss of moisture and rapid temperature changes for at least 7 days from the beginning of the curing operation. Unhardened concrete shall be protected from rain and flowing water. All equipment needed for adequate curing and protection of the concrete shall be on hand and ready for use before actual concrete placement begins. Protection shall be provided as necessary to prevent cracking of the

pavement due to temperature changes during the curing period.

3.7.1.1 Impervious Sheeting Method

The entire exposed surface shall be wetted with a fine spray of water and then covered with impervious sheeting material. Sheets shall be laid directly on the concrete surface with the light-colored side up and overlapped 12 incheswhen a continuous sheet is not used. The curing medium shall not be less than 18-incheswider than the concrete surface to be cured, and shall be securely weighted down by heavy wood planks, or a bank of moist earth placed along edges and laps in the sheets. Sheets shall be satisfactorily repaired or replaced if torn or otherwise damaged during curing. The curing medium shall remain on the concrete surface to be cured for not less than 7 days.

3.7.2 Backfilling

After curing, debris shall be removed and the area adjoining the concrete shall be backfilled, graded, and compacted to conform to the surrounding area in accordance with lines and grades indicated.

3.7.3 Protection

Completed concrete shall be protected from damage until accepted. The Contractor shall repair damaged concrete and clean concrete discolored during construction. Concrete that is damaged shall be removed and reconstructed for the entire length between regularly scheduled joints. Refinishing the damaged portion will not be acceptable. Removed damaged portions shall be disposed of as directed.

3.7.4 Protective Coating

Protective coating of linseed oil mixture shall be applied to the exposed-to-view concrete surface.

3.7.4.1 Application

Curing and backfilling operation shall be completed prior to applying two coats of protective coating. Concrete shall be surface dry and clean before each application. Coverage shall be by spray application at not more than for first application and not more than or second application, except that the number of applications and coverage for each application for commercially prepared mixture shall be in accordance with the manufacturer's instructions. Coated surfaces shall be protected from vehicular and pedestrian traffic until dry.

3.7.4.2 Precautions

Protective coating shall not be heated by direct application of flame or electrical heaters and shall be protected from exposure to open flame, sparks, and fire adjacent to open containers or applicators. Material shall not be applied at ambient or material temperatures lower than 10 degrees C.

3.8 FIELD QUALITY CONTROL

3.8.1 General Requirements

The Contractor shall perform the inspection and tests described and meet

the specified requirements for inspection details and frequency of testing. Based upon the results of these inspections and tests, the Contractor shall take the action and submit reports as required below, and any additional tests to insure that the requirements of these specifications are met.

3.8.2 Concrete Testing

3.8.2.1 Strength Testing

The Contractor shall provide molded concrete specimens for strength tests. Samples of concrete placed each day shall be taken not less than once a day nor less than once for every 250 cubic yards of concrete. The samples for strength tests shall be taken in accordance with ASTM C 172. Cylinders for acceptance shall be molded in conformance with ASTM C 31/C 31M by an approved testing laboratory. Each strength test result shall be the average of 2 test cylinders from the same concrete sample tested at 28 days, unless otherwise specified or approved. Concrete specified on the basis of compressive strength will be considered satisfactory if the averages of all sets of three consecutive strength test results equal or exceed the specified strength, and no individual strength test result falls below the specified strength by more than 500 psi.

3.8.2.2 Air Content

Air content shall be determined in accordance with ASTM C 173 or ASTM C 231. ASTM C 231 shall be used with concretes and mortars made with relatively dense natural aggregates. Two tests for air content shall be made on randomly selected batches of each class of concrete placed during each shift. Additional tests shall be made when excessive variation in concrete workability is reported by the placing foreman or the Government inspector. If results are out of tolerance, the placing foreman shall be notified and he shall take appropriate action to have the air content corrected at the plant. Additional tests for air content will be performed on each truckload of material until such time as the air content is within the tolerance specified.

3.8.2.3 Slump Test

Two slump tests shall be made on randomly selected batches of each class of concrete for every 250 cubic yards, or fraction thereof, of concrete placed during each shift. Additional tests shall be performed when excessive variation in the workability of the concrete is noted or when excessive crumbling or slumping is noted along the edges of slip-formed concrete.

3.8.3 Thickness Evaluation

The anticipated thickness of the concrete shall be determined prior to placement by passing a template through the formed section or by measuring the depth of opening of the extrusion template of the curb forming machine. If a slip form paver is used for sidewalk placement, the subgrade shall be true to grade prior to concrete placement and the thickness will be determined by measuring each edge of the completed slab.

3.8.4 Surface Evaluation

The finished surface of each category of the completed work shall be uniform in color and free of blemishes and form or tool marks.

3.9 SURFACE DEFICIENCIES AND CORRECTIONS

3.9.1 Thickness Deficiency

When measurements indicate that the completed concrete section is deficient in thickness by more than .25 inch the deficient section will be removed, between regularly scheduled joints, and replaced.

3.9.2 High Areas

In areas not meeting surface smoothness and plan grade requirements, high areas shall be reduced either by rubbing the freshly finished concrete with carborundum brick and water when the concrete is less than 36 hours old or by grinding the hardened concrete with an approved surface grinding machine after the concrete is 36 hours old or more. The area corrected by grinding the surface of the hardened concrete shall not exceed 5 percent of the area of any integral slab, and the depth of grinding shall not exceed .25 inch. Pavement areas requiring grade or surface smoothness corrections in excess of the limits specified above shall be removed and replaced.

3.9.3 Appearance

Exposed surfaces of the finished work will be inspected by the Government and any deficiencies in appearance will be identified. Areas which exhibit excessive cracking, discoloration, form marks, or tool marks or which are otherwise inconsistent with the overall appearances of the work shall be removed and replaced.

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SECTION 02921

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PART 1 GENERAL

1.1 REFERENCES

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

AGRICULTURAL MARKETING SERVICE (AMS)

AMS-01	(Aug 95) Federal Seed Act Regulations Part 201

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 602	(1995a) Agricultural Liming Materials
ASTM D 977	(1991) Emulsified Asphalt
ASTM D 2028	(1976; R 1992) Cutback Asphalt (Rapid-Curing Type)
ASTM D 5268	(1992; R 1996) Topsoil Used for Landscaping Purposes
ASTM D 5883	(1996) Standard Guide for Use of Rotary Kiln Produced Expanded Shale, Clay or Slate (ESCS) as a Mineral Amendment in Topsoil Used for Landscaping and Related Purposes

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-07 Certificates

Seed; G
Topsoil;
pH Adjuster;
Fertilizer; G
Organic Material;
Soil Conditioner;
Mulch;
Asphalt Adhesive;
Pesticide;

Prior to the delivery of materials, certificates of compliance attesting that materials meet the specified requirements.

Certified copies of the material certificates shall include the following:

a. Seed. Classification, botanical name, common name, percent pure live seed, minimum percent germination and hard seed, maximum percent weed seed content, and date tested.

b. Topsoil. Particle size, pH, organic matter content, textural class, soluble salts, chemical and mechanical analyses.

c. pH Adjuster. Calcium carbonate equivalent and sieve analysis.

d. Fertilizer. Chemical analysis and composition percent.

e. Organic Material: Composition and source.

f. Soil Conditioner: Composition and source.

g. Mulch: Composition and source.

h. Asphalt Adhesive: Composition.

i. Pesticide. EPA registration number and registered uses.

1.3 SOURCE INSPECTION

The source of delivered topsoil shall be subject to inspection.

1.4 DELIVERY, INSPECTION, STORAGE, AND HANDLING

1.4.1 Delivery

A delivery schedule shall be provided at least 10 calendar days prior to the first day of delivery.

1.4.1.1 Delivered Topsoil

Prior to the delivery of any topsoil, its availability shall be verified in paragraph TOPSOIL. A soil test shall be provided for topsoil delivered to the site.

1.4.1.2 Soil Amendments

Soil amendments shall be delivered to the site in the original, unopened containers bearing the manufacturer's chemical analysis. In lieu of containers, soil amendments may be furnished in bulk. A chemical analysis shall be provided for bulk deliveries.

1.4.1.3 Pesticides

Pesticide material shall be delivered to the site in the original, unopened containers bearing legible labels indicating the EPA registration number and the manufacturer's registered uses.

1.4.2 Inspection

Seed shall be inspected upon arrival at the job site for conformity to species and quality. Seed that is wet, moldy, or bears a test date five

months or older, shall be rejected. Other materials shall be inspected for compliance with specified requirements. The following shall be rejected: open soil amendment containers or wet soil amendments; topsoil that contains slag, cinders, stones, lumps of soil, sticks, roots, trash or other material over a minimum 1-1/2 inch diameter; and topsoil that contains viable plants and plant parts. Unacceptable materials shall be removed from the job site.

1.4.3 Storage

Materials shall be stored in designated areas. Seed, lime, and fertilizer shall be stored in cool, dry locations away from contaminants. Chemical treatment material shall be stored according to manufacturer's instructions and not with seeding operation materials.

1.4.4 Handling

Except for bulk deliveries, materials shall not be dropped or dumped from vehicles.

1.4.5 Time Limitation

Hydroseeding time limitation for holding seed in the slurry shall be a maximum 24 hours.

PART 2 PRODUCTS

2.1 SEED

2.1.1 Seed Classification

State-approved seed of the latest season's crop shall be provided in original sealed packages bearing the producer's guaranteed analysis for percentages of mixture, purity, germination, hard seed, weed seed content, and inert material. Labels shall be in conformance with AMS-01 and applicable state seed laws.

2.1.2 Permanent Seed Species and Mixtures

Permanent seed species and mixtures shall be proportioned by weight as follows:

Spring Seed Mix

	Common Name	Application Rate by Weight (LB/Acre)	Percent Pure Live Seed
March 1 - July 1	Common Bermuda (Hulled)	25	99.5
	Sericea Lespedeza	30	99.5

Fall Seed Mix

	Common Name	Application Rate by Weight (LB/Acre)	Percent Pure Live Seed
March 1 - July 1	Sericea Lespedeza	30	99.5
	Kobe Lespedeza	10	99.5

2.1.3 Temporary Seed Species

Temporary seed species for surface erosion control or overseeding shall be as follows:

Summer Seed Mix

	Common Name	Percent Pure Live Seed
March 1 - July 1	German Millet	99.5

Winter Seed Mix

	Common Name	Percent Pure Live Seed
Sept. 1 - March 1	Kobe Lespedeza	99.5

2.1.4 Quality

Weed seed shall be a maximum 1 percent by weight of the total mixture.

2.1.5 Seed Mixing

The mixing of seed may be done by the seed supplier prior to delivery, or on site as directed.

2.1.6 Substitutions

Substitutions will not be allowed without written request and approval from the Contracting Officer.

2.2 TOPSOIL

Topsoil shall be as defined in ASTM D 5268. When available, the topsoil shall be the existing surface soil stripped and stockpiled onsite. Topsoil shall be free from slag, cinders, stones, lumps of soil, sticks, roots, trash or other material over a minimum 1-1/2 inch diameter. Topsoil shall be free from viable plants and plant parts.

2.3 SOIL AMENDMENTS

Soil amendments shall consist of pH adjuster, fertilizer, organic material and soil conditioners meeting the following requirements. Vermiculite shall not be used.

2.3.1 pH Adjuster

The pH adjuster shall be an agricultural liming material in accordance with ASTM C 602. These materials may be burnt lime, hydrated lime, ground limestone, sulfur, or shells. The pH adjuster shall be used to create a favorable soil pH for the plant material specified.

2.3.1.1 Limestone

Limestone material shall contain a minimum calcium carbonate equivalent of 80 percent. Gradation: A minimum 95 percent shall pass through a No. 8 sieve and a minimum 55 percent shall pass through a No. 60 sieve. To

raise soil pH, ground limestone shall be used.

2.3.1.2 Hydrated Lime

Hydrated lime shall contain a minimum calcium carbonate equivalent of 110 percent. Gradation: A minimum 100 percent shall pass through a No. 8 sieve and a minimum 97 percent shall pass through a No. 60 sieve.

2.3.1.3 Burnt Lime

Burnt lime shall contain a minimum calcium carbonate equivalent of 140 percent. Gradation: A minimum 95 percent shall pass through a No. 8 sieve and a minimum 35 percent shall pass through a No. 60 sieve.

2.3.2 Fertilizer

The nutrients ratio shall be 10 percent nitrogen, 10 percent phosphorus, and 10 percent potassium. Fertilizer shall be controlled release commercial grade, free flowing, uniform in composition, and consist of a nitrogen-phosphorus-potassium ratio. The fertilizer shall be derived from sulphur coated urea, urea formaldehyde, plastic or polymer coated pills, or isobutylenediurea (IBDU). Fertilizer shall be balanced with the inclusion of trace minerals and micro-nutrients.

2.3.3 Nitrogen Carrier Fertilizer

The nutrients ratio shall be 10 percent nitrogen, 10 percent phosphorus, and 10 percent potassium. Nitrogen carrier fertilizer shall be commercial grade, free flowing, and uniform in composition. The fertilizer may be a liquid nitrogen solution.

2.3.4 Organic Material

Organic material shall consist of either bonemeal, rotted manure, decomposed wood derivatives, recycled compost, or worm castings.

2.3.4.1 Bonemeal

Bonemeal shall be finely ground, steamed bone product containing from 2 to 4 percent nitrogen and 16 to 40 percent phosphoric acid.

2.3.4.2 Rotted Manure

Rotted manure shall be unleached horse, chicken or cattle manure containing a maximum 25 percent by volume of straw, sawdust, or other bedding materials. It shall contain no chemicals or ingredients harmful to plants. The manure shall be heat treated to kill weed seeds and be free of stones, sticks, and soil.

2.3.4.3 Decomposed Wood Derivatives

Decomposed wood derivatives shall be ground bark, sawdust, yard trimmings, or other wood waste material that is free of stones, sticks, soil, and toxic substances harmful to plants, and is fully composted or stabilized with nitrogen.

2.3.4.4 Recycled Compost

Compost shall be a well decomposed, stable, weed free organic matter

source. Compost shall be derived from food; agricultural or industrial residuals; biosolids (treated sewage sludge); yard trimmings; or source-separated or mixed solid waste. The compost shall possess no objectionable odors and shall not resemble the raw material from which it was derived. The material shall not contain substances toxic to plants. Gradation: The compost material shall pass through a 3/8 inch screen, possess a pH of 5.5 to 8.0, and have a moisture content between 35-55 percent by weight. The material shall not contain more than 1 percent by weight of man-made foreign matter. Compost shall be cleaned of plastic materials larger than 2 inches in length.

2.3.4.5 Worm Castings

Worm castings shall be screened from worms and food source, and shall be commercially packaged.

2.3.5 Soil Conditioner

Soil conditioner shall be sand, super absorbent polymers, calcined clay, or gypsum for use singly or in combination to meet the requirements of the soil test.

2.3.5.1 Sand

Sand shall be clean and free of toxic materials. Gradation: A minimum 95 percent by weight shall pass a No. 10 sieve and a minimum 10 percent by weight shall pass a No. 16 sieve. Greensand shall be balanced with the inclusion of trace minerals and nutrients.

2.3.5.2 Super Absorbent Polymers

To improve water retention in soils, super absorbent polymers shall be sized and applied according to the manufacturer's recommendations. Polymers shall be added as a soil amendment and be cross-linked polyacrylamide, with an absorption capacity of 250-400 times its weight. Polymers shall also be added to the seed and be a starch grafted polyacrylonitrite, with graphite added as a tacky sticker. It shall have an absorption capacity of 100 plus times its weight.

2.3.5.3 Calcined Clay

Calcined clay shall be granular particles produced from montmorillonite clay calcined to a minimum temperature of 1200 degrees F. Gradation: A minimum 90 percent shall pass a No. 8 sieve; a minimum 99 percent shall be retained on a No. 60 sieve; and a maximum 2 percent shall pass a No. 100 sieve. Bulk density: A maximum 40 pounds per cubic foot.

2.3.5.4 Gypsum

Gypsum shall be commercially packaged, free flowing, and a minimum 95 percent calcium sulfate by volume.

2.3.5.5 Expanded Shale, Clay, or Slate (ESCS)

Rotary kiln produced ESCS material shall be in conformance with ASTM D 5883.

2.4 MULCH

Mulch shall be free from weeds, mold, and other deleterious materials.

Mulch materials shall be native to the region.

2.4.1 Straw

Straw shall be stalks from oats, wheat, rye, barley, or rice, furnished in air-dry condition and with a consistency for placing with commercial mulch-blowing equipment.

2.4.2 Hay

Hay shall be native hay, sudan-grass hay, broomsedge hay, or other herbaceous mowings, furnished in an air-dry condition suitable for placing with commercial mulch-blowing equipment.

2.4.3 Wood Cellulose Fiber

Wood cellulose fiber shall not contain any growth or germination-inhibiting factors and shall be dyed an appropriate color to facilitate placement during application. Composition on air-dry weight basis: 9 to 15 percent moisture, pH range from 4.5 to 6.0.

2.4.4 Paper Fiber

Paper fiber mulch shall be recycled news print that is shredded for the purpose of mulching seed.

2.5 ASPHALT ADHESIVE

Asphalt adhesive shall conform to the following: Emulsified asphalt, conforming to ASTM D 977, Grade SS-1; and cutback asphalt, conforming to ASTM D 2028, Designation RC-70.

2.6 WATER

Water shall be the responsibility of the Contractor, unless otherwise noted. Water shall not contain elements toxic to plant life.

2.7 PESTICIDE

Pesticide shall be insecticide, herbicide, fungicide, nematocide, rodenticide or miticide. For the purpose of this specification, a soil fumigant shall have the same requirements as a pesticide. The pesticide material shall be EPA registered and approved.

2.8 SURFACE EROSION CONTROL MATERIAL

Surface erosion control material shall conform to the following:

2.8.1 Surface Erosion Control Blanket

Blanket shall be machine produced mat of wood excelsior formed from a web of interlocking wood fibers; covered on one side with either knitted straw blanket-like mat construction; covered with biodegradable plastic mesh; or interwoven biodegradable thread, plastic netting, or twisted kraft paper cord netting.

2.8.2 Surface Erosion Control Fabric

Fabric shall be knitted construction of polypropylene yarn with uniform

mesh openings 3/4 to 1 inch square with strips of biodegradable paper. Filler paper strips shall have a minimum life of 6 months.

2.8.3 Surface Erosion Control Net

Net shall be heavy, twisted jute mesh, weighing approximately 1.22 pounds per linear yard and 4 feet wide with mesh openings of approximately 1 inch square.

2.8.4 Surface Erosion Control Chemicals

Chemicals shall be high-polymer synthetic resin or cold-water emulsion of selected petroleum resins.

2.8.5 Hydrophilic Colloids

Hydrophilic colloids shall be physiologically harmless to plant and animal life without phytotoxic agents. Colloids shall be naturally occurring, silicate powder based, and shall form a water insoluble membrane after curing. Colloids shall resist mold growth.

2.8.6 Erosion Control Material Anchors

Erosion control anchors shall be as recommended by the manufacturer.

PART 3 EXECUTION

3.1 INSTALLING SEED TIME AND CONDITIONS

3.1.1 Seeding Time

Seed shall be installed from March to July for spring establishment; from March to September for summer establishment; and from September to November for fall establishment.

3.1.2 Seeding Conditions

Seeding operations shall be performed only during periods when beneficial results can be obtained. When drought, excessive moisture, or other unsatisfactory conditions prevail, the work shall be stopped when directed. When special conditions warrant a variance to the seeding operations, proposed alternate times shall be submitted for approval.

3.1.3 Equipment Calibration

Immediately prior to the commencement of seeding operations, calibration tests shall be conducted on the equipment to be used. These tests shall confirm that the equipment is operating within the manufacturer's specifications and will meet the specified criteria. The equipment shall be calibrated a minimum of once every day during the operation. The calibration test results shall be provided within 1 week of testing.

3.2 SITE PREPARATION

3.2.1 Finished Grade and Topsoil

The Contractor shall verify that finished grades are as indicated on drawings, and the placing of topsoil, smooth grading, and compaction requirements have been completed in accordance with Section 02300

EARTHWORK, prior to the commencement of the seeding operation.

3.2.2 Application of Soil Amendments

3.2.2.1 Applying pH Adjuster

The application rate shall be 100 pounds per 1000 square yards. The pH adjuster shall be incorporated into the soil to a maximum 4 inch depth or may be incorporated as part of the tillage operation.

3.2.2.2 Applying Fertilizer

The application rate shall be 100 pounds per 1000 square yards. Fertilizer shall be incorporated into the soil to a maximum 4 inch depth or may be incorporated as part of the tillage or hydroseeding operation.

3.2.2.3 Applying Soil Conditioner

The application rate shall be 100 pounds per 1000 square yards. The soil conditioner shall be spread uniformly over the soil a minimum 1 inch depth and thoroughly incorporated by tillage into the soil to a maximum 4 inch depth.

3.2.3 Tillage

Soil on slopes up to a maximum 3-horizontal-to-1-vertical shall be tilled to a minimum 4 inch depth. On slopes between 3-horizontal-to-1-vertical and 1-horizontal-to-1 vertical, the soil shall be tilled to a minimum 2 inch depth by scarifying with heavy rakes, or other method. Rototillers shall be used where soil conditions and length of slope permit. On slopes 1-horizontal-to-1 vertical and steeper, no tillage is required. Drainage patterns shall be maintained as indicated on drawings. Areas compacted by construction operations shall be completely pulverized by tillage. Soil used for repair of surface erosion or grade deficiencies shall conform to topsoil requirements. The pH adjuster, fertilizer, and soil conditioner may be applied during this procedure.

3.2.4 Prepared Surface

3.2.4.1 Preparation

The prepared surface shall be a maximum 1 inch below the adjoining grade of any surfaced area. New surfaces shall be blended to existing areas. The prepared surface shall be completed with a light raking to remove debris.

3.2.4.2 Lawn Area Debris

Debris and stones over a minimum 5/8 inch in any dimension shall be removed from the surface.

3.2.4.3 Field Area Debris

Debris and stones over a minimum 3 inch in any dimension shall be removed from the surface.

3.2.4.4 Protection

Areas with the prepared surface shall be protected from compaction or

damage by vehicular or pedestrian traffic and surface erosion.

3.3 INSTALLATION

Prior to installing seed, any previously prepared surface compacted or damaged shall be reworked to meet the requirements of paragraph SITE PREPARATION. Seeding operations shall not take place when the wind velocity will prevent uniform seed distribution.

3.3.1 Installing Seed

Seeding method shall be Broadcast Seeding. Seeding procedure shall ensure even coverage. Gravity feed applicators, which drop seed directly from a hopper onto the prepared soil, shall not be used because of the difficulty in achieving even coverage, unless otherwise approved. Absorbent polymer powder shall be mixed with the dry seed at the rate recommended by the manufacturer.

3.3.1.1 Broadcast Seeding

Seed shall be uniformly broadcast at the rate of 25 pounds per acre using broadcast seeders. Half the total rate of seed application shall be broadcast in 1 direction, with the remainder of the seed rate broadcast at 90 degrees from the first direction. Seed shall be covered a maximum 1/4 inch depth by disk harrow, steel mat drag, cultipacker, or other approved device.

3.3.1.2 Rolling

The entire area shall be firmed with a roller not exceeding 90 pounds per foot roller width. Slopes over a maximum 3-horizontal-to-1 vertical shall not be rolled. Areas seeded with seed drills equipped with rollers shall not be rolled.

3.3.2 Mulching

3.3.2.1 Hay or Straw Mulch

Hay or straw mulch shall be spread uniformly at the rate of 2 tons per acre. Mulch shall be spread by hand, blower-type mulch spreader, or other approved method. Mulching shall be started on the windward side of relatively flat areas or on the upper part of steep slopes, and continued uniformly until the area is covered. The mulch shall not be bunched or clumped. Sunlight shall not be completely excluded from penetrating to the ground surface. All areas installed with seed shall be mulched on the same day as the seeding. Mulch shall be anchored immediately following spreading.

3.3.2.2 Asphalt Adhesive Tackifier

Asphalt adhesive tackifier shall be sprayed at a rate between 10 to 13 gallons per 1000 square feet. Sunlight shall not be completely excluded from penetrating to the ground surface.

3.3.2.3 Asphalt Adhesive Coated Mulch

Hay or straw mulch may be spread simultaneously with asphalt adhesive applied at a rate between 10 to 13 gallons per 1000 square feet, using power mulch equipment which shall be equipped with suitable asphalt pump

and nozzle. The adhesive-coated mulch shall be applied evenly over the surface. Sunlight shall not be completely excluded from penetrating to the ground surface.

3.3.3 Watering Seed

Watering shall be started immediately after completing the seeding of an area. Water shall be applied to supplement rainfall at a rate sufficient to ensure moist soil conditions to a minimum 1 inch depth. Run-off and puddling shall be prevented. Watering trucks shall not be driven over turf areas, unless otherwise directed. Watering of other adjacent areas or plant material shall be prevented.

3.4 SURFACE EROSION CONTROL

3.4.1 Surface Erosion Control Material

Where indicated or as directed, surface erosion control material shall be installed in accordance with manufacturer's instructions. Placement of the material shall be accomplished without damage to installed material or without deviation to finished grade.

3.4.2 Temporary Seeding

When directed during contract delays affecting the seeding operation or when a quick cover is required to prevent surface erosion, the areas designated shall be seeded in accordance with temporary seed species listed under Paragraph SEED.

3.4.2.1 Soil Amendments

When soil amendments have not been applied to the area, the quantity of 1/2 of the required soil amendments shall be applied and the area tilled in accordance with paragraph SITE PREPARATION. The area shall be watered in accordance with paragraph Watering Seed.

3.4.2.2 Remaining Soil Amendments

The remaining soil amendments shall be applied in accordance with the paragraph Tillage when the surface is prepared for installing seed.

3.5 QUANTITY CHECK

For materials provided in bags, the empty bags shall be retained for recording the amount used. For materials provided in bulk, the weight certificates shall be retained as a record of the amount used. The amount of material used shall be compared with the total area covered to determine the rate of application used. Differences between the quantity applied and the quantity specified shall be adjusted as directed.

3.6 RESTORATION AND CLEAN UP

3.6.1 Restoration

Existing turf areas, pavements, and facilities that have been damaged from the seeding operation shall be restored to original condition at Contractor's expense.

3.6.2 Clean Up

Excess and waste material shall be removed from the seeded areas and shall be disposed offsite. Adjacent paved areas shall be cleaned.

3.7 PROTECTION OF INSTALLED AREAS

Immediately upon completion of the seeding operation in an area, the area shall be protected against traffic or other use by erecting barricades and providing signage as required, or as directed. Signage shall be in accordance with Section 10430 EXTERIOR SIGNAGE.

3.8 SEED ESTABLISHMENT PERIOD

3.8.1 Commencement

The seed establishment period to obtain a healthy stand of grass plants shall begin on the first day of work under this contract and shall end 3 months after the last day of the seeding operation. Written calendar time period shall be furnished for the seed establishment period. When there is more than 1 seed establishment period, the boundaries of the seeded area covered for each period shall be described. The seed establishment period shall be modified for inclement weather, shut down periods, or for separate completion dates of areas.

3.8.2 Satisfactory Stand of Grass Plants

Grass plants shall be evaluated for species and health when the grass plants are a minimum 1 inch high.

3.8.2.1 Field Area

A satisfactory stand of grass plants from the seeding operation for a field area shall be a minimum 10 grass plants per square foot. The total bare spots shall not exceed 2 percent of the total seeded area.

3.8.3 Maintenance During Establishment Period

Maintenance of the seeded areas shall include eradicating weeds, insects and diseases; protecting embankments and ditches from surface erosion; maintaining erosion control materials and mulch; protecting installed areas from traffic; mowing; watering; and post-fertilization.

3.8.3.1 Mowing

a. Field Areas: Field areas shall be mowed once during the season to a minimum 3 inch height. Clippings shall be removed when the amount cut prevents sunlight from reaching the ground surface.

3.8.3.2 Repair or Reinstall

Unsatisfactory stand of grass plants and mulch shall be repaired or reinstalled, and eroded areas shall be repaired in accordance with paragraph SITE PREPARATION.

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SECTION 02950

TREES, SHRUBS, GROUND COVERS, AND VINES
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PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN ASSOCIATION OF NURSERYMEN (AAN)

AAN-01	(1990) American Standard for Nursery Stock

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 2607	(1969) Peats, Mosses, Humus, and Related Products

COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-1909	(Basic; Notice 1) Fertilizer

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having an "G" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Edging Material. Erosion Control Material.

Manufacturer's literature discussing physical characteristics, application and installation instructions for edging material and erosion control material.

SD-07 Schedules

Application of Pesticide Material.

A list of the proposed pesticide application equipment to be used in performance of the planting work, including descriptive data and calibration tests.

SD-08 Statements

Application of Pesticide Material.

The following work plans, before work is started.

a. Delivery Schedule at least 10 days prior to the intended date of the first delivery.

b. Pesticide Treatment Plan, giving proposed sequence of pesticide treatment work, before work is started. The pesticide trade name, chemical composition, formulation, concentration, application rate of active ingredients and methods of application for all materials furnished, and the name and state license number of the state certified applicator shall be included.

SD-13 Certificates

Soil Amendments. Plants. Pesticide.

Certificates of compliance certifying that materials meet the requirements specified, prior to the delivery of materials. Reports for the following materials shall be included.

a. Topsoil: For pH, chemical analysis, mechanical analysis and particle size.

b. Fertilizer: For chemical analysis and composition percent.

c. Agricultural Limestone: For sieve analysis and calcium carbonate equivalent.

d. Peat: For compliance with ASTM D 2607.

e. Plant Materials: For botanical and common name, size, quantity by species, grade, nursery grown.

f. Pesticide Material: For EPA registration number and registered uses.

1.3 SOURCE INSPECTIONS

1.3.1 Plant Materials

Plant materials shall be subject to inspection at the growing site by the Contracting Officer.

1.3.2 Delivered Topsoil

The source of topsoil shall be subject to inspection by the Contracting Officer.

1.4 SHIPMENT, DELIVERY, INSPECTION, STORAGE, AND HANDLING

1.4.1 Shipment

1.4.1.1 Preparation

Digging and preparation for shipment shall be done in a manner that will not cause shock or damage to branches, trunk, or root systems.

a. Balled and Burlapped (BB) Plants: Ball size and ratio shall be provided as recommended by AAN-01. The ball shall be of a diameter and depth to encompass enough fibrous and feeding root system necessary for the full recovery of the plant. Removal shall be accomplished by hand digging or mechanical devices. Center the plant stem or trunk in the ball and clean cut all roots at the ball surface. No roots shall be pulled from the ground.

The root ball shall be completely wrapped with burlap or other suitable material and securely laced with twine.

b. Balled and Potted (Pot) Plants: Ball size and ratio shall be provided as recommended by AAN-01. The ball shall be of a diameter and depth to encompass enough fibrous and feeding root system necessary for the full recovery of the plant. Removal shall be accomplished by hand digging or mechanical devices. The plant stem or trunk shall be centered in the ball and all roots shall be clean cut at the ball surface. No roots shall be pulled from the ground. Containers shall be used to retain the ball unbroken. Container shall be sufficiently rigid to hold ball shape and protect root mass during shipping.

c. Balled and Platform (BP) Plants: Ball size and ratio shall be provided as recommended by AAN-01. Plants shall be prepared as BB plants and securely fastened to wood platform for shipping.

d. Bare-Root (BR) Plants: Minimum root spread shall be as recommended by AAN-01. A well branched root system characteristic of the variety specified shall be provided. No roots shall be pulled from the ground. The root system shall be protected from drying out.

e. Container-Grown (C) Plants: Container size shall be provided as recommended by AAN-01. Plants shall be grown in a container sufficiently long for new fibrous roots to have developed and for root mass to retain its shape and hold together when removed from container. Container shall be sufficiently rigid to hold ball shape and protect root mass during shipping.

1.4.1.2 Antidesiccant Application

Plants shall be sprayed with an antidesiccant as leaf budding occurs or when plant material has soft growth.

1.4.2 Delivery

1.4.2.1 Identification

Plants shall be identified with durable waterproof labels and weather-resistant ink. Plants shall have attached labels stating the correct plant name and size.

1.4.2.2 Protection During Delivery

Plants shall be protected during delivery to prevent desiccation of the plant or damage to the roots or balls. Branches of plants shall be protected by tying-in the branches and covering all exposed branches.

1.4.2.3 Topsoil

A soil test shall be provided for topsoil delivered to the site.

1.4.2.4 Soil Amendments

Soil amendments shall be delivered to the site in the original, unopened containers bearing the manufacturer's chemical analysis. In lieu of containers, soil amendments may be furnished in bulk. A chemical analysis

shall be provided for bulk deliveries.

1.4.2.5 Pesticide

Pesticide materials shall be delivered to the site in the original unopened containers bearing legible labels indicating the Environmental Protection Agency (EPA) registration numbers and the registered uses.

1.4.3 Inspection

Plant material shall be inspected upon arrival at the jobsite by the Contracting Officer for conformity to the paragraph PLANTS and paragraph Shipment, and any unacceptable plant material shall be removed from the jobsite.

1.4.4 Storage

1.4.4.1 Plant Storage

Plants not installed on the day of arrival at the site shall be stored and protected in areas designated by the Contracting Officer. Plants shall be protected from exposure to wind and shall be shaded from the sun. Covering that will allow air to circulate and prevent internal heat from building up shall be provided. Bare-root plants shall be heeled-in. All plants shall be kept in a moist condition by watering with a fine mist spray until planted.

1.4.4.2 Storage of Other Materials

Soil amendments shall be stored in dry locations away from contaminants. Pesticide materials shall not be stored with other landscape materials. Storage of materials shall be in areas designated or as approved by the Contracting Officer.

1.4.5 Handling

Care shall be taken to avoid injury to plants. Materials shall not be dropped from vehicles. Balled and burlapped plants shall be handled carefully to avoid cracking or breaking the earth ball and container-grown plants shall be handled by the container. Plants shall not be handled by the trunk or stems.

1.4.5.1 Time Limitation

a. Mulch: Limitation of time between installing plant and placing mulch is 48 hours.

b. Trunk Wrap: Limitation of time between installing deciduous trees and wrapping the trunks is 24 hours.

c. Transplanting Existing Plants: Limitation of time between digging and replanting existing plant material is one hour.

1.5 WARRANTY

Furnished plants shall be guaranteed to be in a vigorous growing condition for a period of 12 months regardless of the contract time period. A plant shall be replaced one time under this guarantee. Transplanted existing plants require no guarantee. A written calendar time period for the

guarantee of plant growth shall be furnished to the Contracting Officer.

PART 2 PRODUCTS

2.1 PLANTS

2.1.1 Varieties

Plants shall be nursery grown or plantation grown stock conforming to AAN-01 and shall be of the varieties specified in the plant list bearing botanical names listed in one or more of the publications listed under "Nomenclature" in AAN-01.

2.1.2 Substitutions

Substitutions will not be permitted without written request from the Contractor for approval by the Contracting Officer.

2.1.3 Growing Conditions

Plants shall be grown under climatic conditions similar to those in the locality of the project.

2.1.4 Quality

Well shaped, well grown, vigorous, healthy plants having healthy and well branched root systems shall be provided. Plants shall be provided free from disease, harmful insects and insect eggs, sun-scald injury, disfigurement and abrasion. Plants shall be provided that are typical of the species or variety and conforming to standards as set forth in AAN-01 and as specified herein.

2.1.4.1 Shade and Flowering Trees

A height relationship to caliper shall be provided as recommended by AAN-01. Height of branching should bear a relationship to the size and variety of tree specified and with the crown in good balance with the trunk. Trees shall not be "poled" or the leader removed.

a. Single stem: Trunk shall be reasonably straight and symmetrical with crown and have a persistent main leader.

b. Multi-stem: All countable stems, in aggregate, shall average the size specified. To be considered a stem, there should be no division of the trunk which branches more than six inches from ground level.

c. Specimen: A plant shall be provided that is well branched and pruned naturally according to the species. The form of growth desired, which may not be in accordance with natural growth habit, shall be as indicated.

2.1.4.2 Deciduous Shrub

Plants shall be provided that have the height and number of primary stems as recommended by AAN-01. An acceptable plant shall be well shaped with sufficient well-spaced side branches recognized by the trade as typical for the variety grown in the region.

2.1.4.3 Coniferous Evergreen

Trees shall be provided that have the height-to-spread ratio as recommended by AAN-01. Trees shall not be "poled" or the leader removed. An acceptable plant shall be exceptionally heavy, well shaped and trimmed to form a symmetrical and tightly knit plant. The form of growth desired shall be as indicated.

2.1.4.4 Broadleaf Evergreen

Plants shall be provided that have ratio of height-to-spread as recommended by AAN-01. An acceptable plant shall be well shaped and recognized by the trade as typical for the variety grown in the region.

2.1.4.5 Groundcovers and Vines

Plants shall be provided with the minimum number of runners and length of runner as recommended by AAN-01. Plants shall be furnished that have heavy, well developed and balanced top with vigorous well developed root system and shall be furnished in containers.

2.1.5 Size

Plants shall be furnished in sizes indicated. Plants larger in size than specified may be provided at no additional cost to the Government.

2.1.6 Measurement

Plant measurements shall be in accordance with AAN-01.

2.2 TOPSOIL

Topsoil shall be the existing surface soil stripped to the depth indicated and stockpiled on the site in accordance with Section 02210 GRADING. Additional topsoil, if required, beyond that available from stripping operations, shall be delivered. Delivered topsoil shall conform to topsoil requirement specified in Section 02210 GRADING and shall be amended as recommended by soil tests for the plants specified.

2.3 SOIL AMENDMENTS

Soil amendments consist of lime, fertilizer, bonemeal, organic soil amendments and soil conditioner.

2.3.1 Lime

Lime shall be agricultural limestone and shall have a minimum calcium carbonate equivalent of 90 percent and shall be ground to such a fineness that at least 90 percent will pass a 10-mesh sieve and at least 50 percent will pass a 60-mesh sieve.

2.3.2 Fertilizer

Fertilizer shall be commercial grade, free flowing, uniform in composition and conforming to CID A-A-1909.

2.3.2.1 Dry Fertilizer

a. Granular fertilizer : Consists of nitrogen-phosphorous-potassium

ratio: 10 percent nitrogen 10 percent phosphorous, and 10 percent potassium.

b. Controlled-Release Fertilizer: Consists of nitrogen-phosphorous-potassium ratio: 10 percent nitrogen 10 percent phosphorous, and 10 percent potassium. Controlled-release fertilizer may be in packet or tablet form.

2.3.2.2 Liquid Fertilizer

Commercially available liquid fertilizer shall consist of completely soluble plant foods suitable for application as foliage spray.

2.3.3 Bonemeal

Bonemeal shall be a finely ground, steamed bone product containing from 2 to 4 percent nitrogen and 16 to 40 percent phosphoric acid.

2.3.4 Organic Soil Amendments

2.3.4.1 Peat

Peat shall be a natural product of peat humus derived from a bog, swampland or marsh and shall conform to ASTM D 2607.

2.3.4.2 Sand

Sand shall be clean and free of toxic materials and at least 95 percent by weight shall pass a 10-mesh sieve, and 10 percent by weight shall pass a 16-mesh sieve.

2.3.4.3 Rotted Manure

Rotted manure shall be unleached stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials and containing no chemicals or ingredients harmful to plants. The manure shall be heat treated to kill weed seeds and be free of stones, sticks, and soil.

2.3.4.4 Decomposed Wood Derivatives

Decomposed wood derivatives shall be ground bark, sawdust, or other wood waste material free of stones, sticks, and toxic substances harmful to plants and stabilized with nitrogen and having the following properties:

Particle size	Minimum percent by weight passing
No. 4 mesh screen	95
No. 8 mesh screen	80

Nitrogen Content	Minimum percent based on dry weight
Redwood Sawdust	0.5

Nitrogen Content	Minimum percent based on dry weight
Fir Sawdust	0.7
Fir or Pine Bark	1.0

2.3.5 Soil Conditioner

For single use or in combination to meet requirements for topsoil.

2.3.5.1 Gypsum

Gypsum shall be commercially packaged, free flowing, and a minimum of 95 percent calcium sulfate by volume.

2.3.5.2 Aluminum Sulfate

Aluminum sulfate shall be commercial grade.

2.4 MULCH

Mulch shall be free from weeds, mold and other deleterious materials.

2.4.1 Inert Mulch Material

Inert mulch materials shall be riverbank stone or crusher run rock and shall range in size from 1 to 4.

2.4.2 Organic Mulch Material

Organic mulch materials shall be pine needles, ground or shredded bark ranging in size from 1 to 4.

2.5 GEOTEXTILE

2.5.1 Woven Polypropylene

Woven polypropylene shall be bi-directional, weigh a minimum 4 ounces per square yard, be a minimum 10 mils thick and come in 6 feet wide rolls.

2.5.2 Nonwoven Polypropylene

Nonwoven polypropylene shall be spunbonded, water permeable, non-brittle, weigh a minimum 4 ounces per square yard, be a minimum 10 mils thick and come in 6 feet wide rolls.

2.5.3 Nonwoven polyester

Nonwoven polyester shall be spunbonded, water permeable, non-brittle, weigh a minimum 4 ounces per square yard, be a minimum 10 milsthick and come in 6 feet wide rolls.

2.5.4 Fiberglass Mat

Fiberglass mat shall be of lime borosilicate glass fibers with an average fiber diameter of 8 to 12 microns and 2 to 4 inch strands of fiber bonded with phenol formaldehyde resin. The mat shall be 100 percent textile glass fiber. Mat shall be roll type, water permeable, and a minimum of 1/4-inch

and a maximum of 1/2-inch thick with a density of not less than 3/4 pound per cubic foot.

2.6 TRUNK WRAPPING MATERIAL

Tree wrap shall be two thicknesses of crinkled paper cemented together with a layer of bituminous material. Wrapping material shall be a minimum of 4 inches in width and have a stretch factor of 33-1/3 percent. Twine for tying shall be lightly tarred medium or coarse sisal yarn.

2.7 GUYING AND STAKING MATERIAL

2.7.1 Stakes

Stakes for tree support shall be rough sawn wood, free from knots, rot, cross grain, or other defects that would impair the strength. Standard stakes shall be hardwood or fir treated with pentachlorophenol.

2.7.1.1 Bracing Stakes

Bracing stakes shall be a minimum of 2 inches by 2 inches or 2-1/2 inches in diameter by 8 feet long and pointed at one end.

2.7.1.2 Ground Stakes

Ground stakes shall be a minimum of 2 inches by 2 inches or 2-1/2 inches in diameter by 3 feetlong and pointed at one end.

2.7.2 Guying Material

2.7.2.1 Guying Wire

Guying wire shall be 12-gauge annealed galvanized steel wire.

2.7.2.2 Guying Cable

Guying cable shall be a minimum of five-strand, 3/16-inch diameter cadmium plated steel cable.

2.7.3 Chafing Guard

Hose chafing guards shall be new or used 2-ply reinforced rubber or plastic hose and shall be all the same color on the project. Length shall be 1-1/2 times the circumference of the plant at its base.

2.7.4 Flags

Flags to be fastened to guys shall be white surveyor's plastic tape, 6 inches in length.

2.7.5 Turnbuckles

Turnbuckles shall be galvanized or cadmium-plated steel and have a 3-inch minimum lengthwise opening fitted with screw eyes.

2.8 EDGING MATERIAL

2.8.1 Steel

Steel edging shall be galvanized with slots provided for stakes and shall be at least 1/8 inch thick and 4 inches wide, and supplied in at least 16-foot lengths.

2.8.2 Plastic

Plastic edging shall be 4-5/8 inches deep by 1/4 inch thick in 15 foot lengths.

2.8.3 Aluminum

Aluminum edging shall be black electrostatically painted aluminum alloy 6061-T6 hardness, 5-1/2 inches deep by 3/16 inch thick in 16 foot lengths with horizontal undulations.

2.8.4 Anchors

Edging material anchors shall be as recommended by the manufacturer.

2.9 WATER

Water shall not contain elements toxic to plant life.

2.10 ANTIDESICCANT

Antidesiccant shall be an emulsion that will provide a film over plant surfaces permeable enough to permit transpiration, and shall not damage the plant.

2.11 EROSION CONTROL MATERIAL

2.11.1 Soil Erosion Control Blanket

Blanket shall be machine-produced mat of wood excelsior formed from a web of interlocking wood fibers, covered on one side with either knitted straw blanket-like mat-construction, covered with biodegradable plastic mesh, or interwoven with biodegradable thread, plastic netting or twisted kraft paper cord netting.

2.11.2 Soil Erosion Control Fabric

Control fabric shall be knitted construction of polypropylene yarn with uniform mesh openings 3/4 to 1 inchsquare with strips of biodegradable paper. Filler paper strips shall last 6 to 8 months.

2.11.3 Soil Erosion Control Net

Control net shall be heavy, twisted jute mesh weighing approximately 1.22 pounds per linear yard and 4 feet wide with mesh openings of approximately 1 inchsquare.

2.11.4 Anchors

Erosion control anchors shall be as recommended by the manufacturer.

2.12 TREE WOUND DRESSING

Tree wound dressing shall be a black asphalt-base antiseptic paint.

2.13 PESTICIDE

Pesticide shall be insecticide, herbicide, fungicide, nematocide, rodenticide, and miticide. Pesticide material shall be labeled for use and applied only as registered by EPA and approved herbicide, insecticide, fungicide and nematocide.

PART 3 EXECUTION

3.1 EXAMINATION

3.1.1 Verify Grades

The Contracting Officer shall verify the finished grades are as indicated on drawings, and the placing of topsoil and smooth grading has been completed in accordance with Section 02210 GRADING.

3.1.2 Underground Obstructions to Planting

The location of underground utilities and facilities shall be verified. Damage to underground utilities and facilities shall be repaired at the Contractor's expense.

3.2 SITE PREPARATION

3.2.1 Layout

Plant material locations and bed outlines shall be staked on the project site before any excavation is made. Plant material locations may be adjusted by the Contracting Officer to meet field conditions.

3.2.2 Protection of Existing Vegetation

If lawns have been established prior to planting operations, the surrounding turf shall be covered before excavations are made in a manner that will protect turf areas. Existing trees, shrubbery, and beds that are to be preserved shall be barricaded in a manner that will effectively protect them during planting operations.

3.3 EXCAVATION

3.3.1 Obstructions Below Ground or Poor Drainage

When obstructions below ground or poor drainage affect the contract operation, proposed adjustments to plant location, type of plant and planting method or drainage correction shall be submitted to and approved by the Contracting Officer.

3.3.2 Turf Removal

Where planting beds occur in existing turf areas, the turf shall be removed to a depth that will ensure the removal of the entire root system.

3.3.3 Plant Pits

Plant pits shall be dug to produce vertical sides and flat, uncompacted bottoms. When pits are dug with an auger and the sides of the pits become glazed, the glazed surface shall be scarified. The minimum allowable dimensions of plant pits shall be 6 inches deeper than the depth of ball or the depth of base roots; for ball or root spreads up to 2 feet, pit diameters shall be twice the root spread; for ball or root spreads from 2 to 4 feet, pit diameters shall be 2 feet greater; for ball or root spreads over 4 feet, pit diameters shall be 1-1/2 times the ball root spread.

3.4 PLANTING TIMES AND CONDITIONS

3.4.1 Deciduous Planting Time

Install deciduous plants from March to May.

3.4.2 Evergreen Planting Time

Install evergreen plants from March to September.

3.4.3 Planting Conditions

Planting operations shall be performed only during periods when beneficial results can be obtained. When drought, excessive moisture or other unsatisfactory conditions prevail, the work shall be stopped when directed. When special conditions warrant a variance to the planting operations, proposed planting times shall be submitted to and approved by the Contracting Officer.

3.5 INSTALLATION

3.5.1 Erosion Control

Where erosion control material is indicated or required, material shall be installed in accordance with manufacturer's instructions. Placement of the erosion control material shall be accomplished without damage to installed material or without deviation to finished grade.

3.5.2 Setting Plants

Plants shall be set plumb and held in position until sufficient soil has been firmly placed around roots or ball. Plants shall be set in relation to surrounding grade so that they are even with the depth at which they were grown in the nursery, or container.

3.5.3 Controlled-Release Fertilizer

Controlled-release fertilizer shall be placed in packet or tablet form in the plant pit in the immediate vicinity of the feeding roots in accordance with the manufacturer's recommendations.

3.5.4 Balled and Burlapped Plants

Materials shall be removed that are metal, plastic, nylon or treated burlap, prior to backfilling. Balled and burlapped stock shall be backfilled with topsoil to approximately half the depth of the ball and then tamped and watered. Biodegradable burlap and tying material shall be carefully opened and folded back. The backfill shall be completed, tamped

and watered. A 4-inch high earth saucer shall be formed around individual plants.

3.5.5 Bare-Root Plants

Bare-root plants shall be installed by arranging the roots in a natural position. Damaged roots shall be removed with a clean cut. Bare-root (BR) plants shall be backfilled with topsoil carefully worked in among the roots. The backfill and water shall be completed. A 4-inch high earth saucer shall be formed around individual plants.

3.5.6 Container-Grown, Balled and Platformed and Balled and Potted Plants

Non-biodegradable containers or platforms shall be removed without damage to the plant or root system. Biodegradable containers shall be split. The backfill shall be completed as specified for BB plants.

3.5.7 Groundcover Bed

3.5.7.1 Plant Beds in Existing Soil

Bed shall be tilled to a minimum depth of 6 inches where existing soil is to be used in-place. Selected soil amendments shall be spread uniformly over the bed.

3.5.7.2 Plant Beds in Replaced Soil

When soil replacement is required, the existing soil shall be excavated and removed to a minimum depth of 6 inches and topsoil shall be placed on previously scarified subsoil to a minimum depth of 6 inches. The bed shall be brought to a smooth and even surface blending to existing areas. Settlement shall be allowed for.

3.5.7.3 Groundcover

Groundcover may be planted after the mulch is in place. Contaminating the mulch with soil shall be avoided.

3.5.8 Transplanting Existing Plants

Existing plant material to be transplanted shall be tagged on the site and/or as indicated. Existing plants shall be removed from the ground by means of mechanical devices or other method with a ball attached, meeting the requirements of paragraph SHIPMENT.

3.5.9 Staking and Guying

3.5.9.1 One Bracing Stake

Trees 4 to 6 feet tall shall be held in place with one bracing stake. The tree shall be held firmly to the stake with a double strand of wire. A chafing guard shall be used where the wire contacts the tree. Bracing stakes shall be driven vertically into firm ground and shall not injure the ball or roots.

3.5.9.2 Two Bracing Stakes

Trees over 6 feet tall shall be held in place with two bracing stakes placed on opposite sides. The tree shall be held firmly between the stakes

with a double strand of wire. Chafing guards shall be used where the wire contacts the tree. Bracing stakes shall be driven vertically into firm ground and shall not injure the ball or roots.

3.5.9.3 Three Guying Wires

Trees shall be held firmly in place with three guying lines of cable spaced equidistantly around the tree. The line shall be anchored with ground stakes. The line shall be anchored to the tree at a point equal to one half its height. Chafing guards shall be used where the line contacts the tree. One turnbuckle shall be centered on each line for tree straightening purposes. Ground stakes shall be driven into firm ground outside the earth saucer and plant pit with the top of the stake flush with the ground surface.

3.5.10 Flags

A flag shall be securely fastened to each guying line to be visible by pedestrians.

3.5.11 Edging Material

Edging material shall be installed in accordance with the manufacturer's recommendations and/or as indicated.

3.6 FINISHING

3.6.1 Plant Beds

Planted areas shall be uniformly edged to provide a clear-cut division line between the planted area and the adjacent turf area and to provide a shape as indicated. The entire planted area shall be raked and smoothed while maintaining the earth saucers.

3.6.2 Pruning

The total amount of foliage shall be pruned by one-fourth to one-third on installed trees and shrubs to compensate for loss of roots and transplanting shock. The typical growth habit of individual plants shall be retained. Clean cuts shall be made flush with the parent trunk. Improper cuts, stubs, dead and broken branches shall be removed. "Headback" cuts at right angles to the line of growth shall not be permitted. Trees shall not be poled or the leader removed, nor shall the leader be pruned or "topped off." Cuts or wounds measuring a minimum 1/2 inch in diameter shall be painted with the specified tree wound dressing.

3.6.3 Mulch

Mulch shall be spread to a uniform thickness of 4 incheswithin 48 hours after planting. Mulch shall be kept out of the crowns of shrubs and off buildings, sidewalks and other facilities.

3.6.4 Geotextile

When required for weed control, geotextile shall be placed in accordance with the manufacturer's recommendations and/or as indicated.

3.6.5 Trunk Wrap

The trunks to deciduous trees shall be wrapped within 24 hours after planting. Trees 1-1/2 inches or greater in caliper shall be wrapped with the specified material beginning at the base and extending up to the first branches. The wrapping shall be securely tied with twine at the top and bottom and at 18-inch intervals.

3.6.6 Water

Plants shall be watered as necessary to maintain an adequate supply of moisture within the root zone. Run-off, puddling and wilting shall be prevented.

3.6.7 Antidesiccant Application

Plants requiring further protection shall be sprayed with anti-desiccant in accordance with manufacturer's recommendations.

3.7 MAINTENANCE DURING PLANTING OPERATION

Installed plants shall be maintained in a healthy growing condition. Maintenance operations shall begin immediately after each plant is installed and shall continue until the plant establishment period commences. The maintenance includes watering, pruning, wound dressing, straightening and other necessary operations. Plant beds and earth saucers shall be kept free of weeds, grass and other undesired vegetation. Plants shall be checked for settlement and shall be reset proper grade as necessary. Run-off, puddling and wilting shall be prevented.

3.8 CARE OF EXISTING PLANT MATERIAL

3.8.1 Identification

Existing plant material to be treated shall be tagged on the site and/or as indicated.

3.8.2 Fertilizing Existing Trees

Holes shall be dug by hand or mechanical devices, a minimum 1-1/2 inches in diameter and 18 inches deep, distributed evenly at not more than 2 feet on center throughout the outer half of the branch spread zone of each tree.

3.8.2.1 Dry Fertilizer

Dry fertilizer shall be placed in the hole to within 4 inches of the surrounding grade.

3.8.2.2 Application

Packet, tablet or wedge-form fertilizer shall be applied in accordance with manufacturer's recommendations.

3.8.2.3 Backfill

Topsoil or sand shall be used as backfill in the hole and shall be blended to the surrounding grade.

3.8.3 Pruning and Cavity Work

An arborist shall perform the required pruning and cavity work on existing plants. Dead wood larger than 1/2 inch in diameter, branches interfering with or hindering the healthy growth of plants, and diseased branches shall be removed. Cut back or remove branches as necessary to give the plants proper shape and balance. Stubs, improper cuts, and broken limbs shall be removed. Clean cuts shall be made flush with the parent trunk. Wounds larger than 1/2 inch in diameter and scars from contractor operations shall be cleaned. Cavities shall be shaped to provide drainage and decayed wood shall be removed. Exposed cambium layers shall be sealed with shellac. Cuts, wounds and cavity work shall be painted with tree wound dressing.

3.9 APPLICATION OF PESTICIDE MATERIAL

When pesticide becomes necessary to remove a disease or pest, a state-certified applicator shall apply required pesticide in accordance with State EPA label restrictions and recommendations. Hydraulic equipment shall be provided for the liquid application of pesticides with a leak-proof tank, positive agitation methods, controlled application pressure and metering gauges. A pesticide treatment plan shall be provided to the Contracting Officer as specified in paragraph SUBMITTALS.

3.10 RESTORATION AND CLEAN UP

3.10.1 Restoration

Turf areas, pavements and facilities that have been damaged from the planting operation shall be restored to original condition at the Contractor's expense.

3.10.2 Clean Up

Excess and waste material from the planting operation shall be removed and disposed of off the site. Adjacent paved areas shall be cleared.

3.11 PLANT ESTABLISHMENT PERIOD

3.11.1 Commencement

On completion of the last day of the planting operation, the plant establishment period for maintaining installed plants in a healthy growing condition shall commence and shall be in effect for the remaining contract time period not to exceed 12 months. When the planting operation extends over more than one season or there is a variance to the planting times, plant establishment periods shall be established for the work completed, as directed. Written calendar time period shall be furnished to the Contracting Officer for the beginning of the plant establishment period. When there is more than one plant establishment period, describe the boundaries of the planted area covered for each period.

3.11.2 Maintenance During Establishment Period

3.11.2.1 General

Maintenance of plants shall include straightening plants, tightening stakes and guying material, repairing tree wrapping, protecting plant areas from erosion, maintaining erosion control material, supplementing mulch,

accomplishing wound dressing, removing dead or broken tip growth by pruning, maintaining edging of beds, checking for girdling of plants and maintaining plant labels, watering, weeding, removing and replacing unhealthy plants.

3.11.2.2 Water

The plants shall be watered as necessary to maintain an adequate supply of moisture within the root zone. An adequate supply of moisture is estimated to be the equivalent of one inch of absorbed water per week delivered in the form of natural rain or augmented as required by periodic waterings. Run-off, puddling and wilting shall be prevented.

3.11.2.3 Weeding

Grass and weeds in earth saucers and plant beds shall not be allowed to reach a height of 3 inches before being completely removed, including the root growth.

3.11.2.4 Unhealthy Plants

A plant shall be considered unhealthy or dead when the main leader has died back, or 25 percent of the crown is dead. Determine the cause for an unhealthy plant. Unhealthy or dead plants shall be removed immediately and shall be replaced as soon as seasonal conditions permit.

3.11.2.5 Fertilizing

The plants shall be topdressed at least once during the period of establishment with dry fertilizer at the rate of 1.5 pounds per 100 square feet of plant pit or bed area or foliar feed plants with liquid fertilizer. Dry fertilizer adhering to plants shall be flushed off. The application shall be timed prior to the advent of winter dormancy.

3.11.2.6 Settlement

Topsoil shall be added to maintain grade and to maintain earth saucers. Serious settlement affecting the setting of the plant in relation to the depth at which it was grown requires replanting in accordance with paragraph INSTALLATION.

3.11.2.7 Pesticide Treatment

Treatment for diseases or pest shall be in accordance with paragraph APPLICATION OF PESTICIDE MATERIAL.

3.11.2.8 Maintenance Report

A written record shall be furnished to the Contracting Officer of the maintenance work performed, the quality of plant losses, cause for plant loss and replacements made on each site visit.

3.11.2.9 Maintenance Instructions

Written instructions shall be furnished to the Contracting Officer for year-round care of installed plants.

3.11.3 Replacement Plants

Plants shall be provided for replacement in accordance with paragraph PLANTS. Replacement plants shall be installed in accordance with paragraph INSTALLATION. No extended plant establishment period Shall be required for replacement plants. A plant will be replaced in accordance with paragraph WARRANTY.

3.12 FINAL ACCEPTANCE

3.12.1 Preliminary Inspection

Prior to the completion of the contract a preliminary inspection shall be held by the Contracting Officer. Time for the inspection will be established in writing. The quantity and type of plants installed and the acceptability of the plants in accordance with the plant establishment period shall be determined.

3.12.2 Final Inspection

A final inspection shall be held by the Contracting Officer to determine that deficiencies noted in the preliminary inspection have been corrected. Time for the inspection shall be established in writing. Acceptance of the planting operation is subject to the guarantee of plant growth.

-- End of Section --

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SECTION 03307A

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11/01

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SECTION 03307A

CONCRETE FOR MINOR STRUCTURES
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PART 1 GENERAL

1.1 REFERENCES

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

ACI INTERNATIONAL (ACI)

ACI 308	(1992; R 1997) Standard Practice for Curing Concrete
ACI 318/318R	(1999) Building Code Requirements for Structural Concrete and Commentary
ACI 347R	(1994; R 1999) Guide to Formwork for Concrete

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 185	(1997) Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM A 615/A 615M	(2000) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM C 143/C 143M	(2000) Slump of Hydraulic Cement Concrete
ASTM C 150	(1999a) Portland Cement
ASTM C 171	(1997a) Sheet Materials for Curing Concrete
ASTM C 172	(1999) Sampling Freshly Mixed Concrete
ASTM C 231	(1997el) Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 260	(2000) Air-Entraining Admixtures for Concrete
ASTM C 309	(1998a) Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 31/C 31M	(2000e1) Making and Curing Concrete Test Specimens in the Field
ASTM C 33	(1999ae1) Concrete Aggregates
ASTM C 39/C 39M	(2001) Compressive Strength of Cylindrical Concrete Specimens
ASTM C 494/C 494M	(1999ae1) Chemical Admixtures for Concrete

ASTM C 618	(2000) Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
ASTM C 685	(2000) Concrete Made by Volumetric Batching and Continuous Mixing
ASTM C 920	(1998) Elastomeric Joint Sealants
ASTM C 94/C 94M	(2000e2) Ready-Mixed Concrete
ASTM D 1752	(1984; R 1996el) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D 75	(1987; R 1997) Sampling Aggregates
ASTM D 98	(1998) Calcium Chloride
ASTM E 96	(2000) Water Vapor Transmission of Materials

U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 400	(1963) Requirements for Water for Use in Mixing or Curing Concrete
COE CRD-C 572	(1974) Corps of Engineers Specifications for Polyvinylchloride Waterstop

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Air-Entraining Admixture
Water-Reducing or Retarding Admixture
Curing Materials
Reinforcing Steel
Expansion Joint Filler Strips, Premolded
Joint Sealants - Field Molded Sealants

Manufacturer's literature is available from suppliers which demonstrates compliance with applicable specifications for the above materials.

Batching and Mixing Equipment

Batching and mixing equipment will be accepted on the basis of manufacturer's data which demonstrates compliance with the applicable specifications.

Conveying and Placing Concrete

The methods and equipment for transporting, handling, depositing, and consolidating the concrete shall be submitted prior to the first concrete placement.

Formwork

Formwork design shall be submitted prior to the first concrete placement.

SD-06 Test Reports

Aggregates

Aggregates will be accepted on the basis of certificates of compliance and test reports that show the material(s) meets the quality and grading requirements of the specifications under which it is furnished.

Concrete Mixture Proportions

Ten days prior to placement of concrete, the contractor shall submit the mixture proportions that will produce concrete of the quality required. Applicable test reports shall be submitted to verify that the concrete mixture proportions selected will produce concrete of the quality specified.

SD-07 Certificates

Cementitious Materials

Certificates of compliance attesting that the concrete materials meet the requirements of the specifications shall be submitted in accordance with the Special Clause "CERTIFICATES OF COMPLIANCE". Cementitious material will be accepted on the basis of a manufacturer's certificate of compliance, accompanied by mill test reports that the material(s) meet the requirements of the specification under which it is furnished.

Aggregates

Aggregates will be accepted on the basis of certificates of compliance and tests reports that show the material(s) meet the quality and grading requirements of the specifications under which it is furnished.

1.3 UNIT PRICES

1.3.1 Concrete

1.3.1.1 Payment

All costs associated with furnishing, delivering, placing, finishing, and curing of concrete for the various items of the schedule, which price shall include the cost of all formwork. Payment for concrete for which payment is made as a lump sum is to be included in this unit price payment item. Payment for grout, preformed expansion joints, field-molded sealants, waterstops, reinforcing steel bars or wire reinforcement is ~~[not]~~ to be

included in this unit price payment item.

1.3.1.2 Measurement

Concrete will be measured for payment on the basis of the actual volume of concrete within the pay lines of the structures as indicated. Measurement of concrete placed against the sides of any excavation without the use of intervening forms will be made only within the pay lines of the structure. No deductions will be made for rounded or beveled edge, for space occupied by meal work, for electrical conduits or timber, or for voids or embedded items that are either less than 5 cubic feet in volume or 1 square foot in cross section.

1.3.1.3 Unit of Measure

Unit of measure: cubic yard.

1.4 DESIGN AND PERFORMANCE REQUIREMENTS

The Government will maintain the option to sample and test joint sealer, joint filler material, waterstop, aggregates and concrete to determine compliance with the specifications. The Contractor shall provide facilities and labor as may be necessary to assist the Government in procurement of representative test samples. Samples of aggregates will be obtained at the point of batching in accordance with ASTM D 75. Concrete will be sampled in accordance with ASTM C 172. Slump and air content will be determined in accordance with ASTM C 143/C 143M and ASTM C 231, respectively, when cylinders are molded. Compression test specimens will be made, cured, and transported in accordance with ASTM C 31/C 31M. Compression test specimens will be tested in accordance with ASTM C 39/C 39M. Samples for strength tests will be taken not less than once each shift in which concrete is produced . A minimum of three specimens will be made from each sample; two will be tested at 28 days (90 days if pozzolan is used) for acceptance, and one will be tested at 7 days for information.

1.4.1 Strength

Acceptance test results will be the average strengths of two specimens tested at 28 days (90 days if pozzolan is used). The strength of the concrete will be considered satisfactory so long as the average of three consecutive acceptance test results equal or exceed the specified compressive strength, f'c, and no individual acceptance test result falls below f'c by more than 500 psi.

1.4.2 Construction Tolerances

A Class "C" finish shall apply to all surfaces except those specified to receive a Class "D" finish. A Class "D" finish shall apply to all surfaces which will be permanently concealed after construction. The surface requirements for the classes of finish required shall be as specified in ACI 347R.

1.4.3 Concrete Mixture Proportions

Concrete mixture proportions shall be the responsibility of the Contractor. Mixture proportions shall include the dry weights of cementitious material(s); the nominal maximum size of the coarse aggregate; the specific gravities, absorptions, and saturated surface-dry weights of fine and coarse aggregates; the quantities, types, and names of admixtures; and

quantity of water per cubic yard of concrete. All materials included in the mixture proportions shall be of the same type and from the same source as will be used on the project. Specified compressive strength f'c shall be 4,000 psi at 28 days (90 days if pozzolan is used). The maximum nominal size coarse aggregate shall be 3/4 inch, in accordance with ACI 318/318R. The air content shall be between 4.5 and 7.5 percent. The slump shall be between 2 and 5 inches. The maximum water cement ratio shall be 0.50.

1.5 REGULATORY REQUIREMENTS

The state statutory and regulatory requirements listed below form a part of this specification to the extent referenced.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Cementitious Materials

Cementitious materials shall conform to the appropriate specifications listed:

2.1.1.1 Portland Cement

ASTM C 150, Type I, IA, II, IIA, III, IIIA or V.

2.1.1.2 Pozzolan

Pozzolan shall conform to ASTM C 618, Class C or F, including requirements of Tables 1A and 2A.

2.1.2 Aggregates

Aggregates shall meet the quality and grading requirements of ASTM C 33 Class Designations 4M or better.

2.1.3 Admixtures

Admixtures to be used, when required or approved, shall comply with the appropriate specification listed. Chemical admixtures that have been in storage at the project site for longer than 6 months or that have been subjected to freezing shall be retested at the expense of the contractor at the request of the Contracting Officer and shall be rejected if test results are not satisfactory.

2.1.3.1 Air-Entraining Admixture

Air-entraining admixture shall meet the requirements of ASTM C 260.

2.1.3.2 Accelerating Admixture

Calcium chloride shall meet the requirements of ASTM D 98. Other accelerators shall meet the requirements of ASTM C 494/C 494M, Type C or E.

2.1.3.3 Water-Reducing or Retarding Admixture

Water-reducing or retarding admixture shall meet the requirements of ASTM C 494/C 494M, Type A, B, or D.

2.1.4 Water

Water for mixing and curing shall be fresh, clean, potable, and free from injurious amounts of oil, acid, salt, or alkali, except that unpotable water may be used if it meets the requirements of COE CRD-C 400.

2.1.5 Reinforcing Steel

Reinforcing steel bar shall conform to the requirements of ASTM A 615/A 615M, Grade 60. Welded steel wire fabric shall conform to the requirements of ASTM A 185, flat sheets only. Details of reinforcement not shown shall be in accordance with ACI 318/318R, Chapters 7 and 12.

2.1.6 Expansion Joint Filler Strips, Premolded

Expansion joint filler strips, premolded shall be sponge rubber conforming to ASTM D 1752, Type I.

2.1.7 Joint Sealants - Field Molded Sealants

All sealants shall be asbestos free or <1% asbestos. Joint sealants - field molded sealants shall conform to ASTM C 920, Type M, Grade NS, Class 25, use NT for vertical joints and Type M, Grade P, Class 25, use T for horizontal joints. Bond-breaker material shall be polyethylene tape, coated paper, metal foil, or similar type materials. The backup material shall be compressible, nonshrink, nonreactive with the sealant, and a nonabsorptive material such as extruded butyl or polychloroprene foam rubber. Immediately prior to installation of field-molded sealants, the joint shall be cleaned of all debris and further cleaned using water, chemical solvents, or other means as recommended by the sealant manufacturer or directed.

2.1.8 Waterstops

Waterstops shall conform to COE CRD-C 572.

2.1.9 Formwork

The design and engineering of the formwork as well as its construction, shall be the responsibility of the Contractor.

2.1.10 Form Coatings

Forms for exposed surfaces shall be coated with a nonstaining form oil, which shall be applied shortly before concrete is placed.

2.1.11 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.

2.1.12 Curing Materials

Curing materials shall conform to the following requirements.

2.1.12.1 Impervious Sheet Materials

Impervious sheet materials, ASTM C 171, type optional, except polyethylene

film, if used, shall be white opaque.

2.1.12.2 Membrane-Forming Curing Compound

ASTM C 309, Type 1-D or 2, Class A or B.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 General

Construction joints shall be prepared to expose coarse aggregate, and the surface shall be clean, damp, and free of laitance. Ramps and walkways, as necessary, shall be constructed to allow safe and expeditious access for concrete and workmen. Snow, ice, standing or flowing water, loose particles, debris, and foreign matter shall have been removed. Earth foundations shall be satisfactorily compacted. Spare vibrators shall be available. The entire preparation shall be accepted by the Government prior to placing.

3.1.2 Embedded Items

Reinforcement shall be secured in place; joints, anchors, and other embedded items shall have been positioned. Internal ties shall be arranged so that when the forms are removed the metal part of the tie will be not less than 2 inches from concrete surfaces permanently exposed to view or exposed to water on the finished structures. Embedded items shall be free of oil and other foreign matters such as loose coatings or rust, paint, and scale. The embedding of wood in concrete will be permitted only when specifically authorized or directed. All equipment needed to place, consolidate, protect, and cure the concrete shall be at the placement site and in good operating condition.

3.1.3 Formwork Installation

Forms shall be properly aligned, adequately supported, and mortar-tight. The form surfaces shall be smooth and free from irregularities, dents, sags, or holes when used for permanently exposed faces. All exposed joints and edges shall be chamfered, unless otherwise indicated.

3.1.4 Vapor Barrier Installation

Vapor barriers shall be applied over gravel fill. Edges shall be lapped not less than 6 inches. All joints shall be sealed with pressure-sensitive adhesive not less than 2 inches wide. The vapor barrier shall be protected at all times to prevent injury or displacement prior to and during concrete placement.

3.1.5 Production of Concrete

3.1.5.1 Ready-Mixed Concrete

Ready-mixed concrete shall conform to ASTM C 94/C 94M except as otherwise specified.

3.1.5.2 Concrete Made by Volumetric Batching and Continuous Mixing

Concrete made by volumetric batching and continuous mixing shall conform to

ASTM C 685.

3.1.5.3 Batching and Mixing Equipment

The contractor shall have the option of using an on-site batching and mixing facility. The facility shall provide sufficient batching and mixing equipment capacity to prevent cold joints. The method of measuring materials, batching operation, and mixer shall be submitted for review.

3.1.6 Waterstops

Waterstops shall be installed and spliced as directed by the manufacturer.

3.2 CONVEYING AND PLACING CONCRETE

Conveying and placing concrete shall conform to the following requirements.

3.2.1 General

Concrete placement shall not be permitted when weather conditions prevent proper placement and consolidation without approval. When concrete is mixed and/or transported by a truck mixer, the concrete shall be delivered to the site of the work and discharge shall be completed within 1-1/2 hours ~~(~~or 45 minutes when the placing temperature is 85 degrees F or greater unless a retarding admixture is used~~)~~. Concrete shall be conveyed from the mixer to the forms as rapidly as practicable by methods which prevent segregation or loss of ingredients. Concrete shall be in place and consolidated within 15 minutes after discharge from the mixer. Concrete shall be deposited as close as possible to its final position in the forms and be so regulated that it may be effectively consolidated in horizontal layers 18 inches or less in thickness with a minimum of lateral movement. The placement shall be carried on at such a rate that the formation of cold joints will be prevented.

3.2.2 Consolidation

Each layer of concrete shall be consolidated by rodding, spading, or internal vibrating equipment. Internal vibration shall be systematically accomplished by inserting the vibrator through the fresh concrete in the layer below at a uniform spacing over the entire area of placement. The distance between insertions shall be approximately 1.5 times the radius of action of the vibrator and overlay the adjacent, just-vibrated area by a few inches. The vibrator shall penetrate rapidly to the bottom of the layer and at least 6 inches into the layer below, if such a layer exists. It shall be held stationary until the concrete is consolidated and then withdrawn slowly at the rate of about 3 inches per second.

3.2.3 Cold-Weather Requirements

No concrete placement shall be made when the ambient temperature is below 35 degrees F or if the ambient temperature is below 40 degrees F and falling. Suitable covering and other means as approved shall be provided for maintaining the concrete at a temperature of at least 50 degrees F for not less than 72 hours after placing and at a temperature above freezing for the remainder of the curing period. Salt, chemicals, or other foreign materials shall not be mixed with the concrete to prevent freezing. Any concrete damaged by freezing shall be removed and replaced at the expense of the contractor.

3.2.4 Hot-Weather Requirements

When the rate of evaporation of surface moisture, as determined by use of Figure 1 of ACI 308, is expected to exceed 0.2 pound per square foot per hour, provisions for windbreaks, shading, fog spraying, or covering with a light-colored material shall be made in advance of placement, and such protective measures shall be taken as quickly as finishing operations will allow.

3.3 FORM REMOVAL

Forms shall not be removed before the expiration of 24 hours after concrete placement except where otherwise specifically authorized. Supporting forms and shoring shall not be removed until the concrete has cured for at least 5 days. When conditions on the work are such as to justify the requirement, forms will be required to remain in place for longer periods.

3.4 FINISHING

3.4.1 General

No finishing or repair will be done when either the concrete or the ambient temperature is below 50 degrees F.

3.4.2 Finishing Formed Surfaces

All fins and loose materials shall be removed, and surface defects including tie holes shall be filled. All honeycomb areas and other defects shall be repaired. All unsound concrete shall be removed from areas to be repaired. Surface defects greater than 1/2 inch in diameter and holes left by removal of tie rods in all surfaces not to receive additional concrete shall be reamed or chipped and filled with dry-pack mortar. The prepared area shall be brush-coated with an approved epoxy resin or latex bonding compound or with a neat cement grout after dampening and filled with mortar or concrete. The cement used in mortar or concrete for repairs to all surfaces permanently exposed to view shall be a blend of portland cement and white cement so that the final color when cured will be the same as adjacent concrete.

3.4.3 Finishing Unformed Surfaces

All unformed surfaces that are not to be covered by additional concrete or backfill shall be float finished to elevations shown, unless otherwise specified. Surfaces to receive additional concrete or backfill shall be brought to the elevations shown and left as a true and regular surface. Exterior surfaces shall be sloped for drainage unless otherwise shown. Joints shall be carefully made with a jointing tool. Unformed surfaces shall be finished to a tolerance of 3/8 inch for a float finish as determined by a 10 foot straightedge placed on surfaces shown on the plans to be level or having a constant slope. Finishing shall not be performed while there is excess moisture or bleeding water on the surface. No water or cement shall be added to the surface during finishing.

3.4.3.1 Float Finish

Surfaces to be float finished shall be screeded and darbied or bullfloated to eliminate the ridges and to fill in the voids left by the screed. In addition, the darby or bullfloat shall fill all surface voids and only slightly embed the coarse aggregate below the surface of the fresh

concrete. When the water sheen disappears and the concrete will support a person's weight without deep imprint, floating should be completed. Floating should embed large aggregates just beneath the surface, remove slight imperfections, humps, and voids to produce a plane surface, compact the concrete, and consolidate mortar at the surface.

3.4.3.2 Trowel Finish

Trowelling shall be done immediately following floating to provide a smooth, even, dense finish free from blemishes including trowel marks. Finished surfaces shall be protected from damage during the construction period.

3.4.3.3 Broom Finish

The concrete shall be screeded and floated to required finish plane with no coarse aggregate visible. After surface moisture disappears, the surface shall be broomed or brushed with a broom or fiber bristle brush in a direction transverse to that of the main traffic or as directed.

3.4.3.4 Expansion and Contraction Joints

Expansion and contraction joints shall be made in accordance with the details shown or as otherwise specified. Provide 1/2 inch thick transverse expansion joints where new work abuts an existing concrete. Expansion joints shall be provided at a maximum spacing of 30 feet on center in sidewalks, unless otherwise indicated. Contraction joints shall be provided at a maximum spacing of 6 linear feet in sidewalks, unless otherwise indicated. Contraction joints shall be cut at a minimum of 1 inch(es) deep with a jointing tool after the surface has been finished.

3.5 CURING AND PROTECTION

Beginning immediately after placement and continuing for at least 7 days, except for concrete made with Type III cement, at least 3 days, all concrete shall be cured and protected from premature drying, extremes in temperature, rapid temperature change, freezing, mechanical damage, and exposure to rain or flowing water. All materials and equipment needed for adequate curing and protection shall be available and at the site of the placement prior to the start of concrete placement. Preservation of moisture for concrete surfaces not in contact with forms shall be accomplished by one of the following methods:

a. Continuous sprinkling or ponding.

b. Application of absorptive mats or fabrics kept continuously wet.

c. Application of sand kept continuously wet.

d. Application of impervious sheet material conforming to ASTM C 171.

e. Application of membrane-forming curing compound conforming to ASTM C 309, Type 1-D, on surfaces permanently exposed to view and Type 2 on other surfaces shall be accomplished in accordance with manufacturer's instructions.

The preservation of moisture for concrete surfaces placed against wooden forms shall be accomplished by keeping the forms continuously wet for 7 days, except for concrete made with Type III cement, 3 days. If forms are

removed prior to end of the required curing period, other curing methods shall be used for the balance of the curing period. During the period of protection removal, the temperature of the air in contact with the concrete shall not be allowed to drop more than 25 degrees F within a 24 hour period.

3.6 TESTS AND INSPECTIONS

3.6.1 General

The individuals who sample and test concrete as required in this specification shall have demonstrated a knowledge and ability to perform the necessary test procedures equivalent to the ACI minimum guidelines for certification of Concrete Field Testing Technicians, Grade I.

3.6.2 Inspection Details and Frequency of Testing

3.6.2.1 Preparations for Placing

Foundation or construction joints, forms, and embedded items shall be inspected in sufficient time prior to each concrete placement by the Contractor to certify that it is ready to receive concrete.

3.6.2.2 Air Content

Air content shall be checked at least twice during each shift that concrete is placed. Samples shall be obtained in accordance with ASTM C 172 and tested in accordance with ASTM C 231.

3.6.2.3 Slump

Slump shall be checked twice during each shift that concrete is produced. Samples shall be obtained in accordance with ASTM C 172 and tested in accordance with ASTM C 143/C 143M.

3.6.2.4 Consolidation and Protection

The Contractor shall ensure that the concrete is properly consolidated, finished, protected, and cured.

3.6.3 Action Required

3.6.3.1 Placing

The placing foreman shall not permit placing to begin until he has verified that an adequate number of acceptable vibrators, which are in working order and have competent operators, are available. Placing shall not be continued if any pile is inadequately consolidated.

3.6.3.2 Air Content

Whenever a test result is outside the specification limits, the concrete shall not be delivered to the forms and an adjustment shall be made to the dosage of the air-entrainment admixture.

3.6.3.3 Slump

Whenever a test result is outside the specification limits, the concrete shall not be delivered to the forms and an adjustment should be made in the batch weights of water and fine aggregate. The adjustments are to be made

so that the water-cement ratio does not exceed that specified in the submitted concrete mixture proportion.

3.6.4 Reports

The results of all tests and inspections conducted at the project site shall be reported informally at the end of each shift and in writing weekly and shall be delivered within 3 days after the end of each weekly reporting period. See Section 01451 CONTRACTOR QUALITY CONTROL.

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SECTION 05500A

MISCELLANEOUS METAL

01/02

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SECTION 05500A

MISCELLANEOUS METAL
01/02

PART 1 GENERAL

1.1 REFERENCES

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

ALUMINUM ASSOCIATION (AA)

AA DAF-45	(1997) Designation System for Aluminum Finishes

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A14.3	(1992) Ladders - Fixed - Safety Requirements
ANSI MH28.1	(1982) Design, Testing, Utilization, and Application of Industrial Grade Steel Shelving

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36	(2000a) Carbon Structural Steel
ASTM A 500	(1999) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1	(2000) Structural Welding Code - Steel

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM MBG 531	(1994) Metal Bar Grating Manual

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 211	(2000) Chimneys, Fireplaces, Vents and Solid Fuel-Burning Appliances

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Miscellaneous Metal Items;

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.

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 standard mill finish or anodized finish as indicated. The thickness of the coating shall be not

less than that specified for protective and decorative type finishes for items used in interior locations or architectural Class I type finish for items used in exterior locations in AA DAF-45. Items to be anodized shall receive a polished satin finish. Aluminum surfaces to be in contact with plaster or concrete during construction shall be protected with a field coat conforming to CID A-A-344.

1.8 SHOP PAINTING

Surfaces of ferrous metal except galvanized surfaces, shall be cleaned and shop coated with the manufacturer's standard protective coating unless otherwise specified. Surfaces of items to be embedded in concrete shall not be painted. Items to be finish painted shall be prepared according to manufacturer's recommendations or as specified.

PART 2 PRODUCTS

2.1 ACCESS DOORS AND PANELS

Doors and panels shall be flush type unless otherwise indicated. Frames for access doors shall be fabricated of not lighter than 16 gauge steel with welded joints and finished with anchorage for securing into construction. Access doors shall be a minimum of 14 by 20 inches and of not lighter than 14 gauge steel, with stiffened edges, complete with attachments. Access doors shall be hinged to frame and provided with a flush face, screw driver operated latch. Exposed metal surfaces shall have a shop applied prime coat.

2.2 VENTS

Vents shall be designed and constructed in accordance with NFPA 211.

2.3 CORNER GUARDS AND SHIELDS

Corner guards and shields for jambs and sills of openings and edges of platforms shall be steel shapes and plates anchored in masonry or concrete with welded steel straps or end weld stud anchors. Corner guards for use with glazed or ceramic tile finish on walls shall be formed of 0.0625 inch thick corrosion-resisting steel with polished or satin finish, shall extend 5 feet above the top of cove base or to the top of the wainscot, whichever is less, and shall be securely anchored to the supporting wall. Corner guards on exterior shall be galvanized.

2.4 PIPE GUARDS

Pipe guards shall be heavy duty steel pipe conforming to ASTM A 53, Type E or S, weight STD, black finish.

2.5 EXPANSION JOINT COVERS

Expansion joint covers shall be constructed of extruded aluminum with anodized satin finish for walls and ceilings and with standard mill finish for floor covers and exterior covers. Plates, backup angles, expansion filler strip and anchors shall be designed as indicated. Expansion joint system shall provide a fire rating as indicated.

2.6 HANDRAILS

Handrails shall be designed to resist a concentrated load of 200 pounds in

any direction at any point of the top of the rail or 20 pounds per foot applied horizontally to top of the rail, whichever is more severe. Steel handrails, including inserts in concrete, shall be steel pipe conforming to ASTM A 53 or structural tubing conforming to ASTM A 500, Grade A or B of equivalent strength. Steel railings shall be 2 inch nominal size. Railings shall be hot-dip galvanized and shop painted. Pipe collars shall be hot-dip galvanized steel.

a. Joint posts, rail, and corners shall be fabricated by one of the following methods:

(1) Flush type rail fittings of commercial standard, welded and ground smooth with railing splice locks secured with 3/8 inch hexagonal recessed-head setscrews.

(2) Mitered and welded joints by fitting post to top rail and intermediate rail to post, mitering corners, groove welding joints, and grinding smooth. Railing splices shall be butted and reinforced by a tight fitting interior sleeve not less than 6 inches long.

(3) Railings may be bent at corners in lieu of jointing, provided bends are made in suitable jigs and the pipe is not crushed.

b. Removable sections, toe-boards, and brackets shall be provided as indicated.

2.7 LADDERS

Ladders shall be galvanized steel or aluminum, fixed rail type in accordance with ANSI A14.3.

2.8 MISCELLANEOUS

Miscellaneous plates and shapes for items that do not form a part of the structural steel framework, such as lintels, sill angles, miscellaneous mountings, and frames, shall be provided to complete the work.

2.8 SHELVING

Shelving shall conform to ANSI MH28.1 and shall be bolted or clipped. Minimum dimensions and number of shelves shall be as indicated.

2.9 STEEL STAIRS

Steel stairs shall be complete with structural or formed channel stringers, steel plate treads and risers, landings, columns, handrails, and necessary bolts and other fastenings as indicated. Structural steel shall conform to ASTM A 36. Stairs and accessories shall be galvanized. Risers on stairs with metal pan treads shall be deformed to form a sanitary cove to retain the tread concrete. Integral nosings shall have braces extended into the concrete fill. Gratings for treads and landings shall conform to NAAMM MBG 531. Grating treads shall have slip-resistant nosings. Design stairs to sustain a live load of not less than 100 pounds per square foot, or a concentrated load of 300 applied where it is most critical. Conform to AISC S335 or AISC S342L with the design and fabrication of steel stairs, other than a commercial product. Design fire stairs to conform to NFPA 101. Before fabrication, obtain necessary field measurements and verify drawing dimensions.

2.10 Trolley/Monorail System

See architectural drawings for sizes of monorail members and capacities of trolley system and manufacturers.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

All items shall be installed at the locations shown and according to the manufacturer's recommendations. Items listed below require additional procedures as specified.

3.2 REMOVABLE ACCESS PANELS

A removable access panel not less than 12 by 12 inches shall be installed directly below each valve, flow indicator, damper, or air splitter that is located above the ceiling, other than an acoustical ceiling, and that would otherwise not be accessible.

3.3 ATTACHMENT OF HANDRAILS

Toeboards and brackets shall be installed where indicated. Splices, where required, shall be made at expansion joints. Removable sections shall be installed as indicated.

3.3.1 Installation of Steel Handrails

Installation shall be in pipe sleeves embedded in concrete and filled with molten lead or sulphur with anchorage covered with standard pipe collar pinned to post.

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SECTION 07600

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02/03

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SECTION 07600

FLASHING AND SHEET METAL
02/03

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167	(1999) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 308	(1999) Steel Sheet, Terne (Lead-Tin Alloy) Coated by the Hot Dip Process
ASTM A 653/A 653M	(2001, Rev A) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B 32	(2000) Solder Metal
ASTM B 69	(2001, Rev A) Rolled Zinc
ASTM B 101	(2001) Lead-Coated Copper Sheet and Strip for Building Construction
ASTM B 209	(2001) Aluminum and Aluminum Alloy Sheet and Plate
ASTM B 221	(2000) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B 370	(1998) Copper Sheet and Strip for Building Construction
ASTM D 1784	(1999, Rev A) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 4586	(2000) Asphalt Roof Cement, Asbestos-Free

AMERICAN WELDING SOCIETY (AWS)

AWS D1.2	(1997) Structural Welding Code Aluminum

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA Arch. Manual	(1993) Architectural Sheet Metal Manual

1.2 General Requirements

Sheet metalwork shall be accomplished to form weathertight construction without waves, warps, buckles, fastening stresses or distortion, and shall allow for expansion and contraction. Cutting, fitting, drilling, and other operations in connection with sheet metal required to accommodate the work of other trades shall be performed by sheet metal mechanics. Installation of sheet metal items used in conjunction with roofing shall be coordinated with roofing work to permit continuous roofing operations.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Covering on flat, sloped, or curved surfaces

Expansion joints

Gravel stops and fascias

Splash pans

Flashing for roof drains

Counterflashing

Flashing at roof penetrations

Reglets

Scuppers

Copings

Drip edge

Eave flashing

Indicate thicknesses, dimensions, fastenings and anchoring methods, expansion joints, and other provisions necessary for thermal expansion and contraction. Scaled manufacturer's catalog data may be submitted for factory fabricated items.

SD-11 Closeout Submittals

Quality Control Plan

Submit for sheet metal work in accordance with paragraph entitled "Field Quality Control."

1.4 DELIVERY, HANDLING, AND STORAGE

Package and protect materials during shipment. Uncrate and inspect materials for damage, dampness, and wet-storage stains upon delivery to the job site. Remove from the site and replace damaged materials that cannot be restored to like-new condition. Handle sheet metal items to avoid damage to surfaces, edges, and ends. Store materials in dry, weather-tight, ventilated areas until immediately before installation.

PART 2 PRODUCTS

2.1 MATERIALS

Furnish sheet metal items in 8 to 10 foot lengths. Single pieces less than 8 feet long may be used to connect to factory-fabricated inside and outside corners, and at ends of runs. Factory fabricate corner pieces with minimum 12 inch legs. Provide accessories and other items essential to complete the sheet metal installation. These accessories shall be made of the same materials as the items to which they are applied. Fabricate sheet metal items of the materials specified below and to the gage, thickness, or weight shown in Table I at the end of this section. Sheet metal items shall have mill finish unless specified otherwise. Where more than one material is listed for a particular item in Table I, each is acceptable and may be used except as follows:

2.1.1 Exposed Sheet Metal Items

Shall be of the same material. The following items shall be considered as exposed sheet metal: gutters, including hangers; downspouts; gravel stops and fascias; cap, valley, steeped, base, and eave flashings and related accessories.

2.1.2 Drainage

Do not use copper for an exposed item if drainage from that item will pass over exposed masonry, stonework or other metal surfaces. In addition to the metals listed in Table I, lead-coated copper may be used for such items.

2.1.3 Copper, Sheet and Strip

ASTM B 370, cold-rolled temper, H 00 (standard).

2.1.4 Lead-Coated Copper Sheet

ASTM B 101.

2.1.5 Lead Sheet

Minimum weight 4 pounds per square foot.

2.1.6 Steel Sheet, Zinc-Coated (Galvanized)

ASTM A 653/A 653M.

2.1.7 Zinc Sheet and Strip

ASTM B 69, Type I, a minimum of 0.024 inch thick.

2.1.8 Stainless Steel

ASTM A 167, Type 302 or 304, 2D Finish, fully annealed, dead-soft temper.

2.1.9 Terne-Coated Steel

Minimum of 14 by 20 inches with minimum of 40 pound coating per double base box. ASTM A 308.

2.1.10 Aluminum Alloy Sheet and Plate

ASTM B 209.

2.1.11 Aluminum Alloy, Extruded Bars, Rods, Shapes, and Tubes

ASTM B 221.

2.1.12 Solder

ASTM B 32, 95-5 tin-antimony.

2.1.13 Polyvinyl Chloride Reglet

ASTM D 1784, Type II, Grade 1, Class 14333-D, 0.075 inch minimum thickness.

2.1.14 Bituminous Plastic Cement

ASTM D 4586, Type I.

2.1.15 Fasteners

Use the same metal or a metal compatible with the item fastened. Use stainless steel fasteners to fasten dissimilar materials.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Metal Roofing

3.1.1.1 Standing-seam Method

Make standing seams parallel with slope of roof. Fabricate sheets into long lengths at shop by locking short dimensions together and thoroughly soldering joints thus formed. In applying metal, turn up one edge of course at each side seam at right angles 1.5 inches. Then install 2 by 3 inch cleats spaced 12 inches apart by fastening one end of each cleat to roof with two one inch long nails and folding roof end back over nail heads. Turn end adjoining turned-up side seam up over upstanding edge of course. Turn up adjoining edge of next course 1.75 inches and abutting upstanding edges locked, turned over, and flattened against one side of standing seam. Make standing seams straight, rounded neatly at the top edges, and stand about one inch above roof deck. All sheets shall be same length, except as required to complete run or maintain pattern. Locate transverse joints of each panel half way between joints in adjacent sheets. Align joints of alternate sheets horizontally to produce uniform pattern, as shown in SMACNA Arch. Manual.

3.1.2 Workmanship

Make lines, arrises, and angles sharp and true. Free exposed surfaces from visible wave, warp, and buckle, and tool marks. Fold back exposed edges neatly to form a 1/2 inch hem on the concealed side. Make sheet metal exposed to the weather watertight with provisions for expansion and contraction.

Make surfaces to receive sheet metal plumb and true, clean, even, smooth, dry, and free of defects and projections which might affect the application. For installation of items not shown in detail or not covered by specifications conform to the applicable requirements of SMACNA Arch. Manual, Architectural Sheet Metal Manual. Provide sheet metal flashing in the angles formed where roof decks abut walls, curbs, ventilators, pipes, or other vertical surfaces and wherever indicated and necessary to make the work watertight. Join sheet metal items together as shown in Table II.

3.1.3 Nailing

Confine nailing of sheet metal generally to sheet metal having a maximum width of 18 inches. Confine nailing of flashing to one edge only. Space nails evenly not over 3 inches on centers and approximately 1/2 inch from edge unless otherwise specified or indicated. Face nailing will not be permitted. Where sheet metal is applied to other than wood surfaces, include in shop drawings, the locations for sleepers and nailing strips required to secure the work. Sleepers and nailing strips are specified in Section 06100N, "Rough Carpentry."

3.1.4 Cleats

Provide cleats for sheet metal 18 inches and over in width. Space cleats evenly not over 12 inches on centers unless otherwise specified or indicated. Unless otherwise specified, cleats shall be not less than 2 inches wide by 3 inches long and of the same material and thickness as the sheet metal being installed. Secure one end of the cleat with two nails and the cleat folded back over the nailheads. Lock the other end into the seam. Where the fastening is to be made to concrete or masonry, screws shall be used and shall be driven in expansion shields set in concrete or masonry. Pretin cleats for soldered seams.

3.1.5 Bolts, Rivets, and Screws

Install bolts, rivets, and screws where indicated or required. Provide compatible washers where required to protect surface of sheet metal and to provide a watertight connection. Joints in aluminum sheets 0.040 inch or less in thickness shall be mechanically made.

3.1.6 Seams

Straight and uniform in width and height with no solder showing on the face.

3.1.6.1 Flat-lock Seams

Finish not less than 3/4 inch wide.

3.1.6.2 Lap Seams

Finish soldered seams not less than one inch wide. Overlap seams not soldered, not less than 3 inches.

3.1.6.3 Loose-Lock Expansion Seams

Not less than 3 inches wide; provide minimum one inch movement within the joint. Completely fill the joints with the specified sealant, applied at not less than 1/8 inch thick bed.

3.1.6.4 Standing Seams

Not less than one inch high, double locked without solder.

3.1.6.5 Flat Seams

Make seams in the direction of the flow.

3.1.7 Soldering

Where soldering is specified, it shall apply to copper, terne-coated stainless steel, zinc-coated steel, and stainless steel items. Edges of sheet metal shall be pretinned before soldering is begun. Seal the joints in aluminum sheets of 0.040 inch or less in thickness with specified sealants. Do not solder aluminum.

3.1.7.1 Edges

Scrape or wire-brush the edges of lead-coated material to be soldered to produce a bright surface. Flux brush the seams in before soldering. Treat with soldering acid flux the edges of stainless steel to be pretinned. Seal the joints in aluminum sheets of 0.040 inch or less in thickness with specified sealants. Do not solder aluminum.

3.1.8 Welding and Mechanical Fastening

Use welding for aluminum of thickness greater than 0.040 inch. Aluminum 0.040 inch or less in thickness shall be butted and the space backed with formed flashing plate; or lock joined, mechanically fastened, and filled with sealant as recommended by the aluminum manufacturer.

3.1.8.1 Welding of Aluminum

Use welding of the inert gas, shield-arc type. For procedures, appearance and quality of welds, and the methods used in correcting welding work, conform to AWS D1.2.

3.1.8.2 Mechanical Fastening of Aluminum

Use No. 12, aluminum alloy, sheet metal screws or other suitable aluminum alloy or stainless steel fasteners. Drive fasteners in holes made with a No. 26 drill in securing side laps, end laps, and flashings. Space fasteners 12 inches maximum on centers. Where end lap fasteners are required to improve closure, locate the end lap fasteners not more than 2 inches from the end of the overlapping sheet.

3.1.9 Protection from Contact with Dissimilar Materials

3.1.9.1 Copper or Copper-bearing Alloys

Paint with heavy-bodied bituminous paint surfaces in contact with dissimilar metal, or separate the surfaces by means of moistureproof

building felts.

3.1.9.2 Aluminum

Aluminum surfaces shall not directly contact other metals except stainless steel, zinc, or zinc coating. Where aluminum contacts another metal, paint the dissimilar metal with a primer followed by two coats of aluminum paint. Where drainage from a dissimilar metal passes over aluminum, paint the dissimilar metal with a non-lead pigmented paint.

3.1.9.3 Metal Surfaces

Paint surfaces in contact with mortar, concrete, or other masonry materials with alkali-resistant coatings such as heavy-bodied bituminous paint.

3.1.9.4 Wood or Other Absorptive Materials

Paint surfaces that may become repeatedly wet and in contact with metal with two coats of aluminum paint or a coat of heavy-bodied bituminous paint.

3.1.10 Expansion and Contraction

Provide expansion and contraction joints at not more than 32 foot intervals for aluminum and at not more than 40 foot intervals for other metals. Where the distance between the last expansion joint and the end of the continuous run is more than half the required interval, an additional joint shall be provided. Space joints evenly. Join extruded aluminum gravel stops and fascias by expansion and contraction joints spaced not more than 12 feet apart.

3.1.11 Counterflashing

Except where indicated or specified otherwise, insert counterflashing in reglets located from 9 to 10 inches above roof decks, extend down vertical surfaces over upturned vertical leg of base flashings not less than 3 inches. Fold the exposed edges of counterflashings 1/2 inch. Provide end laps in counterflashings not less than 3 inches and make it weathertight with plastic cement. Do not make lengths of metal counterflashings exceed 10 feet. Form the flashings to the required shapes before installation. Factory-form the corners not less than 12 inches from the angle. Turn up the concealed edge of counterflashings built into masonry or concrete walls not less than 1/4 inch and extend not less than 2 inches into the walls. Install counterflashing to provide a spring action against base flashing.

3.1.12 Metal Reglets

Caulked type or friction type reglets shall be factory fabricated with a minimum opening of 1/4 inch and a depth of 1 1/4 inches, as approved.

3.1.12.1 Caulked Reglets

Provide with rounded edges and metal strap brackets or other anchors for securing to the concrete forms. Provide reglets with a core to protect them from injury during the installation. Provide built-up mitered corner pieces for internal and external angles. Wedge the flashing in the reglets with lead wedges every 18 inches, caulked full and solid with an approved compound.

3.1.12.2 Friction Reglets

Provide with flashing receiving slots not less than 5/8 inch deep, one inch jointing tongues, and upper and lower anchoring flanges installed at 24 inches maximum snaplock receiver. Insert the flashing the full depth of the slot and lock by indentations made with a dull-pointed tool, wedges, and filled with a sealant. For friction reglets, install flashing snaplock receivers at 24 inches o.c. maximum. When the flashing has been inserted the full depth, caulk the slot and lock and fill with sealant.

3.1.13 Polyvinyl Chloride Reglets

Rigid polyvinyl chloride reglets ASTM D 1784, Type II, Grade 1, Class 14333-D, 0.075 inches minimum thickness may be provided in lieu of metal reglets for temporary construction.

3.1.14 Gravel Stops and Fascias

Prefabricate in the shapes and sizes indicated and in lengths not less than 8 feet. Extend flange at least 4 inches onto roofing. Provide prefabricated, mitered corners internal and external corners. Install gravel stops and fascias after all plies of the roofing membrane have been applied, but before the flood coat of bitumen is applied. Prime roof flange of gravel stops and fascias on both sides with an asphalt primer. After primer has dried, set flange on roofing membrane and strip-in. Nail flange securely to wood nailer with large-head, barbed-shank roofing nails 1.5 inches long spaced not more than 3 inches on centers, in two staggered rows.

3.1.14.1 Edge Strip

Hook the lower edge of fascias at least 3/4 inch over a continuous strip of the same material bent outward at an angle not more than 45 degrees to form a drip. Nail hook strip to a wood nailer at 6 inches maximum on centers. Where fastening is made to concrete or masonry, use screws spaced 12 inches on centers driven in expansion shields set in the concrete or masonry. Where horizontal wood nailers are slotted to provide for insulation venting, install strips to prevent obstruction of vent slots. Where necessary, install strips over 1/16 inch thick compatible spacer or washers.

3.1.14.2 Joints

Leave open the section ends of gravel stops and fascias 1/4 inch and backed with a formed flashing plate, mechanically fastened in place and lapping each section end a minimum of 4 inches set laps in plastic cement. Face nailing will not be permitted. Install prefabricated aluminum gravel stops and fascias in accordance with the manufacturer's printed instructions and details.

3.1.15 Metal Drip Edge

Provide a metal drip, designed to allow water run-off to drip free of underlying construction, at eaves and rakes prior to the application of roofing shingles. Apply directly on the wood deck at the eaves and over the underlay along the rakes. Extend back from the edge of the deck not more than 3 inches and secure with compatible nails spaced not more than 10 inches on center along upper edge.

3.1.16 OMITTED

3.1.17 OMITTED

3.1.18 Flashing for Roof Drains

Taper insulation to drain from 24 inches out. Set flashing on finished felts in a full bed of asphalt roof cement, ASTM D 4586. Clamp the roof membrane, flashing sheet, and stripping felt in the drain clamping ring. Secure clamps so that felts and drain flashing are free of wrinkles and folds.

3.1.19 Scuppers

Line interior of scupper openings with sheet metal. Extend the lining through and project outside of the wall to form a drip on the bottom edge and form to return not less than one inch against the face of the outside wall at the top and sides. Fold outside edges under 1/2 inch on all sides. Provide the perimeter of the lining approximately 1/2 inch less than the perimeter of the scupper. Join the top and sides of the lining on the roof deck side to a closure flange by a locked and soldered joint. Join the bottom edge by a locked and soldered joint to the closure flange, where required, form with a ridge to act as a gravel stop around the scupper inlet. Provide surfaces to receive the scupper lining and coat with bituminous plastic cement. Mechanically fasten joints in aluminum and seal.

3.1.20 Eave Flashing

One piece in width, applied in 8 to 10 foot lengths with expansion joints spaced as specified in paragraph entitled "Expansion and Contraction." Provide a 3/4 inch continuous fold in the upper edge of the sheet to engage cleats spaced not more than 10 inches on centers. Locate the upper edge of flashing not less than 18 inches from the outside face of the building, measured along the roof slope. Fold lower edge of the flashing over and loose-lock into a continuous edge strip on the fascia. Where eave flashing intersects metal valley flashing, secure with one inch flat locked joints with cleats that are 10 inches on centers. Place eave flashing over underlayment and in plastic bituminous cement.

3.1.21 Sheet Metal Covering on Flat, Sloped, or Curved Surfaces

Except as specified or indicated otherwise, cover and flash all minor flat, sloped, or curved surfaces such as crickets, bulkheads, dormers and small decks with metal sheets of the material used for flashing; maximum size of sheets, 16 by 18 inches. Fasten sheets to sheathing with metal cleats. Lock seams and solder. Lock aluminum seams and fill with sealer as recommended by aluminum manufacturer. Provide an underlayment of building paper for all sheet metal covering.

3.1.22 Expansion Joints

Provide expansion joints for roofs, walls, and floors. Joints shall be evenly spaced. An additional joint shall be provided where the distance between the last expansion joint and the end of the continuous run is more than half the required interval spacing]. Conform to the requirements of Table I.

3.1.23 Flashing at Roof Penetrations and Equipment Supports

Provide metal flashing for all pipes, ducts, and conduits projecting through the roof surface and for equipment supports, guy wire anchors, and similar items supported by or attached to the roof deck.

3.1.24 Copings

Provide coping using aluminum sheets 8 or 10 feet long joined by a 3/4 inch locked and soldered seam. Terminate outer edges in edge strips.

3.2 PAINTING

Field-paint sheet metal for separation of dissimilar materials.

3.3 CLEANING

Clean exposed sheet metal work at completion of installation. Remove grease and oil films, handling marks, contamination from steel wool, fittings and drilling debris, and scrub-clean. Free the exposed metal surfaces of dents, creases, waves, scratch marks, and solder or weld marks.

3.4 REPAIRS TO FINISH

Scratches, abrasions, and minor surface defects of finish may be repaired in accordance with the manufacturer's printed instructions and as approved. Repair damaged surfaces caused by scratches, blemishes, and variations of color and surface texture. Replace items which cannot be repaired.

3.5 FIELD QUALITY CONTROL

Establish and maintain a Quality Control Plan for sheet metal used in conjunction with roofing to assure compliance of the installed sheet metalwork with the contract requirements. Work not in compliance with the contract shall be promptly removed and replaced or corrected. Quality control shall include, but not be limited to, the following:

a. Observation of environmental conditions; number and skill level of sheet metal workers; condition of substrate.

b. Verification that specified material is provided and installed.

c. Inspection of sheet metalwork, for proper size(s) and thickness(es), fastening and joining, and proper installation.

-- End of Section --

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DIVISION 07 - THERMAL AND MOISTURE PROTECTION

SECTION 07840

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04/03

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SECTION 07840

FIRESTOPPING
04/03

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM E 84	(2001) Surface Burning Characteristics of Building Materials
ASTM E 119	(2000a) Fire Tests of Building Construction and Materials
ASTM E 814	(2002) Fire Tests of Through-Penetration Fire Stops
ASTM E 1399	(1997; R 2000) Cyclic Movement and Measuring the Minimum and Maximum Joint Widths of Architectural Joint Systems
ASTM E 1966	(2001) Fire-Resistive Joint Systems

FM GLOBAL (FM)

FM P7825a	(2003) Approval Guide Fire Protection

UNDERWRITERS LABORATORIES (UL)

UL 723	(1996; Rev thru Sep 2001) Test for Surface Burning Characteristics of Building Materials
UL 1479	(1994; Rev thru Aug 2000) Fire Tests of Through-Penetration Firestops
UL 2079	(1998) Tests for Fire Resistance of Building Joint Systems
UL Fire Resist Dir	(2001) Fire Resistance Directory (2 Vol.)

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Firestopping Materials.

Detail drawings including manufacturer's descriptive data, typical details conforming to UL Fire Resist Dir or other details certified by another nationally recognized testing laboratory, installation instructions or UL listing details for a firestopping assembly in lieu of fire-test data or report. For those firestop applications for which no UL tested system is available through a manufacturer, a manufacturer's engineering judgement, derived from similar UL system designs or other tests, shall be submitted for review and approval prior to installation. Submittal shall indicate the firestopping material to be provided for each type of application. When more than 5 penetrations or construction joints are to receive firestopping, drawings shall indicate location and type of application.

SD-07 Certificates

Firestopping Materials.

Certificates attesting that firestopping material complies with the specified requirements. In lieu of certificates, drawings showing UL classified materials as part of a tested assembly may be provided. Drawings showing evidence of testing by an alternate nationally recognized independent laboratory may be substituted.

Installer Qualifications.

Documentation of training and experience.

Inspection.

Manufacturer's representative certification stating that firestopping work has been inspected and found to be applied according to the manufacturer's recommendations and the specified requirements.

1.3 GENERAL REQUIREMENTS

Firestopping shall consist of furnishing and installing tested and listed firestop systems, combination of materials, or devices to form an effective barrier against the spread of flame, smoke and gases, and maintain the integrity of fire resistance rated walls, partitions, floors, and ceiling-floor assemblies, including through-penetrations and construction joints and gaps. Through-penetrations include the annular space around pipes, tubes, conduit, wires, cables and vents. Construction joints include those used to accommodate expansion, contraction, wind, or seismic movement; firestopping material shall not interfere with the required movement of the joint. Gaps requiring firestopping include gaps between the curtain wall and the floor slab and between the top of the fire-rated walls and the roof or floor deck above.

1.4 DELIVERY AND STORAGE

Materials shall be delivered in the original unopened packages or containers showing name of the manufacturer and the brand name. Materials shall be stored off the ground and shall be protected from damage and exposure to elements. Damaged or deteriorated materials shall be removed

from the site.

1.5 INSTALLER QUALIFICATIONS

The Contractor shall engage an experienced Installer who is certified, licensed, or otherwise qualified by the firestopping manufacturer as having the necessary staff, training, and a minimum of 3 years experience in the installation of manufacturer's products per specified requirements. A manufacturer's willingness to sell its firestopping products to the Contractor or to an installer engaged by the Contractor does not in itself confer qualification on the buyer. The Installer shall have been trained by a direct representative of the manufacturer (not distributor or agent) in the proper selection and installation procedures.

1.6 COORDINATION

The specified work shall be coordinated with other trades. Firestopping materials, at penetrations of pipes and ducts, shall be applied prior to insulating, unless insulation meets requirements specified for firestopping. Firestopping materials at building joints and construction gaps shall be applied prior to completion of enclosing walls or assemblies. Cast-in-place firestop devices shall be located and installed in place before concrete placement. Pipe, conduit or cable bundles shall be installed through cast-in-place device after concrete placement but before area is concealed or made inaccessible.

PART 2 PRODUCTS

2.1 FIRESTOPPING MATERIALS

Firestopping materials shall consist of commercially manufactured, asbestos-free, containing no water soluble intumescent imgredients, noncombustible products FM P7825a approved for use with applicable construction and penetrating items, complying with the following minimum requirements:

2.1.1 Fire Hazard Classification

Material shall have a flame spread of 25 or less, and a smoke developed rating of 50 or less, when tested in accordance with ASTM E 84 or UL 723. Material shall be an approved firestopping material as listed in UL Fire Resist Dir or by a nationally recognized testing laboratory.

2.1.2 Toxicity

Material shall be nontoxic to humans at all stages of application or during fire conditions.

2.1.3 Fire Resistance Rating

Firestopping will not be required to have a greater fire resistance rating than that of the assembly in which it is being placed.

2.1.3.1 Through-Penetrations

Firestopping materials for through-penetrations, as described in paragraph GENERAL REQUIREMENTS, shall provide "F" and "T" fire resistance ratings in accordance with ASTM E 814 or UL 1479.

2.1.3.2 Construction Joints and Gaps

Fire resistance ratings of construction joints, as described in paragraph GENERAL REQUIREMENTS, and gaps such as those between floor slabs or roof decks and curtain walls shall be the same as the construction in which they occur. Construction joints and gaps shall be provided with firestopping materials and systems that have been tested per ASTM E 119, ASTM E 1966 or UL 2079 to meet the required fire resistance rating. Systems installed at construction joints shall meet the cycling requirements of ASTM E 1399 or UL 2079.

PART 3 EXECUTION

3.1 PREPARATION

Areas to receive firestopping shall be free of dirt, grease, oil, or loose materials which may affect the fitting or fire resistance of the firestopping system. For cast-in-place firestop devices, formwork or metal deck to receive device prior to concrete placement shall be sound and capable of supporting device. Surfaces shall be prepared as recommended by the manufacturer.

3.2 INSTALLATION

Firestopping material shall completely fill void spaces regardless of geometric configuration, subject to tolerance established by the manufacturer. Firestopping systems for filling floor voids 4 inches or more in any direction shall be capable of supporting the same load as the floor is designed to support or shall be protected by a permanent barrier to prevent loading or traffic in the firestopped area. Firestopping shall be installed in accordance with manufacturer's written instructions. Tested and listed firestop systems shall be provided in the following locations, except in floor slabs on grade:

a. Penetrations of duct, conduit, tubing, cable and pipe through floors and through fire-resistance rated walls, partitions, and ceiling-floor assemblies.

b. Penetrations of vertical shafts such as pipe chases, elevator shafts, and utility chutes.

c. Gaps at the intersection of floor slabs and curtain walls, including inside of hollow curtain walls at the floor slab.

d. Gaps at perimeter of fire-resistance rated walls and partitions, such as between the top of the walls and the bottom of roof decks.

e. Construction joints in floors and fire rated walls and partitions.

f. Other locations where required to maintain fire resistance rating of the construction.

3.2.1 Insulated Pipes and Ducts

Thermal insulation shall be cut and removed where pipes or ducts pass through firestopping, unless insulation meets requirements specified for firestopping. Thermal insulation shall be replaced with a material having equal thermal insulating and firestopping characteristics.

3.2.2 Fire Dampers

Fire dampers shall be installed and firestopped in accordance with Section 15895 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM.

3.2.3 Data and Communication Cabling

Cabling for data and communication applications shall be sealed with re-enterable firestopping products that do not cure over time. For areas where cabling moves, add-ons and changes are expected to be frequent, fire-rated modular devices, containing built in self-sealing intumescent inserts, shall be utilized as path way device for cables passing through fire rated floors and walls and partitions.

3.3 INSPECTION

Firestopped areas shall not be covered or enclosed until inspection is complete and approved. A manufacturer's representative shall inspect the applications initially to ensure adequate preparations (clean surfaces suitable for application, etc.) and periodically during the work to assure that the completed work has been accomplished according to the manufacturer's written instructions and the specified requirements. The Contractor shall submit written reports indicating locations of and types of penetrations and types of firestopping used at each location; type shall be recorded by UL listed printed numbers.

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SECTION 07900A

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06/97

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SECTION 07900A

JOINT SEALING
06/97

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 570	(1995) Oil- and Resin-Base Caulking Compound for Building Construction
ASTM C 834	(1995) Latex Sealants
ASTM D 1056	(1991) Flexible Cellular Materials - Sponge or Expanded Rubber

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Backing; Bond-Breaker;

Sealant.

Manufacturer's descriptive data including storage requirements, shelf life, curing time, instructions for mixing and application, and primer data (if required). A copy of the Material Safety Data Sheet shall be provided for each solvent, primer or sealant material.

SD-07 Certificates

Sealant;

Certificates of compliance stating that the materials conform to the specified requirements.

1.3 ENVIRONMENTAL REQUIREMENTS

The ambient temperature shall be within the limits of 40 to 90 degrees F when the sealants are applied.

1.4 DELIVERY AND STORAGE

Materials shall be delivered to the job in the manufacturer's original unopened containers. The container label or accompanying data sheet shall include the following information as applicable: manufacturer, name of

material, formula or specification number, lot number, color, date of manufacture, mixing instructions, shelf life, and curing time at the standard conditions for laboratory tests. Materials shall be handled and stored to prevent inclusion of foreign materials. Materials shall be stored at temperatures between 40 and 90 degrees F unless otherwise specified by the manufacturer.

PART 2 PRODUCTS

2.1 BACKING

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, Class A, round cross section.

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 CAULKING

Oil- and resin-based caulking shall be ASTM C 570.

2.5 SEALANT

2.5.1 LATEX

Latex Sealant shall be ASTM C 834.

2.6 SOLVENTS AND CLEANING AGENTS

Solvents, cleaning agents, and accessory materials shall be provided as recommended by the manufacturer.

PART 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.

3.1.5 Wood Surfaces

Wood surfaces to be in contact with sealants shall be free of splinters and sawdust or other loose particles.

3.2 APPLICATION

3.2.1 Masking Tape

Masking tape may be placed on the finish surface on one or both sides of a joint cavity to protect adjacent finish surfaces from primer or sealant smears. Masking tape shall be removed within 10 minutes after joint has been filled and tooled.

3.2.2 Backing

Backing shall be installed to provide the indicated sealant depth. The installation tool shall be shaped to avoid puncturing the backing.

3.2.3 Bond-Breaker

Bond-breaker 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.

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SECTION 08110

STEEL DOORS AND FRAMES

05/01

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SECTION 08110

STEEL DOORS AND FRAMES
05/01

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A250.4	(1994) Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors and Hardware Reinforcings
ANSI A250.6	(1997) Hardware on Standard Steel Doors (Reinforcement - Application)
ANSI A250.8	(1998) SDI-100 Recommended Specifications for Standard Steel Doors and Frames

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 591	(1998) Steel Sheet, Electrolytic Zinc-Coated, for Light Coating Mass Applications
ASTM A 653/A 653M	(2000) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 924/A 924M	(1999) General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process

DOOR AND HARDWARE INSTITUTE (DHI)

BHMA A115	(1991) Steel Door Preparation Standards (Consisting of A115.1 through A115.6 and A115.12 through A115.18)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80	(1999) Fire Doors and Fire Windows
NFPA 105	(1999) The Installation of Smoke-Control Door Assemblies
NFPA 252	(1999) Standard Methods of Fire Tests of Door Assemblies

STEEL DOOR INSTITUTE (SDOI)

SDI 105	(1998) Recommended Erection Instructions

	for Steel Frames
SDI 111-C	Recommended Louver Details for Standard Steel Doors
SDI 111-F	Recommended Existing Wall Anchors for Standard Steel Doors and Frames

UNDERWRITERS LABORATORIES (UL)

UL 10B	(1997) Fire Tests of Door Assemblies

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-02 Shop Drawings

Doors

Frames

Accessories

Show elevations, construction details, metal gages, hardware provisions, method of glazing, and installation details.

Schedule of doors

Schedule of frames

Submit door and frame locations.

SD-03 Product Data

Doors

Frames

Accessories

Submit manufacturer's descriptive literature for doors, frames, and accessories. Include data and details on door construction, panel (internal) reinforcement, insulation, and door edge construction. When "custom hollow metal doors" are provided in lieu of "standard steel doors," provide additional details and data sufficient for comparison to ANSI A250.8 requirements.

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver doors, frames, and accessories undamaged and with protective wrappings or packaging. Store doors and frames on platforms under cover in

clean, dry, ventilated, and accessible locations, with 1/4 inch airspace between doors. Remove damp or wet packaging immediately and wipe affected surfaces dry. Replace damaged materials with new.

PART 2 PRODUCTS

2.1 STANDARD STEEL DOORS

ANSI A250.8, except as specified otherwise. Prepare doors to receive hardware specified . Undercut where indicated. Exterior doors shall have top edge closed flush and sealed to prevent water intrusion. Doors shall be 1 3/4 inches thick, unless otherwise indicated.

2.1.1 Classification - Level, Performance

2.1.1.1 Standard Duty Doors

ANSI A250.8, Level 1, physical performance Level c, and design(s) indicated and core construction as required by the manufacturer.

2.2 INSULATED STEEL DOOR SYSTEMS

At all exterior doors insulated steel doors and frames shall be provided. Door size(s), design, and material shall be as specified for standard steel doors. Insulated steel doors shall have a core of polyurethane foam and an R factor of 10.0 or more (based on a k value of 0.16); face sheets, edges, and frames of galvanized steel not lighter than 23 gage, 16 gage, and 16 gage respectively; . Doors and frames shall receive phosphate treatment, rust-inhibitive primer. Doors shall have been tested in accordance with ANSI A250.4 and shall have met the requirements for Level C.

2.3 ACCESSORIES

2.3.1 Louvers

2.3.1.1 Interior Louvers

SDI 111-C, Louvers shall be stationary sightproof type. Detachable moldings on room or non security side of door; on security side of door, moldings to be integral part of louver. Form louver frames of 20 gage steel and louver blades of a minimum 24 gage.

2.3.1.2 Exterior Louvers

Louvers shall be inverted type with minimum of 30 percent net-free opening. Weld or tenon louver blades to continuous channel frame and weld assembly to door to form watertight assembly. Form louvers of hot-dip galvanized steel of same gage as door facings. Louvers shall have steel-framed insect screens secured to room side and readily removable.

2.3.2 Astragals

For pairs of exterior steel doors which will not have aluminum astragals or removable mullions, provide overlapping steel astragals with the doors. For interior pairs of fire rated and smoke control doors, provide stainless steel astragals complying with NFPA 80 for fire rated assemblies and NFPA 105 for smoke control assemblies.

2.4 STANDARD STEEL FRAMES

ANSI A250.8, except as otherwise specified. Form frames to sizes and shapes indicated, with welded corners or knock-down field-assembled corners.

2.4.1 Welded Frames

Continuously weld frame faces at corner joints. Mechanically interlock or continuously weld stops and rabbets. Grind welds smooth.

2.4.2 Knock-Down Frames

Design corners for simple field assembly by concealed tenons, splice plates, or interlocking joints that produce square, rigid corners and a tight fit and maintain the alignment of adjoining members. Provide locknuts for bolted connections. Knock-down frames may be installed in metal stud walls where there are no integral sidelights or transoms incorperated into frame.

2.4.3 Mullions and Transom Bars

Mullions and transom bars shall be closed or tubular construction and shall member with heads and jambs butt-welded thereto. Bottom of door mullions shall have adjustable floor anchors and spreader connections.

2.4.4 Stops and Beads

Form stops and beads from 20 gage steel. Provide for glazed and other openings in standard steel frames. Secure beads to frames with oval-head, countersunk Phillips self-tapping sheet metal screws or concealed clips and fasteners. Space fasteners approximately 12 to 16 inches on centers. Miter molded shapes at corners. Butt or miter square or rectangular beads at corners.

2.4.5 Cased Openings

Fabricate frames for cased openings of same material, gage, and assembly as specified for metal door frames, except omit door stops and preparation for hardware.

2.4.6 Anchors

Provide anchors to secure the frame to adjoining construction. Provide steel anchors, zinc-coated or painted with rust-inhibitive paint, not lighter than 18 gage.

2.4.6.1 Wall Anchors

Provide at least three anchors for each jamb. For frames which are more than 7.5 feet in height, provide one additional anchor for each jamb for each additional 2.5 feet or fraction thereof.

a. Masonry: Provide anchors of corrugated or perforated steel straps or 3/16 inch diameter steel wire, adjustable or T-shaped;

b. Stud partitions: Weld or otherwise securely fasten anchors to backs of frames. Design anchors to be fastened to closed steel studs with sheet metal screws, and to open steel studs by wiring or welding;

c. Completed openings: Secure frames to previously placed concrete or masonry with expansion bolts in accordance with SDI 111-F; and

2.4.6.2 Floor Anchors

Provide floor anchors drilled for 3/8 inch anchor bolts at bottom of each jamb member.

2.5 FIRE AND SMOKE DOORS AND FRAMES

NFPA 80 and NFPA 105 and this specification. The requirements of NFPA 80 and NFPA 105 shall take precedence over details indicated or specified.

2.5.1 Labels

Fire doors and frames shall bear the label of Underwriters Laboratories (UL), Factory Mutual Engineering and Research (FM), or Warnock Hersey International (WHI) attesting to the rating required. Testing shall be in accordance with NFPA 252 or UL 10B. Labels shall be metal with raised letters, and shall bear the name or file number of the door and frame manufacturer. Labels shall be permanently affixed at the factory to frames and to the hinge edge of the door. Door labels shall not be painted.

2.5.2 Oversized Doors

For fire doors and frames which exceed the size for which testing and labeling are available, furnish certificates stating that the doors and frames are identical in design, materials, and construction to a door which has been tested and meets the requirements for the class indicated.

2.5.3 Astragal on Fire and Smoke Doors

On pairs of labeled fire doors, conform to NFPA 80 and UL requirements. On smoke control doors, conform to NFPA 105.

2.6 HARDWARE PREPARATION

Provide minimum hardware reinforcing gages as specified in ANSI A250.6. Drill and tap doors and frames to receive finish hardware. Prepare doors and frames for hardware in accordance with the applicable requirements of ANSI A250.8 and ANSI A250.6. For additional requirements refer to BHMA A115. Drill and tap for surface-applied hardware at the project site. Build additional reinforcing for surface-applied hardware into the door at the factory. Locate hardware in accordance with the requirements of ANSI A250.8, as applicable. Punch door frames to receive a minimum of two rubber or vinyl door silencers on lock side of single doors and one silencer for each leaf at heads of double doors. Set lock strikes out to provide clearance for silencers.

2.7 FINISHES

2.7.1 Factory-Primed Finish

All surfaces of doors and frames shall be thoroughly cleaned, chemically treated and factory primed with a rust inhibiting coating as specified in ANSI A250.8.

2.7.2 Hot-Dip Zinc-Coated and Factory-Primed Finish

Fabricate exterior doors and frames from hot dipped zinc coated steel, alloyed type, that complies with ASTM A 924/A 924M and ASTM A 653/A 653M. The Coating weight shall meet or exceed the minimum requirements for coatings having 0.4 ounces per square foot, total both sides, i.e., A40. Repair damaged zinc-coated surfaces by the application of zinc dust paint. Thoroughly clean and chemically treat to insure maximum paint adhesion. Factory prime as specified in ANSI A250.8.

2.7.3 Electrolytic Zinc-Coated Anchors and Accessories

Provide electrolytically deposited zinc-coated steel to exterior frames in accordance with ASTM A 591, Commercial Quality, Coating Class A. Phosphate treat and factory prime zinc-coated surfaces as specified in ANSI A250.8.

2.8 FABRICATION AND WORKMANSHIP

Finished doors and frames shall be strong and rigid, neat in appearance, and free from defects, waves, scratches, cuts, dents, ridges, holes, warp, and buckle. Molded members shall be clean cut, straight, and true, with joints coped or mitered, well formed, and in true alignment. Dress exposed welded and soldered joints smooth. Design door frame sections for use with the wall construction indicated. Corner joints shall be well formed and in true alignment. Conceal fastenings where practicable.

2.8.1 Grouted Frames

For frames to be installed in exterior walls and to be filled with mortar or grout, fill the stops with strips of rigid insulation to keep the grout out of the stops and to facilitate installation of stop-applied head and jamb seals.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Frames

Set frames in accordance with SDI 105. Plumb, align, and brace securely until permanent anchors are set. Anchor bottoms of frames with expansion bolts or powder-actuated fasteners. Build in or secure wall anchors to adjoining construction.

3.1.2 Doors

Hang doors in accordance with clearances specified in ANSI A250.8. After erection and glazing, clean and adjust hardware.

3.1.3 Fire and Smoke Doors and Frames

Install fire rated, smoke doors and frames in accordance with NFPA 80 and NFPA 105.

3.2 PROTECTION

Protect doors and frames from damage. Repair damaged doors and frames prior to completion and acceptance of the project or replace with new, as

directed. Wire brush rusted frames until rust is removed. Clean thoroughly. Apply an all-over coat of rust-inhibitive paint of the same type used for shop coat.

3.3 CLEANING

Upon completion, clean exposed surfaces of doors and frames thoroughly. Remove mastic smears and other unsightly marks.

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SECTION 08210

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08/00

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SECTION 08210

WOOD DOORS
08/00

PART 1 GENERAL

1.1 REFERENCES

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

ARCHITECTURAL WOODWORK INSTITUTE (AWI)

AWI-02	(1994) Architectural Woodwork Quality Standards, Guide Specifications and Quality Certification Program

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80	(1995) Fire Doors and Windows
NFPA 101	(1997) Safety to Life from Fire in Buildings and Structures
NFPA 252	(1995) Fire Tests of Door Assemblies

NATIONAL WOOD WINDOW & DOOR ASSOCIATION (NWWDA)

NWWDA I.S. 1-A	(1993) Architectural Wood Flush Doors
NWWDA I.S. 4	(1994) Water-Repellent Preservative Non-Pressure Treatment for Millwork

1.2 GENERAL REQUIREMENTS

1.2.1 Standard Products

Doors shall be of the type, size, and design indicated on the drawings, and shall be the standard products of manufacturers regularly engaged in the manufacture of wood doors.

1.2.2 Marking

Each door shall bear a stamp, brand, or other identifying mark indicating quality and construction of the door. The identifying mark or a separate certification shall include identification of the standard on which construction of the door is based, identity of the manufacturing plant, identification of the standard under which preservative treatment, if used, was made, and identification of the doors having a Type I glue bond.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Wood Doors;

Drawings indicating the location of each door, elevation of each type of door, details of construction, marks to be used to identify the doors, and location and extent of hardware blocking. Drawings shall include catalog cuts or descriptive data for doors, weatherstripping, flashing, and thresholds to be used.

SD-08 Manufacturer's Instructions

Fire Rated Doors;

Manufacturers preprinted installation and touch-up instructions.

1.4 STORAGE

Doors shall be stored in fully covered areas and protected from damage and from extremes in temperature and humidity. Doors shall be stored on supports to prevent warping or twisting, and to provide ventilation. Factory cartons or wrappers shall be kept intact until installation.

1.5 HARDWARE

Hardware, including weatherstripping and thresholds, is specified in Section 08702 BUILDERS' HARDWARE.

1.6 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

PART 2 PRODUCTS

2.1 GENERAL FABRICATION REQUIREMENTS

2.1.1 Edge Sealing

Wood end-grain exposed at edges of doors shall be sealed prior to shipment.

2.1.2 Preservative Treatment

Exterior softwood doors shall be water-repellent preservative treated in accordance with NWWDA I.S. 4.

2.1.3 Adhesives

Adhesives shall be in accordance with NWWDA I.S. 1-A, requirements for Type I Bond Doors (waterproof) for exterior doors and requirements for Type II Bond Doors (water-repellent) for interior doors. Adhesive for doors to receive a transparent finish shall be nonstaining. Adhesives shall contain no formaldehydes.

2.1.4 Prefitting

Doors shall be furnished prefitted or unfitted at the option of the Contractor, except plastic laminate clad doors shall be furnished prefit in

accordance with the standards under which they are produced.

2.2 FLUSH DOORS

Flush doors shall be solid core as shown and shall conform to NWWDA I.S. 1-A, except for the one year acclimatization requirement in paragraph T-2, which shall not apply. Wood doors shall be 5-ply or 7-ply construction with faces, stiles, and rails bonded to the cores. Flush doors in Joint Ops Facility shall be red oak.

2.2.1 Core Construction

2.2.1.1 Solid Cores

Door construction shall be glued wood block core or particle board or mineral core with vertical and horizontal edges bonded to the core. Blocking and hardware reinforcements for particle board and mineral core doors shall be in accordance with NWWDA I.S. 1-A.

2.3 Wood Panel Doors

Wood panel doors shall be 6-panel type, 1-3/4" thick. Wood species shall be premium red oak. Doors shall be SD-418 by Sun-Door Co. or equal. Standard mouldings and bevel panel profiles shall be used.

2.4 Natural Finished Doors

All Doors, in all buildings except the Joint Ops Facility, to receive natural finish shall be Premium Grade rotary cut birch in accordance with AWI-02. Finish shall be in accordance with paragraph FIELD FINISHING.

2.5 FIRE RATED DOORS

Fire rated door assemblies shall bear the listing identification label of a nationally recognized testing laboratory qualified to perform tests of fire door assemblies in accordance with NFPA 252 and having a listing for the tested assemblies. The specific time interval rating on the labels shall be as shown. Door assemblies shall be in accordance with NFPA 80. Listing identification on labels shall be constructed and permanently applied by a method which results in their destruction should they be removed.

2.5.1 Reinforcement Blocking

Fire rated doors shall be provided, as required, with hardware reinforcement blocking, and top, bottom, and intermediate rail blocking. Lock blocks shall be manufacturer's standard. Reinforcement blocking shall be in compliance with the manufacturer's labeling requirements. Reinforcement blocking shall not be of mineral material.

2.5.2 Stile Edges

Composite fire rated doors shall be provided with vertical stile edges that do not contain fire retardant salts.

PART 3 EXECUTION

3.1 INSTALLATION OF DOORS

3.1.1 General Use Doors

Doors shall be fit, hung, and trimmed as required. Door shall have a clearance of 1/8 inch at the sides and top and shall have a bottom clearance of 1/4 inch over thresholds and 1/2 inch at other locations unless otherwise shown. The lock edge or both edges of doors shall be beveled at the rate of 1/8 inchin 2 inches. Cuts made on the job shall be sealed immediately after cutting, using a clear varnish or sealer. Bottom of doors shall be undercut to allow clear door swing over carpeted areas. Vertical edges of doors which have not been rounded or beveled at the factory shall be eased when the doors are installed.

3.1.2 Fire Rated Doors

Installation, hardware, and operational characteristics shall conform to NFPA 80 and NFPA 101 and shall be in strict conformance with the manufacturer's printed instructions. Properly sized pilot holes shall be drilled for screws in door edges. Factory applied labels shall remain intact where installed. Labeled hinge stile edge and top edge of door shall not be trimmed. Lockstile edge and bottom edge may be trimmed only to the extent recommended by the door manufacturer.

3.2 FIELD FINISHING

Doors shall be factory primed or sealed, as required, and then shall be finished in accordance with Section 09900 PAINTING, GENERAL. Factory applied sealer shall not prevent doors from accepting field finish. Field touch-up of factory finishes shall be in accordance with manufacturers instructions.

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SECTION 08702

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03/96

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SECTION 08702

BUILDERS' HARDWARE
(FORT BRAGG PROJECTS)
03/96

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM 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-01	(Effective thru Jun 1995) Directory of Certified Locks & Latches
BHMA-02	(Effective thru Jul 1995) Directory of Certified Door Closers
BHMA-03	(Effective thru Jul 1996) Directory of Certified Exit Devices
BHMA ANSI/BHMA A156.1	(2000) Butts and Hinges
BHMA ANSI/BHMA A156.2	(1989) Bored and Preassembled Locks and Latches
BHMA ANSI/BHMA A156.3	(2001) Exit Devices
BHMA ANSI/BHMA A156.4	(2000) Door Controls - Closers
BHMA ANSI/BHMA A156.5	(2001) Auxiliary Locks & Associated Products
BHMA ANSI/BHMA A156.6	(1994) Architectural Door Trim
BHMA ANSI/BHMA A156.7	(1988) Template Hinge Dimensions
BHMA ANSI/BHMA A156.13	(1994) Mortise Locks & Latches
BHMA ANSI/BHMA A156.16	(1989) Auxiliary Hardware
BHMA ANSI/BHMA A156.18	(2000) Materials and Finishes
BHMA ANSI/BHMA A156.21	(2001) Thresholds

DOOR AND HARDWARE INSTITUTE (DHI)

DHI-04	(1976) Recommended Locations for Builders' Hardware for Custom Steel Doors and Frames
DHI-05	(1990) Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames
DHI-A115.IG	(1994) Installation Guide for Doors and Hardware
DHI A115-W	(Varies) Wood Door Hardware Standards (Incl All5-W1 thru A115-W9)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80	(1999) Fire Doors and Windows
NFPA 101	(2000) Safety to Life from Fire in Buildings and Structures
NFPA 105	(1993) Installation of Smoke-Control Door Assemblies

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Hardware and Accessories; G, RE.

Manufacturer's descriptive data, technical literature, catalog cuts, and installation instructions. Spare parts data for locksets, exit devices, closers, electric locks, electric strikes, electro-magnetic closer holder release devices, and electric exit devices, after approval of the detail drawings, and not later than 1 month prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply.

SD-02 Shop Drawings

Hardware Devices; G, RE.

Detail drawings for hardware devices for computerized keying systems, magnetic cards, keyless push button access control systems, and other electrical hardware devices showing complete wiring and schematic diagrams and other details required to demonstrate proper function of units.

Hardware Schedule;

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.

Keying Schedule; G, RE.

The keying schedule shall be developed in accordance with the schedule shown on the drawings and with DHI publication "Keying Procedures, Systems, and Nomenclature." The keying schedule and bitting list shall be compatible with the installation's existing keying system and shall be submitted for approval by the installation prior to ordering any keying hardware.

Bitting List;

The bitting list shall be furnished (prior to the prefinal inspection) to the PWBC locksmith by certified mail from the manufacturer or registered locksmith originating the system. The bitting list will include the type of keying system used and actual identification of key cuts and codes or cylinders. The bitting list shall be prepared by the manufacturer. However, if the contract requires less than 50 cores or cylinders, the bitting list may be prepared by the manufacturer or a registered locksmith certified by the Associated Locksmiths of America, Inc.

SD-07 Certificates

Hardware and Accessories;

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-01, BHMA-02 and BHMA-03 directories 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.

1.7 OPERATION AND MAINTENANCE MANUALS

Six complete copies of maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides shall be provided. The instructions for electric locks, electric strikes, electro-magnetic closer holder release devices, and electric exit devices shall include simplified diagrams as installed.

PART 2 PRODUCTS

2.1 GENERAL HARDWARE REQUIREMENTS

Hardware shall conform to the requirements specified herein and the HARDWARE SETS listing at the end of this section. Hardware set numbers correspond to the set numbers shown on the drawings.

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 ANSI/BHMA A156.7.

2.3 HINGES

Hinges shall conform to BHMA ANSI/BHMA A156.1. Hinges used on metal doors and frames shall also conform to BHMA ANSI/BHMA A156.7. Except as otherwise specified, hinge sizes shall conform to the hinge manufacturer's printed recommendations.

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, except where prohibited for fire doors by the requirements of NFPA 80.

2.4 LOCKS AND LATCHES

To the maximum extent possible, locksets, latchsets and deadlocks shall be the products of a single manufacturer. Strikes for wood frames and pairs of wood doors shall be furnished with wrought boxes.

2.4.1 Omitted

2.4.2 Bored Lock and Latchsets

Bored lock, latchsets, and strikes shall be series 4000 and shall conform to BHMA ANSI/BHMA A156.2, Grade 1. Bored type locks and latches for doors 1-3/8 inches thick and over shall have adjustable bevel fronts or otherwise conform to the shape of the door.

2.4.3 Lock Cylinders (Mortise, Rim and Bored)

Lock cylinders shall comply with BHMA ANSI/BHMA A156.5. Lock cylinder shall have not less than six pins. Cylinders shall have key removable type cores. A grand master keying system shall be provided. An extension of the existing keying system shall be provided. A construction master keying system shall be provided. Disassembly of knob or lockset shall not be required to remove core from lockset. All locksets, lockable exit devices, and padlocks shall accept same interchangeable cores. Manufacturer shall be Casi-Rusco or approved equal.

2.4.4 Lock Trim

Lock trim shall be cast, forged, or heavy wrought construction of commercial plain design. In addition to meeting the test requirement of BHMA ANSI/BHMA A156.2 or BHMA ANSI/BHMA A156.13, knobs, 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. Knob diameter shall be 2-1/8 to 2-1/4 inches.Lever handles shall be of plain design with ends returned to no more than 1/2 inch from the door face.

2.5 EXIT DEVICES AND EXIT DEVICE ACCESSORIES

Exit devices and exit device accessories shall conform to BHMA ANSI/BHMA A156.3, Grade 1.

2.5.1 Exit Devices and Auxiliary Items

Trim shall be of wrought construction and commercial plain design with straight, beveled, or smoothly rounded sides, corners, and edges. Adjustable strikes shall be provided for rim type and vertical rod devices. Open back strikes shall be provided for pairs of doors with mortise and vertical rod devices; except open back strikes shall be used on labeled doors only where specifically provided for in the published listings. Touch bars shall be provided in lieu of conventional crossbars and arms. Escutcheons shall be provided not less than 7 by 2-1/4 inches. Escutcheons shall be cut to suit cylinders and operating trim.

2.5.2 Door Coordinator

Door coordinator with carry bar shall be Type 21 and shall be provided for each pair of doors equipped with an overlapping astragal. The coordinator may be gravity operated and shall be capable of holding the active door of a pair open until the inactive door has preceded it in the closing cycle. When used as fire exit hardware, the coordinator and carry bar shall be listed or labeled by a nationally recognized independent testing laboratory.

2.5.3 Omitted

2.5.4 Automatic Flush Bolts

Automatic flush bolts shall be Type 25 in accordance with BHMA ANSI/BHMA A156.3, and shall be installed at the top and bottom of the inactive leaf of pairs of fire rated doors where specified in the hardware sets. Flush bolts shall be mortised in the strike edge of the door.

2.6 KEYING

Locks shall be keyed in sets or subsets as scheduled. Locks shall be furnished with the manufacturer's standard construction key system. Change keys for locks shall be stamped with change number and the inscription "U.S. Property - Do Not Duplicate." Keys shall be supplied as follows:

Locks:	2 change keys each lock

The keys will be furnished to the Contracting Officer as described below in a container arranged for key control system storage in sets or subsets as approved in the keying schedule along with a chart identifying key location as to door, room, and key numbers.

2.6.1 Manufacturing

Permanent core control keys, grand masters, masters, or any submasters and the bitting list will be sent to the DPWE locksmith by registered mail prior to the prefinal inspection. Keying will be done by the manufacturer, if over 50 cores or cylinders. If the contract requires less than 50 cores or cylinders, the keying may be prepared by the manufacturer or a registered locksmith certified by the Associated Locksmiths of America, Inc.

2.6.2 Installation

The permanent cores or cylinders will be installed by a registered locksmith certified by the Associated Locksmiths of America, Inc. The Contractor's locksmith will change out all construction cores prior to final inspection. After the prefinal inspection and once the Contracting Officer's Representative has determined that the work is ready for a final inspection, all interior keys will be inserted in the locks so that the hardware can be checked for proper operation during final inspection. The exterior keys will be available during final inspection so that the exterior hardware can be checked for proper operation. At the completion of final inspection, all exterior keys will be retained by the Contracting Officer's Representative and controlled access will be allowed the Contractor and DPWE until all work has been completed. Once all work has been completed, the Contracting Officer's Representative will transfer the exterior keys to the DPWE.

2.7 DOOR CLOSING DEVICES

Door closing devices shall conform to BHMA ANSI/BHMA A156.4, Grade 1. Closing devices shall be products of one manufacturer for each type specified. The opening resistance of closing devices shall not exceed 15 1bf applied at the latch stile or exceed 5 1bfwhere low opening resistance is scheduled.

2.7.1 Surface Type Closers

Surface type closers shall be Grade 1, Series C01000 with options PT-4C and PT-4D with options PT-4H, Size 1 or 2 through Size 6, and PT-4D with back check position valve. Except as otherwise specified, sizes shall conform to the manufacturer's published recommendations. Closers for outswinging exterior doors shall have parallel arms or shall be top jamb mounted. Closers for doors close to a wall shall be of narrow projection so as not to strike the wall at the 90-degree open position.

2.8 ARCHITECTURAL DOOR TRIM

Architectural door trim shall conform to BHMA ANSI/BHMA A156.6.

2.8.1 Door Protection Plates

2.8.1.1 Kick Plates

Kick plates shall be Type J102 stainless steel. Width of plates shall be 2 inches less than door width for single doors and 1 inchless for pairs of doors. Height shall be 12 inches, Edges of metal plates shall be bevele.

2.8.2 Push Plates

2.8.2.1 Combination Push-Pull Plates

Combination push-pull plates shall be Type J303, 0.050 inchthick minimum stainless steel beveled four edges.

2.9 AUXILIARY HARDWARE

Auxiliary hardware, consisting of door stops, shall conform to BHMA ANSI/BHMA A156.16. Lever extension flush bolts shall be Type L14081. Dust-proof strikes shall be Type L04011 for doors that are not fire rated. Dust-proof strikes shall be Type L04021 for fire rated doors. Other auxiliary hardware of the types listed below, shall conform to BHMA ANSI/BHMA A156.16.

2.10 MISCELLANEOUS

2.10.1 Metal Thresholds

Thresholds shall conform to BHMA ANSI/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. Where required, thresholds shall be modified to receive projecting bolts of exit devices. 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.

2.10.2 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 clear (natural) 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.

2.11 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. Sex bolts, through bolts, or machine screws and grommet nuts, where used on reverse-bevel exterior doors equipped with half-surface or full-surface hinges, shall employ one-way screws or other approved tamperproof screws.

2.12 FINISHES

Unless otherwise specified, finishes shall conform to those identified in BHMA ANSI/BHMA A156.18.

2.13 HARDWARE FOR FIRE DOORS

Hardware for fire doors shall conform to the requirements of NFPA 80and NFPA 101.

PART 3 EXECUTION

3.1 APPLICATION

Hardware shall be located in accordance with DHI-04 and DHI-05, except that deadlocks shall be mounted 48 inches above finish floor. When approved, slight variations in locations or dimensions will be permitted. Application shall be in accordance with DHI-A115.IG or DHI A115-W. Door control devices for exterior doors such as closers and holders, shall be attached to doors with thru bolts and nuts or sex bolts. 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. Electric hardware items and access control devices shall be installed in accordance with manufacturer's printed installation procedures.

3.1.1 Hardware for Fire Doors and Smoke-Control Door Assemblies

Hardware for fire doors shall be installed in accordance with the requirements of NFPA 80. Exit devices installed on fire doors shall have a visible label bearing the marking "Fire Exit Hardware". Other hardware installed on fire doors, such as locksets, closers, and hinges shall have a visible label or stamp indicating that the hardware items have been approved by an approved testing agency for installation on fire-rated doors. Hardware for smoke-control door assemblies shall be installed in accordance with NFPA 105.

3.1.2 Door-Closing Devices

Door-closing devices shall be installed and adjusted in accordance with the templates and printed instructions supplied by the manufacturer of the devices. Insofar as practicable, doors opening to or from halls and corridors shall have the closer mounted on the room side of the door.

3.1.3 Kick Plates

Kick plates shall be installed on the push side of single-acting doors.

3.1.4 Thresholds

Thresholds shall be secured with a minimum of three fasteners per single door width and six fasteners per double door width with a maximum spacing of 12 inches. Exterior thresholds shall be installed in a bed of sealant with expansion anchors and stainless steel screws. Minimum screw size shall be No. 10 length, dependent on job conditions, with a minimum of 3/4 inchthread engagement into the floor or anchoring device used.

3.1.5 Weatherseals

Weatherseals shall be located 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 SETS

Set#	Quanity	Item	ANSI #	Finish
HW-1	3	Hinges	A5111 4.5x4.5	630
	1	Lockset w/ levers & Simplex 1000	F90 Grade 1	630
	3	Silencers	L03011	630
	1	Door Stop, Wall mounted		630
HW-2	3	Hinges	A5111 4.5x4.5	630
	1	Lockset w/ levers & Simplex 1000	F90 Grade 1	630
	1	Closer	C02021	689
	1	Kickplate	J102 8"x 2" LDW	630
	3	Silencers	L03011	630
HW-3	6	Hinges w/ N.R.P.	A5111 4.5x4.5	630
	1	Lockset w/ levers on active flush bolts on inactive leaf, hardened steel	F81 Grade 1	630
	1	Coordinator-Gravity type surface mounted		630
	2	Closers	C02021	689
	2	Kickplates	J102 8"x 2" LDW	630
	1	Astragal-overlapping, integral with door		
	2	Silencers	L03011	630
	1	Proximity Card Reader		
	1	Door strip above door		
	1	Threshhold	J601	AL
	1	Weatherstrip set, seal flange vinyl tube		AL
	1	Sweep, 1/4" Neoprene in alum. housing		AL
HW-4	3	Hinges	A5111 4.5x4.5	630
	1	Lockset w/ levers & Simplex 1000	F76 Grade 1	630
	3	Silencers	L03011	630

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SECTION 09100

METAL SUPPORT ASSEMBLIES

09/99

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3.2 ERECTION TOLERANCES

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SECTION 09100

METAL SUPPORT ASSEMBLIES
09/99

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 463/A 463M	(1997; Rev. A) Steel Sheet, Aluminum-Coated, by the Hot-Dip Process
ASTM A 653/A 653M	(1998) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM C 645	(1998) Nonstructural Steel Framing Members
ASTM C 754	(1997) Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products
ASTM C 841	(1997) Installation of Interior Lathing and Furring

METAL LATH/STEEL FRAMING ASSOCIATION (ML/SFA)

NAAMM ML/SFA MLF	(1991) Metal Lathing and Furring

UNDERWRITERS LABORATORIES (UL)

UL Fire Resist Dir	(1997) Fire Resistance Directory

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-02 Shop Drawings

Metal support systems

Submit for the erection of metal framing, furring, and ceiling suspension systems. Indicate materials, sizes, thicknesses, and fastenings.

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the job site and store in ventilated dry locations. Storage area shall permit easy access for inspection and handling. If materials are stored outdoors, stack materials off the ground, supported on a level platform, and fully protected from the weather. Handle materials

carefully to prevent damage. Remove damaged items and provide new items.

PART 2 PRODUCTS

2.1 MATERIALS

Provide steel materials for metal support systems with galvanized coating ASTM A 653/A 653M, G-60; aluminum coating ASTM A 463/A 463M, T1-25; or a 55-percent aluminum-zinc coating.

2.1.1 Materials for Attachment of Lath

2.1.1.1 Suspended and Furred Ceiling Systems and Wall Furring

ASTM C 841.

2.1.1.2 Nonload-Bearing Wall Framing

NAAMM ML/SFA MLF.

2.1.2 Materials for Attachment of Gypsum Wallboard

2.1.2.1 Suspended and Furred Ceiling Systems

ASTM C 645.

2.1.2.2 Nonload-Bearing Wall Framing and Furring

ASTM C 645, but not thinner than 0.0179 inch thickess, with 0.0329 inch minimum thickness supporting wall hung items such as cabinetwork, equipment and fixtures.

2.1.2.3 Furring Structural Steel Columns

ASTM C 645. Steel (furring) clips and support angles listed in UL Fire Resist Dir may be provided in lieu of steel studs for erection of gypsum wallboard around structural steel columns.

2.1.2.4 Z-Furring Channels with Wall Insulation

Not lighter than 26 gage galvanized steel, Z-shaped, with1 1/4 inch and 3/4 inch flanges and depth as required by the insulation thickness provided.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Systems for Attachment of Lath

3.1.1.1 Suspended and Furred Ceiling Systems and Wall Furring

ASTM C 841, except as indicated otherwise.

3.1.1.2 Nonload-Bearing Wall Framing

NAAMM ML/SFA MLF, except that framing members shall be 16 inches o.c. unless indicated otherwise.

3.1.2 Systems for Attachment of Gypsum Wallboard

3.1.2.1 Suspended and Furred Ceiling Systems

ASTM C 754, except that framing members shall be 16 inches o.c. unless indicated otherwise.

3.1.2.2 Nonload-Bearing Wall Framing and Furring

ASTM C 754, except as indicated otherwise.

3.1.2.3 Furring Structural Steel Columns

Install studs or galvanized steel clips and support angles for erection of gypsum wallboard around structural steel columns in accordance with the UL Fire Resist Dir, design number(s) of the fire resistance rating indicated.

3.1.2.4 Z-Furring Channels with Wall Insulation

Install Z-furring channels vertically spaced not more than 24 inches o.c. Locate Z-furring channels at interior and exterior corners in accordance with manufacturer's printed erection instructions. Fasten furring channels to masonry and concrete walls with powder-driven fasteners or hardened concrete steel nails through narrow flange of channel. Space fasteners not more than 24 inches o.c.

3.2 ERECTION TOLERANCES

Framing members which will be covered by finish materials such as wallboard, plaster, or ceramic tile set in a mortar setting bed, shall be within the following limits:

a. Layout of walls and partitions: 1/4 inch from intended position;

b. Plates and runners: 1/4 inch in 8 feet from a straight line;

c. Studs: 1/4 inch in 8 feet out of plumb, not cumulative; and

d. Face of framing members: 1/4 inch in 8 feet from a true plane.

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SECTION 09250

GYPSUM BOARD & SOUND INSULATION

11/01

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SECTION 09250

GYPSUM BOARD & SOUND INSULATION
11/01

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A108.11	(1992) Interior Installation of Cementitious Backer Units
ANSI A118.9	(1992) Cementitious Backer Units

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 36/C 36M	(1999) Gypsum Wallboard
ASTM C 442/C 442M	(1999; Rev. A) Gypsum Backing Board and Coreboard
ASTM C 475	(1994) Joint Compound and Joint Tape for Finishing Gypsum Board
ASTM C 514	(1996) Nails for the Application of Gypsum Board
ASTM C 557	(1999) Adhesives for Fastening Gypsum Wallboard to Wood Framing
ASTM C 630/C 630M	(2001) Water-Resistant Gypsum Backing Board
ASTM C 840	(2001) Application and Finishing of Gypsum Board
ASTM C 954	(2000) Steel Drill Screws for the Application of Gypsum Board or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness
ASTM C 1002	(2000) Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases
ASTM C 1047	(1999) Accessories for Gypsum Wallboard and Gypsum Veneer Base
ASTM C 1396/C 1396M	(2000) Standard Specification for Gypsum Board
ASTM D 226	(1997) Standard Specification for

	Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing

GYPSUM ASSOCIATION (GA)

GA 214	(1996) Recommended Levels of Gypsum Board Finish
GA 216	(2000) Application and Finishing of Gypsum Board
GA 600	(2000) Fire Resistance and Sound Control Design Manual

UNDERWRITERS LABORATORIES (UL)

UL Fire Resist Dir	(2000) Fire Resistance Directory

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-03 Product Data

Cementitious backer units

Water-Resistant Gypsum Backing Board

Accessories

Submit for each type of gypsum board and for cementitious backer units.

SD-07 Certificates

Asbestos Free Materials

Certify that gypsum board types, gypsum backing board types, cementitious backer units, and joint treating materials do not contain asbestos.

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery

Deliver materials in the original packages, containers, or bundles with each bearing the brand name, applicable standard designation, and name of manufacturer, or supplier.

1.3.2 Storage

Keep materials dry by storing inside a sheltered building. Where necessary to store gypsum board and cementitious backer units outside, store off the ground, properly supported on a level platform, and protected from direct exposure to rain, snow, sunlight, and other extreme weather conditions. Provide adequate ventilation to prevent condensation.

1.3.3 Handling

Neatly stack gypsum board and cementitious backer units flat to prevent sagging or damage to the edges, ends, and surfaces.

1.4 ENVIRONMENTAL CONDITIONS

1.4.1 Temperature

Maintain a uniform temperature of not less than 50 degrees F in the structure for at least 48 hours prior to, during, and following the application of gypsum board, cementitious backer units, and joint treatment materials, or the bonding of adhesives.

1.4.2 Exposure to Weather

Protect gypsum board and cementitious backer unit products from direct exposure to rain, snow, sunlight, and other extreme weather conditions.

1.5 QUALIFICATIONS

Manufacturer shall specialize in manufacturing the types of material specified and shall have a minimum of 5 years of documented successful experience. Installer shall specialize in the type of gypsum board work required and shall have a minimum of 3 years of documented successful experience.

PART 2 PRODUCTS

2.1 MATERIALS

Conform to specifications, standards and requirements specified herein. Provide gypsum board types, gypsum backing board types, cementitious backing units, and joint treating materials manufactured from asbestos free materials only.

2.1.1 Gypsum Board

ASTM C 36/C 36M and ASTM C 1396/C 1396M.

2.1.1.1 Regular

48 inches wide,5/8 inch thick, tapered edges.

2.1.1.2 Type X (Special Fire-Resistant)

48 inches wide, 5/8 inch thick, tapered edges.

2.1.2 Gypsum Backing Board

ASTM C 442/C 442M, gypsum backing board shall be used as a base in a multilayer system.

2.1.2.1 Regular

48 inches wide, 5/8 inch thick, square edges.

2.1.2.2 Type X (Special Fire-Resistant)

48 inches wide, 5/8 inch thick, square edges.

2.1.3 Regular Water-Resistant Gypsum Backing Board

ASTM C 630/C 630M

2.1.3.1 Regular

48 inches wide, 5/8 inch thick, tapered edges.

2.1.3.2 Type X (Special Fire-Resistant)

48 inches wide, 5/8 inch thick, tapered edges.

2.1.4 Cementitious Backer Units

ANSI A118.9.

2.1.5 Joint Treatment Materials

ASTM C 475.

2.1.5.1 Embedding Compound

Specifically formulated and manufactured for use in embedding tape at gypsum board joints and compatible with tape, substrate and fasteners.

2.1.5.2 Finishing or Topping Compound

Specifically formulated and manufactured for use as a finishing compound.

2.1.5.3 All-Purpose Compound

Specifically formulated and manufactured to serve as both a taping and a finishing compound and compatible with tape, substrate and fasteners.

2.1.5.4 Setting or Hardening Type Compound

Specifically formulated and manufactured for use with fiber glass mesh tape.

2.1.5.5 Joint Tape

Cross-laminated, tapered edge, reinforced paper, or fiber glass mesh tape recommended by the manufacturer.

2.1.6 Fasteners

2.1.6.1 Nails

ASTM C 514.

2.1.6.2 Screws

ASTM C 1002, Type "G", Type "S" or Type "W" steel drill screws for fastening gypsum board to gypsum board, wood framing members and steel framing members less than 0.033 inch thick. ASTM C 954 steel drill screws for fastening gypsum board to steel framing members 0.033 to 0.112 inch

thick. Provide cementitious backer unit screws with a polymer coating.

2.1.6.3 Staples

No. 16 USS gage flattened galvanized wire staples with 7/16 inch wide crown outside measurement and divergent point for base ply of two-ply gypsum board application. Use as follows:

Length of Legs (inch)	Thickness of Gypsum Board (inch)
1 1/4	5/8

2.1.7 Adhesives

Do not use adhesive containing benzene, carbon tetrachloride, or trichloroethylene.

2.1.7.1 Adhesive for Fastening Gypsum Board to Metal Framing

Type recommended by gypsum board manufacturer.

2.1.7.2 Adhesive for Fastening Gypsum Board to Wood Framing

ASTM C 557.

2.1.7.3 Adhesive for Laminating

For laminating two-ply gypsum board systems and gypsum studs to face panels, provide adhesive recommended by gypsum board manufacturer.

2.1.8 Gypsum Studs

One inch minimum thickness and 6 inch minimum width. Studs may be of one inch thick gypsum board or multilayers laminated to required thickness. Conform to ASTM C 36/C 36M or ASTM C 442/C 442M for material.

2.1.9 Shaftwall Liner Panel

ASTM C 442/C 442M. Shaftwall liner panel shall conform to UL Fire Resist Dir for the Design Number(s) indicated. Liner Panel shall be specifically manufactured for cavity shaftwall system, with water-resistant paper faces, bevel edges, single lengths to fit required conditions, 1" thick, by 24" wide.

2.1.10 Accessories

ASTM C 1047. Fabricate from corrosion protected steel or plastic designed for intended use. Accessories manufactured with paper flanges are not acceptable. Flanges shall be free of dirt, grease, and other materials that may adversely affect bond of joint treatment. Provide prefinished or job decorated materials.

2.1.11 Asphalt Impregnated Building Felt

The moisture barrier over gypsum sheathing shall be 15-lb asphalt impregnated felt conforming to ASTM D 226 Type I (No. 15).

2.1.12 Water

Clean, fresh, and potable.

2.1.13 Sound Attenuation Blankets

Sound attenuation blankets shall be 3" thick, paperless, semi-rigid spun mineral fiber mat which substantially improves STC ratings when used in stud cavities of partition assemblies. Surface burning characterics per ASTM E84, flame spread 15, smoke developed "O", meet Fed. Specs HH-I-521F, Type I. Drawings Sound attenuation system requirements are; (1) Steel stud partitions with single layer gypsum panels with a STC Rating between 45 and 51 and (2) all cavity Shaft walls with a STC Rating between 47 and 51.

PART 3 EXECUTION

3.1 EXAMINATION

3.1.1 Framing and Furring

Verify that framing and furring are securely attached and of sizes and spacing to provide a suitable substrate to receive gypsum board and cementitious backer units. Verify that all blocking, headers and supports are in place to support plumbing fixtures and to receive soap dishes, grab bars, towel racks, and similar items. Do not proceed with work until framing and furring are acceptable for application of gypsum board and cementitious backer units.

3.1.2 Gypsum Board and Framing

Verify that surfaces of gypsum board and framing to be bonded with an adhesive are free of dust, dirt, grease, and any other foreign matter. Do not proceed with work until surfaces are acceptable for application of gypsum board with adhesive.

3.1.3 Masonry and Concrete Walls

Verify that surfaces of masonry and concrete walls to receive gypsum board applied with adhesive are dry, free of dust, oil, form release agents, protrusions and voids, and any other foreign matter. Do not proceed with work until surfaces are acceptable for application of gypsum board with adhesive.

3.2 APPLICATION OF GYPSUM BOARD

Apply gypsum board to framing and furring members in accordance with ASTM C 840 or GA 216 and the requirements specified herein. Apply gypsum board with separate panels in moderate contact; do not force in place. Stagger end joints of adjoining panels. Neatly fit abutting end and edge joints. Use gypsum board of maximum practical length. Cut out gypsum board as required to make neat close joints around openings. In vertical application of gypsum board, provide panels in lengths required to reach full height of vertical surfaces in one continuous piece. Surfaces of gypsum board and substrate members may be bonded together with an adhesive, except where prohibited by fire rating(s). Treat edges of cutouts for plumbing pipes, screwheads, and joints with water-resistant compound as recommended by the gypsum board manufacturer. Provide type of gypsum board

for use in each system specified herein as indicated.

3.2.1 Application of Gypsum Board

Apply in accordance with ASTM C 840, System VIII or GA 216.

3.3 APPLICATION OF CEMENTITIOUS BACKER UNITS

3.3.1 Application

In wet areas (tubs, shower enclosures, saunas, steam rooms, gang shower rooms), apply cementitious backer units in accordance with ANSI A108.11. A 15 lb asphalt impregnated, continuous felt paper membrane shall be placed behind cementitious backer units, between backer units and studs or base layer of gypsum board. Membrane shall be placed with a minimum 6 inch overlap of sheets laid shingle style.

3.3.2 Joint Treatment

ANSI A108.11.

3.4 FINISHING OF GYPSUM BOARD

Tape and finish gypsum board in accordance with ASTM C 840, GA 214 and GA 216. Plenum areas above ceilings shall be finished to Level 1 in accordance with GA 214. Water resistant gypsum backing board, ASTM C 630/C 630M, to receive ceramic tile shall be finished to Level 2 in accordance with GA 214. Walls and ceilings to receive a heavy-grade wall covering or heave textured finish before painting shall be finished to Level 3 in accordance with GA 214. Walls and ceilings without critical lighting to receive flat paints, light textures, or wall coverings shall be finished to Level 4 in accordance with GA 214. Unless otherwise specified, all gypsum board walls, partitions and ceilings shall be finished to Level 5 in accordance with GA 214. Provide joint, fastener depression, and corner treatment. Do not use fiber glass mesh tape with conventional drying type joint compounds; use setting or hardening type compounds only. Provide treatment for water-resistant gypsum board as recommended by the gypsum board manufacturer.

3.4.1 Uniform Surface

Wherever gypsum board is to receive eggshell, semigloss or gloss paint finish, or where severe, up or down lighting conditions occur, finish gypsum wall surface in accordance to GA 214 Level 5. In accordance with GA 214 Level 5, apply a thin skim coat of joint compound to the entire gypsum board surface, after the two-coat joint and fastener treatment is complete and dry.

3.5 SEALING

Seal openings around pipes, fixtures, and other items projecting through gypsum board and cementitious backer units. Apply material with exposed surface flush with gypsum board or cementitious backer units.

3.6 FIRE-RESISTANT ASSEMBLIES

Wherever fire-rated construction is indicated, provide materials and application methods, including types and spacing of fasteners, in accordance with the specifications contained in UL Fire Resist Dir for the

Design Number(s) indicated, or GA 600 for the File Number(s) indicated. Joints of fire-rated gypsum board enclosures shall be closed and sealed in accordance with UL test requirements or GA requirements. Penetrations through rated partitions and ceilings shall be sealed tight in accordance with tested systems. Fire ratings shall be as indicated.

3.7 PATCHING

Patch surface defects in gypsum board to a smooth, uniform appearance, ready to receive finish as specified.

3.8 SHAFT WALL FRAMING

The shaft wall system shall be installed in accordance with the system manufacturer's published instructions. Bucks, anchors, blocking and other items placed in or behind shaft wall framing shall be coordinated with electrical and mechanical work. Fireproofing materials which are damaged or removed during shaft wall construction shall be patched or replaced.

-- End of Section --

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SECTION 09510

ACOUSTICAL CEILINGS

07/02

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SECTION 09510

ACOUSTICAL CEILINGS
07/02

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 366/A 366M	(1997e1) Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality
ASTM A 580/A 580M	(1998) Stainless Steel Wire
ASTM A 641/A 641M	(1998) Zinc-Coated (Galvanized) Carbon Steel Wire
ASTM A 653/A 653M	(2001a) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B 633	(1998e1) Electrodeposited Coatings of Zinc on Iron and Steel
ASTM C 423	(2001) Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
ASTM C 635	(2000) Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings
ASTM C 636	(1996) Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels
ASTM C 834	(2000e1) Latex Sealants
ASTM E 84	(2001) Surface Burning Characteristics of Building Materials
ASTM E 119	(2000a) Fire Tests of Building Construction and Materials
ASTM E 580	(2000) Application of Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels in Areas Requiring Moderate Seismic Restraint
ASTM E 795	(2000) Mounting Test Specimens During Sound Absorption Tests

ASTM E 1264	(1998) Acoustical Ceiling Products
ASTM E 1414	(2000a) Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum
ASTM E 1477	(1998a) Luminous Reflectance Factor of Acoustical Materials by Use of Integrating-Sphere Reflectometers

U.S. ARMY CORPS OF ENGINEERS (USACE)

TI 809-04	(1998) Seismic Design for Buildings

UNDERWRITERS LABORATORIES (UL)

UL Fire Resist Dir	(1999) Fire Resistance Directory (2 Vol.)

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Approved Detail Drawings

Drawings showing suspension system, method of anchoring and fastening, details, and reflected ceiling plan.

SD-03 Product Data

Acoustical Ceiling Systems

Manufacturer's descriptive data, catalog cuts, and installation instructions. Submittals which do not provide adequate data for the product evaluation will be rejected.

SD-04 Samples

Acoustical Units

Two samples of each type of acoustical unit and each type of suspension grid tee section showing texture, finish, and color.

SD-06 Test Reports

Fire Resistive Ceilings
Ceiling Attenuation Class and Test

Reports by an independent testing laboratory attesting that acoustical ceiling systems meet specified requirements. Data attesting to conformance of the proposed system to Underwriters Laboratories requirements for the fire endurance rating listed in UL Fire Resist Dir may be submitted in lieu of test reports.

SD-07 Certificates

Acoustical Units

Certificate attesting that the mineral based acoustical units furnished for the project contain recycled material and showing an estimated percent of such material.

1.3 GENERAL REQUIREMENTS

Acoustical treatment shall consist of sound controlling units mechanically mounted on a ceiling suspension system. The unit size, texture, finish, and color shall be as specified. . The location and extent of acoustical treatment shall be as shown on the approved detail drawings. Reclamation of mineral fiber acoustical ceiling panels to be removed from the job site shall be in accordance with paragraph RECLAMATION PROCEDURES.

1.3.1 Fire Resistive Ceilings

Acoustical ceiling systems indicated as fire resistant shall be rated for fire endurance as indicated when tested in accordance with ASTM E 119. Suspended ceiling shall have been tested with a specimen roof/floor assembly representative of the indicated construction, including mechanical and electrical work within ceiling space openings for light fixtures, and air outlets, and access panels. Ceiling assembly rating shall be as shown on drawings. Flame spread of acoustical units shall be 25 or less and smoke development shall be 50 or less when tested in accordance with ASTM E 84.

1.3.2 Ceiling Attenuation Class and Test

The ceiling attenuation class (CAC) of the ceiling system shall be in accordance with ASTM E 1414. Provide fixture attenuators over light fixtures and other ceiling penetrations, and provide acoustical blanket insulation adjacent to partitions, as required to achieve the specified CAC. Test ceiling shall be continuous at the partition and shall be assembled in the suspension system in the same manner that the ceiling will be installed on the project.

1.3.3 Ceiling Sound Absorption

Determine the NRC in accordance with ASTM C 423 Method of Test.

1.3.4 Light Reflectance

Determine light reflectance factor in accordance with ASTM E 1477 Test Method.

1.4 DELIVERY AND STORAGE

Materials shall be delivered to the site in the manufacturer's original unopened containers with brand name and type clearly marked. Materials shall be carefully handled and stored in dry, watertight enclosures. Immediately before installation, acoustical units shall be stored for not less than 24 hours at the same temperature and relative humidity as the space where they will be installed in order to assure proper temperature and moisture acclimation.

1.5 ENVIRONMENTAL REQUIREMENTS

A uniform temperature of not less than 60 degrees F nor more than 85 degrees F and a relative humidity of not more than 70 percent shall be maintained for 24 hours before, during, and 24 hours after installation of acoustical units.

1.6 SCHEDULING

Interior finish work such as plastering, concrete and terrazzo work shall be complete and dry before installation. Mechanical, electrical, and other work above the ceiling line shall be completed and heating, ventilating, and air conditioning systems shall be installed and operating in order to maintain temperature and humidity requirements.

1.7 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one year period shall be provided. Standard performance guarantee or warranty shall contain an agreement to repair or replace acoustical panels that fail within the warranty period. Failures include, but are not limited to, sagging and warping of panels; rusting and manufacturers defects of grid system.

1.8 EXTRA MATERIALS

Spare tiles of each color shall be furnished at the rate of 5 tiles for each 1000 tiles installed. Tiles shall be from the same lot as those installed.

PART 2 PRODUCTS

2.1 ACOUSTICAL UNITS

Acoustical units shall conform to ASTM E 1264, Class A, and the following requirements:

2.1.1 Units for Exposed-Grid System A

Type: III (non-asbestos mineral fiber with painted finish).

Minimum NRC: 0.75 in open office areas; 0.60 in conference rooms, executive offices, teleconferencing rooms, and other rooms as designated; 0.50 in all other rooms and areas when tested on mounting Type E-400 of ASTM E 795.

Pattern: A

Nominal size: 24 by 24 inches.

Edge detail: Square.

Finish: Factory-applied standard finish.

Minimum LR coefficient: LR-1, 0.75 or greater.

Minimum CAC: 40.

Flame Spread: Class A, 25 or less

2.1.2 Unit Acoustical Absorbers

Absorbers shall be individually mounted sound absorbing plaques composed of glass fibers or non-asbestos mineral fibers and having a NRC range of not less than 0.60 - 0.70 when tested in accordance with ASTM C 423 and reported as a 4 frequency average.

2.2 SUSPENSION SYSTEM

Suspension system shall be standard exposed-grid and shall conform to ASTM C 635. Surfaces exposed to view shall be aluminum or steel with a factory-applied white baked-enamel finish]. Wall molding shall have a flange of not less than 15/16 inch. Standard corners shall be provided. Suspended ceiling framing system shall have the capability to support the finished ceiling, light fixtures, air diffusers, and accessories, as shown. The suspension system shall have a maximum deflection of 1/360 of span length. Seismic details shall conform to the guidance in TI 809-04 and ASTM E 580.

2.3 HANGERS

Hangers and attachment shall support a minimum 300 pound ultimate vertical load without failure of supporting material or attachment.

2.3.1 Wires

Wires shall conform to ASTM A 641/A 641M, Class 1, 0.106 inches in diameter or ASTM A 580/A 580M, composition 302 or 304, condition annealed stainless steel, 0.1055 inches in diameter.

2.3.2 Straps

Straps shall be 1 by 3/16 inch galvanized steel conforming to ASTM A 653/A 653M, with a light commercial zinc coating or ASTM A 366/A 366Mwith an electrodeposited zinc coating conforming to ASTM B 633, Type RS.

2.3.3 Rods

Rods shall be 3/16 inch diameter threaded steel rods, zinc or cadmium coated.

2.4 ACCESS PANELS

Access panels shall match adjacent acoustical units and shall be designed and equipped with suitable framing and fastenings for removal and replacement without damage. Panel shall be not less than 12 by 12 inches or more than 12 by 24 inches.

a. An identification plate of 0.032 inch thick aluminum, 3/4 inch in diameter, stamped with the letters "AP" and finished the same as the unit, shall be attached near one corner on the face of each access panel.

b. Identify ceiling access panel by a number utilizing white identification plates or plastic buttons with contrasting numerals. The plates or buttons shall be of minimum 1 inch diameter and securely attached to one corner of each access unit. Provide a typewritten card framed under glass listing the code identification numbers and

corresponding system descriptions listed above. Mount the framed card where directed and furnish a duplicate card to the Contracting Officer.

2.5 ADHESIVE

Adhesive shall be as recommended by tile manufacturer.

2.6 FINISHES

Acoustical units and suspension system members shall have manufacturer's standard textures, patterns and finishes as specified. Ceiling suspension system components shall be treated to inhibit corrosion.

2.7 ACOUSTICAL SEALANT

Acoustical sealant shall conform to ASTM C 834, nonstaining.

PART 3 EXECUTION

3.1 INSTALLATION

Examine surfaces to receive directly attached acoustical units for uneveness, irregularities, and dampness that would affect quality and execution of the work. Areas where acoustical units will be cemented shall be free of oils, form residue, or other materials that reduce bonding capabilities of the adhesive. Interior finish work such as plastering, concrete, and terrazzo work shall be completed and dry before installation. Mechanical, electrical, and other work above the ceiling line shall be completed and approved prior to the start of acoustical ceiling installation. Acoustical work shall be provided complete with necessary fastenings, clips, and other accessories required for a complete installation. Mechanical fastenings shall not be exposed in the finished work. Hangers shall be laid out for each individual room or space. Hangers shall be placed to support framing around beams, ducts, columns, grilles, and other penetrations through ceilings. Main runners and carrying channels shall be kept clear of abutting walls and partitions. At least two main runners shall be provided for each ceiling span. Wherever required to bypass an object with the hanger wires, a subsuspension system shall be installed, so that all hanger wires will be plumb.

3.1.1 Suspension System

Suspension system shall be installed in accordance with ASTM C 636 and as specified herein. There shall be no hanger wires or other loads suspended from underside of steel decking.

3.1.1.1 Plumb Hangers

Hangers shall be plumb and shall not press against insulation covering ducts and pipes. Where lighting fixtures are supported from the suspended ceiling system, hangers shall be provided at a minimum of four hangers per fixture and located not more than 6 inches from each corner of each fixture.

3.1.1.2 Splayed Hangers

Where hangers must be splayed (sloped or slanted) around obstructions, the resulting horizontal force shall be offset by bracing, countersplaying, or other acceptable means.

3.1.2 Wall Molding

Wall molding shall be provided where ceilings abut vertical surfaces. Miter corners where wall moldings intersect or install corner caps. Wall molding shall be secured not more than 3 inches from ends of each length and not more than 16 inches on centers between end fastenings. Wall molding springs shall be provided at each acoustical unit in semi-exposed or concealed systems.

3.1.3 Acoustical Units

Acoustical units shall be installed in accordance with the approved installation instructions of the manufacturer. Edges of acoustical units shall be in close contact with metal supports, with each other, and in true alignment. Acoustical units shall be arranged so that units less than one-half width are minimized. Units in exposed-grid system shall be held in place with manufacturer's standard hold-down clips, if units weigh less than 1 psf or if required for fire resistance rating.

3.1.4 Caulking

Seal all joints around pipes, ducts or electrical outlets penetrating the ceiling. Apply a continuous ribbon of acoustical sealant on vertical web of wall or edge moldings.

3.1.5 Adhesive Application

Wipe back of tile to remove accumulated dust. Daub acoustical units on back side with four equal daubs of adhesive. Apply daubs near corners of tiles. Contact area of each daub shall be at least 2 inches diameter in final position. Press units into place, aligning joints and abutting units tight and uniform without differences in joint widths.

3.2 CEILING ACCESS PANELS

Ceiling access panels shall be located directly under the items which require access.

3.3 CLEANING

Following installation, dirty or discolored surfaces of acoustical units shall be cleaned and left free from defects. Units that are damaged or improperly installed shall be removed and new units provided as directed.

3.4 RECLAMATION PROCEDURES

Ceiling tile, designated for recycling by the Contracting Officer, shall be neatly stacked on 4 by 4 foot pallets not higher than 4 foot. Panels shall be completely dry. Pallets shall then be shrink wrapped and symmetrically stacked on top of each other without falling over.

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DIVISION 09 - FINISHES

SECTION 09650

RESILIENT FLOORING

08/02

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SECTION 09650

RESILIENT FLOORING
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PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 2240	(2002) Rubber Property - Durometer Hardness
ASTM D 4078	(1992; R 1996) Water Emulsion Floor Polish
ASTM E 648	(2000) Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source
ASTM E 662	(2001) Specific Optical Density of Smoke Generated by Solid Materials
ASTM F 1066	(1999) Vinyl Composition Floor Tile

1.2 FIRE RESISTANCE REQUIREMENTS

Flooring in corridors and exits shall have a minimum average critical radiant flux of 0.22 watts per square centimeter when tested in accordance with ASTM E 648. The smoke density rating shall be less than 450 when tested in accordance with ASTM E 662.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Tile Flooring; G

Drawings indicating location of seams, integral cove, including details of outside corner and cap, and edge strips.

SD-03 Product Data

Tile Flooring
Adhesive for Vinyl Composition Tile
Adhesive for Wall Base

Manufacturer's descriptive data and installation instructions

including cleaning and maintenance instructions.

SD-04 Samples

Tile Flooring
Wall Base

Three samples of each indicated color and type of flooring and base. Sample size shall be minimum 2-1/2 x 4 inches.

SD-06 Test Reports

Moisture Test

Copies of test reports showing that representative product samples of the flooring proposed for use have been tested by an independent testing laboratory within the past three years or when formulation change occurred and conforms to the requirements specified.

SD-08 Manufacturer's Instructions

Tile Flooring

Copies of flooring manufacturer's recommended installation procedures.

1.4 DELIVERY AND STORAGE

Materials shall be delivered to the building site in original unopened containers bearing the manufacturer's name, brands, stock names, production run, project identification, and handling instructions. Materials shall be stored in a clean dry area with temperature maintained above 70 degrees F for 2 days prior to installation, and shall be stacked according to manufacturer's recommendations. Materials shall be protected from the direct flow of heat from hot-air registers, radiators and other heating fixtures and appliances. Do not open containers until materials are to be used, except for inspection to verify compliance with requirements.

1.5 ENVIRONMENTAL REQUIREMENTS

a. Areas to receive resilient flooring shall be maintained at a temperature above 70 degrees F and below 100 degrees F for 2 days before application, during application and 2 days after application ~~[and until Style C flooring is tensioned to a point of being completely somooth]~~. A minimum temperature of 55 degrees F shall be maintained thereafter.

b. Provide adequate ventilation to remove moisture from area and to comply with regulations limiting concentrations of hazardous vapors.

1.6 SCHEDULING

Resilient flooring application shall be scheduled after the completion of other work which would damage the finished surface of the flooring.

1.7 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one year period shall be provided.

1.8 EXTRA MATERIALS

Extra flooring material of each color and pattern shall be furnished at the rate of 5 tiles for each 1000 tiles installed. Extra materials shall be from the same lot as those installed. Extra base material composed of 20 linear feet of each color shall be furnished. All extra materials shall be packaged in original containers, properly marked.

PART 2 PRODUCTS

2.1 UNDERLAYMENT

Underlayment shall be latex type, as recommended by flooring manufacturer.

2.2 TILE FLOORING

2.2.1 Vinyl-Composition Style A

Vinyl-composition tile shall conform to ASTM F 1066, Composition 1, asbestos-free, and shall be 12 inches square and 1/8 inch thick. Tile shall have the color and pattern uniformly distributed throughout the thickness of the tile. Flooring in any one continuous area shall be from the same lot and shall have the same shade and pattern.

2.2.2 Stair Treads, Risers, and Stringers

Treads, risers, and stringers shall conform to composition rubber compounded from a mixture of synthetic and reclaimed rubber. Overall thickness at treads shall be not less than 1/8 inch. Durometer hardness shall be 90, plus or minus 5, when tested in accordance with ASTM D 2240. Treads to have 80 percent of back and nose sanded by manufacturer to assure good adhesion; provide manufacturer's epoxy filler to completely fill gap between stair and tread nose for all treads or vinyl compounded from virgin polymer or copolymer of vinyl chloride resin, plasticized with phosphate or phthalate esters. Overall thickness shall be not less than 3/32 inch. Design shall be either a one piece nosing/tread/riser or a two piece nosing/tread with a matching coved riser. Installation shall include stringer angles on both the wall and banister sides, and landing trim.

2.2.3 Lining Felt

Asphalt felt shall be as recommended by flooring manufacturer.

2.2.4 Adhesive for Vinyl Composition Tile

Cutback adhesive for installation of tile over concrete above, on or above grade. Moisture and alkali resistant. Non-asbestos formulated or a latex adhesive recommended by flooring manufacturer.

2.2.5 Adhesive for Wall Base

Adhesive for wall base shall be emulsified acrylic latex; non-flamable.

2.3 STRIPS

2.3.1 Edge

Provide carpet reducer, tile reducer of vinyl or aluminum or other

nonferrous metal and approved by flooring manufacturer. Limit vertical lips in edge strips to 1/4 inch; limit total rise to 1/2 inch.

2.4 WALL BASE

Base shall be manufacturers standard rubber or vinyl, straight style (installed with carpet), coved style (installed with resilient flooring) butt toe cove (installed with 1/8 inch thick flooring). Base shall be 6 inches high and a minimum 1/8 inch thick, in approved color, and in matte finsih. Preformed outside corners shall be furnished. Use flexible base to conform to irregularities in walls, partitions, and floors. Provide premolded corners in matching size, shape, and color for all right-angle inside and outside corners.

2.5 POLISH/FINISH

Polish shall conform to ASTM D 4078. Use flooring manufacturer's standard high-solids finish for shine without buffing; non-flamable; compatible with factory-applied finish; may be buffed or burnished for maximum gloss.

2.6 MANUFACTURER'S COLOR AND TEXTURE

Color and distinct pattern shall be uniformly distributed throughout thickness of tile. Flooring in continuous area or replacement of damaged flooring in continuous area shall be from same production run with same shade and pattern,

PART 3 EXECUTION

3.1 EXAMINATION/VERIFICATION OF CONDITIONS

The Contractor shall examine and verify that site conditions are in agreement with the design package and shall report all conditions that will prevent a proper installation. The Contractor shall not take any corrective action without written permission from the Government.

3.1.1 Removal of Existing Flooring

Remove existing flooring and adhesive in accordance with Section 02220 DEMOLITION and in accordance with new flooring manufacturer's printed instructions.

3.2 SURFACE PREPARATION

Flooring shall be in a smooth, true, level plane, except where indicated as sloped. Before any work under this section is begun, all defects such as rough or scaling concrete, low spots, high spots, and uneven surfaces shall have been corrected, and all damaged portions of concrete slabs shall have been repaired as recommended by the flooring manufacturer. Concrete curing compounds, other than the type that does not adversely affect adhesion, shall be entirely removed from the slabs. Paint, varnish, oils, release agents, sealers, waxers, and adhesives shall be removed, as recommended by the flooring manufacturer.

3.2.1 Concrete Floor

Grind ridges and other uneven surfaces smooth. Cut out and fill cracks 1/16 inch or wider with crack filler. Provide mastic underlayment to fill remaining holes, cracks, and depressions and for smoothing, leveling, or

creating a feather edge in accordance with instructions of mastic manufacturer. After cleaning and removal of loose particles, prime chalky or dusty surfaces with primer recommended by flooring manufacturer.

3.3 MOISTURE TEST

The suitability of the concrete subfloor for receiving the resilient flooring with regard to moisture content shall be determined by a moisture test as recommended by the flooring manufacturer.

3.4 GENERAL APPLICATION REQUIREMENTS

To avoid damage, install flooring after other work in same area has been completed. Apply flooring and accessories in accordance with manufacturer's directions, using experienced workers. Detailed requirements follow:

a. Adhesives: Do not allow smoking, open flames or other sources of ignition in area where solvent-containing adhesives are being used or spread, after posting conspicuous signs reading "NO SMOKING OR OPEN FLAME".

b. Flooring: Apply in patterns indicated. Start in center of room or area, and work toward edges. Keep tile lines and joints square, symmetrical, tight, and even. Keep each floor in true, level plane, except where slope is indicated. Vary width of edge tiles as necessary to maintain full-size tiles in field, but no edge tile shall be less than one-half full size, except where irregular-shape makes it impossible.

c. Cutting: Cut flooring edges and scribe to walls and partitions after field flooring has been applied.

d. Edge Strips: Provide edging strips where flooring terminates at points higher than contiguous finished flooring, except where thresholds are provided.

3.5 INSTALLATION OF VINYL-COMPOSITION TILE AND SOLID VINYL TILE

Tile flooring shall be installed with adhesive in accordance with the manufacturer's installation instructions. Tile lines and joints shall be kept square, symmetrical, tight, and even. Edge width shall vary as necessary to maintain full-size tiles in the field, but no edge tile shall be less than one-half the field tile size, except where irregular shaped rooms make it impossible. Flooring shall be cut to, and fitted around, all permanent fixtures, built-in furniture and cabinets, pipes, and outlets. Edge tile shall be cut, fitted, and scribed to walls and partitions after field flooring has been applied.

3.6 INSTALLATION OF WALL BASE

Wall base shall be installed with adhesive in accordance with the manufacturer's written instructions. Base joints shall be tight and base shall be even with adjacent resilient flooring. Voids along the top edge of base at masonry walls shall be filled with caulk. Where wall base is used in conjunction with vinyl wall covering, cut vinyl wall covering off 1/4 inch below top of base. Roll entire vertical surface of base with hand roller, and press toe of base with a straight piece of wood to ensure proper alignment. Avoid excess adhesive in corners.

3.7 INSTALLATION OF TREADS AND RISERS

Stair treads and risers shall be installed with adhesive in accordance with the manufacturer's written installation instructions. Treads and risers shall cover the surface of the stairs to within 6 inches of the edges. Stairs wider than manufacturer's standard lengths shall have equal length pieces butted together to cover the treads.

3.8 CLEANING

Immediately upon completion of installation of tile in a room or an area, flooring and adjacent surfaces shall be dry-cleaned to remove all surplus adhesive. No sooner than 5 days after installation, flooring shall be washed with a nonalkaline cleaning solution, rinsed thoroughly with clear cold water, and, except for raised pattern rubber flooring, rubber tile and sheet rubber flooring, rubber stair treads, and static control vinyl tile, given two coats of polish in accordance with manufacturers written instructions. Raised pattern rubber flooring, rubber tile and sheet rubber flooring, rubber stair treads, and static control vinyl tile shall be cleaned and maintained as recommended by the manufacturer.

a. Vinyl flooring, except prewaxed flooring and flooring designated as no-wax or never-wax by manufacturer, shall have two coats of polish applied and each coat buffed to an even luster with an electric polishing machine, using a lamb's wool pad when dry buffing.

b. Translucent or transparent-surfaced sheet vinyl flooring shall be cleaned by damp mopping. Do not buff finish. Follow flooring manufacturer's cleaning and maintenance instructions.

3.9 PROTECTION

From the time of laying until acceptance, flooring shall be protected from damage as recommended by the flooring manufacturer. Flooring which becomes damaged, loose, broken, or curled and cove base which is not tight to backing fillet shall be removed and replaced.

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SECTION 09680A

CARPET

08/02

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SECTION 09680A

CARPET
08/02

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS (AATCC)

AATCC 16	(1998) Test Method: Colorfastness to Light
AATCC 134	(2001) Test Method: Electrostatic Propensity of Carpets
AATCC 165	(1999) Test Method: Colorfastness to Crocking: Carpets - AATCC Crockmeter Method
AATCC 174	(1998) Antimicrobial Activity Assessment of Carpet

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 418	(1993; R 1997) Pile Yarn Floor Covering Construction
ASTM D 3278	(1996e1) Test Methods for Flash Point of Liquids by Small Scale Closed-Cup Apparatus
ASTM D 5252	(2001) Practice for the Operation of the Hexapod Tumble Drum Tester
ASTM D 5417	(1999) Practice for Operation of the Vettermann Drum Tester
ASTM D 5793	(1995) Standard Test Method for Binding Sites Per Unit Length or Width of Pile Yarn Floor Coverings
ASTM D 5848	(1999) Standard Test Method for Mass Per Unit Area of Pile Yarn Floor Coverings
ASTM E 648	(2000) Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source

CARPET AND RUG INSTITUTE (CRI)

CRI 104	(1996) Commercial Carpet Installation Standard

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

16 CFR 1630	Standard for the Surface Flammability of Carpet and Rugs (FF 1-70)
40 CFR 247	Comprehensive Procurement Guideline for Products Containing Recovered Materials

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 2551	(1981) Machine-made Textile Floor Coverings - Determination of Dimensional Changes Due to the Effect of Varied Water and Heat Conditins (AACHEN Test)

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation
Molding

Three copies of drawings indicating areas receiving carpet, carpet types, textures and patterns, direction of pile, location of seams, and locations of edge molding.

SD-03 Product Data

Carpet

Manufacturer's catalog data and printed documentation stating physical characteristics, durability, resistance to fading, and flame resistance characteristics for each type of carpet material and installation accessory.

Surface Preparation
Installation

Three copies of the manufacturer's printed installation instructions for the carpet, including preparation of substrate, seaming techniques, and recommended adhesives and tapes.

Regulatory Requirements

Three copies of report stating that carpet contains recycled materials and/or involvement in a recycling or reuse program. Report shall include percentage of recycled material.

SD-04 Samples

Carpet; G

Molding; G

a. Carpet: Two "Production Quality" samples 18 x 18 inches of each carpet proposed for use, showing quality, pattern, and color specified.

b. Vinyl or Aluminum Moldings: Two pieces of each type at least 12 inches long.

c. Special Treatment Materials: Two samples showing system and installation method.

SD-06 Test Reports

Moisture and Alkalinity Tests

Three copies of test reports of moisture and alkalinity content of concrete slab stating date of test, person conducting the test, and the area tested.

SD-07 Certificates

Carpet

Certificates of compliance from a laboratory accredited by the National Laboratory Accreditation Program of the National Institute of Standards and Technology attesting that each type of carpet and carpet with cushion material conforms to the standards specified.

Regulatory Requirements

Report stating that the carpet contains recycled materials and indicating the actual percentage of recycled material.

SD-10 Operation and Maintenance Data

Carpet
Cleaning and Protection

Three copies of carpet manufacturer's maintenance instructions describing recommended type of cleaning equipment and material, spotting and cleaning methods, and cleaning cycles.

1.3 REGULATORY REQUIREMENTS

Carpet and adhesives shall bear the Carpet and Rug Institute (CRI) Indoor Air Quality (IAQ) label or demonstrate compliance with testing criteria and frequencies through independent laboratory test results. Carpet type bearing the label will indicate that the carpet has been tested and meets the criteria of the CRI IAQ Carpet Testing Program, and minimizes the impact on indoor air quality. Contractor shall procure carpet in accordance with 40 CFR 247. Where possible, product shall be purchased locally to reduce emissions of fossil fuels from transporting.

1.4 DELIVERY AND STORAGE

Materials shall be delivered to the site in the manufacturer's original wrappings and packages clearly labeled with the manufacturer's name, brand

name, size, dye lot number, and related information. Materials shall be stored in a clean, dry, well ventilated area, protected from damage and soiling, and shall be maintained at a temperature above 60 degrees F for 2 days prior to installation.

1.5 ENVIRONMENTAL REQUIREMENTS

Areas in which carpeting is to be installed shall be maintained at a temperature above 60 degrees F for 2 days before installation, during installation, and for 2 days after installation. A minimum temperature of 55 degrees F shall be maintained thereafter for the duration of the contract. Traffic or movement of furniture or equipment in carpeted area shall not be permitted for 24 hours after installation. Other work which would damage the carpet shall be completed prior to installation of carpet.

1.6 WARRANTY

Manufacturer's standard performance guarantees or warranties including minimum ten (10) year wear warranty, two (2) year material and workmanship and ten (10) year tuft bind and delamination.

1.7 EXTRA MATERIAL

Extra material from same dye lot consisting of full width continuous broadloom and shall be provided for future maintenance. A minimum of 2 percent of total square yards of each carpet type, pattern, and color shall be provided.

PART 2 PRODUCTS

2.1 CARPET

Carpet shall be first quality; free of visual blemishes, streaks, poorly dyed areas, fuzzing of pile yarn, spots or stains, and other physical and manufacturing defects. Carpet materials and treatments shall be reasonably nonallergenic and free of other recognized health hazards. All grade carpets shall have a static control construction which gives adequate durability and performance.

2.1.1 Physical Characteristics

2.1.1.1 BROADLOOM CARPET, MODULAR TILE CARPET

Carpet shall comply with the following:

a. Carpet Construction: Tofted.

b. Type: Broadloom 12 feet minimum usable carpet width. Modular tile 24 x 24 inches square with 0.15 percent growth/shrink rate in accordance with ISO 2551.

c. Pile Fiber: Commercial 100% branded (federally registered trademark) nylon continuous filament.

d. Pile or Wire Height: Minimum height 0.187 inch in accordance with ASTM D 418.

e. Yarn Ply: Minimum 2.

f. Gauge or Pitch: Minimum 1/10 inch in accordance with ASTM D 5793.

g. Finished Pile Yarn Weight: Minimum 26 ounces per square yard. This does not include weight of backings. Weight shall be determined in accordance with ASTM D 5848.

h. Pile Density: Minimum 188,651.

i. Backing Materials: Primary backing materials shall be those customarily used and accepted by the trade for each type of carpet polypropylene. Secondary backing to suit project requirements shall be those customarily used and accepted by the trade for each type of carpet, except when a special unitary back designed for gluedown is provided.

2.1.2 Performance Requirements

a. ARR (Appearance Retention Rating): Carpet shall be tested and have the minimum 3.0-3.5 (Heavy) ARR when tested in accordance with either the ASTM D 5252(Hexapod) or ASTM D 5417 (Vettermann) test methods using the number of cycles for short and long term tests as specified.

b. Static Control: Static control shall be provided to permanently control static buildup to less than 3.5 kV when tested at 20 percent relative humidity and 70 degrees F in accordance with AATCC 134.

c. Flammability and Critical Radiant Flux Requirements: Carpet shall comply with 16 CFR 1630. Carpet in corridors and exits shall have a minimum average critical radiant flux of 0.22 watts per square centimeter when tested in accordance with ASTM E 648.

d. Tuft Bind: Tuft bind force required to pull a tuft or loop free from carpet backing shall be a minimum 10 pound average force for loop pile.

e. Colorfastness to Crocking: Dry and wet crocking shall comply with AATCC 165 and shall have a Class 4 minimum rating on the AATCC Color Transference Chart for all colors.

f. Colorfastness to Light: Colorfastness to light shall comply with AATCC 16, Test Option E "Water-Cooled Xenon-Arc Lamp, Continuous Light" and shall have a minimum 4 grey scale rating after 40 hours.

g. Delamination Strength: Delamination strength for tufted carpet with a secondary back shall be minimum of 2.5 lbs./inch.

h. Antimicrobial: Nontoxic antimicrobial treatment in accordance with AATCC 174 Part I (qualitatiave), guaranteed by the carpet manufacturer to last the life of the carpet.

2.2 ADHESIVES AND CONCRETE PRIMER

Adhesives and concrete primers for installation of carpet shall be waterproof, nonflammable, meet local air-quality standards, and shall be as required by the carpet manufacturer. Seam adhesive shall be waterproof, nonflammable, and nonstaining as recommended by the carpet manufacturer.

Release adhesive for modular tile carpet shall be as recommended by the carpet manufacturer. Adhesives flashpoint shall be minimum 140 degrees F in accordance with ASTM D 3278.

2.3 MOLDING

Aluminum molding shall be a hammered surface, pinless clamp-down type, designed for the type of carpet being installed. Finish shall be natural color anodized.

2.4 TAPE

Tape for seams shall be as recommended by the carpet manufacturer for the type of seam used in installation.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Carpet shall not be installed on surfaces that are unsuitable and will prevent a proper installation. Holes, cracks, depressions, or rough areas shall be repaired using material recommended by the carpet or adhesive manufacturer. Floor shall be free of any foreign materials and swept broom clean. Before beginning work, subfloor shall be tested with glue and carpet to determine "open time" and bond.

3.2 MOISTURE AND ALKALINITY TESTS

Concrete slab shall be tested for moisture content and excessive alkalinity in accordance with CRI 104.

3.3 PREPARATION OF CONCRETE SUBFLOOR

Installation of the carpeting shall not commence until concrete substrate is at least 90 days old. The concrete surfaces shall be prepared in accordance with instructions of the carpet manufacturer. Type of concrete sealer, when required, shall be compatible with the carpet.

3.4 INSTALLATION

All work shall be performed by installers who are CFI certified (International Certified Floorcovering Installer Association), or manufacturer's approved installers. Installation shall be in accordance with the manufacturer's instructions and CRI 104. Edges of carpet meeting hard surface flooring shall be protected with molding; installation shall be in accordance with the molding manufacturer's instructions.

3.4.1 Broadloom Installation

Broadloom carpet shall be installed direct glue down and shall be smooth, uniform, and secure, with a minimum of seams. Seams shall be regular, unnoticeable, and treated with a seam adhesive. Side seams shall be run toward the light where practical and where such layout does not increase the number of seams. Breadths shall be installed parallel, with carpet pile in the same direction. Patterns shall be accurately matched. Cutouts, as at door jambs, columns and ducts shall be neatly cut and fitted securely. Seams at doorways shall be located parallel to and centered directly under doors. Seams shall not be made perpendicular to doors or at pivot points. Seams at changes in directions of corridors shall follow the

wall line parallel to the carpet direction. Corridors with widths less than 6 feet shall have the carpet laid lengthwise down the corridors.

3.4.2 Modular Tile Installation

Modular tiles shall be installed with release adhesive and shall be snugly jointed together. Tiles shall be laid with accessibility to the subfloor where required.

3.5 CLEANING AND PROTECTION

3.5.1 Cleaning

After installation of the carpet, debris, scraps, and other foreign matter shall be removed. Soiled spots and adhesive shall be removed from the face of the carpet with appropriate spot remover. Protruding face yarn shall be cut off and removed. Carpet shall be vacuumed clean.

3.5.2 Protection

The installed carpet shall be protected from soiling and damage with heavy, reinforced, nonstaining kraft paper, plywood, or hardboard sheets. Edges of kraft paper protection shall be lapped and secured to provide a continuous cover. Traffic shall be restricted for at least 45 hours. Protective covering shall be removed when directed by the Contracting Officer.

3.6 REMNANTS

Remnants remaining from the installation, consisting of scrap pieces more than 2 feet in dimension with more than 6 square feet total, shall be provided. Non-retained scraps shall be removed from site and recycled appropriately.

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SECTION 09900

PAINTS AND COATINGS
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PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)

ACGIH Limit Values	(1991-1992) Threshold Limit Values (TLVs) for Chemical Substances and Physical Agents and Biological Exposure Indices (BEIs)
ACGIH Limit Values	Documentation of Threshold Limit Values and Biological Exposure Indices

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A13.1	Scheme for Identification of Piping Systems

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 235	Standard Specification for Mineral Spirits (Petroleum Spirits) (Hydrocarbon Dry Cleaning Solvent)
ASTM D 523	(1999) Standard Test Method for Specular Gloss
ASTM D 2092	(1995) Preparation of Zinc-Coated (Galvanized) Steel Surfaces for Painting
ASTM D 4263	(1983; R 1999) Indicating Moisture in Concrete by the Plastic Sheet Method
ASTM D 4444	(1998) Standard Test Methods for Use and Calibration of Hand-Held Moisture Meters
ASTM F 1869	(1998) Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910.1000	Air Contaminants

FEDERAL STANDARDS (FED-STD)

FED-STD-313	(Rev. C) Material Safety Data, Transportation Data and Disposal Data for Hazardous Materials Furnished to

Government Activities

MASTER PAINTERS INSTITUTE (MPI)

MPI 4	(2001) Interior/Exterior Latex Block Filler
MPI 7	(2001) Exterior Oil Wood Primer
MPI 8	(2001) Exterior Alkyd, Flat
MPI 9	(2001) Exterior Alkyd Enamel
MPI 10	(2001) Exterior Latex, Flat
MPI 11	(2001) Exterior Latex, Semi-Gloss
MPI 23	(2001) Surface Tolerant Metal Primer
MPI 39	(2001) Interior Latex-based Wood Primer
MPI 42	(2001) Latex Stucco and Masonry Textured Coating
MPI 44	Interior Latex, Gloss Level 2
MPI 45	(2001) Interior Primer Sealer
MPI 47	(2001) Interior Alkyd, Semi-Gloss
MPI 48	(2001) Interior Alkyd, Gloss
MPI 49	(2001) Interior Alkyd, Flat
MPI 50	(2001) Interior Latex Primer Sealer
MPI 51	(2001) Interior Alkyd, Eggshell
MPI 52	(2001) Interior Latex, Gloss Level 3
MPI 54	(2001) Interior Latex, Semi-Gloss
MPI 56	(2001) Interior Alkyd Dry Fog/Fall
MPI 57	(2001) Interior Oil Modified Clear Urethane, Satin
MPI 77	(2001) Epoxy Cold Cured, Gloss
MPI 79	(2001) Marine Alkyd Metal Primer
MPI 94	(2001) Exterior Alkyd, Semi-Gloss
MPI 95	(2001) Fast Drying Metal Primer
MPI 107	(2001) Rust Inhibitive Primer (Water-Based)
MPI 110	(2001) Interior/Exterior High Performance Acrylic

MPI 116	(2001) Epoxy Block Filler
MPI 119	(2001) Exterior Latex, High Gloss (acrylic)
MPI 138	(2001) High Performance Latex, White and Tints - MPI Gloss Level 2
MPI 139	(2001) High Performance Latex, White and Tints - MPI Gloss Level 3
MPI 140	(2001) High Performance Architectural Latex - Gloss Level 4
MPI 141	(2001) High Performance Semigloss Latex, White and Tints - Gloss Level 5

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-STD-101	(Rev. B) Color Code for Pipelines and for Compressed Gas Cylinders

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS SP01-01	(2001) Environmentally Preferable Product Specification for Architectural and Anti-Corrosive Paints

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC QP 1	(1989) Evaluating Qualifications of Painting Contractors (Field Application to Complex Structures)
SSPC PA 1	(2000) Shop, Field, and Maintenance Painting
SSPC Guide 3	(1995) Safety in Paint Application
SSPC VIS 1	(1989) Visual Standard for Abrasive Blast Cleaned Steel (Standard Reference Photographs)
SSPC VIS 3	(1993) Visual Standard for Power- and Hand-Tool Cleaned Steel (Standard Reference Photographs)
SSPC VIS 4	(2001) Guide and Reference Photographs for Steel Surfaces Prepared by Waterjetting
SSPC SP 1	(1982) Solvent Cleaning
SSPC SP 2	(1995) Hand Tool Cleaning
SSPC SP 3	(1995) Power Tool Cleaning
SSPC SP 6	(1994) Commercial Blast Cleaning
SSPC SP 7	(1994) Brush-Off Blast Cleaning

SSPC SP 10	(1994) Near-White Blast Cleaning
SSPC SP 12	(1995) Surface Preparation and Cleaning of Steel and Other Hard Materials by High-and Ultra high-Pressure Water Jetting Prior to Recoating
SSPC Paint 18	(1991) Chlorinated Rubber Intermediate Coat Paint

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

The current MPI, "Approved Product List" which lists paint by brand, label, product name and product code as of the date of contract award, will be used to determine compliance with the submittal requirements of this specification. The Contractor may choose to use a subsequent MPI "Approved Product List", however, only one list may be used for the entire contract and each coating system is to be from a single manufacturer. All coats on a particular substrate must be from a single manufacturer. No variation from the MPI Approved Products List is acceptable.

Samples of specified materials may be taken and tested for compliance with specification requirements.

In keeping with the intent of Executive Order 13101, "Greening the Government through Waste Prevention, Recycling, and Federal Acquisition", products certified by SCS as meeting SCS SP01-01 shall be given preferential consideration over registered products. Products that are registered shall be given preferential consideration over products not carrying any EPP designation.

SD-02 Shop Drawings

Piping identification

Submit color stencil codes

SD-03 Product Data

Coating; G

Manufacturer's Technical Data Sheets

Sealant

SD-04 Samples

Color; G

Submit manufacturer's samples of paint colors. Cross reference color samples to color scheme as indicated.

SD-07 Certificates

Applicator's qualifications

Qualification Testing laboratory for coatings

SD-08 Manufacturer's Instructions

Application instructions

Mixing

Detailed mixing instructions, minimum and maximum application temperature and humidity, potlife, and curing and drying times between coats.

Manufacturer's Material Safety Data Sheets

Submit manufacturer's Material Safety Data Sheets for coatings, solvents, and other potentially hazardous materials, as defined in FED-STD-313.

SD-10 Operation and Maintenance Data

Coatings:

Preprinted cleaning and maintenance instructions for all coating systems shall be provided.

1.3 APPLICATOR'S QUALIFICATIONS

1.3.1 Contractor Qualification

Submit the name, address, telephone number, FAX number, and e-mail address of the contractor that will be performing all surface preparation and coating application. Submit evidence that key personnel have successfully performed surface preparation and application of coatings on a minimum of three similar projects within the past three years. List information by individual and include the following:

a. Name of individual and proposed position for this work.

b. Information about each previous assignment including:

Position or responsibility

Employer (if other than the Contractor)

Name of facility owner

Mailing address, telephone number, and telex number (if non-US) of facility owner

Name of individual in facility owner's organization who can be contacted as a reference

Location, size and description of structure

Dates work was carried out

Description of work carried out on structure

1.3.2 SSPC QP 1 Certification

All contractors and subcontractors that perform surface preparation or coating application shall be certified by the Society for Protective Coatings (formerly Steel Structures Painting Council) (SSPC) to the requirements of SSPC QP 1 prior to contract award, and shall remain certified while accomplishing any surface preparation or coating application. The painting contractors and painting subcontractors must remain so certified for the duration of the project. If a contractor's or subcontractor's certification expires, the firm will not be allowed to perform any work until the certification is reissued. Requests for extension of time for any delay to the completion of the project due to an inactive certification will not be considered and liquidated damages will apply. Notify the Contracting Officer of any change in contractor certification status.

1.4 QUALITY ASSURANCE

1.4.1 Field Samples and Tests

The Contracting Officer may choose up to two coatings that have been delivered to the site to be tested at no cost to the Government. Take samples of each chosen product as specified in the paragraph "Sampling Procedures." Test each chosen product as specified in the paragraph "Testing Procedure." Products which do not conform, shall be removed from the job site and replaced with new products that confrom to the referenced specification. Testing of replacement products that failed initial testing shall be at no cost to the Government.

1.4.1.1 Sampling Procedure

The Contracting Officer will select paint at random from the products that have been delivered to the job site for sample testing. The Contractor shall provide one quart samples of the selected paint materials. The samples shall be taken in the presence of the Contracting Officer, and labeled, identifying each sample. Provide labels in accordance with the paragraph "Packaging, Labeling, and Storage" of this specification.

1.4.1.2 Testing Procedure

Provide Batch Quality Conformance Testing for specified products, as defined by and performed by MPI. As an alternative to Batch Quality Conformance Testing, the Contractor may provide Qualification Testing for specified products above to the appropriate MPI product specification, using the third-party laboratory approved under the paragraph "Qualification Testing" laboratory for coatings. The qualification testing lab report shall include the backup data and summary of the test results. The summary shall list all of the reference specification requirements and the result of each test. The summary shall clearly indicate whether the tested paint meets each test requirement. Note that Qualification Testing may take 4 to 6 weeks to perform, due to the extent of testing required.

Submit name, address, telephone number, FAX number, and e-mail address of the independent third party laboratory selected to perform testing of coating samples for compliance with specification requirements. Submit documentation that laboratory is regularly engaged in testing of paint samples for conformance with specifications, and that employees performing

testing are qualified. If the Contractor chooses MPI to perform the Batch Quality Conformance testing, the above submittal information is not required, only a letter is required from the Contractor stating that MPI will perform the testing.

1.5 REGULATORY REQUIREMENTS

1.5.1 Environmental Protection

In addition to requirements specified elsewhere for environmental protection, provide coating materials that conform to the restrictions of the local Air Pollution Control District and regional jurisdiction. Notify Contracting Officer of any paint specified herein which fails to conform.

1.5.2 Lead Content

Do not use coatings having a lead content over 0.06 percent by weight of nonvolatile content.

1.5.3 Chromate Content

Do not use coatings containing zinc-chromate or strontium-chromate.

1.5.4 Asbestos Content

Materials shall not contain asbestos.

1.5.5 Mercury Content

Materials shall not contain mercury or mercury compounds.

1.5.6 Silica

Abrasive blast media shall not contain free crystilline silica.

1.5.7 Human Carcinogens

Materials shall not contain ACGIH Limit Values and ACGIH Limit Values confirmed human carcinogens (A1) or suspected human carcinogens (A2).

1.6 PACKAGING, LABELING, AND STORAGE

Paints shall be in sealed containers that legibly show the contract specification number, designation name, formula or specification number, batch number, color, quantity, date of manufacture, manufacturer's formulation number, manufacturer's directions including any warnings and special precautions, and name and address of manufacturer. Pigmented paints shall be furnished in containers not larger than 5 gallons. Paints and thinners shall be stored in accordance with the manufacturer's written directions, and as a minimum, stored off the ground, under cover, with sufficient ventilation to prevent the buildup of flammable vapors, and at temperatures between 40 to 95 degrees F.

1.7 SAFETY AND HEALTH

Apply coating materials using safety methods and equipment in accordance with the following:

Work shall comply with applicable Federal, State, and local laws and regulations, and with the ACCIDENT PREVENTION PLAN. The Activity Hazard Analysis shall include analyses of the potential impact of painting operations on painting personnel and on others involved in and adjacent to the work zone.

1.7.1 Safety Methods Used During Coating Application

Comply with the requirements of SSPC Guide 3.

1.7.2 Toxic Materials

To protect personnel from overexposure to toxic materials, conform to the most stringent guidance of:

a. The applicable manufacturer's Material Safety Data Sheets (MSDS) or local regulation.

b. 29 CFR 1910.1000.

c. ACGIH Limit Values, threshold limit values.

1.8 ENVIRONMENTAL CONDITIONS

1.8.1 Coatings

Do not apply coating when air or substrate conditions are:

a. Less than 5 degrees F above dew point;

b. Below 50 degrees F or over 95 degrees F, unless specifically pre-approved by the Contracting Officer and the product manufacturer. Under no circumstances shall application conditions exceed manufacturer recommendations.

1.9 COLOR SELECTION

Colors of finish coats shall be as indicated or specified. Where not indicated or specified, colors shall be selected by the Contracting Officer. Manufacturers' names and color identification are used for the purpose of color identification only. Named products are acceptable for use only if they conform to specified requirements. Products of other manufacturers are acceptable if the colors approximate colors indicated and the product conforms to specified requirements.

Tint each coat progressively darker to enable confirmation of the number of coats.

1.10 LOCATION AND SURFACE TYPE TO BE PAINTED

1.10.1 Painting Included

Where a space or surface is indicated to be painted, include the following unless indicated otherwise.

a. Surfaces behind portable objects and surface mounted articles readily detachable by removal of fasteners, such as screws and bolts.

b. New factory finished surfaces that require identification or color coding and factory finished surfaces that are damaged during performance of the work.

c. Existing coated surfaces that are damaged during performance of the work.

1.10.1.1 Exterior Painting

Includes new surfaces, existing coated surfaces, and existing uncoated surfaces, of the buildings and appurtenances as indicated. Also included are existing coated surfaces made bare by cleaning operations.

1.10.1.2 Interior Painting

Includes new surfaces, existing uncoated surfaces, and existing coated surfaces of the building[s] and appurtenances as indicated and existing coated surfaces made bare by cleaning operations. Where a space or surface is indicated to be painted, include the following items, unless indicated otherwise.

a. Exposed columns, girders, beams, joists, and metal deck; and

b. Other contiguous surfaces.

1.10.2 Painting Excluded

Do not paint the following unless indicated otherwise.

a. Surfaces concealed and made inaccessible by panelboards, fixed ductwork, machinery, and equipment fixed in place.

b. Surfaces in concealed spaces. Concealed spaces are defined as enclosed spaces above suspended ceilings, furred spaces, attic spaces, crawl spaces, elevator shafts and chases.

c. Steel to be embedded in concrete.

d. Copper, stainless steel, aluminum, brass, and lead except existing coated surfaces.

e. Hardware, fittings, and other factory finished items.

1.10.3 Mechanical and Electrical Painting

Includes field coating of interior and exterior new surfaces.

a. Where a space or surface is indicated to be painted, include the following items unless indicated otherwise.

(1) Exposed piping, conduit, and ductwork;

(2) Supports, hangers, air grilles, and registers;

(3) Miscellaneous metalwork and insulation coverings.

1.10.4 Definitions and Abbreviations

1.10.4.1 Qualification Testing

Qualification testing is the performance of all test requirements listed in the product specification. This testing is accomplished by MPI to qualify each product for the MPI Approved Product List, and may also be accomplished by Contractor's third party testing lab if an alternative to Batch Quality Conformance Testing by MPI is desired.

1.10.4.2 Batch Quality Conformance Testing

Batch quality conformance testing determines that the product provided is the same as the product qualified to the appropriate product specification. This testing shall only be accomplished by MPI testing lab.

1.10.4.3 Coating

A film or thin layer applied to a base material called a substrate. A coating may be a metal, alloy, paint, or solid/liquid suspensions on various substrates (metals, plastics, wood, paper, leather, cloth, etc.). They may be applied by electrolysis, vapor deposition, vacuum, or mechanical means such as brushing, spraying, calendering, and roller coating. A coating may be applied for aesthetic or protective purposes or both. The term "coating" as used herein includes emulsions, enamels, stains, varnishes, sealers, epoxies, and other coatings, whether used as primer, intermediate, or finish coat. The terms paint and coating are used interchangeably.

1.10.4.4 DFT or dft

Dry film thickness, the film thickness of the fully cured, dry paint or coating.

1.10.4.5 DSD

Degree of Surface Degradation, the MPI system of defining degree of surface degradation. Five (5) levels are generically defined under the Assessment sections in the MPI Maintenance Repainting Manual.

1.10.4.6 EPP

Environmentally Preferred Products, a standard for determining environmental preferability in support of Executive Order 13101.

1.10.4.7 EXT

MPI short term designation for an exterior coating system.

1.10.4.8 INT

MPI short term designation for an interior coating system.

1.10.4.9 micron / microns

The metric measurement for 0.001 mm or one/one-thousandth of a millimeter.

1.10.4.10 mil / mils

The English measurement for 0.001 in or one/one-thousandth of an inch, equal to 25.4 microns or 0.0254 mm.

1.10.4.11 mm

The metric measurement for millimeter, 0.001 meter or one/one-thousandth of a meter.

1.10.4.12 MPI Gloss Levels

MPI system of defining gloss. Seven (7) gloss levels (G1 to G7) are generically defined under the Evaluation sections of the MPI Manuals. Traditionally, Flat refers to G1/G2, Eggshell refers to G3, Semigloss refers to G5, and Gloss refers to G6.

Gloss levels are defined by MPI as follows:

Gloss Level	Description	Units @ 60 degrees	Units @ 85 degrees
G1	Matte or Flat	0 to 5	10 max
G2	Velvet	0 to 10	10 to 35
G3	Eggshell	10 to 25	10 to 35
G4	Satin	20 to 35	35 min
G5	Semi-Gloss	35 to 70	
G6	Gloss	70 to 85	
G7	High Gloss		

Gloss is tested in accordance with ASTM D 523. Historically, the Government has used Flat (G1 / G2), Eggshell (G3), Semi-Gloss (G5), and Gloss (G6).

1.10.4.13 MPI System Number

The MPI coating system number in each Division found in either the MPI Architectural Painting Specification Manual or the Maintenance Repainting Manual and defined as an exterior (EXT/REX) or interior system (INT/RIN). The Division number follows the CSI Master Format.

1.10.4.14 Paint

See Coating definition.

1.10.4.15 REX

MPI short term designation for an exterior coating system used in repainting projects or over existing coating systems.

1.10.4.16 RIN

MPI short term designation for an interior coating system used in repainting projects or over existing coating systems.

PART 2 PRODUCTS

2.1 MATERIALS

Conform to the coating specifications and standards referenced in PART 3. Submit manufacturer's technical data sheets for specified coatings and solvents.

PART 3 EXECUTION

3.1 PROTECTION OF AREAS AND SPACES NOT TO BE PAINTED

Prior to surface preparation and coating applications, remove, mask, or otherwise protect, hardware, hardware accessories, machined surfaces, radiator covers, plates, lighting fixtures, public and private property, and other such items not to be coated that are in contact with surfaces to be coated. Following completion of painting, workmen skilled in the trades involved shall reinstall removed items. Restore surfaces contaminated by coating materials, to original condition and repair damaged items.

3.2 SURFACE PREPARATION

Remove dirt, splinters, loose particles, grease, oil, and other foreign matter and substances deleterious to coating performance as specified for each substrate before application of paint or surface treatments. Oil and grease shall be removed prior to mechanical cleaning. Cleaning shall be programmed so that dust and other contaminants will not fall on wet, newly painted surfaces. Exposed ferrous metals such as nail heads on or in contact with surfaces to be painted with water-thinned paints, shall be spot-primmed with a suitable corrosion-inhibitive primer capable of preventing flash rusting and compatible with the coating specified for the adjacent areas.

3.3 PREPARATION OF METAL SURFACES

3.3.1 Existing and New Ferrous Surfaces

a. Ferrous Surfaces including Shop-coated Surfaces and Small Areas That Contain Rust, Mill Scale and Other Foreign Substances: Solvent clean or detergent wash in accordance with SSPC SP 1 to remove oil and grease. Where shop coat is missing or damaged, clean according to SSPC SP 2, SSPC SP 3, SSPC SP 6, or SSPC SP 10. Water jetting to SSPC SP 12 WJ-4 may be used to remove loose coating and other loose materials. Use inhibitor as recommended by coating manufacturer to prevent premature rusting. Shop-coated ferrous surfaces shall be protected from corrosion by treating and touching up corroded areas immediately upon detection.

b. Surfaces With More Than 20 Percent Rust, Mill Scale, and Other Foreign Substances: Clean entire surface in accordance with SSPC SP 6/SSPC SP 12 WJ-3 or SSPC SP 10/SSPC SP 12 WJ-2.

3.3.2 Final Ferrous Surface Condition:

For tool cleaned surfaces, the requirements are stated in SSPC SP 2 and SSPC SP 3. As a visual reference, cleaned surfaces shall be similar to photographs in SSPC VIS 3.

For abrasive blast cleaned surfaces, the requirements are stated in SSPC SP 7, SSPC SP 6, and SSPC SP 10. As a visual reference, cleaned surfaces shall be similar to photographs in SSPC VIS 1.

For waterjet cleaned surfaces, the requirements are stated in SSPC SP 12. As a visual reference, cleaned surfaces shall be similar to photographs in SSPC VIS 4.

3.3.3 Galvanized Surfaces

a. New or Existing Galvanized Surfaces With Only Dirt and Zinc Oxidation Products: Clean with solvent, steam, or non-alkaline detergent solution in accordance with SSPC SP 1. If the galvanized metal has been passivated or stabilized, the coating shall be completely removed by brush-off abrasive blast. New galvanized steel to be coated shall not be "passivated" or "stabilized" If the absence of hexavalent stain inhibitors is not documented, test as described in ASTM D 2092, Appendix X2, and remove by one of the methods described therein.

b. Galvanized with Slight Coating Deterioration or with Little or No Rusting: Water jetting to SSPC SP 12 WJ3 to remove loose coating from surfaces with less than 20 percent coating deterioration and no blistering, peeling, or cracking. Use inhibitor as recommended by the coating manufacturer to prevent rusting.

3.3.4 Non-Ferrous Metallic Surfaces

Aluminum and aluminum-alloy, lead, copper, and other nonferrous metal surfaces.

a. Surface Cleaning: Solvent clean in accordance with SSPC SP 1 and wash with mild non-alkaline detergent to remove dirt and water soluble contaminants.

3.3.5 Terne-Coated Metal Surfaces

Solvent clean surfaces with mineral spirits, ASTM D 235. Wipe dry with clean, dry cloths.

3.3.6 Existing Surfaces with a Bituminous or Mastic-Type Coating

Remove chalk, mildew, and other loose material by washing with a solution of 1/2 cup trisodium phosphate, 1/4 cup household detergent, one quart 5 percent sodium hypochlorite solution and 3 quarts of warm water.

3.4 PREPARATION OF CONCRETE AND CEMENTITIOUS SURFACE

3.4.1 Concrete and Masonry

a. Curing: Concrete, stucco and masonry surfaces shall be allowed to cure at least 30 days before painting, except concrete slab on grade, which shall be allowed to cure 90 days before painting.

b. Surface Cleaning: Remove the following deleterious substances.

(1) Dirt, Grease, and Oil: Wash new surfaces with a solution composed of 1/2 cup trisodium phosphate, 1/4 cuphousehold detergent, and 4 quarts of warm water. Then rinse thoroughly

with fresh water. For large areas, water blasting may be used.

(2) Fungus and Mold: Wash new surfaces with a solution composed of 1/2 cup trisodium phosphate, 1/4 cup household detergent, 1 quart 5 percent sodium hypochlorite solution and 3 quarts of warm water. Rinse thoroughly with fresh water.

(3) Paint and Loose Particles: Remove by wire brushing.

(4) Efflorescence: Remove by scraping or wire brushing followed by washing with a 5 to 10 percent by weight aqueous solution of hydrochloric (muriatic) acid. Do not allow acid to remain on the surface for more than five minutes before rinsing with fresh water. Do not acid clean more than 4 square feet of surface, per workman, at one time.

[(5) Removal of Existing Coatings: For surfaces to receive textured coating MPI 42, remove existing coatings including soundly adhered coatings if recommended by textured coating manufacturer.]

c. Cosmetic Repair of Minor Defects: Repair or fill mortar joints and minor defects, including but not limited to spalls, in accordance with manufacturer's recommendations and prior to coating application.

d. Allowable Moisture Content: Latex coatings may be applied to damp surfaces, but not to surfaces with droplets of water. Do not apply epoxies to damp vertical surfaces as determined by ASTM D 4263 or horizontal surfaces that exceed 3 lbs of moisture per 1000 square feet in 24 hours as determined by ASTM F 1869. In all cases follow manufacturers recommendations. Allow surfaces to cure a minimum of 30 days before painting.

3.4.2 Gypsum Board, Plaster, and Stucco

a. Surface Cleaning: Plaster and stucco shall be clean and free from loose matter; gypsum board shall be dry. Remove loose dirt and dust by brushing with a soft brush, rubbing with a dry cloth, or vacuum-cleaning prior to application of the first coat material. A damp cloth or sponge may be used if paint will be water-based.

b. Repair of Minor Defects: Prior to painting, repair joints, cracks, holes, surface irregularities, and other minor defects with patching plaster or spackling compound and sand smooth.

c. Allowable Moisture Content: Latex coatings may be applied to damp surfaces, but not surfaces with droplets of water. Do not apply epoxies to damp surfaces as determined by ASTM D 4263. New plaster to be coated shall have a maximum moisture content of 8 percent, when measured in accordance with ASTM D 4444, Method A, unless otherwise authorized. In addition to moisture content requirements, allow new plaster to age a minimum of 30 days before preparation for painting.

3.5 PREPARATION OF WOOD AND PLYWOOD SURFACES

3.5.1 New Plywood and Wood Surfaces, Except Floors:

a. Wood surfaces shall be cleaned of foreign matter.

   Surface Cleaning: Surfaces shall be free from dust and other deleterious substances and in a condition approved by the Contracting Officer prior to receiving paint or other finish. Do not use water to clean uncoated wood.

b. Moisture content of the wood shall not exceed 12 percent as measured by a moisture meter in accordance with ASTM D 4444, Method A, unless otherwise authorized.

c. Wood surfaces adjacent to surfaces to receive water-thinned paints shall be primed and/or touched up before applying water-thinned paints.

d. Cracks and Nailheads: Set and putty stop nailheads and putty cracks after the prime coat has dried.

e. Cosmetic Repair of Minor Defects:

   (1) Knots and Resinous Wood: Prior to application of coating, cover knots and stains with two or more coats of 3-pound-cut shellac varnish, plasticized with 5 ounces of castor oil per gallon. Scrape away existing coatings from knotty areas, and sand before treating. Prime before applying any putty over shellacked area.

   (2) Open Joints and Other Openings: Fill with whiting putty, linseed oil putty. Sand smooth after putty has dried.

   (3) Checking: Where checking of the wood is present, sand the surface, wipe and apply a coat of pigmented orange shellac. Allow to dry before paint is applied.

f. Prime Coat For New Exterior Surfaces: Prime coat before wood becomes dirty, warped, or weathered.

3.6 APPLICATION

3.6.1 Coating Application

Painting practices shall comply with applicable federal, state and local laws enacted to insure compliance with Federal Clean Air Standards. Apply coating materials in accordance with SSPC PA 1. SSPC PA 1 methods are applicable to all substrates, except as modified herein.

At the time of application, paint shall show no signs of deterioration. Uniform suspension of pigments shall be maintained during application.

Unless otherwise specified or recommended by the paint manufacturer, paint may be applied by brush, roller, or spray. Rollers for applying paints and enamels shall be of a type designed for the coating to be applied and the surface to be coated.

Paints, except water-thinned types, shall be applied only to surfaces that are completely free of moisture as determined by sight or touch.

Thoroughly work coating materials into joints, crevices, and open spaces. Special attention shall be given to insure that all edges, corners, crevices, welds, and rivets receive a film thickness equal to that of adjacent painted surfaces.

Each coat of paint shall be applied so dry film shall be of uniform thickness and free from runs, drops, ridges, waves, pinholes or other voids, laps, brush marks, and variations in color, texture, and finish. Hiding shall be complete.

Touch up damaged coatings before applying subsequent coats. Interior areas shall be broom clean and dust free before and during the application of coating material.

a. Drying Time: Allow time between coats, as recommended by the coating manufacturer, to permit thorough drying, but not to present topcoat adhesion problems. Provide each coat in specified condition to receive next coat.

b. Primers, and Intermediate Coats: Do not allow primers or intermediate coats to dry more than 30 days, or longer than recommended by manufacturer, before applying subsequent coats. Follow manufacturer's recommendations for surface preparation if primers or intermediate coats are allowed to dry longer than recommended by manufacturers of subsequent coatings. Each coat shall cover surface of preceding coat or surface completely, and there shall be a visually perceptible difference in shades of successive coats.

c. Finished Surfaces: Provide finished surfaces free from runs, drops, ridges, waves, laps, brush marks, and variations in colors.

d. Thermosetting Paints: Topcoats over thermosetting paints (epoxies and urethanes) should be applied within the overcoating window recommended by the manufacturer.

3.6.2 Mixing and Thinning of Paints

Reduce paints to proper consistency by adding fresh paint, except when thinning is mandatory to suit surface, temperature, weather conditions, application methods, or for the type of paint being used. Obtain written permission from the Contracting Officer to use thinners. The written permission shall include quantities and types of thinners to use.

When thinning is allowed, paints shall be thinned immediately prior to application with not more than 1 pint of suitable thinner per gallon. The use of thinner shall not relieve the Contractor from obtaining complete hiding, full film thickness, or required gloss. Thinning shall not cause the paint to exceed limits on volatile organic compounds. Paints of different manufacturers shall not be mixed.

3.6.3 Two-Component Systems

Two-component systems shall be mixed in accordance with manufacturer's instructions. Any thinning of the first coat to ensure proper penetration and sealing shall be as recommended by the manufacturer for each type of substrate.

3.6.4 Coating Systems

a. Systems by Substrates: Apply coatings that conform to the respective specifications listed in the following Tables:

Table

Division 3. Exterior Concrete Paint Table
Division 4. Exterior Concrete Masonry Units Paint Table
Division 5. Exterior Metal, Ferrous and Non-Ferrous Paint Table
Division 6. Exterior Wood; Dressed Lumber, Paneling, Decking, Shingles Paint Table
Division 3. Interior Concrete Paint Table
Division 4. Interior Concrete Masonry Units Paint Table
Division 5. Interior Metal, Ferrous and Non-Ferrous Paint Table
Division 6. Interior Wood Paint Table
Division 9: Interior Plaster, Gypsum Board, Textured Surfaces Paint Table

b. Minimum Dry Film Thickness (DFT): Apply paints, primers, varnishes, enamels, undercoats, and other coatings to a minimum dry film thickness of 1.5 mil each coat unless specified otherwise in the Tables. Coating thickness where specified, refers to the minimum dry film thickness.

c. Coatings for Surfaces Not Specified Otherwise: Coat surfaces which have not been specified, the same as surfaces having similar conditions of exposure.

d. Existing Surfaces Damaged During Performance of the Work, Including New Patches In Existing Surfaces: Coat surfaces with the following:

(1) One coat of primer.

(2) One coat of undercoat or intermediate coat.

(3) One topcoat to match adjacent surfaces.

e. Existing Coated Surfaces To Be Painted: Apply coatings conforming to the respective specifications listed in the Tables herein, except that pretreatments, sealers and fillers need not be provided on surfaces where existing coatings are soundly adhered and in good condition. Do not omit undercoats or primers.

3.7 COATING SYSTEMS FOR METAL

Apply coatings of Tables in Division 5 for Exterior and Interior.

a. Apply specified ferrous metal primer on the same day that surface is cleaned, to surfaces that meet all specified surface preparation requirements at time of application.

b. Inaccessible Surfaces: Prior to erection, use one coat of specified primer on metal surfaces that will be inaccessible after erection.

c. Shop-primed Surfaces: Touch up exposed substrates and damaged coatings to protect from rusting prior to applying field primer.

d. Surface Previously Coated with Epoxy or Urethane: Apply MPI 101, 1.5 mils DFT immediately prior to application of epoxy or urethane coatings.

e. Pipes and Tubing: The semitransparent film applied to some pipes and tubing at the mill is not to be considered a shop coat, but shall be overcoated with the specified ferrous-metal primer prior to application of finish coats.

f. Exposed Nails, Screws, Fasteners, and Miscellaneous Ferrous Surfaces. On surfaces to be coated with water thinned coatings, spot prime exposed nails and other ferrous metal with latex primer MPI 107.

3.8 COATING SYSTEMS FOR CONCRETE AND CEMENTITIOUS SUBSTRATES

Apply coatings of Tables in Division 3, 4 and 9 for Exterior and Interior.

3.9 COATING SYSTEMS FOR WOOD AND PLYWOOD

a. Apply coatings of Tables in Division 6 for Exterior and Interior.

b. Prior to erection, apply two coats of specified primer to treat and prime wood and plywood surfaces which will be inaccessible after erection.

c. Apply stains in accordance with manufacturer's printed instructions.

3.10 PIPING IDENTIFICATION

Piping Identification, Including Surfaces In Concealed Spaces: Provide in accordance with MIL-STD-101 or ANSI A13.1. Place stenciling in clearly visible locations. On piping not covered by MIL-STD-101 and ANSI A13.1, stencil approved names or code letters, in letters a minimum of 1/2 inch high for piping and a minimum of 2 inches high elsewhere. Stencil arrow-shaped markings on piping to indicate direction of flow using black stencil paint.

3.11 INSPECTION AND ACCEPTANCE

In addition to meeting previously specified requirements, demonstrate mobility of moving components, including swinging and sliding doors, cabinets, and windows with operable sash, for inspection by the Contracting Officer. Perform this demonstration after appropriate curing and drying times of coatings have elapsed and prior to invoicing for final payment.

3.12 PAINT TABLES

All DFT's are minimum values.

3.12.1 EXTERIOR PAINT TABLES

DIVISION 3: EXTERIOR CONCRETE PAINT TABLE

A. Concrete vertical surfaces, including undersides of balconies and soffits but excluding tops of slabs:

DIVISION 3: EXTERIOR CONCRETE PAINT TABLE

1. Latex

New; MPI EXT 3.1A-G2 (Flat) / Existing; MPI REX 3.1A-G2 (Flat)

Primer:	Intermediate:	Topcoat:
MPI 10	MPI 10	MPI 10

System DFT: 3.5 mils

New; MPI EXT 3.1A-G5 (Semigloss) / Existing; MPI EXT 3.1A-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 11	MPI 11	MPI 11

System DFT: 3.5 mils

New; MPI EXT 3.1A-G6 (Gloss) / Existing; MPI REX 3.1A-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 119	MPI 119	MPI 119

System DFT: 3.5 mils

Primer as recommended by manufacturer. Topcoat: Coating to match adjacent surfaces.

B. Concrete walls and bottom of swimming pools.

1. Chlorinated Rubber

New; / Existing;

Primer:	Intermediate:	Topcoat:
SSPC Paint 18	SSPC Paint 18	SSPC Paint 18

System DFT: Per Manufacturer

NOTE: Thin first coat (primer) with 1 part of approved thinner to 4 parts of paint by volume.

DIVISION 4: EXTERIOR CONCRETE MASONRY UNITS PAINT TABLE

A. Concrete masonry on uncoated surface:

1. Latex

New; MPI EXT 4.2A-G1 (Flat) / Existing; MPI REX 4.2A-G1 (Flat)

Block Filler:	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 10	MPI 10

System DFT: 11 mils

New; MPI EXT 4.2A-G5 (Semigloss) / Existing; MPI REX 4.2A-G5 (Semigloss)

Block Filler:	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 11	MPI 11

System DFT: 11 mils

New; MPI EXT 4.2A-G6 (Gloss) / Existing; MPI REX 4.2A-G6 (Gloss)

Block Filler:	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 119	MPI 119

System DFT: 11 mils

Topcoat: Coating to match adjacent surfaces.

DIVISION 5: EXTERIOR METAL, FERROUS AND NON-FERROUS PAINT TABLE

STEEL / FERROUS SURFACES

A. Steel that has been hand or power tool cleaned to SSPC SP 2 or SSPC SP 3

STEEL / FERROUS SURFACES

1. Alkyd
   New; MPI EXT 5.1Q-G5 (Semigloss) Existing; MPI REX 5.1D-G5
   Primer: Intermediate: Topcoat:
   MPI 23 MPI 94 MPI 94
   System DFT: 5.25 mils

   New; MPI EXT 5.1Q-G6 (Gloss) / Existing; MPI REX 5.1D-G6
   Primer: Intermediate: Topcoat:
   MPI 23 MPI 9 MPI 9
   System DFT: 5.25 mils

B. New Steel that has been blast-cleaned to SSPC SP 6:

2. Alkyd
   New; MPI EXT 5.1D-G5 (Semigloss) / Existing; MPI REX 5.1D-G5
   Primer: Intermediate: Topcoat:
   MPI 79 MPI 94 MPI 94
   System DFT: 5.25 mils

   New; MPI EXT 5.1D-G6 (Gloss) / Existing; MPI REX 5.1D-G6
   Primer: Intermediate: Topcoat:
   MPI 79 MPI 9 MPI 9
   System DFT: 5.25 mils

EXTERIOR SURFACES, OTHER METALS (NON-FERROUS)

C. Aluminum, aluminum alloy and other miscellaneous non-ferrous metal items not otherwise specified except hot metal surfaces, roof surfaces, and new prefinished equipment. Match surrounding finish:

1. Alkyd
   MPI EXT 5.4F-G1 (Flat)
   Primer: Intermediate: Topcoat:
   MPI 95 MPI 8 MPI 8
   System DFT: 5 mils

   MPI EXT 5.4F-G5 (Semigloss)
   Primer: Intermediate: Topcoat:
   MPI 95 MPI 94 MPI 94
   System DFT: 5 mils

   MPI EXT 5.4F-G6 (Gloss)
   Primer: Intermediate: Topcoat:
   MPI 95 MPI 9 MPI 9
   System DFT: 5 mils

DIVISION 6: EXTERIOR WOOD; DRESSED LUMBER, PANELING, DECKING, SHINGLES PAINT TABLE

A. Wood and plywood, trim, not otherwise specified:

1. Alkyd
   MPI EXT 6.3B-G5 (Semigloss)
   Primer: Intermediate: Topcoat:
   MPI 7 MPI 94 MPI 94
   System DFT: 5 mils

DIVISION 6: EXTERIOR WOOD; DRESSED LUMBER, PANELING, DECKING, SHINGLES PAINT TABLE

MPI EXT 6.3B-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 7	MPI 9	MPI 9

System DFT: 5 mils

2. Latex

MPI EXT 6.3A-G1 (Flat)

Primer:	Intermediate:	Topcoat:
MPI 7	MPI 10	MPI 10

System DFT: 5 mils

MPI EXT 6.3A-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 7	MPI 11	MPI 11

System DFT: 5 mils

MPI EXT 6.3A-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 7	MPI 119	MPI 119

System DFT: 5 mils

3.12.2 INTERIOR PAINT TABLES

DIVISION 3: INTERIOR CONCRETE PAINT TABLE

A. Concrete, vertical surfaces, not specified otherwise:

1. Latex

[New; MPI INT 3.1A-G2 (Flat) / Existing; MPI RIN 3.1A-G2 (Flat)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 44	MPI 44

System DFT: 4 mils

New; MPI INT 3.1A-G3 (Eggshell) / Existing; MPI RIN 3.1A-G3 (Eggshell)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 52	MPI 52

System DFT: 4 mils

New; MPI INT 3.1A-G5 (Semigloss) / Existing; MPI RIN 3.1A-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 54	MPI 54

System DFT: 4 mils

B. Concrete ceilings, uncoated:

1. Latex Aggregate

MPI INT 3.1N

Primer:	Intermediate:	Topcoat:
N/A	N/A	MPI 42

System DFT: Per Manufacturer

Texture - Coarse. Surface preparation, number of coats, and primer in accordance with manufacturer's instructions. Topcoat: Coating to match adjacent surfaces.

C. Concrete in toilets, laundry areas, shower areas, not otherwise specified except floors:

DIVISION 3: INTERIOR CONCRETE PAINT TABLE

1. Waterborne Light Industrial Coating
   New; MPI INT 3.1L-G3(Eggshell) / Existing; MPI RIN 3.1C-G3(Eggshell)

Primer:	Intermediate:	Topcoat:
MPI 110-G3	MPI 110-G3	MPI 110-G3

   System DFT: 4.8 mils

   New; MPI INT 3.1L-G5(Semigloss) / Existing; MPI RIN 3.1C-G5(Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 110-G5	MPI 110-G5	MPI 110-G5

   System DFT: 4.8 mils

   New; MPI INT 3.1L-G6(Gloss) / Existing; MPI RIN 3.1C-G6(Gloss)

Primer:	Intermediate:	Topcoat:
MPI 110-G6	MPI 110-G6	MPI 110-G6

   System DFT: 4.8 mils

2. Alkyd
   New; MPI INT 3.1D-G3 (Eggshell) / Existing; RIN 3.1D-G3 (Eggshell)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 51	MPI 51

   System DFT: 4.5 mils

   MPI INT 3.1D-G5 (Semigloss) / Existing; RIN 3.1D-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 47	MPI 47

   System DFT: 4.5 mils

   MPI INT 3.1D-G6 (Gloss) / Existing; RIN 3.1D-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 48	MPI 48

   System DFT: 4.5 mils

3. Epoxy
   New; MPI INT 3.1F-G6 (Gloss) / Existing; MPI RIN 3.1E-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 77	MPI 77	MPI 77

   System DFT: 4 mils

   Note: Primer may be reduced for penetration per manufacturer's instructions.

DIVISION 4: INTERIOR CONCRETE MASONRY UNITS PAINT TABLE

A. Concrete masonry:

1. High Performance Architectural Latex
   MPI INT 4.2D-G2 (Flat)

Filler	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 138	MPI 138

   System DFT: 11 mils

   MPI INT 4.2D-G3 (Eggshell)

Filler	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 139	MPI 139

   System DFT: 11 mils

   MPI INT 4.2D-G4 (Satin)

DIVISION 4: INTERIOR CONCRETE MASONRY UNITS PAINT TABLE

Filler	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 140	MPI 140

System DFT: 11 mils

MPI INT 4.2D-G5 (Semigloss)

Filler	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 141	MPI 141

System DFT: 11 mils

Fill all holes in masonry surface

B. Concrete masonry units in toilets, laundry areas, shower areas, unless otherwise specified:

1. Waterborne Light Industrial Coating

MPI INT 4.2K-G3(Eggshell)

Filler:	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 110-G3	MPI 110-G3

System DFT: 11 mils

MPI INT 4.2K-G5(Semigloss)

Filler:	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 110-G5	MPI 110-G5

System DFT: 11 mils

MPI INT 4.2K-G6(Gloss)

Filler:	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 110-G6	MPI 110-G6

System DFT: 11 mils

Fill all holes in masonry surface

2. Alkyd

MPI INT 4.2N-G3 (Eggshell)

Filler:	Primer:	Intermediate:	Topcoat:
MPI 4	MPI 50	MPI 51	MPI 51

System DFT: 12 mils

MPI INT 4.2N-G5 (Semigloss)

Filler:	Primer:	Intermediate:	Topcoat:
MPI 4	MPI 50	MPI 47	MPI 47

System DFT: 12 mils

MPI INT 4.2N-G6 (Gloss)

Filler:	Primer:	Intermediate:	Topcoat:
MPI 4	MPI 50	MPI 48	MPI 48

System DFT: 12 mils

Fill all holes in masonry surface

3. Epoxy

MPI INT 4.2G-G6 (Gloss)

Filler:	Primer:	Intermediate:	Topcoat:
MPI 116	N/A	MPI 77	MPI 77

System DFT: 10 mils

Fill all holes in masonry surface

DIVISION 5: INTERIOR METAL, FERROUS AND NON-FERROUS PAINT TABLE

INTERIOR STEEL / FERROUS SURFACES

A. Metal, not otherwise specified except floors, hot metal surfaces, and new prefinished equipment:

1. High Performance Architectural Latex
   MPI INT 5.1R-G2 (Flat)
   Primer: Intermediate: Topcoat:
   MPI 79 MPI 138 MPI 138
   System DFT: 5 mils

   MPI INT 5.1R-G3 (Eggshell)
   Primer: Intermediate: Topcoat:
   MPI 79 MPI 139 MPI 139
   System DFT: 5 mils

   MPI INT 5.1R-G5 (Semigloss)
   Primer: Intermediate: Topcoat:
   MPI 79 MPI 141 MPI 141
   System DFT: 5 mils

2. Alkyd
   MPI INT 5.1E-G2 (Flat)
   Primer: Intermediate: Topcoat:
   MPI 79 MPI 49 MPI 49
   System DFT: 5.25 mils

   MPI INT 5.1E-G3 (Eggshell)
   Primer: Intermediate: Topcoat:
   MPI 79 MPI 51 MPI 51
   System DFT: 5.25 mils

   MPI INT 5.1E-G5 (Semigloss)
   Primer: Intermediate: Topcoat:
   MPI 79 MPI 47 MPI 47
   System DFT: 5.25 mils]

   MPI INT 5.1E-G6 (Gloss)
   Primer: Intermediate: Topcoat:
   MPI 79 MPI 48 MPI 48
   System DFT: 5.25 mils

B. Metal in toilets, laundry areas, shower areas not otherwise specified except floors, hot metal surfaces, and new prefinished equipment:

1. Alkyd
   MPI INT 5.1E-G3 (Eggshell)
   Primer: Intermediate: Topcoat:
   MPI 79 MPI 51 MPI 51
   System DFT: 5.25 mils

   MPI INT 5.1E-G5 (Semigloss)
   Primer: Intermediate: Topcoat:
   MPI 79 MPI 47 MPI 47
   System DFT: 5.25 mils

   MPI INT 5.1E-G6 (Gloss)

INTERIOR STEEL / FERROUS SURFACES

Primer:	Intermediate:	Topcoat:
MPI 79	MPI 48	MPI 48

System DFT: 5.25 mils

2. Alkyd

MPI INT 5.1T-G3 (Eggshell) For hand tool cleaning

Primer:	Intermediate:	Topcoat:
MPI 23	MPI 51	MPI 51

System DFT: 5.25 mils

MPI INT 5.1T-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 23	MPI 47	MPI 47

System DFT: 5.25 mils

MPI INT 5.1T-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 23	MPI 48	MPI 48

System DFT: 5.25 mils

DIVISION 6: INTERIOR WOOD PAINT TABLE

A. Wood and plywood not otherwise specified:

1. High Performance Architectural Latex

MPI INT 6.4S-G3 (Eggshell)

Primer:	Intermediate:	Topcoat:
MPI 39	MPI 139	MPI 139

System DFT: 4.5 mils

MPI INT 6.4S-G4 (Satin)

Primer:	Intermediate:	Topcoat:
MPI 39	MPI 140	MPI 140

System DFT: 4.5 mils

MPI INT 6.4S-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 39	MPI 141	MPI 141

System DFT: 4.5 mils

2. Alkyd

MPI INT 6.4B-G3 (Eggshell)

Primer:	Intermediate:	Topcoat:
MPI 45	MPI 51	MPI 51

System DFT: 4.5 mils

MPI INT 6.4B-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 45	MPI 47	MPI 47

System DFT: 4.5 mils

MPI INT 6.4B-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 45	MPI 48	MPI 48

System DFT: 4.5 mils

3. Silicone Alkyd System - Max Temperature 500 degree F. - 1000 degree F.

DIVISION 6: INTERIOR WOOD PAINT TABLE

Aluminum Finish: 1st Coat - Hi-Heat Silicone Alkyd Aluminum
2nd Coat - Hi-Heat Silicone Alkyd Aluminum
3 mils wet, 0.75 mils dry coats.

B. Wood surfaces in toilets, laundry areas, shower areas, not otherwise specified.:

1. Waterborne Light Industrial

MPI INT 6.3P-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 45	MPI 110-G5	MPI 110-G5

System DFT: 4.5 mils

MPI INT 6.3P-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 45	MPI 110-G6	MPI 110-G6

System DFT: 4.5 mils

2. Alkyd

MPI INT 6.3B-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 45	MPI 47	MPI 47

System DFT: 4.5 mils

MPI INT 6.3B-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 45	MPI 48	MPI 48

System DFT: 4.5 mils

C. Wood Doors; Natural Finish or Stained:

1. Natural finish, oil-modified polyurethane

New; MPI INT 6.3K-G4 / Existing; MPI RIN 6.3K-G4

Primer:	Intermediate:	Topcoat:
MPI 57	MPI 57	MPI 57

System DFT: 4 mils

New; MPI INT 6.3K-G6 (Gloss) / Existing; MPI RIN 6.3K-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 56	MPI 56	MPI 56

System DFT: 4 mils

Note: Sand between all coats per manufacturers recommendations.]

DIVISION 9: INTERIOR PLASTER, GYPSUM BOARD, TEXTURED SURFACES PAINT TABLE

A. Plaster and Wallboard not otherwise specified:

1. Latex

New; MPI INT 9.2A-G2 (Flat) / Existing; RIN 9.2A-G2 (Flat)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 44	MPI 44

System DFT: 4 mils

New; MPI INT 9.2A-G3 (Eggshell) / Existing; RIN 9.2A-G3 (Eggshell)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 52	MPI 52

System DFT: 4 mils

DIVISION 9: INTERIOR PLASTER, GYPSUM BOARD, TEXTURED SURFACES PAINT TABLE

New; MPI INT 9.2A-G5 (Semigloss) / Existing; RIN 9.2A-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 54	MPI 54

System DFT: 4 mils

B. Plaster and Wallboard in toilets, laundry areas, shower areas, not otherwise specified.:

1. Waterborne Light Industrial Coating
   New; MPI INT 9.2L-G5(Semigloss) / Existing; MPI RIN 9.2L-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 110-G5	MPI 110-G5

   System DFT: 4 mils

2. Alkyd
   New; MPI INT 9.2C-G5 (Semigloss) / Existing; MPI RIN 9.2C-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 47	MPI 47

   System DFT: 4 mils

3. Epoxy
   New; MPI INT 9.2E-G6 (Gloss) / Existing; MPI RIN 9.2D-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 77	MPI 77

   System DFT: 4 mils

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 10 - SPECIALTIES

SECTION 10270A

RAISED FLOOR SYSTEM

01/97

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1.1.2 SUBMITTALS
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-- End of Section Table of Contents --

SECTION 10270A

RAISED FLOOR SYSTEM
01/97

PART 1 GENERAL

1.1 [Enter Appropriate Subpart Title Here]1.1.1 WORK DESCRIPTION

A. Work of this section includes, but is not limited to: access floor panels, floor coverings, understructure and various electrical, data and communication accessories. The raised floor system shall be the standard product of a manufacturer specializing in the manufacture of raised floor systems.

1.2 RELATED SECTIONS

A. General contractor shall provide clear access, dry secure storage, and a clean sub-floor area which is free of construction debris and other trades during installation of the access floor system. Area to receive the access floor shall be enclosed and be maintained at a temperature range of 50(to 90(F and a humidity range of 20% to 70% relative. Access floor must be stored in this environment at least 24 hours before the installation begins.

B. Concrete sealer shall be compatible with pedestal adhesive, see Division 3.

C. Electrical contractor shall provide necessary material and labor to electrically connect the access floor to the building, see Division 16.

1.3 Performance Requirements

Pedestals:

A. Axial Load: Pedestal assembly shall provide a 6000 lb. axial load without permanent deformation.

B. Overturning Moment: Pedestal assembly shall provide an average overturning moment of 1000 in-lbs. when glued to a clean, sound, uncoated concrete surface. ICBO number for the specific system or structural calculations shall be required attesting to the lateral stability of the system under seismic conditions.

Floor Panels:

A. Concentrated Load: Panel shall be capable of supporting a concentrated load of 1000 lbs. placed on a one square inch area (using a round or square indentor) at any location on the panel with a maximum top surface deflection of 0.100 inches. Panel shall not exceed a permanent set of 0.010 inches, after the load is removed. Panel shall demonstrate ductility by being loaded to a deflection of 0.100 inches without incurring damage.

B. Uniform Load: Panel shall be capable of supporting a uniform load of 250 lbs. placed on a one square foot area at any location on the panel with a maximum top surface deflection of 0.060 inches. Panel shall not exceed a permanent set of 0.010 inches, after the load is removed. Note: The uniform load rating of an access floor panel as specified herein should not

be confused with the "uniform live load" as specified in seismic zone applications.

C. Ultimate Load: Panel shall be capable of withstanding a concentrated load of 3250 lbs. applied onto a one square inch area (using a round or square indentor) at any location on the panel without failure. Failure is defined as the point at which the panel will no longer accept the load. Certified test report shall be shall be provided attesting to this ultimate load.

D. Rolling Load: Panel and supporting understructure shall be able to withstand the following rolling loads at any location on the panel without developing a local and overall surface deformation greater than 0.040 inches. Note: wheel 1 and wheel 2 tests shall be performed on two separate panels.

Wheel 1: Size: 3" dia x 1 13/16" wide Load: 800 lbs. Passes: 10
Wheel 2: Size: 6" dia x 1 1/2" wide Load: 600 lbs. Passes: 10,000

E. Impact Load: Panel and supporting understructure shall be capable of supporting an impact load of 100 lbs. dropped from a height of 36 inches onto a one square inch area (using a round or square indentor) at any location on the panel, after which it shall continue to meet all load performance requirements as previously defined.

F. Panel Drop Test: Panel shall be capable of being dropped face up onto to a concrete slab from a height of 36", after which it shall continue to meet all load performance requirements as previously defined.

G. Panel Cutout: Panel with 8" diameter cutout shall be capable of withstanding an ultimate load without failure of 1500 lbs. anywhere on the panel.

1.4 Design Requirements:

A. Access floor system, where indicated on the design documents, shall consist of modular and removable cementitious filled welded steel panels fastened onto, and supported by, adjustable height pedestal assemblies. Pedestal head and panel corner design must provide a positive location and lateral engagement of the panel to the understructure support system without the use of fasteners.

B. Panel shall be easily removed by one person with a lifting device and shall be interchangeable except where cut for special conditions.

C. Quantities, finished floor heights (FFH) and location of accessories shall be as specified on the contract drawings.

1.6 Submittals for Review

A. Detail sheets, for each proposed product type, which provide the necessary information to describe the product and its performance.

B. Test reports, by an independent testing laboratory within the U.S. with minimum 5 years experience testing, certifying that component parts perform as specified.

1.7 Submittals for Information

A. Manufacturer's installation instructions and guidelines.

B. Manufacturer's Owner Manual outlining recommended care and maintenance procedures.

1.1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Raised Floor System;

Drawings showing layout of the work, sizes and details of components, details at floor perimeter, bracing to resist seismic or other lateral loads, typical cutout details including size and shape limitation, method of grounding, description of shop coating, and installation height above structural floor.

SD-03 Product Data

Raised Floor System;

Manufacturer's descriptive data, catalog cuts, and installation instructions. The data shall include information about any design and production techniques, procedures and policies used to conserve energy, reduce material, improve waste management or incorporate green building/recycled products into the manufacturer of their components or products. Cleaning and maintenance instructions shall be included. Design calculations which demonstrate that the proposed floor system meets requirements for seismic loading, prepared in accordance with subparagraph Underfloor Bracing under paragraph PANEL SUPPORT SYSTEM and ICBO UBC. Certified copies of test reports may be submitted in lieu of calculations.

SD-04 Samples

Raised Floor System; G

One sample of each panel type and suspension system proposed for use.

SD-06 Test Reports

Tests;
Testing of Electrical Resistance;

Certified copies of test reports from an approved testing laboratory, attesting that the proposed floor system components meet the performance requirements specified.

SD-07 Certificates

Raised Floor System;

Certificate of compliance attesting that the raised floor system meets specification requirements.

1.1.3 DELIVERY, STORAGE, AND HANDLING

Materials shall be stored in original protective packaging in a safe, dry, and clean location and shall be handled in a manner to prevent damage. Panels shall be stored at temperatures between 40 and 90 degrees F, and between 20 percent and 70 percent humidity.

1.1.4 EXTRA MATERIALS

Spare floor panels, and spare complete pedestal assemblies shall be furnished at the rate of one space for each 100 or fraction thereof required.

1.1.5 OPERATION AND MAINTENANCE MANUALS

Provide maintenance instructions for proper care of the floor panel surface. When conductive flooring is specified, require submittal of maintenance instructions to identify special cleaning and maintenance requirements to maintain "conductivity" properties of the panel finish.

PART 2 PRODUCTS

2.1 RAISED FLOOR SYSTEMS

A. Alternative products shall meet or exceed the feature requirements as indicated herein and the performance requirements as outlined in section 1.4 and must receive prior written approval by the Contracting Officer.

C. Quality Assurance Source Limitations: Obtain access flooring through one source from a ~~single domestic~~ manufacturer who has a minimum of 5 years experience in the manufacture and distribution of access floor systems and can demonstrate that they have completed projects of like scope and size. ~~Access panels shall be stamped "Made in USA".~~ Any alternate products shall meet or exceed the requirements outlined herein.

2.2 SUPPORT COMPONENTS

Pedestals:

A. Pedestal assemblies shall be corrosive resistant, all steel welded construction, and shall provide an adjustment range of +/- 1" for finished floor heights 6" or greater.

B. Pedestal assemblies shall provide a means of leveling and locking the assembly at a selected height, which requires deliberate action to change height setting and prevents vibration displacement.

C. Pedestal head shall be designed with locating tabs and integral shape to interface with the panel for positive lateral retention and positioning without fasteners.

D. Galvanized steel pedestal head shall be welded to a threaded rod which includes a specially designed adjusting nut. The nut shall provide location lugs to engage the pedestal base assembly, such that deliberate action is

required to change the height setting.

E. Threaded rod shall provide a specially designed anti-rotation device, such that when the head assembly is engaged in the base assembly, the head cannot freely rotate (for FFH of 6" or greater).

F. Pedestal base assembly shall consist of a formed galvanized steel plate with no less than 16 inches of bearing area, welded to a 7/8" square galvanized steel tube and shall be designed to engage the head assembly.

2.3 PANEL COMPONENTS/FLOOR PANELS:

A. Panels shall consist of a top steel sheet welded to a formed steel bottom pan filled internally by a lightweight cementitious material. Mechanical or adhesive methods for attachment of the steel top and bottom sheets are unacceptable.

B. Cementitious fill material shall be totally encased within the steel welded shell except where cut for special conditions. Note: This greatly reduces the potential for dust in the environment from exposed cement materials.

C. Panel shall have an electrically conductive epoxy paint finish.

D. Corner of panel shall have a locating tab and integral shape design to interface with the pedestal head for positive lateral retention and positioning with or without fasteners.

E. Fastening of panels to pedestal heads shall be accomplished by the use of a machine screw which is specially designed to be self capturing within the body of the panel. Note: This prevents the inadvertent loss of panel fastening screws when accessing the underfloor space and potential damage to objects by screws which extend beyond the depth of the panel.

~~F. Top surface of the panel shall have option for four positioning location holes to engage positioning buttons on the carpet tile for precise matching of the carpet tile to the panel.~~

G. Fit between the pedestal head, panel, and screw shall enable an installation with an average panel to panel gap of 0.015".

2.4 ACCESSORIES

A. Modular Wiring System

1. Modular power system shall ensure efficient electrification and delivery of power from power panels to workstations or equipment at any location. System shall be prefabricated and totally flexible, with true "plug and play"

2. Modular wiring system is based on zone wiring requirements. Power distribution is achieved above the ceiling or below the access floor through use of multi-conductor open power cables run from circuit breaker panel to prewired master power distribution modules. This method of wiring eliminates need for individual home run cabling. Master power distribution modules branch out to feed satellite power distribution modules by modular connectorized closed power cables, in hierarchy scheme. From zone locations closed power cables distribute power to any point where electrical power is required.

3. Modular connectors shall accommodate up to 10 conductors and employ following safety features:

a) Mating connectors shall be of locking type and be keyed by physical or mechanical means to maintain correct polarity, consistent with wiring diagram affixed to system components.

b) Grounding conductor contact on each modular assembly shall be designed and manufactured to provide for First Make / Last Break (FM/LB) feature, such that grounding connection is made before contact being made with current carrying conductors when connectors are mated. Grounding conductor shall break its connection only after current carrying conductors have broken their connections when connectors are disengaged.

c) Contacts of 10-pin connector shall conform to MIL-STD-202, 204 Cond. A, and 213 Cond. A to ensure durability and UL 486A for crimp retention force.

d) Plastic housings encase contacts within modular connector.

1. UL flammability rating of 94VO.

2. Genderless and keyed to prevent possible mismatching of dissimilar voltages.

3. Color coded to match industry-standard wiring colors (for example, green, black, red, blue, white, and grey) to aid in system installation and troubleshooting.

B. UL listed access floor outlet boxes shall be provided in locations as detailed on the contract drawings. High capacity 11 1/4 inch square service outlet boxes shall be capable of accommodating four duplex receptacles, six individual voice/data termination points or four individual voice/data termination points and one grommet opening. Standard capacity 7-5/16 by 6-15/16 inch service outlet boxes shall be capable of accommodating two duplex receptacles and four individual voice data/termination points or two individual voice/data termination points and one grommet opening. The service outlet box shall be a drop-in design having a hinged lid with carpet insert and frame with tapered edge. Service outlet box shall be capable of withstanding without failure a load of 800 lb.

C. Provide manufacturer's standard steps, ramps, fascia plate, perimeter support, and grommets where indicated on the contract drawings.

D. Provide 5% spare floor panels for each type used in the project for maintenance stock. Deliver to project in manufacturer's standard packaging clearly marked with the contents.

E. Provide 3 panel lifting devices.

2.5 FINISHES

A. Finish the surface of floor panels with floor covering material as indicated on the contract drawings. Where floor coverings are by the access floor manufacturer, the type, color and pattern shall be selected from manufacturer's standard.

B. Carpet tile: Access floor system shall be designed ~~as option~~ to accommodate ~~a~~ modular carpet tile that ~~precisely~~ matches one carpet tile to one panel. ~~This is accomplished utilizing four precisely located positioning~~

~~buttons on the carpet tile which engage into four positioning location holes within the top surface of the access floor panel.~~ The carpet tile's durable backing maintains dimensional stability, and holds the carpet tile flat without adhesives. Adhesives are not necessary and shall not be permitted on the installation except where the carpet is cut~~ and more than two positioners are removed~~.

C. Vinyl edge trim for factory applied VCT and all other tile coverings shall be applied to the panel's top surface and shall not wrap around the panel's edge.

2.6 FABRICATION TOLERENCES

A. Floor panel flatness: +/- 0.040" diagonally
+/- 0.025" along perimeter edges

B. Floor panel width or length tolerance: +/- 0.010"

C. Floor panel squareness: +/- 0.015"

2.1 UNDERFLOOR BRACING

Special bracing to resist the effects of seismic or other forces shall be in accordance with Section 13080 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT.

2.2 TESTS

Raised flooring shall be factory tested by an independent laboratory at the same position and maximum design elevation and in the same arrangement as shown on the drawings for installation so as to duplicate service conditions as much as possible.

PART 3 EXECUTION

3.1 INSTALLATION

The floor system shall be installed in accordance with the manufacturer's instructions and with the approved detail drawings. Open ends of the floor, where the floor system does not abut wall or other construction, shall have positive anchorage and rigid support. Areas to receive raised flooring shall be maintained between 60 and 90 degrees F, and between 20 percent and 70 percent humidity for 24 hours prior to and during installation.

3.1.1 Preparation for Installation

The area in which the floor system is to be installed shall be cleared of all debris. Structural floor surfaces shall be thoroughly cleaned and all dust shall be removed. Floor coatings required for dust or vapor control shall be installed prior to installation of pedestals only if the pedestal adhesive will not damage the coating. If the coating and adhesive are not compatible, the coating shall be applied after the pedestals have been installed and the adhesive has cured.

3.1.2 Pedestals

Pedestals shall be accurately spaced, and shall be set plumb and in true alignment. Base plates shall be in full and firm contact with the

structural floor, and shall be secured to the structural floor with adhesive.

3.2 TESTING OF ELECTRICAL RESISTANCE

Testing of electrical resistance in the completed installation shall be conducted in the presence of the Contracting Officer. Testing shall be in accordance with NFPA 99 modified by placing one electrode on the center of the panel surface and connecting the other electrode to the metal flooring support. Measurements shall be made at five or more locations. Each measurement shall be the average of five readings of 15 seconds duration at each location. During the tests, relative humidity shall be 45 to 55 percent and temperature shall be 69 to 75 degrees F. The panels used in the testing will be selected at random and will include two panels most distant from the ground connection. Electrical resistance shall be measured with instruments that are accurate within 2 percent and that have been calibrated within 60 days prior to the performance of the resistance tests. The metal-to-metal resistance from panel to supporting pedestal shall not exceed 10 ohms. The resistance between the wearing surface of the floor covering and the ground connection, as measured on the completed installation, shall be in accordance with paragraph FLOOR COVERING.

3.3 FIRE SAFETY

An automatic detection system shall be installed below the raised floor meeting the requirements of NFPA 75 paragraph 5-2.1 and shall sound an audible and visual alarm. Air space below the raised floor shall be subdivided into areas not exceeding 10,000 square feet by tight, noncombustible bulkheads. All penetrations for piping and cables shall be sealed to maintain bulkhead properties.

-- End of Section --

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SECTION 12320A

CABINETS AND COUNTERTOPS

05/98

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SECTION 12320A

CABINETS AND COUNTERTOPS
05/98

PART 1 GENERAL

1.1 REFERENCES

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

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

BHMA A156.9	(1994) Cabinet Hardware

KITCHEN CABINET MANUFACTURERS ASSOCIATION (KCMA)

KCMA ANSI/KCMA A161.1	(1995) Performance & Construction Standards for Kitchen and Vanity Cabinets

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA LD 3	(1995) High-Pressure Decorative Laminates

1.2 DESIGN

Cabinets shall be wood, factory-fabricated and finished in the manufacturer's standard sizes and finishes of the type, design, and configuration indicated. Cabinets shall be constructed as specified and shall meet the requirements of KCMA ANSI/KCMA A161.1. Wall and base cabinet assemblies shall consist of individual units joined into continuous sections. Fastenings shall be accomplished to permit removal and replacement of individual units without affecting the remainder of the installation. Counters shall be provided with watertight sink rim when indicated. Drawers shall be removable and shall be equipped with position stops to avoid accidental complete withdrawals. Shelves shall be fixed or adjustable as indicated.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation;

Drawings showing each type of cabinet and related item, and clearly indicating the complete plan, location, and elevations of the cabinets and accessories and pertinent details of construction, fabrication, and attachments.

SD-03 Product Data

Cabinets;
Countertops and Backsplash;

Manufacturer's printed data, catalog cuts, installation and cleaning instructions.

SD-04 Samples

Cabinets;
Countertops and Backsplash;

In lieu of individual samples, complete minimum size cabinets may be furnished as samples. Mock-up units are not acceptable. Samples shall be of sufficient size to show color, pattern, and method of assembly.

a. Countertop and backsplash - One section, containing both.

b. Door and drawer front - One of each, with hardware mounted.

c. Countertop color samples approximately 2 x 3 inches size.

d. Stain/color samples approximately 2 x 3 inches size.

SD-06 Test Reports

Cabinets and Countertops;

Test reports certifying that all cabinets comply with the requirements of KCMA ANSI/KCMA A161.1. Tests shall be conducted by independent laboratories approved by KCMA. KCMA certification seals affixed to the cabinets will be accepted in lieu of certified test reports.

1.4 DELIVERY AND STORAGE

Cabinets shall be delivered to the jobsite wrapped in a protective covering. Cabinets shall be stored in accordance with manufacturer's recommendations in an adequately ventilated, dry location that is free of dust, water, or other contaminants and in a manner to permit access for inspection and handling. Cabinets shall be handled carefully to prevent damage to the surfaces. Damaged items that cannot be restored to like-new condition shall be replaced.

PART 2 PRODUCTS

2.1 CABINETS

Wall and base cabinets shall be of the same construction and same outside appearance. Door design shall be framed inset hardwood panels from vendors standard styles. Shelves shall be fixed or fully adjustable as indicated. Adjustable shelves shall be capable of adjusting on approximately 3 inch increments. Shelves shall be supported by self-locking clips or wood dowels. Dowels shall be approximately 5/16 inch in diameter by 1-9/16 inches long. Dowels shall be inserted into borings for the shelf adjustments. Shelves shall be minimum 1/2 inch thick plywood or minimum 1/2 inch thick 45 pound density particle board. Drawer fronts shall be 45 pound density particle board or hardwood plywood to match cabinet door construction or 3/4 inch thick solid hardwood frame with hardwood plywood

panel.

2.2 COUNTERTOPS AND BACKSPLASH

2.2.1 High-Pressure Laminated Plastic Clad Countertops

Clad countertop and backsplash shall be constructed of 3/4 inch thick plywood or 3/4 inch thick, 45 pound density particle board core and shall be post formed cove type or fully formed type. Cove type shall be a single unit with self-edging and plastic laminate coved at the juncture of the countertop and backsplash. Edging and trim shall consist of plastic laminate cut and fitted to all exposed edges. End splashes constructed of 3/4 inch plywood or 3/4 inch thick, 45 pound density particle board core shall be supplied. Continuous sheets of longest lengths practicable shall be provided. Joints in surface sheeting shall be tight and flush and held to a practicable minimum. When the countertop and backsplash are two separate units, GP50 plastic laminate shall be used. When the countertop and backsplash are one unit, PF42 plastic laminate shall be used. Plastic laminate shall conform to the requirements of NEMA LD 3 and plastic laminate adhesive shall be contact type applied to both surfaces. For fully formed and cove type countertops, the post-forming plastic laminate shall not be bent to a radius smaller than the limit recommended by the plastic manufacturer.

2.3 Sink/Lavatory Rims

Sink/lavatory rims shall be of the corrosion resistant steel clamping type, sized to the sink, and a standard product of a manufacturer regularly producing this type of equipment.

2.4 FINISH

2.4.1 Cabinet Finish

Cabinets shall be provided with a factory-applied durable finish in accordance with KCMA ANSI/KCMA A161.1 requirements and of a type standard with the manufacturer. Natural finish wood doors, drawer fronts, cabinet fronts, and exposed cabinet sides shall be fabricated of wood which will be free of extreme color variations within each panel or between adjacent panels.

2.4.2 Melamine Laminated Interior Cabinet Finish

Plywood, particle board or tempered hardboard cabinet backs shall be finished with a melamine laminate on the exposed side. Particle board shelves shall be covered on both sides with a laminated melamine finish. Melamine laminate shall conform to the requirements of NEMA LD 3 and laminate adhesive shall be contact type applied to both surfaces.

2.4.3 Backer Sheets

Backer Sheets of high pressure plastic laminate, shall conform to NEMA LD 3, Grade BK20 and shall be applied to the underside of all core material.

2.5 HARDWARE

Hardware shall conform to BHMA A156.9, shall be suitable for kitchen cabinet use, and shall include all miscellaneous hardware for a complete installation. Door hinges shall be self-closing type. Drawer runners

shall have nylon rollers standard with the manufacturer. Hardware and fastenings for doors and drawers with particle board cores shall be of the through-bolt type.

PART 3 EXECUTION

3.1 INSTALLATION

Cabinets shall be installed level, plumb, and true to line, and shall be attached to the walls or floors with suitable devices to securely anchor each unit. Countertops, accessories, and hardware shall be installed as indicated on the drawings. Installation shall be in accordance with the manufacturer's approved printed instructions. The inner edge of sink cut-outs in laminated plastic tops shall be painted with a coat of semigloss enamel paint and sink flanges shall be set in a bed of sealant. Closer and filler strips and finish moldings shall be provided as required. Prior to final acceptance, doors shall be aligned, and hardware shall be adjusted.

3.2 CLEANING

Cabinet and countertop surfaces shall be cleaned in accordance with manufacturer's instructions.

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SECTION 13851A

FIRE DETECTION AND ALARM SYSTEM, ADDRESSABLE

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SECTION 13851A

FIRE DETECTION AND ALARM SYSTEM, ADDRESSABLE
02/02

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI S3.41	(1990; R 1996) Audible Emergency Evacuation Signal

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41	(1991; R 1995) Surge Voltages in Low-Voltage AC Power Circuits

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code
NFPA 72	(1999) National Fire Alarm Code
NFPA 90A	(1999) Installation of Air Conditioning and Ventilating Systems

UNDERWRITERS LABORATORIES (UL)

UL 1242	(1996; Rev Mar 1998) Intermediate Metal Conduit
UL 1971	(1995; Rev thru Apr 1999) Signaling Devices for the Hearing Impaired
UL 228	(1997; Rev Jan 1999) Door Closers-Holders, With or Without Integral Smoke Detectors
UL 268	(1996; Rev thru Jan 1999) Smoke Detectors for Fire Protective Signaling Systems
UL 268A	(1998) Smoke Detectors for Duct Application
UL 38	(1999) Manually Actuated Signaling Boxes for Use with Fire-Protective Signaling Systems
UL 464	(1996; Rev thru May 1999) Audible Signal Appliances
UL 521	(1999) Heat Detectors for Fire Protective Signaling Systems

UL 6	(1997) Rigid Metal Conduit
UL 632	(2000) Electrically-Actuated Transmitters
UL 797	(1993; Rev thru Mar 1997) Electrical Metallic Tubing
UL 864	(1996; Rev thru Mar 1999) Control Units for Fire Protective Signaling Systems

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fire Alarm Reporting System; G

Detail drawings, prepared and signed by a Registered Professional Engineer or a NICET Level 3 or 4 Fire Alarm Technician, consisting of a complete list of equipment and material, including manufacturer's descriptive and technical literature, catalog cuts, and installation instructions. Note that the contract drawings show layouts based on typical detectors. The Contractor shall check the layout based on the actual detectors to be installed and make any necessary revisions in the detail drawings. The detail drawings shall also contain complete wiring and schematic diagrams for the equipment furnished, equipment layout, and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Detailed point-to-point wiring diagram shall be prepared and signed by a Registered Professional Engineer or a NICET Level 3 or 4 Fire Alarm Technician showing points of connection. Diagram shall include connections between system devices, appliances, control panels, supervised devices, and equipment that is activated or controlled by the panel.

SD-03 Product Data

Storage Batteries; G

Substantiating battery calculations for supervisory and alarm power requirements. Ampere-hour requirements for each system component and each panel component, and the battery recharging period shall be included.

Voltage Drop;

Voltage drop calculations for notification appliance circuits to indicate that sufficient voltage is available for proper appliance operation.

Special Tools and Spare Parts;

Spare parts data for each different item of material and equipment specified, not later than 3 months prior to the date of beneficial occupancy. Data shall include a complete list of parts and supplies with the current unit prices and source of supply and a list of the parts recommended by the manufacturer to be replaced after 1 year of service.

Technical Data and Computer Software; G

Technical data which relates to computer software.

Training;

Lesson plans, operating instructions, maintenance procedures, and training data, furnished in manual format, for the training courses. The operations training shall familiarize designated government personnel with proper operation of the fire alarm system. The maintenance training course shall provide the designated government personnel adequate knowledge required to diagnose, repair, maintain, and expand functions inherent to the system.

Testing;

Detailed test procedures, prepared and signed by a Registered Professional Engineer or a NICET Level 3 or 4 Fire Alarm Technician, for the fire detection and alarm system 60 days prior to performing system tests.

SD-06 Test Reports

Testing;

Test reports, in booklet form, showing field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall document readings, test results and indicate the final position of controls. The Contractor shall include the NFPA 72 Certificate of Completion and NFPA 72 Inspection and Testing Form, with the appropriate test reports.

SD-07 Certificates

Equipment;

Certified copies of current approvals or listings issued by an independent test lab if not listed by UL, FM or other nationally recognized testing laboratory, showing compliance with specified NFPA standards.

Qualifications;

Proof of qualifications for required personnel. The installer shall submit proof of experience for the Professional Engineer, fire alarm technician, and the installing company.

SD-10 Operation and Maintenance Data

Technical Data and Computer Software; G

Six copies of operating manual outlining step-by-step procedures required for system startup, operation, and shutdown. The manual shall include the manufacturer's name, model number, service manual, parts list, and complete description of equipment and their basic operating features. Six copies of maintenance manual listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guide. The manuals shall include conduit layout, equipment layout and simplified wiring, and control diagrams of the system as installed. The manuals shall include complete procedures for system revision and expansion, detailing both equipment and software requirements. Original and backup copies of all software delivered for this project shall be provided, on each type of media utilized. Manuals shall be approved prior to training.

1.3 GENERAL REQUIREMENTS

1.3.1 Standard Products

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 2 years prior to bid opening. Equipment shall be supported by a service organization that can provide service within 24 hours of notification.

1.3.2 Nameplates

Major components of equipment shall have the manufacturer's name, address, type or style, voltage and current rating, and catalog number on a noncorrosive and nonheat-sensitive plate which is securely attached to the equipment.

1.3.3 Keys and Locks

Locks shall be keyed alike. Four keys for the system shall be provided.

1.3.4 Tags

Tags with stamped identification number shall be furnished for keys and locks.

1.3.5 Verification of Dimensions

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

1.3.6 Compliance

The fire detection and alarm system and the central reporting system shall be configured in accordance with NFPA 72; exceptions are acceptable as directed by the Contracting Officer. The equipment furnished shall be compatible and be UL listed, FM approved, or approved or listed by a nationally recognized testing laboratory in accordance with the applicable NFPA standards.

1.3.7 Qualifications

1.3.7.1 Engineer and Technician

a. Registered Professional Engineer with verification of experience and at least 4 years of current experience in the design of the fire protection and detection systems.

b. National Institute for Certification in Engineering Technologies (NICET) qualifications as an engineering technician in fire alarm systems program with verification of experience and current NICET certificate.

c. The Registered Professional Engineer may perform all required items under this specification. The NICET Fire Alarm Technician shall perform only the items allowed by the specific category of certification held.

1.3.7.2 Installer

The installing Contractor shall provide the following: NICET Fire Alarm Technicians to perform the installation of the system. A NICET Level 3 or 4 Fire Alarm Technician shall supervise the installation of the fire alarm system. NICET Level 2 or higher Fire Alarm Technician shall install and terminate fire alarm devices, cabinets and panels. An electrician or NICET Level 1 Fire Alarm Technician shall install conduit for the fire alarm system. The Fire Alarm technicians installing the equipment shall be factory trained in the installation, adjustment, testing, and operation of the equipment specified herein and on the drawings.

1.3.7.3 Design Services

Installations requiring designs or modifications of fire detection, fire alarm, or fire suppression systems shall require the services and review of a qualified fire protection engineer. For the purposes of meeting this requirement, a qualified fire protection engineer is defined as an individual meeting one of the following conditions:

a. An engineer having a Bachelor of Science or Masters of Science Degree in Fire Protection Engineering from an accredited university engineering program, plus a minimum of 2 years' work experience in fire protection engineering.

b. A registered professional engineer (P.E.) in fire protection engineering.

c. A registered PE in a related engineering discipline and member grade status in the National Society of Fire Protection Engineers.

d. An engineer with a minimum of 10 years' experience in fire protection engineering and member grade status in the National Society of Fire Protection Engineers.

1.4 SYSTEM DESIGN

1.4.1 Operation

The fire alarm and detection system shall be a complete, supervised fire alarm reporting system. The system shall be activated into the alarm mode by actuation of any alarm initiating device. The system shall remain in

the alarm mode until the initiating device is reset and the fire alarm control panel is reset and restored to normal. Alarm initiating devices shall be connected to initiating device circuits (IDC), Style B or Style D, to signal line circuits (SLC), Style 5 or 6, in accordance with NFPA 72. Alarm notification appliances shall be connected to notification appliance circuits (NAC), Style Z in accordance with NFPA 72. A looped conduit system shall be provided so that if the conduit and all conductors within are severed at any point, all IDC, NAC and SLC will remain functional. The conduit loop requirement is not applicable to the signal transmission link from the local panels (at the protected premises) to the Supervising Station (fire station, fire alarm central communication center). Textual, audible, and visual appliances and systems shall comply with NFPA 72. Fire alarm system components requiring power, except for the control panel power supply, shall operate on 24 Volts dc. Addressable system shall be microcomputer (microprocessor or microcontroller) based with a minimum word size of eight bits and shall provide the following features:

a. Sufficient memory to perform as specified and as shown for addressable system.

b. Individual identity of each addressable device for the following conditions: alarm; trouble; open; short; and appliances missing/failed remote detector - sensitivity adjustment from the panel for smoke detectors

c. Capability of each addressable device being individually disabled or enabled from the panel.

d. Each SLC shall be sized to provide 40 percent addressable expansion without hardware modifications to the panel.

1.4.2 Operational Features

The system shall have the following operating features:

a. Monitor electrical supervision of IDC, SLC, and NAC. Smoke detectors shall not have combined alarm initiating and power circuits.

b. Monitor electrical supervision of the primary power (ac) supply, battery voltage, placement of alarm zone module (card, PC board) within the control panel, and transmitter tripping circuit integrity.

c. A trouble buzzer and trouble LED/LCD (light emitting diode/liquid crystal diode) to activate upon a single break, open, or ground fault condition which prevents the required normal operation of the system. The trouble signal shall also operate upon loss of primary power (ac) supply, low battery voltage, removal of alarm zone module (card, PC board), and disconnection of the circuit used for transmitting alarm signals off-premises. A trouble alarm silence switch shall be provided which will silence the trouble buzzer, but will not extinguish the trouble indicator LED/LCD. Subsequent trouble and supervisory alarms shall sound the trouble signal until silenced. After the system returns to normal operating conditions, the trouble buzzer shall again sound until the silencing switch returns to normal position, unless automatic trouble reset is provided.

d. A one person test mode. Activating an initiating device in this mode will activate an alarm for a short period of time, then automatically reset the alarm, without activating the transmitter during the entire process.

e. A transmitter disconnect switch to allow testing and maintenance of the system without activating the transmitter but providing a trouble signal when disconnected and a restoration signal when reconnected.

f. Evacuation alarm silencing switch which, when activated, will silence alarm devices, but will not affect the zone indicating LED/LCD nor the operation of the transmitter. This switch shall be over-ridden upon activation of a subsequent alarm from an unalarmed device and the NAC devices will be activated.

g. Electrical supervision for circuits used for supervisory signal services (i.e., sprinkler systems, valves, etc.). Supervision shall detect any open, short, or ground.

h. Confirmation or verification of all smoke detectors. The control panel shall interrupt the transmission of an alarm signal to the system control panel for a factory preset period. This interruption period shall be adjustable from 1 to 60 seconds and be factory set at 20 seconds. Immediately following the interruption period, a confirmation period shall be in effect during which time an alarm signal, if present, will be sent immediately to the control panel. Fire alarm devices other than smoke detectors shall be programmed without confirmation or verification.

i. The fire alarm control panel shall provide supervised addressable relays for HVAC shutdown. An override at the HVAC panel shall not be provided.

j. Provide one person test mode - Activating an initiating device in this mode will activate an alarm for a short period of time, then automatically reset the alarm, without activating the transmitter during the entire process.

k. The fire alarm control panel shall provide the required monitoring and supervised control outputs needed to accomplish elevator recall.

l. The fire alarm control panel shall monitor and control the fire sprinkler system, or other fire protection extinguishing system.

m. The control panel and field panels shall be software reprogrammable to enable expansion or modification of the system without replacement of hardware or firmware. Examples of required changes are: adding or deleting devices or zones; changing system responses to particular input signals; programming certain input signals to activate auxiliary devices.

n. Zones for IDC and NAC shall be arranged as indicated on the contract drawings.

1.4.3 Alarm Functions

An alarm condition on a circuit shall automatically initiate the following functions:

a. Transmission of signals over the station telephonic fire reporting system and shall be fully compatible with the existing basewide system, see notes on drawings.

b. Visual indications of the alarmed devices on the fire alarm control panel display and on the remote audible/visual display.

c. Continuous sounding or operation of alarm notification appliances throughout the building as required by ANSI S3.41.

d. Closure of doors held open by electromagnetic devices.

e. Operation of the smoke control system.

f. Deactivation of the air handling units throughout the building.

g. Shutdown of power to the data processing equipment in the alarmed area.

h. Automatic discharge of the designated fire suppression systems. A 15 second maximum delay shall be provided for the pre-action system, a 30 second delay for the wet pipe system.

1.4.4 Primary Power

Operating power shall be provided as required by paragraph Power Supply for the System. Transfer from normal to emergency power or restoration from emergency to normal power shall be fully automatic and not cause transmission of a false alarm. Loss of ac power shall not prevent transmission of a signal via the fire reporting system upon operation of any initiating circuit.

1.4.5 Battery Backup Power

Battery backup power shall be through use of rechargeable, sealed-type storage batteries and battery charger.

1.4.6 Interface With Existing Fire Alarm Equipment

The equipment specified herein shall operate as an extension to an existing configuration. Existing control, monitoring equipment shall be expanded, modified, or supplemented as necessary to extend the existing control and monitoring functions of the new systems. New components shall be capable of merging with the existing configuration without degrading the performance of either system. The scope of the acceptance tests of paragraph Testing shall include aspects of operation that involve combined use of both new and existing portions of the final configuration.

1.4.7 Interface With other Equipment

Interfacing components shall be furnished as required to connect to subsystems or devices which interact with the fire alarm system, such as supervisory or alarm contacts in suppression systems, operating interfaces for smoke control systems, door releases, etc.

1.5 TECHNICAL DATA AND COMPUTER SOFTWARE

Technical data and computer software (meaning technical data which relates to computer software) which is specifically identified in this project, and which may be defined/required in other specifications, shall be delivered, strictly in accordance with the CONTRACT CLAUSES, and in accordance with the Contract Data Requirements List, DD Form 1423. Data delivered shall be identified by reference to the particular specification paragraph against which it is furnished. Data to be submitted shall include complete system, equipment, and software descriptions. Descriptions shall show how the equipment will operate as a system to meet the performance requirements of this contract. The data package shall also include the following:

(1) Identification of programmable portions of system equipment and capabilities.

(2) Description of system revision and expansion capabilities and methods of implementation detailing both equipment and software requirements.

(3) Provision of operational software data on all modes of programmable portions of the fire alarm and detection system.

(4) Description of Fire Alarm Control Panel equipment operation.

(5) Description of auxiliary and remote equipment operations.

(6) Library of application software.

(7) Operation and maintenance manuals as specified in SD-19 of the Submittals paragraph.

1.6 DELIVERY AND STORAGE

Equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variation, dirt, dust, and any other contaminants.

PART 2 PRODUCTS

2.1 CONTROL PANEL

Control Panel shall comply with the applicable requirements of UL 864 and shall be able to interface with the basewide Fire Alarm central system within another building. Panel shall be modular, installed in a flush mounted steel cabinet with hinged door and cylinder lock. Control panel shall be a Honeywell XLS 200 panel, or approved equal, and shall be clean, uncluttered, and orderly assembled panel containing components and equipment required to provide the specified operating and supervisory functions of the system. The panel shall have prominent rigid plastic, phenolic or metal identification plates for LED/LCDs, zones, SLC, controls, meters, fuses, and switches. Nameplates for fuses shall also include ampere rating. The LED/LCD displays shall be located on the exterior of the cabinet door or be visible through the cabinet door. Control panel switches shall be within the locked cabinet. A suitable means (single operation) shall be provided for testing the control panel visual indicating devices (meters or LEDs/LCDs). Meters and LEDs shall be plainly visible when the cabinet door is closed. Signals and LEDs/LCDs shall be

provided to indicate by zone any alarm, supervisory or trouble condition on the system.

2.1.1 Remote System Audible/Visual Display

Audible appliance shall have a minimum sound level output rating of 85 dBA at 10 feet and operate in conjunction with the panel integral display. The audible device shall be silenced by a system silence switch on the remote system. The audible device shall be silenced by the system silence switch located at the remote location, but shall not extinguish the visual indication. The remote LED/LCD visual display shall provide identification, consisting of the word description and id number for each device as displayed on the control panel. A rigid plastic, phenolic or metal identification sign which reads "Fire Alarm System Remote Display" shall be provided at the remote audible/visual display. The remote visual appliance located with the audible appliance shall not be extinguished until the trouble or alarm has been cleared.

2.1.2 Circuit Connections

Circuit conductors entering or leaving the panel shall be connected to screw-type terminals with each conductor and terminal marked for identification.

2.1.3 System Expansion and Modification Capabilities

Any equipment and software needed by qualified technicians to implement future changes to the fire alarm system shall be provided as part of this contract.

2.1.4 Addressable Control Module

The control module shall be capable of operating as a relay (dry contact form C) for interfacing the control panel with other systems, and to control door holders or initiate elevator fire service. The module shall be UL listed as compatible with the control panel. The indicating device or the external load being controlled shall be configured as a Style Y notification appliance circuits. The system shall be capable of supervising, audible, visual and dry contact circuits. The control module shall have both an input and output address. The supervision shall detect a short on the supervised circuit and shall prevent power from being applied to the circuit. The control model shall provide address setting means compatible with the control panel's SLC supervision and store an internal identifying code. The control module shall contain an integral LED that flashes each time the control module is polled. Existing fire alarm system notification appliance circuits shall be connected to a single module to power and supervise the circuit.

2.1.5 Addressable Initiating Device Circuits Module

The initiating device being monitored shall be configured as a Style D or Style B initiating device circuits. The system shell be capable of defining any module as an alarm module and report alarm trouble, loss of polling, or as a supervisory module, and reporting supervisory short, supervisory open or loss of polling. The module shall be UL listed as compatible with the control panel. The monitor module shall provide address setting means compatible with the control panel's SLC supervision and store an internal identifying code. Monitor module shall contain an integral LED that flashes each time the monitor module is polled. Pull

stations with a monitor module in a common backbox are not required to have an LED. Existing fire alarm system initiating device circuits shall be connected to a single module to power and supervise the circuit.

2.2 STORAGE BATTERIES

Storage batteries shall be provided and shall be 24 Vdc sealed, lead-calcium type requiring no additional water. The batteries shall have ample capacity, with primary power disconnected, to operate the fire alarm system for a period of 72 hours. Following this period of battery operation, the batteries shall have ample capacity to operate all components of the system, including all alarm signaling devices in the total alarm mode for a minimum period of 15 minutes. Batteries shall be located at the bottom of the panel. Batteries shall be provided with overcurrent protection in accordance with NFPA 72.

2.3 BATTERY CHARGER

Battery charger shall be completely automatic, 24 Vdc with high/low charging rate, capable of restoring the batteries from full discharge (18 Volts dc) to full charge within 48 hours. A pilot light indicating when batteries are manually placed on a high rate of charge shall be provided as part of the unit assembly, if a high rate switch is provided. Charger shall be located in control panel cabinet or in a separate battery cabinet.

2.4 ADDRESSABLE MANUAL FIRE ALARM STATIONS

Addressable manual fire alarm stations shall conform to the applicable requirements of UL 38. Manual stations shall be connected into signal line circuits. Stations shall be installed on semi-flush mounted outlet boxes. Manual stations shall be mounted at 48 inches. Stations shall be single action type. Stations shall be finished in red, with raised letter operating instructions of contrasting color. Stations requiring the breaking of glass or plastic panels for operation are not acceptable. Stations employing glass rods are not acceptable. The use of a key or wrench shall be required to reset the station. Gravity or mercury switches are not acceptable. Switches and contacts shall be rated for the voltage and current upon which they operate. Addressable pull stations shall be capable of being field programmed, shall latch upon operation and remain latched until manually reset. Stations shall have a separate screw terminal for each conductor. Surface mounted boxes shall be matched and painted the same color as the fire alarm manual stations.

2.5 FIRE DETECTING DEVICES

Fire detecting devices shall comply with the applicable requirements of NFPA 72, NFPA 90A, UL 268, UL 268A, and UL 521. The detectors shall be provided as indicated. Detector base shall have screw terminals for making connections. No solder connections will be allowed. Detectors located in concealed locations (above ceiling, raised floors, etc.) shall have a remote visible indicator LED/LCD. Addressable fire detecting devices, except flame detectors, shall be dynamically supervised and uniquely identified in the control panel. All fire alarm initiating devices shall be individually addressable, except where indicated. Installed devices shall conform to NFPA 70 hazard classification of the area where devices are to be installed.

2.5.1 Heat Detectors

Heat detectors shall be designed for detection of fire by fixed temperature, combination fixed temperature and rate-of-rise principle. Heat detector spacing shall be rated in accordance with UL 521. Detectors located in areas subject to moisture, exterior atmospheric conditions, or hazardous locations as defined by NFPA 70, shall be types approved for such locations. Heat detectors located in attic spaces or similar concealed spaces below the roof shall be intermediate temperature rated.

2.5.1.1 Combination Fixed-Temperature and Rate-of-Rise Detectors

Detectors shall be designed for surface outlet box mounting and supported independently of wiring connections. Contacts shall be self-resetting after response to rate-of-rise principle. Under fixed temperature actuation, the detector shall have a permanent external indication which is readily visible. Detector units located in boiler rooms, showers, or other areas subject to abnormal temperature changes shall operate on fixed temperature principle only. The UL 521 test rating for the fixed temperature portion shall be 135 degrees F.. The UL 521 test rating for the Rate-of-Rise detectors shall be rated for 50 by 50 ft.

2.5.1.2 Rate Compensating Detectors

Detectors shall be surface mounted vertical or horizontal type, with outlet box supported independently of wiring connections. Detectors shall be hermetically sealed and automatically resetting. Rate Compensated detectors shall be rated for 50 by 50 ft.

2.5.1.3 Fixed Temperature Detectors

Detectors shall be designed for surface outlet box mounting and supported independently of wiring connections. Detectors shall be designed to detect high heat. The detectors shall have a specific temperature setting of 135 degrees F.. The UL 521 test rating for the fixed temperature detectors shall be rated for 15 by 15 ft.

2.5.2 Smoke Detectors

Smoke detectors shall be designed for detection of abnormal smoke densities. Smoke detectors shall be ionization type. Detectors shall contain a visible indicator LED/LCD that shows when the unit is in alarm condition. Detectors shall not be adversely affected by vibration or pressure. Detectors shall be the plug-in type in which the detector base contains terminals for making wiring connections. Detectors that are to be installed in concealed (above false ceilings, etc.) locations shall be provided with a remote indicator LED/LCD suitable for mounting in a finished, visible location.

2.5.2.1 Ionization Detectors

Ionization detectors with a dual chamber shall be responsive to both invisible and visible particles of combustion. One chamber shall be a reference chamber and the second a sampling chamber. Detectors containing radium shall not be provided. Detectors shall not cause an alarm condition due to anticipated fluctuations in relative humidity. The sensitivity of the detector shall be field adjustable to compensate for operating conditions. Detector shall require no replacement or readjustment to restore it to normal operation after an alarm condition. Each detector

shall be capable of withstanding ambient air velocity up to 300 fpm in accordance with UL 268. Addressable smoke detectors shall be capable of having the sensitivity being remotely adjusted by the control panel.

2.5.2.2 Duct Detectors

Duct-mounted photoelectric smoke detectors shall be furnished and installed where indicated and in accordance with NFPA 90A. Units shall consist of a smoke detector as specified in paragraph Photoelectric Detectors, mounted in a special housing fitted with duct sampling tubes. Detector circuitry shall be mounted in a metallic enclosure exterior to the duct. Detectors shall have a manual reset. Detectors shall be rated for air velocities that include air flows between 500 and 4000 fpm. Detectors shall be powered from the fire alarm panel. Sampling tubes shall run the full width of the duct. The duct detector package shall conform to the requirements of NFPA 90A, UL 268A, and shall be UL listed for use in air-handling systems. The control functions, operation, reset, and bypass shall be controlled from the fire alarm control panel. Lights to indicate the operation and alarm condition; and the test and reset buttons shall be visible and accessible with the unit installed and the cover in place. Detectors mounted above 6 feet and those mounted below 6 feet that cannot be easily accessed while standing on the floor, shall be provided with a remote detector indicator panel containing test and reset switches. Remote lamps and switches as well as the affected fan units shall be properly identified in etched plastic placards. Detectors shall have auxiliary contacts, 2 sets of NO alarm contacts and 2 sets of NC contacts, to provide control, interlock, and shutdown functions. The detectors shall be supplied by the fire alarm system manufacturer to ensure complete system compatibility.

2.5.3 Combination Smoke and Heat Detectors

Combination smoke and heat detectors shall have an audible device (self-contained) and be designed for detection of abnormal smoke densities by the photoelectric principle and abnormal heat by a fixed temperature sensor. Smoke detectors shall be provided with an LED light source. Failure of the LED shall not cause an alarm condition and the sensitivity shall be factory set at a nominal 3 percent and require no field adjustments of any kind. Heat detector portion shall be fixed temperature sensor rated at 135 degrees F. The audible appliances shall have a minimum sound output of at least 85 dBA at 10 feet.Detectors shall contain a visible indicator LED that shows when the unit is in alarm condition. Detectors shall not be adversely affected by vibration or pressure. Heat detectors shall connect to a control panel SLC, IDC and shall be self restorable.

2.6 NOTIFICATION APPLIANCES

Audible appliances shall conform to the applicable requirements of UL 464. Devices shall be connected into notification appliance circuits. Devices shall have a separate screw terminal for each conductor. Audible appliances shall generate a unique audible sound from other devices provided in the building and surrounding area. Surface mounted audible appliances shall be painted red. Recessed audible appliances shall be installed with a grill that is painted red.

2.6.1 Alarm Bells

Bells shall not be allowed.

2.6.2 Alarm Horns

Horns shall be surface mounted, with the matching mounting back box surface mounted vibrating type suitable for use in an electrically supervised circuit. Horns shall produce a sound rating of at least 85 dBA at 10 feet. Horns used in exterior locations shall be specifically listed or approved for outdoor use and be provided with metal housing and protective grilles.

2.6.3 Chimes

Chimes shall be not be allowed.

2.6.4 Visual Notification Appliances

Visual notification appliances shall conform to the applicable requirements of UL 1971 and the contract drawings. Appliances shall have clear high intensity optic lens, xenon flash tubes, and output white light. Strobe flash rate shall be between 1 to 3 flashes per second and a minimum of 75 candela. Strobe shall be surface mounted.

2.6.5 Combination Audible/Visual Notification Appliances

Combination audible/visual notification appliances shall provide the same requirements as individual units except they shall mount as a unit in standard backboxes. Units shall be factory assembled. Any other audible notification appliance employed in the fire alarm systems shall be approved by the Contracting Officer.

2.7 FIRE DETECTION AND ALARM SYSTEM PERIPHERAL EQUIPMENT

2.7.1 Electromagnetic Door Hold-Open Devices

Devices shall be attached to the walls unless otherwise indicated. Devices shall comply with the appropriate requirements of UL 228. Devices shall operate on 24 Volt dc power. Compatible magnetic component shall be attached to the door. Under normal conditions, the magnets shall attract and hold the doors open. When magnets are de-energized, they shall release the doors. Magnets shall have a holding force of 25 pounds. Devices shall be UL or FM approved. Housing for devices shall be brushed aluminum or stainless steel. Operation shall be fail safe with no moving parts. Electromagnetic door hold-open devices shall not be required to be held open during building power failure.

2.7.2 Conduit

Conduit and fittings shall comply with NFPA 70, UL 6, UL 1242, and UL 797.

2.7.3 Wiring

Wiring shall conform to NFPA 70. Wiring for 120 Vac power shall be No. 12 AWG minimum. The SLC wiring shall be fiber optic or copper cable in accordance with the manufacturers requirements. Wiring for fire alarm dc circuits shall be No. 14 AWG minimum. Voltages shall not be mixed in any junction box, housing, or device, except those containing power supplies and control relays. Wiring shall conform to NFPA 70. System field wiring shall be solid copper and installed in metallic conduit or electrical metallic tubing, except that rigid plastic conduit may be used under slab-on-grade. Conductors shall be color coded. Conductors used for the

same functions shall be similarly color coded. Wiring code color shall remain uniform throughout the circuit. Pigtail or T-tap connections to initiating device circuits, supervisory alarm circuits, and notification appliance circuits are prohibited. T-tapping using screw terminal blocks is allowed for style 5 addressable systems.

2.7.4 Special Tools and Spare Parts

Software, connecting cables and proprietary equipment, necessary for the maintenance, testing, and reprogramming of the equipment shall be furnished to the Contracting Officer. Two spare fuses of each type and size required shall be furnished. Two percent of the total number of each different type of detector, but no less than two each, shall be furnished. Spare fuses shall be mounted in the fire alarm panel.

2.8 TRANSMITTERS

2.8.1 Radio Alarm Transmitters

Transmitters shall be compatible with proprietary supervising station receiving equipment.

2.8.1.1 Transmitter Power Supply

Each radio alarm transmitter shall be powered by a combination of locally available 120-volt ac power and a sealed, lead-calcium battery.

a. Operation: Each transmitter shall operate from 120-volt ac power. In the event of 120-volt ac power loss, the transmitter shall automatically switch to battery operation. Switchover shall be accomplished with no interruption of protective service, and shall automatically transmit a trouble message. Upon restoration of ac power, transfer back to normal ac power supply shall also be automatic.

b. Battery Power: Transmitter standby battery capacity shall provide sufficient power to operate the transmitter in a normal standby status for a minimum of 72 hours and be capable of transmitting alarms during that period.

2.8.2 Master Fire Alarm Boxes

Master fire alarm boxes shall be of the coded, shunt or positive noninterfering type with succession features having a shunt type auxiliary tripping device, and of the prewound, open-door, pull-lever type. Mechanism shall be housed in a weatherproof cottage shell type of housing with metallic or rigid plastic code number plate mounted on the exterior face of the cottage shell. Operation of the actuating pull lever shall cause the box to transmit four complete rounds of code to gongs, recorders, and other devices on the same circuit. Driving springs shall have the capability to transmit not less than eight complete four-round groups of code before being rewound. Boxes shall be designed for operation of 100 milliamperes dc, but with capability of full operation of 70 milliamperes and up to 120 milliamperes. Activation of box when a single open fault is present on exterior fire alarm circuit shall have box to idle for one complete round only, then immediately transmit four complete code rounds via the box earth ground connection. Each box shall be equipped with manual signaling key, telephone jack, silent test device, and box shunt device. Code wheel shall be metallic and box code shall be as directed. Electrically powered master fire alarm boxes shall have standby sealed,

lead calcium battery capacity for a minimum of 72 hours and be capable of transmitting alarms during that period.

2.8.3 Telephonic Reporting System

Transmitters shall be compatible with existing receiving equipment at the Supervising Station and shall comply with applicable requirements of UL 632. Transmitter shall respond to the actuation of the fire alarm control panel and shall be of the electric motor-driven or prewound spring mechanism type; it shall transmit not less than four rounds of code. When motor-driven transmitters are provided, the motor shall be connected to a supervised circuit in a control panel. Metallic or rigid plastic code number plates on the exterior face of transmitters shall be provided. Transmitters shall be designed to provide the same features as the fire alarm boxes for electrically-supervised. Activation of box when a single open fault is present on exterior fire alarm circuit shall have box to idle for one complete round only, then immediately transmit four complete code rounds via the box earth ground connection.

PART 3 EXECUTION

3.1 INSTALLATION

All work shall be installed as shown, and in accordance with NFPA 70 and NFPA 72, and in accordance with the manufacturer's diagrams and recommendations, unless otherwise specified. Smoke detectors shall not be installed until construction is essentially complete and the building has been thoroughly cleaned.

3.1.1 Power Supply for the System

A single dedicated circuit connection for supplying power from a branch circuit to each building fire alarm system shall be provided. The power shall be supplied as shown on the drawings. The power supply shall be equipped with a locking mechanism and marked in red with the words "FIRE ALARM CIRCUIT CONTROL".

3.1.2 Wiring

Conduit size for wiring shall be in accordance with NFPA 70. Wiring for the fire alarm system shall not be installed in conduits, junction boxes, or outlet boxes with conductors of lighting and power systems. Not more than two conductors shall be installed under any device screw terminal. The wires under the screw terminal shall be straight when placed under the terminal then clamped in place under the screw terminal. The wires shall be broken and not twisted around the terminal. Circuit conductors entering or leaving any mounting box, outlet box enclosure, or cabinet shall be connected to screw terminals with each terminal and conductor marked in accordance with the wiring diagram. Connections and splices shall be made using screw terminal blocks. The use of wire nut type connectors in the system is prohibited. Wiring within any control equipment shall be readily accessible without removing any component parts. The fire alarm equipment manufacturer's representative shall be present for the connection of wiring to the control panel.

3.1.3 Control Panel

The control panel and its assorted components shall be mounted so that no part of the enclosing cabinet is less than 12 inches nor more than 78

inches above the finished floor. Manually operable controls shall be between 36 and 42 inches above the finished floor. Panel shall be installed to comply with the requirements of UL 864.

3.1.4 Detectors

Detectors shall be located and installed in accordance with NFPA 72. Detectors shall be connected into signal line circuits or initiating device circuits as indicated on the drawings. Detectors shall be at least 12 inches from any part of any lighting fixture. Detectors shall be located at least 3 feet from diffusers of air handling systems. Each detector shall be provided with appropriate mounting hardware as required by its mounting location. Detectors which mount in open space shall be mounted directly to the end of the stubbed down rigid conduit drop. Conduit drops shall be firmly secured to minimize detector sway. Where length of conduit drop from ceiling or wall surface exceeds 3 feet, sway bracing shall be provided.

3.1.5 Notification Appliances

Notification appliances shall be mounted 80 inches above the finished floor or 6 inches below the ceiling, whichever is lower.

3.1.6 Annunciator Equipment

Annunciator equipment shall be mounted where indicated on the drawings.

3.1.7 Addressable Initiating Device Circuits Module

The initiating device circuits module shall be used to connect supervised conventional initiating devices (water flow switches, water pressure switches, manual fire alarm stations, high/low air pressure switches, and tamper switches). The module shall mount in an electrical box adjacent to or connected to the device it is monitoring and shall be capable of Style B supervised wiring to the initiating device. In order to maintain proper supervision, there shall be no T-taps allowed on style B lines. Addressable initiating device circuits modules shall monitor only one initiating device each. Contacts in suppression systems and other fire protection subsystems shall be connected to the fire alarm system to perform supervisory and alarm functions as indicated on the drawings and as specified herein.

3.1.8 Addressable Control Module

Addressable and control modules shall be installed in the outlet box or adjacent to the device they are controlling. If a supplementary suppression releasing panel is provided, then the monitor modules shall he mounted in a common enclosure adjacent to the suppression releasing panel and both this enclosure and the suppression releasing panel shall be in the same room as the releasing devices. All interconnecting wires shall be supervised unless an open circuit or short circuit abnormal condition does not affect the required operation of the fire alarm system. If control modules are used as interfaces to other systems, such as HVAC or elevator control, they shall be within the control panel or immediately adjacent to it. Control modules that control a group of notification appliances shall be adjacent to the first notification appliance in the notification appliance circuits. Control modules that connect to devices shall supervise the notification appliance circuits. Control modules that connect to auxiliary systems or interface with other systems (non-life

safety systems) and where not required by NFPA 72, shall not require the secondary circuits to be supervised. Contacts in suppression systems and other fire protection subsystems shall be connected to the fire alarm system to perform required alarm functions as indicated on the drawings and as specified herein.

3.2 OVERVOLTAGE AND SURGE PROTECTION

3.2.1 Power Line Surge Protection

All equipment connected to alternating current circuits shall be protected from surges per IEEE C62.41 B3 combination waveform and NFPA 70. Fuses shall not be used for surge protection. The surge protector shall be rated for a maximum let thru voltage of 350 Volts ac (line-to-neutral) and 350 Volt ac (neutral-to-ground).

3.2.2 Low Voltage DC Circuits Surge Protection

All IDC, NAC, and communication cables/conductors, except fiber optics, shall have surge protection installed at each point where it exits or enters a building. Equipment shall be protected from surges per IEEE C62.41 B3 combination waveform and NFPA 70. The surge protector shall be rated to protect the 24 Volt dc equipment. The maximum dc clamping voltages shall be 36 V (line-to-ground) and 72 Volt dc (line-to-line).

3.2.3 Signal Line Circuit Surge Protection

All SLC cables/conductors, except fiber optics, shall have surge protection/isolation circuits installed at each point where it exits or enters a building. The circuit shall be protected from surges per IEEE C62.41 B3 combination waveform and NFPA 70. The surge protector/isolator shall be rated to protect the equipment.

3.3 GROUNDING

Grounding shall be provided by connecting to building ground system.

3.4 EXISTING SUPERVISING STATION PROVISIONS

3.4.1 Revisions to Existing Facilities

Existing supervising components shall be modified as indicated on the drawings and programming shall be updated if required to accommodate the revised configuration. Acceptance testing shall include procedures that would demonstrate that operation of existing equipment has not been degraded and that the revised configuration plus interfacing components operates compatibly with the new fire alarm system at the protected premises. Work on existing equipment shall be performed in accordance with the manufacturer's instructions or under supervision of the manufacturer's representative.

3.4.2 Additions to Existing Facilities

Supplemental components shall be added to the existing supervising equipment as required to accommodate the new fire alarm system to be installed at the protected premises. All present functions shall be extended, including recording and storage in memory, and programming shall be updated if required to accommodate the revised configuration. Acceptance testing shall include procedures that would demonstrate that

operation of existing equipment has not been degraded and that the expanded configuration operates compatibly with the new fire alarm system.

3.5 TESTING

The Contractor shall notify the Contracting Officer at least 10 days before the preliminary and acceptance tests are to be conducted. The tests shall be performed in accordance with the approved test procedures in the presence of the Contracting Officer. The control panel manufacturer's representative shall be present to supervise tests. The Contractor shall furnish instruments and personnel required for the tests.

3.5.1 Preliminary Tests

Upon completion of the installation, the system shall be subjected to functional and operational performance tests including tests of each installed initiating and notification appliance, when required. Tests shall include the meggering of system conductors to determine that the system is free from grounded, shorted, or open circuits. The megger test shall be conducted prior to the installation of fire alarm equipment. If deficiencies are found, corrections shall be made and the system shall be retested to assure that it is functional. After completing the preliminary testing the Contractor shall complete and submit the NFPA 72, Certificate of Completion.

3.5.2 Acceptance Test

Acceptance testing shall not be performed until the Contractor has completed and submitted the Certificate of Completion. Testing shall be in accordance with NFPA 72. The recommended tests in NFPA 72 shall be considered mandatory and shall verify that previous deficiencies have been corrected. The Contractor shall complete and submit the NFPA 72, Inspection and Testing Form. The test shall include all requirements of NFPA 72 and the following:

a. Test of each function of the control panel.

b. Test of each circuit in both trouble and normal modes.

c. Tests of each alarm initiating devices in both normal and trouble conditions.

d. Tests of each control circuit and device.

e. Tests of each alarm notification appliance.

f. Tests of the battery charger and batteries.

g. Complete operational tests under emergency power supply.

h. Visual inspection of wiring connections.

i. Opening the circuit at each alarm initiating device and notification appliance to test the wiring supervisory feature.

j. Ground fault

k. Short circuit faults

l. Stray voltage

m. Loop resistance

3.6 TRAINING

Training course shall be provided for the operations and maintenance staff. The course shall be conducted in the building where the system is installed or as designated by the Contracting Officer. The training period for systems operation shall consist of 1 training day (8 hours per day) and shall start after the system is functionally completed but prior to final acceptance tests. The training period for systems maintenance shall consist of 2 training days (8 hours per day) and shall start after the system is functionally completed but prior to final acceptance tests. The instructions shall cover items contained in the operating and maintenance instructions. In addition, training shall be provided on performance of expansions or modifications to the fire detection and alarm system. The training period for system expansions and modifications shall consist of at least 1 training day (8 hours per day) and shall start after the system is functionally completed but prior to final acceptance tests.

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SECTION 15080A

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SECTION 15080A

THERMAL INSULATION FOR MECHANICAL SYSTEMS
07/02

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. At the discretion of the Government, the manufacturer of any material supplied will be required to furnish test reports pertaining to any of the tests necessary to assure compliance with the standard or standards referenced in this specification.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167	(1999) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 580/A 580M	(1998) Stainless Steel Wire
ASTM B 209	(2001) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM C 1126	(2000) Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation
ASTM C 1136	(1995) Flexible, Low Permeance Vapor Retarders for Thermal Insulation
ASTM C 1290	(2000e1) Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts
ASTM C 195	(1995) Mineral Fiber Thermal Insulating Cement
ASTM C 449/C 449M	(2000) Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement
ASTM C 533	(1995; R 2001) Calcium Silicate Block and Pipe Thermal Insulation
ASTM C 534	(2001a) Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
ASTM C 547	(2000) Mineral Fiber Pipe Insulation
ASTM C 552	(2000) Cellular Glass Thermal Insulation
ASTM C 553	(2000) Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications

ASTM C 591	(2001) Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM C 610	(1999) Molded Expanded Perlite Block and Pipe Thermal Insulation
ASTM C 612	(2000a) Mineral Fiber Block and Board Thermal Insulation
ASTM C 647	(1995; R 2000) Properties and Tests of Mastics and Coating Finishes for Thermal Insulation
ASTM C 665	(2001e1) Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
ASTM C 795	(1992; R 1998el) Thermal Insulation for Use in Contact with Austenitic Stainless Steel
ASTM C 916	(1985; R 1996el) Adhesives for Duct Thermal Insulation
ASTM C 920	(2002) Elastomeric Joint Sealants
ASTM C 921	(1989; R 1996) Determining the Properties of Jacketing Materials for Thermal Insulation
ASTM D 882	(1997) Tensile Properties of Thin Plastic Sheeting
ASTM E 84	(2001) Surface Burning Characteristics of Building Materials
ASTM E 96	(2000e1) Water Vapor Transmission of Materials

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

MSS SP-69	(1996) Pipe Hangers and Supports - Selection and Application

MIDWEST INSULATION CONTRACTORS ASSOCIATION (MICA)

MICA Insulation Stds	(1999) National Commercial & Industrial Insulation Standards

1.2 SYSTEM DESCRIPTION

Field-applied insulation and accessories on mechanical systems shall be as specified herein; factory-applied insulation is specified under the piping, duct or equipment to be insulated. Field applied insulation materials required for use on Government-furnished items as listed in the SPECIAL CONTRACT REQUIREMENTS shall be furnished and installed by the Contractor.

1.3 GENERAL QUALITY CONTROL

1.3.1 Standard Products

Materials shall be the standard products of manufacturers regularly engaged in the manufacture of such products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

1.3.2 Installer's Qualifications

Qualified installers shall have successfully completed three or more similar type jobs within the last 5 years.

1.3.3 Surface Burning Characteristics

Unless otherwise specified, insulation not covered with a jacket shall have a flame spread index no higher than 75 and a smoke developed index no higher than 150. Insulation systems which are located in air plenums, in ceiling spaces, and in attic spaces shall have a flame spread index no higher than 25 and a smoke developed index no higher than 50. Insulation materials located exterior to the building perimeter are not required to be fire-rated. Flame spread, and smoke developed indexes, shall be determined by ASTM E 84. Insulation shall be tested in the same density and installed thickness as the material to be used in the actual construction. Material supplied by a manufacturer with a jacket shall be tested as a composite material. Jackets, facings, and adhesives shall have a flame spread index no higher than 25 and a smoke developed index no higher than 50 when tested in accordance with ASTM E 84.

1.3.4 Identification of Materials

Packages or standard containers of insulation, jacket material, cements, adhesives, and coatings delivered for use, and samples required for approval shall have manufacturer's stamp or label attached giving the name of the manufacturer and brand, and a description of the material.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Mica Plates.

After approval of materials and prior to applying insulation, a booklet shall be prepared and submitted for approval. The booklet shall contain marked-up MICA Insulation Stds plates (or detail drawings showing the insulation material and insulating system) for each pipe, duct, or piece of equipment that must be insulated per this specification. The MICA plates shall be marked up showing the materials to be installed in accordance with the requirements of this specification for the specific insulation application. The Contractor shall submit all MICA Plates required to show the entire insulating system, including Plates required to

show insulation penetrations, vessel bottom and top heads, legs, and skirt insulation as applicable. If the Contractor elects to submit detailed drawings instead of marked-up MICA Plates, the detail drawings shall show cut-away, section views, and details indicating each component of the insulation system and showing provisions for insulating jacketing, and sealing portions of the equipment. For each type of insulation installation on the drawings, provide a label that identifies each component in the installation (i.e., the duct, insulation, adhesive, vapor retarder, jacketing, tape, mechanical fasteners, etc.) Indicate insulation by type and manufacturer. Three copies of the booklet shall be submitted at the jobsite to the Contracting Officer. One copy of the approved booklet shall remain with the insulation Contractor's display sample and two copies shall be provided for Government use.

SD-03 Product Data

General Materials.

A complete list of materials, including manufacturer's descriptive technical literature, performance data, catalog cuts, and installation instructions. The product number, k-value, thickness and furnished accessories for each mechanical system requiring insulation shall be included. Materials furnished under this section of the specification shall be submitted at one time.

SD-04 Samples

Thermal Insulation Materials.

After approval of materials actual sections of installed systems, properly insulated in accordance with the specification requirements, shall be displayed. Such actual sections must remain accessible to inspection throughout the job and will be reviewed from time to time for controlling the quality of the work throughout the construction site. Each material used shall be identified, by indicating on an attached sheet the specification requirement for the material and the material by each manufacturer intended to meet the requirement. The Contracting Officer will inspect display sample sections at the jobsite. Approved display sample sections shall remain on display at the jobsite during the construction period. Upon completion of construction, the display sample sections will be closed and sealed.

Pipe Insulation Display Sections: Display sample sections shall include as a minimum an elbow or tee, a valve, dielectric waterways and flanges, a hanger with protection shield and insulation insert, or dowel as required, at support point, method of fastening and sealing insulation at longitudinal lap, circumferential lap, butt joints at fittings and on pipe runs, and terminating points for each type of pipe insulation used on the job, and for hot pipelines and cold pipelines, both interior and exterior, even when the same type of insulation is used for these services.

Duct Insulation Display Sections: Display sample sections for rigid and flexible duct insulation used on the job. A temporary

covering shall be used to enclose and protect display sections for duct insulation exposed to weather.

1.5 STORAGE

Materials shall be delivered in the manufacturer's unopened containers. Materials delivered and placed in storage shall be provided with protection from weather, humidity, dirt, dust and other contaminants. The Contracting Officer may reject insulation material and supplies that become dirty, dusty, wet, or contaminated by some other means.

PART 2 PRODUCTS

2.1 GENERAL MATERIALS

Materials shall be compatible and shall not contribute to corrosion, soften, or otherwise attack surfaces to which applied in either the wet or dry state. Materials to be used on stainless steel surfaces shall meet ASTM C 795 requirements. Materials shall be asbestos free and conform to the following:

2.1.1 Adhesives

2.1.1.1 Acoustical Lining Insulation Adhesive

Adhesive shall be a nonflammable, fire-resistant adhesive conforming to ASTM C 916, Type I.

2.1.1.2 Mineral Fiber Insulation Cement

Cement shall be in accordance with ASTM C 195.

2.1.1.3 Lagging Adhesive

Lagging is the material used for thermal insulation, especially around a cylindrical object. This may include the insulation as well as the cloth/material covering the insulation. Lagging adhesives shall be nonflammable and fire-resistant and shall have a flame spread rating no higher than 25 and a smoke developed rating no higher than 50 when tested in accordance with ASTM E 84. Adhesive shall be pigmented white and be suitable for bonding fibrous glass cloth to faced and unfaced fibrous glass insulation board; for bonding cotton brattice cloth to faced and unfaced fibrous glass insulation board; for sealing edges of and bonding fibrous glass tape to joints of fibrous glass board; for bonding lagging cloth to thermal insulation; or for attaching fibrous glass insulation to metal surfaces. Lagging adhesives shall be applied in strict accordance with the manufacturer's recommendations.

2.1.2 Contact Adhesive

Adhesives may be dispersed in a volatile organic solvent. Adhesives may be any of, but not limited to, the neoprane based, rubber based, or elastomeric type that have a flame spread index no higher than 25 and a smoke developed index no higher than 50 when tested in the dry state in accordance with ASTM E 84. The adhesive shall not adversely affect, initially or in service, the insulation to which it is applied, nor shall it cause any corrosive effect on metal to which it is applied. Any solvent dispersing medium or volatile component of the adhesive shall have no objectionable odor and shall not contain any benzene or carbon

tetrachloride. The dried adhesive shall not emit nauseous, irritating, or toxic volatile matters or aerosols when the adhesive is heated to any temperature up to 212 degrees F. The dried adhesive shall be nonflammable and fire resistant. Natural cross-ventilation, local (mechanical) pickup, and/or general area (mechanical) ventilation shall be used to prevent an accumulation of solvent vapors, keeping in mind the ventilation pattern must remove any heavier-than-air solvent vapors from lower levels of the workspaces. Gloves and spectacle-type safety glasses are recommended in accordance with safe installation practices.

2.1.3 Caulking

ASTM C 920, Type S, Grade NS, Class 25, Use A.

2.1.4 Corner Angles

Nominal 0.016 inch aluminum 1 x 1 inch with factory applied kraft backing. Aluminum shall be ASTM B 209, Alloy 3003, 3105, or 5005.

2.1.5 Finishing Cement

ASTM C 449/C 449M: Mineral fiber hydraulic-setting thermal insulating and finishing cement. All cements that may come in contact with Austenitic stainless steel must include testing per ASTM C 795.

2.1.6 Fibrous Glass Cloth and Glass Tape

Fibrous glass cloth and glass tape shall have flame spread and smoke developed ratings of no greater than 25/50 when measured in accordance with ASTM E 84. Tape shall be 4 inch wide rolls.

2.1.7 Staples

Outward clinching type monel or ASTM A 167, Type 304 or 316 stainless steel. Monel is a nickel rich alloy that has high strength, high ductility, and excellent resistance to corrosion.

2.1.8 Jackets

ASTM C 921, Type I, maximum moisture vapor transmission 0.02 perms, (measured before factory application or installation), minimum puncture resistance 50 Beach units on all surfaces except concealed ductwork, where a minimum puncture resistance of 25 Beach units is acceptable. Minimum tensile strength, 35 pounds/inch width. ASTM C 921, Type II, minimum puncture resistance 25 Beach units, tensile strength minimum 20 pounds/inch width. Jackets used on insulation exposed in finished areas shall have white finish suitable for painting without sizing. Based on the application, insulation materials that require factory applied jackets are mineral fiber, cellular glass, and phenolic foam. All non-metallic jackets shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E 84.

2.1.8.1 White Vapor Retarder All Service Jacket (ASJ)

For use on hot/cold pipes, ducts, or equipment vapor retarder jackets used on insulation exposed in finished areas shall have white finish suitable for painting without sizing.

2.1.8.2 Aluminum Jackets

Aluminum jackets shall be corrugated, embossed or smooth sheet, 0.016 inch nominal thickness; ASTM B 209, Temper H14, Temper H16, Alloy 3003, 5005, or 3105 with factory applied moisture retarder. Corrugated aluminum jacket shall not be used outdoors. Aluminum jacket securing bands shall be Type 304 stainless steel, 0.015 inch thick, 1/2 inch wide for pipe under 12 inch diameter and 3/4 inch wide for pipe over 12 inch and larger diameter. Aluminum jacket circumferential seam bands shall be 2 x 0.016 inch aluminum matching jacket material. Bands for insulation below ground shall be 3/4 x 0.020 inch) thick stainless steel, or fiberglass reinforced tape. The jacket may, at the option of the Contractor, be provided with a factory fabricated Pittsburg or "Z" type longitudinal joint. When the "Z" joint is used, the bands at the circumferential joints shall be designed by the manufacturer to seal the joints and hold the jacket in place.

2.1.8.3 Polyvinyl Chloride (PVC) Jackets

Polyvinyl chloride (PVC) jacket and fitting covers shall have high impact strength, UV resistant rating or treatment and moderate chemical resistance with minimum thickness 0.030 inch.

2.1.9 Vapor Retarder Required

2.1.9.1 Vapor Retarder Mastic Coatings

The vapor retarder coating shall be fire and water resistant and appropriately selected for either outdoor or indoor service. Color shall be white. The water vapor permeance of the compound shall be determined according to procedure B of ASTM E 96 utilizing apparatus described in ASTM E 96. The coating shall be a nonflammable, fire resistant type. All other application and service properties shall be in accordance with ASTM C 647.

2.1.9.2 Laminated Film Vapor Retarder

ASTM C 1136, Type I, maximum moisture vapor transmission 0.02 perms, minimum puncture resistance 50 Beach units on all surfaces except concealed ductwork, where Type II, maximum moisture vapor transmission 0.02 perms, a minimum puncture resistance of 25 Beach units is acceptable.

2.1.9.3 Polyvinylidene Chloride (PVDC) Film Vapor Retarder

The PVDC film vapor retarder shall have a maximum moisture vapor transmission of 0.02 perms, minimum puncture resistance of 150 Beach units, a minimum tensile strength in any direction of 30 lb/inch when tested per ASTM D 882, and a maximum flame spread/smoke developed index of 25/50 per ASTM E 84.

2.1.9.4 Polyvinylidene Chloride Vapor Retarder Adhesive Tape

Requirements must meet the same as specified for PVDC Film Vapor Retarder in paragraph 2.1.9.2 above.

2.1.10 Vapor Retarder Not Required

ASTM C 1136, Type III, maximum moisture vapor transmission 0.10 perms, minimum puncture resistance 50 Beach units on all surfaces except ductwork, where Type IV, maximum moisture vapor transmission 0.10, a minimum puncture resistance of 25 Beach units is acceptable.

2.1.11 Wire

Soft annealed ASTM A 580/A 580M Type 302, 304 or 316 stainless steel, 16 or 18 gauge.

2.1.12 Sealants

Sealants shall be chosen from the butyl polymer type, the styrene-butadiene rubber type, or the butyl type of sealants. Sealants shall have a maximum moisture vapor transmission of 0.02 perms, and a maximum flame spread/smoke developed index of 25/50 per ASTM E 84.

2.2 PIPE INSULATION MATERIALS

Pipe insulation materials shall be limited to those listed herein and shall meet the following requirements:

2.2.1 Aboveground Cold Pipeline

Insulation for minus 30 degrees to plus 60 degrees F for outdoor, indoor, exposed or concealed applications, shall be as follows:

a. Cellular Glass: ASTM C 552, Type II, and Type III. Supply the insulation with manufacturer's recommended factory-applied jacket.

b. Flexible Elastomeric Cellular Insulation: ASTM C 534, Type I or II. Type II shall have vapor retarder skin on both sides of the insulation.

c. Phenolic Insulation: ASTM C 1126, Type III. Phenolic insulations shall comply with ASTM C 795 and with the ASTM C 665 paragraph Corrosiveness. Supply the insulation with manufacturer's recommended factory-applied jacket.

d. Polyisocyanurate Insulation: ASTM C 591, type I. Supply the insulation with manufacturer's recommended factory-applied vapor retarder.

2.2.2 Aboveground Hot Pipeline

Insulation for above 60 degrees F, for outdoor, indoor, exposed or concealed applications shall meet the following requirements. Supply the insulation with manufacturer's recommended factory-applied jacket.

a. Mineral Fiber: ASTM C 547, Types I, II or III, supply the insulation with manufacturer's recommended factory-applied jacket.

b. Calcium Silicate: ASTM C 533, Type I indoor only, or outdoors above 250 degrees F pipe temperature. Supply insulation with the manufacturer's recommended factory-applied jacket.

c. Cellular Glass: ASTM C 552, Type II and Type III. Supply the insulation with manufacturer's recommended factory-applied jacket.

d. Flexible Elastomeric Cellular Insulation: ASTM C 534, Type I or II to 200 degrees F service.

e. Phenolic Insulation: ASTM C 1126 Type III to 250 F service shall

comply with ASTM C 795. Supply the insulation with manufacturer's recommended factory-applied jacket.

f. Perlite Insulation: ASTM C 610

g. Polyisocyanurate Insulation: ASTM C 591, Type 1, to 300 degrees F service. Supply the insulation with manufacturer's recommended factory applied jacket.

2.2.3 Above Ground Dual Temperature Pipeline - Outdoors, Indoor - Exposed or Concealed

Selection of insulation for use over a dual temperature pipeline system shall be in accordance with the most limiting/restrictive case. Find an allowable material from paragraph PIPE INSULATION MATERIALS and determine the required thickness from the most restrictive case. Use the thickness listed in paragraphs INSULATION THICKNESS for cold & hot pipe applications.

2.2.4 Below-ground Pipeline Insulation

For below-ground pipeline insulation the following requirements shall be met.

2.2.4.1 Cellular Glass

ASTM C 552, type II.

2.2.4.2 Polyisocyanurate

ASTM C 591, Type 1, to 300 degrees F.

2.3 DUCT INSULATION MATERIALS

Duct insulation materials shall be limited to those listed herein and shall meet the following requirements:

2.3.1 Rigid Mineral Fiber

ASTM C 612: Type IA, IB, II, III, & IV.

2.3.2 Flexible Mineral Fiber

ASTM C 553: Type I,or Type II up to 250 F. ASTM C 1290 Type III.

2.3.3 Cellular Glass

ASTM C 552, Type I.

2.3.4 Phenolic Foam

ASTM C 1126: Type II shall comply with ASTM C 795.

2.3.5 Flexible Elastomeric Cellular

ASTM C 534: Type II.

2.3.6 Polyisocyanurate

ASTM C 591: Type 1. Supply the insulation with manufacturer's recommended

factory-applied jacket.

2.4 EQUIPMENT INSULATION MATERIALS

Equipment insulation materials shall be limited to those listed herein and shall meet the following requirements:

2.4.1 Cold Equipment Insulation

For equipment operating temperatures below 60 degrees F.

2.4.1.1 Cellular Glass

ASTM C 552: Type I, Type III, or Type IV as required.

2.4.1.2 Flexible Elastomeric Cellular Insulation

ASTM C 534, Type II.

2.4.1.3 Phenolic Foam

ASTM C 1126: Type II shall comply with ASTM C 795.

2.4.1.4 Polyisocyanurate Foam

ASTM C 591, Type I. Supply the insulation with manufacturer's factory-applied jacket.

2.4.2 Hot Equipment Insulation

For equipment operating temperatures above 60 degrees F.

2.4.2.1 Rigid Mineral Fiber

ASTM C 612: Type IA, IB, II, III, IV, or V as required for temperatures encountered to 1800 degrees F.

2.4.2.2 Flexible Mineral Fiber

ASTM C 553: Type I, II, III, IV, V, VI or VII as required for temperatures encountered to 1200 degrees F.

2.4.2.3 Calcium Silicate

ASTM C 533, Type I, in-doors only, or outdoors above 250 degrees F. Pipe shape may be used on diesel engine exhaust piping and mufflers to 1200 degrees F.

2.4.2.4 Cellular Glass

ASTM C 552: Type I, Type III, or Type IV as required.

2.4.2.5 Flexible Elastomeric Cellular Insulation

ASTM C 534, Type II, to 200 degrees F.

2.4.2.6 Phenolic Foam

ASTM C 1126, Type II, to 250 degrees F shall comply with ASTM C 795.

2.4.2.7 Molded Expanded Perlite

ASTM C 610.

2.4.2.8 Polyisocyanurate Foam:

ASTM C 591, Type I to 300 degrees F service. Supply the insulation with manufacturer's recommended factory-applied jacket.

PART 3 EXECUTION

3.1 APPLICATION - GENERAL

Insulation shall only be applied to unheated and uncooled piping and equipment. Flexible elastomeric cellular insulation shall not be compressed at joists, studs, columns, ducts, hangers, etc. The insulation shall not pull apart after a one hour period; any insulation found to pull apart after one hour, shall be replaced.

3.1.1 Installation

Except as otherwise specified, material shall be installed in accordance with the manufacturer's written instructions. Insulation materials shall not be applied until ~~[~~tests~~] [tests and heat tracing]~~ specified in other sections of this specification are completed. Material such as rust, scale, dirt and moisture shall be removed from surfaces to receive insulation. Insulation shall be kept clean and dry. Insulation shall not be removed from its shipping containers until the day it is ready to use and shall be returned to like containers or equally protected from dirt and moisture at the end of each workday. Insulation that becomes dirty shall be thoroughly cleaned prior to use. If insulation becomes wet or if cleaning does not restore the surfaces to like new condition, the insulation will be rejected, and shall be immediately removed from the jobsite. Joints shall be staggered on multi layer insulation. Mineral fiber thermal insulating cement shall be mixed with demineralized water when used on stainless steel surfaces. Insulation, jacketing and accessories shall be installed in accordance with MICA Insulation Stds plates except where modified herein or on the drawings.

3.1.2 Fire-stopping

Where pipes and ducts pass through fire walls, fire partitions, above grade floors, and fire rated chase walls, the penetration shall be sealed with fire stopping materials as specified in Section 07840A FIRESTOPPING.

3.1.3 Painting and Finishing

Painting shall be as specified in Section 09900 PAINTS AND COATINGS.

3.1.4 Installation of Flexible Elastomeric Cellular Insulation

Flexible elastomeric cellular insulation shall be installed with seams and joints sealed with rubberized contact adhesive. Insulation with pre-applied adhesive is not permitted. Flexible elastomeric cellular insulation shall not be used on surfaces greater than 200 degrees F. Seams shall be staggered when applying multiple layers of insulation. Insulation exposed to weather and not shown to have jacketing shall be protected with two coats of UV resistant finish as recommended by the manufacturer after

the adhesive is dry. A brush coating of adhesive shall be applied to both butt ends to be joined and to both slit surfaces to be sealed. The adhesive shall be allowed to set until dry to touch but tacky under slight pressure before joining the surfaces. Insulation seals at seams and joints shall not be capable of being pulled apart one hour after application. Insulation that can be pulled apart one hour after installation shall be replaced.

3.1.5 Welding

No welding shall be done on piping, duct or equipment without written approval of the Contracting Officer. The capacitor discharge welding process may be used for securing metal fasteners to duct.

3.1.6 Pipes/Ducts/Equipment which Require Insulation

Insulation is required on all pipes, ducts, or equipment, except for omitted items, as specified.

3.2 PIPE INSULATION INSTALLATION

3.2.1 Pipe Insulation

3.2.1.1 General

Pipe insulation shall be installed on aboveground hot and cold pipeline systems as specified below to form a continuous thermal retarder, including straight runs, fittings and appurtenances unless specified otherwise. Installation shall be with full length units of insulation and using a single cut piece to complete a run. Cut pieces or scraps abutting each other shall not be used. Pipe insulation shall be omitted on the following:

a. Pipe used solely for fire protection.

b. Chromium plated pipe to plumbing fixtures. However, fixtures for use by the physically handicapped shall have the hot water supply and drain, including the trap, insulated where exposed.

c. Sanitary drain lines.

d. Air chambers.

3.2.1.2 Pipes Passing Through Walls, Roofs, and Floors

a. Pipe insulation shall be continuous through the sleeve.

b. An aluminum jacket with factory applied moisture retarder shall be provided over the insulation wherever penetrations require sealing.

c. Where pipes penetrate interior walls, the aluminum jacket shall extend 2 inches beyond either side of the wall and shall be secured on each end with a band.

d. Where penetrating floors, the aluminum jacket shall extend from a point below the backup material to a point 10 inches above the floor with one band at the floor and one not more than 1 inch from the end of the aluminum jacket.

e. Where penetrating waterproofed floors, the aluminum jacket shall

extend from below the backup material to a point 2 inchesabove the flashing with a band 1 inch from the end of the aluminum jacket.

f. Where penetrating exterior walls, the aluminum jacket required for pipe exposed to weather shall continue through the sleeve to a point 2 inches beyond the interior surface of the wall.

g. Where penetrating roofs, pipe shall be insulated as required for interior service to a point flush with the top of the flashing and sealed with vapor retarder coating. The insulation for exterior application shall butt tightly to the top of flashing and interior insulation. The exterior aluminum jacket shall extend 2 inches down beyond the end of the insulation to form a counter flashing. The flashing and counter flashing shall be sealed underneath with caulking.

h. For hot water pipes supplying lavatories or other similar heated service that requires insulation, the insulation shall be terminated on the backside of the finished wall. The insulation termination shall be protected with two coats of vapor barrier coating with a minimum total thickness of 1/16 inch applied with glass tape embedded between coats (if applicable). The coating shall extend out onto the insulation 2 inches and shall seal the end of the insulation. Glass tape seams shall overlap 1 inch. The annular space between the pipe and wall penetration shall be caulked with approved fire stop material. The pipe and wall penetration shall be covered with a properly sized (well fitting) escutcheon plate. The escutcheon plate shall overlap the wall penetration at least 3/8 inches.

i. For domestic cold water pipes supplying lavatories or other similar cooling service that requires insulation, the insulation shall be terminated on the finished side of the wall (i.e., insulation must cover the pipe throughout the wall penetration). The insulation shall be protected with two coats of vapor barrier coating with a minimum total thickness of 1/16 inch. The coating shall extend out onto the insulation 2 inches and shall seal the end of the insulation. The annular space between the outer surface of the pipe insulation and the wall penetration shall be caulked with an approved fire stop material having vapor retarder properties. The pipe and wall penetration shall be covered with a properly sized (well fitting) escutcheon plate. The escutcheon plate shall overlap the wall penetration by at least 3/8 inches.

3.2.1.3 Pipes Passing Through Hangers

a. Insulation, whether hot or cold application, shall be continuous through hangers. All horizontal pipes 2 inches and smaller shall be supported on hangers with the addition of a Type 40 protection shield to protect the insulation in accordance with MSS SP-69. Whenever insulation shows signs of being compressed, or when the insulation or jacket shows visible signs of distortion at or near the support shield, insulation inserts as specified below for piping larger than 2 inches shall be installed.

b. Horizontal pipes larger than 2 inches at 60 degrees F and above shall be supported on hangers in accordance with MSS SP-69.

c. Horizontal pipes larger than 2 inches and below 60 degrees F shall

be supported on hangers with the addition of a Type 40 protection shield in accordance with MSS SP-69. An insulation insert of cellular glass, calcium silicate (or perlite above 80 F), or the necessary strength polyisocyanurate shall be installed above each shield. The insert shall cover not less than the bottom 180-degree arc of the pipe. Inserts shall be the same thickness as the insulation, and shall extend 2 inches on each end beyond the protection shield. When insulation inserts are required per the above, and the insulation thickness is less than 1 inch, wooden or cork dowels or blocks may be installed between the pipe and the shield to prevent the weight of the pipe from crushing the insulation, as an option to installing insulation inserts. The insulation jacket shall be continuous over the wooden dowel, wooden block, or insulation insert.

d. Vertical pipes shall be supported with either Type 8 or Type 42 riser clamps with the addition of two Type 40 protection shields in accordance with MSS SP-69 covering the 360-degree arc of the insulation. An insulation insert of cellular glass or calcium silicate shall be installed between each shield and the pipe. The insert shall cover the 360-degree arc of the pipe. Inserts shall be the same thickness as the insulation, and shall extend 2 inches on each end beyond the protection shield. When insulation inserts are required per the above, and the insulation thickness is less than 1 inch, wooden or cork dowels or blocks may be installed between the pipe and the shield to prevent the hanger from crushing the insulation, as an option instead of installing insulation inserts. The insulation jacket shall be continuous over the wooden dowel, wooden block, or insulation insert. The vertical weight of the pipe shall be supported with hangers located in a horizontal section of the pipe. When the pipe riser is longer than 30 feet, the weight of the pipe shall be additionally supported with hangers in the vertical run of the pipe that are directly clamped to the pipe, penetrating the pipe insulation. These hangers shall be insulated and the insulation jacket sealed as indicated herein for anchors in a similar service.

e. Inserts shall be covered with a jacket material of the same appearance and quality as the adjoining pipe insulation jacket, shall overlap the adjoining pipe jacket 1-1/2 inches, and shall be sealed as required for the pipe jacket. The jacket material used to cover inserts in flexible elastomeric cellular insulation shall conform to ASTM C 1136, Type 1, and is allowed to be of a different material than the adjoining insulation material.

3.2.1.4 Flexible Elastomeric Cellular Pipe Insulation

Flexible elastomeric cellular pipe insulation shall be tubular form for pipe sizes 6 inches and less. Type II sheet insulation used on pipes larger than 6 inches shall not be stretched around the pipe. On pipes larger than 12 inches, the insulation shall be adhered directly to the pipe on the lower 1/3 of the pipe. Seams shall be staggered when applying multiple layers of insulation. Sweat fittings shall be insulated with miter-cut pieces the same size as on adjacent piping. Screwed fittings shall be insulated with sleeved fitting covers fabricated from miter-cut pieces and shall be overlapped and sealed to the adjacent pipe insulation.

3.2.1.5 Pipes in high abuse areas.

In high abuse areas such as janitor closets and traffic areas in equipment rooms, kitchens, and mechanical rooms, welded PVC, stainless steel or aluminum jackets shall be utilized. Pipe insulation to the 6 foot level shall be protected.

3.2.2 Aboveground Cold Pipelines

The following cold pipelines shall be insulated per Table I minus 30 degrees to plus 60 degrees F:

a. Domestic cold and chilled drinking water.

b. Make-up water.

c. Horizontal and vertical portions of interior roof drains.

d. Refrigerant suction lines.

e. Chilled water.

f. Dual temperature water, i.e. HVAC hot/chilled water.

g. Air conditioner condensate drains.

h. Brine system cryogenics

i. Exposed lavatory drains and domestic water lines serving plumbing fixtures for handicap persons.

3.2.2.1 Insulation Thickness

Insulation thickness for cold pipelines shall be determined using Table I.

Table I - Cold Piping Insulation Thickness
Pipe Size (inches)

Type of Service	Material	Run-outs up to 2 in*	1 in & less	1.25 - 2 in	2.5 - 4 in	5 - 6 in	8 in & larger
Refrigerant suction piping	CG		1.5	1.5	1.5	1.5	1.5
	FC		1.0	1.0	1.0	1.0	1.0
	PF		1.5	1.5	1.5	1.5	1.5
	PC		1.0	1.0	1.0	1.0	1.0
Chilled water supply & return & dual temp piping	CG	1.5	1.5	1.5	2.0	2.0	2.0
	FC	0.5	1.0	1.0	1.0	1.0	1.0
	PF	1.5	1.5	1.5	1.5	1.5	1.5
	PC	1.0	1.0	1.0	1.0	1.0	1.0
Cold domestic water, above and below ceilings & makeup water	CG	1.5	1.5	1.5	1.5	1.5	1.5
	FC	3/8	3/8	3/8	3/8	3/8	3/8
	PF	1.5	1.5	1.5	1.5	1.5	1.5
	PC	1.0	1.0	1.0	1.0	1.0	1.0
Exposed	FC	0.5	0.5	0.5	0.5	3/4	3/4

Table I - Cold Piping Insulation Thickness
Pipe Size (inches)

Type of Service	Material	Run-outs up to 2 in*	1 in & less	1.25 - 2 in	2.5 - 4 in	5 - 6 in	8 in & larger
lavatory drains & domestic water lines serving& plumbing fixtures for handicap personnel	MF	0.5	1.0	1.0	1.5	1.5	1.5
Horizontal & vertical roof drain leaders (including underside of roof drain fitting)	FC	0.5	0.5	0.5	0.5	0.5	
	PF	1.5	1.5	1.5	1.5	1.5	
	CG	1.5	1.5	1.5	1.5	1.5	
	PC	1.0	1.0	1.0	1.0	1.0	
Air conditioning condensate drain located inside building	FC	3/8	0.5	0.5	N/A	N/A	
	PF	1.5	1.5	1.5	N/A	N/A	
	PC	1.0	1.0	1.0	N/A	N/A	

*When run-outs to terminal units exceed 12 feet, the entire length of run-out shall be insulated like main feed pipe. Insulations may not be applied if their flame and smoke developed ratings exceed the requirements of 25/50 established in this guide specification. Layered insulations, or installation where multiple layers of the same insulation are used, must be checked for this (in particular if the insulation has been rated per ASTM E 84 for one thickness).

LEGEND:

PF - Phenolic Foam
CG - Cellular Glass
MF - Mineral Fiber
FC - Flexible Elastomeric Cellular
PC - Polyisocyanurate Foam

3.2.2.2 Jacket for Mineral Fiber, Cellular Glass, Phenolic Foam, and Polyisocyanurate Foam Insulated Pipe

Insulation shall be covered with a factory applied vapor retarder jacket or field applied seal welded PVC jacket. Insulation inside the building, to be protected with an aluminum jacket, shall have the insulation and vapor retarder jacket installed as specified herein. The aluminum jacket shall be installed as specified for piping exposed to weather, except sealing of the laps of the aluminum jacket is not required. In high abuse areas such as janitor closets and traffic areas in equipment rooms, kitchens, and mechanical rooms, aluminum jackets shall be utilized. Pipe insulation to the 6 ft level shall be protected.

3.2.2.3 Insulation for Straight Runs (Mineral Fiber, Cellular Glass, Phenolic Foam and Polyisocyanurate Foam)

a. Insulation shall be applied to the pipe with joints tightly butted. All butted joints and ends shall be sealed with joint sealant and sealed with a vapor retarder coating or PVDC adhesive tape.

b. Longitudinal laps of the jacket material shall overlap not less than 1-1/2 inches. Butt strips 3 inches wide shall be provided for circumferential joints.

c. Laps and butt strips shall be secured with adhesive and stapled on 4 inch centers if not factory self-sealing. If staples are used, they shall be sealed per item "e." below. Note that staples are not required with cellular glass systems.

d. Factory self-sealing lap systems may be used when the ambient temperature is between 40 degrees and 120 degrees F during installation. The lap system shall be installed in accordance with manufacturer's recommendations. Stapler shall be used only if specifically recommended by the manufacturer. Where gaps occur, the section shall be replaced or the gap repaired by applying adhesive under the lap and then stapling.

e. All Staples, including those used to repair factory self-seal lap systems, shall be coated with a vapor retarder coating or PVDC adhesive tape. All seams, except those on factory self-seal systems shall be coated with vapor retarder coating or PVDC adhesive tape.

f. Breaks and punctures in the jacket material shall be patched by wrapping a strip of jacket material around the pipe and securing it with adhesive, stapling, and coating with vapor retarder coating or PVDC adhesive tape. The patch shall extend not less than 1-1/2 inches past the break.

g. At penetrations such as thermometers, the voids in the insulation shall be filled and sealed with vapor retarder coating or PVDC adhesive tape.

3.2.2.4 Insulation for Fittings and Accessories

a. Pipe insulation shall be tightly butted to the insulation of the fittings and accessories. The butted joints and ends shall be sealed with joint sealant and sealed with a vapor retarder coating or PVDC adhesive tape.

b. Precut or preformed insulation shall be placed around all fittings and accessories and shall conform to MICA plates except as modified herein: 5 for anchors; 10, 11, and 13 for fittings; 14 for valves; and 17 for flanges and unions. Insulation shall be the same insulation as the pipe insulation, including same density, thickness, and thermal conductivity. Where precut/preformed is unavailable, rigid preformed pipe insulation sections may be segmented into the shape required. Insulation of the same thickness and conductivity as the adjoining pipe insulation shall be used. If nesting size insulation is used, the insulation shall be overlapped 2 inches or one pipe diameter. Elbows insulated using segments shall conform to MICA Tables 12.20 "Mitered Insulation Elbow'.

c. Upon completion of insulation installation on flanges, unions, valves, anchors, fittings and accessories, terminations, seams, joints and insulation not protected by factory vapor retarder jackets or PVC fitting covers shall be protected with PVDC adhesive tape or two coats of vapor retarder coating with a

minimum total thickness of 1/16 inch, applied with glass tape embedded between coats. Tape seams shall overlap 1 inch. The coating shall extend out onto the adjoining pipe insulation 2 inches. Fabricated insulation with a factory vapor retarder jacket shall be protected with PVDC adhesive tape or two coats of vapor retarder coating with a minimum thickness of 1/16 inch and with a 2 inch wide glass tape embedded between coats. Where fitting insulation butts to pipe insulation, the joints shall be sealed with a vapor retarder coating and a 4 inch wide ASJ tape which matches the jacket of the pipe insulation.

d. Anchors attached directly to the pipe shall be insulated for a sufficient distance to prevent condensation but not less than 6 inches from the insulation surface.

e. Insulation shall be marked showing the location of unions, strainers, and check valves.

3.2.2.5 Optional PVC Fitting Covers

At the option of the Contractor, premolded, one or two piece PVC fitting covers may be used in lieu of the vapor retarder and embedded glass tape. Factory precut or premolded insulation segments shall be used under the fitting covers for elbows. Insulation segments shall be the same insulation as the pipe insulation including same density, thickness, and thermal conductivity. The covers shall be secured by PVC vapor retarder tape, adhesive, seal welding or with tacks made for securing PVC covers. Seams in the cover, and tacks and laps to adjoining pipe insulation jacket, shall be sealed with vapor retarder tape to ensure that the assembly has a continuous vapor seal.

3.2.3 Aboveground Hot Pipelines

The following hot pipelines above 60 degrees F shall be insulated per Table II:

a. Domestic hot water supply & re-circulating system.

b. Steam.

c. Condensate & compressed air discharge.

d. Hot water heating.

e. Heated oil.

f. Water defrost lines in refrigerated rooms.

3.2.3.1 Insulation Thickness

Insulation thickness for hot pipelines shall be determined using Table II.

LEGEND:

PF - Phenolic Foam
CG - Cellular Glass
CS - Calcium Silicate
MF - Mineral Fiber
FC - Flexible Elastomeric Cellular

PL - Perlite
PC - Polyisocyanurate Foam

Table II - Hot Piping Insulation Thickness
Pipe Size (inches)

Type of Service (degrees F)	Material	Run-outs up to 2 in *	1 in & less	1.25 - 2 in	2.5 - 4 in	5 - 6 in	8 in & larger
Hot domestic water supply & re-circulating system, & water defrost lines (200 F max)**	CG	1.5	1.5	1.5	1.5	1.5	1.5
	FC	0.5	0.5	1.0	1.0	1.5	1.5
	PF	0.5	0.5	1.0	1.0	1.0	1.0
	MF	0.5	1.5	1.5	1.5	1.5	1.5
	PC	1.0	1.0	1.0	1.0	1.0	1.0
Compressed Air discharge steam & condensate return (201-250 F)	CG		1.5	2.0	2.0	2.0	3.5
	PF		1.0	1.0	1.0	1.0	1.5
	MF		1.5	1.5	2.0	2.0	2.5
	CS/PL		1.5	2.0	2.5	2.5	3.5
	PC		1.0	1.0	1.0	1.0	1.0
Heating hot water, supply & return, & Heating oil (250 F max)	CG	1.5	1.5	2.0	2.0	2.5	3.0
	PF	0.5	1.0	1.0	1.0	1.0	1.5
	MF	0.5	1.5	1.5	2.0	2.5	3.0
	CS	1.0	1.5	2.0	2.5	2.5	3.0
	PC	1.0	1.0	1.0	1.0	1.0	1.0]
Medium Temp Hot water & steam, & heated oil (251 - 350F)	CG	1.5	2.5	3.0	3.5	3.5	4.0
	MF	1.5	2.0	2.5	2.5	3.0	3.5
	CS/PL	1.5	2.5	2.5	3.5	3.5	4.5

* When run-outs to terminal units exceed 12 feet, the entire length of run-out shall be insulated like the main feed pipe.

** Applies to re-circulating sections of service or domestic hot water systems and first 8 feet from storage tank for non-re-circulating systems.

3.2.3.2 Jacket for Insulated Hot Pipe, Except Pipe Insulated with Flexible Elastomeric Cellular

Insulation shall be covered, in accordance with manufacturer's recommendations, with a factory applied Type II jacket or field applied aluminum where required or seal welded PVC.

3.2.3.3 Insulation for Straight Runs

a. Insulation shall be applied to the pipe with joints tightly butted.

b. Longitudinal laps of the jacket material shall overlap not less than 1-1/2 inches, and butt strips 3 inches wide shall be provided for circumferential joints.

c. Laps and butt strips shall be secured with adhesive and stapled on 4 inch centers if not factory self-sealing. Adhesive may be omitted where pipe is concealed.

d. Factory self-sealing lap systems may be used when the ambient temperature is between 40 degrees and 120 degrees F and shall be installed in accordance with manufacturer's instructions. Laps and butt strips shall be stapled whenever there is non-adhesion of the system. Where gaps occur, the section shall be replaced or the gap repaired by applying adhesive under the lap and then stapling.

e. Breaks and punctures in the jacket material shall be patched by either wrapping a strip of jacket material around the pipe and securing with adhesive and staple on 4 inch centers (if not factory self-sealing), or patching with tape and sealing with a brush coat of vapor retarder coating. Adhesive may be omitted where pipe is concealed. Patch shall extend not less than 1-1/2 inches past the break.

f. Installation of flexible elastomeric cellular pipe insulation shall be by slitting the tubular sections and applying them onto the piping or tubing. Alternately, whenever possible slide un-slit sections over the open ends of piping or tubing. All seams and butt joints shall be secured and sealed with adhesive. When using self seal products only the butt joints shall be secured with adhesive. Insulation shall be pushed on the pipe, never pulled. Stretching of insulation may result in open seams and joints. All edges shall be clean cut. Rough or jagged edges of the insulation shall not be permitted. Proper tools such as sharp knives shall be used. Type II sheet insulation when used on pipe larger than 6 inches shall not be stretched around the pipe. On pipes larger than 12 inches, adhere sheet insulation directly to the pipe on the lower 1/3 of the pipe.

3.2.3.4 Insulation for Fittings and Accessories

a. Pipe insulation shall be tightly butted to the insulation of the fittings and accessories.

b. Precut or preformed insulation shall be placed around all fittings and accessories and shall conform to MICA plates, except as modified herein: 5 for anchors; 10, 11, 12,and 13 for fittings; 14, 15 and 16 for valves; 17 for flanges and unions; and 18 for couplings. Insulation shall be the same as the pipe insulation, including same density, thickness, and thermal conductivity. Where precut/preformed is unavailable, rigid preformed pipe insulation sections may be segmented into the shape required. Insulation of the same thickness and conductivity as the adjoining pipe insulation shall be used. If nesting size insulation is used, the insulation shall be overlapped 2 inches or one pipe diameter. Elbows insulated using segments shall conform to MICA Tables 12.20 "Mitered Insulation Elbow".

c. Upon completion of installation of insulation on flanges, unions, valves, anchors, fittings and accessories, terminations and insulation not protected by factory jackets or PVC fitting covers shall be protected with two coats of adhesive applied with glass tape embedded between coats. Tape seams shall overlap 1 inch.

Adhesive shall extend onto the adjoining insulation not less than 2 inches. The total dry film thickness shall be not less than 1/16 inch.

d. Insulation terminations shall be tapered to unions at a 45-degree angle.

e. At the option of the Contractor, factory pre-molded one- or two-piece PVC fitting covers may be used in lieu of the adhesive and embedded glass tape. Factory pre-molded segments or factory or field cut blanket insert insulation segments shall be used under the cover and shall be the same thickness as adjoining pipe insulation. The covers shall be secured by PVC vapor retarder tape, adhesive, seal welding or with tacks made for securing PVC covers.

3.2.4 Piping Exposed to Weather

Piping exposed to weather shall be insulated and jacketed as specified for the applicable service inside the building. After this procedure, an aluminum jacket or PVC jacket shall be applied. PVC jacketing requires no factory-applied jacket beneath it, however an all service jacket shall be applied if factory applied jacketing is not furnished. Flexible elastomeric cellular insulation exposed to weather shall be treated in accordance with paragraph INSTALLATION OF FLEXIBLE ELASTOMERIC CELLULAR INSULATION.

3.2.4.1 Aluminum Jacket

The jacket for hot piping may be factory applied. The jacket shall overlap not less than 2 inches at longitudinal and circumferential joints and shall be secured with bands at not more than 12 inch centers. Longitudinal joints shall be overlapped down to shed water and located at 4 or 8 o'clock positions. Joints on piping 60 degrees F and below shall be sealed with caulking while overlapping to prevent moisture penetration. Where jacketing on piping 60 degrees F and below abuts an un-insulated surface, joints shall be caulked to prevent moisture penetration. Joints on piping above 60 degrees F shall be sealed with a moisture retarder.

3.2.4.2 Insulation for Fittings

Flanges, unions, valves, fittings, and accessories shall be insulated and finished as specified for the applicable service. Two coats of breather emulsion type weatherproof mastic (impermeable to water, permeable to air) recommended by the insulation manufacturer shall be applied with glass tape embedded between coats. Tape overlaps shall be not less than 1 inch and the adjoining aluminum jacket not less than 2 inches. Factory preformed aluminum jackets may be used in lieu of the above. Molded PVC fitting covers shall be provided when PVC jackets are used for straight runs of pipe. PVC fitting covers shall have adhesive welded joints and shall be weatherproof.

3.2.4.3 PVC Jacket

PVC jacket shall be ultraviolet resistant and adhesive welded weather tight with manufacturer's recommended adhesive. Installation shall include provision for thermal expansion.

3.2.5 Below ground Pipe Insulation

The following shall be included:

a. Heated oil.

b. Domestic hot water.

c. Heating hot water.

d. Dual temperature water.

e. Steam.

f. Condensate.

3.2.5.1 Type of Insulation

Below ground pipe shall be insulated with Cellular Glass insulation, or with Polyisocyanurate insulation, in accordance with manufacturer's instructions for application with thickness as determined from Table I or Table II (whichever is the most restrictive).

3.2.5.2 Installation of Below ground Pipe Insulation

a. Bore surfaces of the insulation shall be coated with a thin coat of gypsum cement of a type recommended by the insulation manufacturer. Coating thickness shall be sufficient to fill surface cells of insulation. Mastic type materials shall not be used for this coating. Note that unless this is for a cyclic application (i.e., one that fluctuates between high and low temperature on a daily process basis) there is no need to bore coat the material.

b. Stainless steel bands, 3/4 inch wide by 0.020 inch thick shall be used to secure insulation in place. A minimum of two bands per section of insulation shall be applied. As an alternate, fiberglass reinforced tape may be used to secure insulation on piping up to 12 inches in diameter. A minimum of two bands per section of insulation shall be applied.

c. Insulation shall terminate at anchor blocks but shall be continuous through sleeves and manholes.

d. At point of entry to buildings, underground insulation shall be terminated 2 inches inside the wall or floor, shall butt tightly against the aboveground insulation and the butt joint shall be sealed with high temperature silicone sealant.

e. Provision for expansion and contraction of the insulation system shall be made in accordance with the insulation manufacturer's recommendations.

f. Flanges, couplings, valves, and fittings shall be insulated with factory pre-molded, prefabricated, or field-fabricated sections of insulation of the same material and thickness as the adjoining pipe insulation. Insulation sections shall be secured in place with wire, the bore surfaces coated, and joints sealed as specified.

g. Insulation, including fittings, shall be finished with three coats of asphaltic mastic, with 6 by 5.5 mesh synthetic reinforcing fabric embedded between coats. Fabric shall be overlapped a minimum of 2 inches at joints. Total film thickness shall be a minimum of 3/16 inch. As an alternate, a prefabricated bituminous laminated jacket, reinforced with internal reinforcement mesh, shall be applied to the insulation. Jacketing material and application procedures shall match manufacturer's written instructions.

h. At termination points, other than building entrances, the mastic and cloth or tape shall cover the ends of insulation and extend 2 inches along the bare pipe.

3.3 DUCT INSULATION INSTALLATION

Except for oven hood exhaust duct insulation, corner angles shall be installed on external corners of insulation on ductwork in exposed finished spaces before covering with jacket. Air conditioned spaces shall be defined as those spaces directly supplied with cooled conditioned air (or provided with a cooling device such as a fan-coil unit) and heated conditioned air (or provided with a heating device such as a unit heater, radiator or convector).

3.3.1 Duct Insulation Thickness

Duct insulation thickness shall be in accordance with Table III. Maximum thickness for flexible elastomeric cellular insulation shall not exceed 25 mm, and maximum thickness for polyisocyanurate foam insulation shall not exceed 40 mm to comply with ASTM E 84 flame spread/smoke developed ratings of 25/50

Table III - Minimum Duct Insulation (inches)

Cold Air Ducts	2.0
Relief Ducts	1.5
Fresh Air Intake Ducts	1.5
Warm Air Ducts	2.0
Relief Ducts	1.5
Fresh Air Intake Ducts	1.5

Maximum thickness for flexible elastomeric cellular insulation shall not exceed 1 inch and maximum thickness for polyisocyanurate foam insulation shall not exceed 1.5 inch, to comply with ASTM E 84 flame spread/smoke developed ratings of 25/50.

3.3.2 Insulation and Vapor Retarder for Cold Air Duct

Insulation and vapor retarder shall be provided for the following cold air ducts and associated equipment.

a. Supply ducts.

b. Return air ducts.

c. Relief ducts.

d. Flexible run-outs (field-insulated).

e. Plenums.

f. Duct-mounted coil casings.

g. Coil headers and return bends.

h. Coil casings.

i. Fresh air intake ducts.

j. Filter boxes.

k. Mixing boxes (field-insulated).

l. Supply fans (field-insulated).

m. Site-erected air conditioner casings.

n. Ducts exposed to weather.

o. Combustion air intake ducts.

Insulation for rectangular ducts shall be flexible type where concealed, minimum density 3/4 pcf and rigid type where exposed, minimum density 3 pcf. Insulation for round/oval ducts shall be flexible type, minimum density 3/4 pcf with a factory Type I or II jacket; or, a semi rigid board, minimum density 3 pcf, formed or fabricated to a tight fit, edges beveled and joints tightly butted and staggered, with a factory applied Type I or II all service jacket. Insulation for exposed ducts shall be provided with either a white, paint-able, factory-applied Type I jacket or a vapor retarder jacket coating finish as specified. Insulation on concealed duct shall be provided with a factory-applied Type I or II vapor retarder jacket. The total dry film thickness shall be approximately 1/16 inch.. Duct insulation shall be continuous through sleeves and prepared openings except firewall penetrations. Duct insulation terminating at fire dampers, shall be continuous over the damper collar and retaining angle of fire dampers, which are exposed to unconditioned air and which may be prone to condensate formation. Duct insulation and vapor retarder shall cover the collar, neck, and any un-insulated surfaces of diffusers, registers and grills. Vapor retarder materials shall be applied to form a complete unbroken vapor seal over the insulation.

3.3.2.1 Installation on Concealed Duct

a. For rectangular, oval or round ducts, insulation shall be attached by applying adhesive around the entire perimeter of the duct in 6 inch wide strips on 12 inch centers.

b. For rectangular and oval ducts, 24 inches and larger insulation shall be additionally secured to bottom of ducts by the use of mechanical fasteners. Fasteners shall be spaced on 16 inch centers and not more than 16 inches from duct corners.

c. For rectangular, oval and round ducts, mechanical fasteners shall be provided on sides of duct risers for all duct sizes. Fasteners

shall be spaced on 16 inch centers and not more than 16 inches from duct corners.

d. Insulation shall be impaled on the mechanical fasteners (self stick pins) where used and shall be pressed thoroughly into the adhesive. Care shall be taken to ensure vapor retarder jacket joints overlap 2 inches. The insulation shall not be compressed to a thickness less than that specified. Insulation shall be carried over standing seams and trapeze-type duct hangers.

e. Self-locking washers shall be installed where mechanical fasteners are used. The pin shall be trimmed back and bent over.

f. Jacket overlaps shall be secured with staples and tape as necessary to ensure a secure seal. Staples, tape and seams shall be coated with a brush coat of vapor retarder coating or PVDC adhesive tape.

g. Breaks in the jacket material shall be covered with patches of the same material as the vapor retarder jacket. The patches shall extend not less than 2 inches beyond the break or penetration in all directions and shall be secured with tape and staples. Staples and tape joints shall be sealed with a brush coat of vapor retarder coating or PVDC adhesive tape.

h. At jacket penetrations such as hangers, thermometers, and damper operating rods, voids in the insulation shall be filled and the penetration sealed with a brush coat of vapor retarder coating or PVDC adhesive tape.

i. Insulation terminations and pin punctures shall be sealed and flashed with a reinforced vapor retarder coating finish or tape with a brush coat of vapor retarder coating.. The coating shall overlap the adjoining insulation and un-insulated surface 2 inches. Pin puncture coatings shall extend 2 inches from the puncture in all directions.

j. Where insulation standoff brackets occur, insulation shall be extended under the bracket and the jacket terminated at the bracket.

3.3.2.2 Installation on Exposed Duct Work

a. For rectangular ducts, rigid insulation shall be secured to the duct by mechanical fasteners on all four sides of the duct, spaced not more than 12 inches apart and not more than 3 inches from the edges of the insulation joints. A minimum of two rows of fasteners shall be provided for each side of duct 12 inches and larger. One row shall be provided for each side of duct less than 12 inches.

b. Duct insulation shall be formed with minimum jacket seams. Each piece of rigid insulation shall be fastened to the duct using mechanical fasteners. When the height of projections is less than the insulation thickness, insulation shall be brought up to standing seams, reinforcing, and other vertical projections and shall not be carried over. Vapor retarder jacket shall be continuous across seams, reinforcing, and projections. When height of projections is greater than the insulation thickness,

insulation and jacket shall be carried over.

c. Insulation shall be impaled on the fasteners; self-locking washers shall be installed and the pin trimmed or bent over.

d. Joints in the insulation jacket shall be sealed with a 4 inchwide strip of tape. Tape seams shall be sealed with a brush coat of vapor retarder coating.

e. Breaks and ribs or standing seam penetrations in the jacket material shall be covered with a patch of the same material as the jacket. Patches shall extend not less than 2 inches beyond the break or penetration and shall be secured with tape and stapled. Staples and joints shall be sealed with a brush coat of vapor retarder coating.

f. At jacket penetrations such as hangers, thermometers, and damper operating rods, the voids in the insulation shall be filled and the penetrations sealed with a brush coat of vapor retarder coating.

g. Insulation terminations and pin punctures shall be sealed and flashed with a reinforced vapor retarder coating finish. The coating shall overlap the adjoining insulation and un-insulated surface 2 inches. Pin puncture coatings shall extend 2 inches from the puncture in all directions.

h. Oval and round ducts, flexible type, shall be insulated with factory Type I jacket insulation with minimum density of 3/4 pcf, attached as per MICA standards.

3.3.3 Insulation for Warm Air Duct

Insulation and vapor barrier shall be provided for the following warm air ducts and associated equipment:.

a. Supply ducts.

b. Return air ducts

c. Relief air ducts

d. Flexible run-outs (field insulated)

e. Plenums

f. Duct-mounted coil casings

g. Coil-headers and return bends

h. Coil casings.

i. Fresh air intake ducts

j. Filter boxes

k. Mixing boxes

l. Supply fans

m. Site-erected air conditioner casings

n. Ducts exposed to weather

Insulation for rectangular ducts shall be flexible type where concealed, minimum density 3/4 pcf; and rigid type where exposed, minimum density 3 pcf. Insulation on exposed ducts shall be provided with a white, paint-able, factory-applied Type II jacket, or finished with adhesive finish. Flexible type insulation shall be used for round ducts, minimum density 3/4 pcf with a factory-applied Type II jacket. Insulation on concealed duct shall be provided with a factory-applied Type II jacket. Adhesive finish where indicated to be used shall be accomplished by applying two coats of adhesive with a layer of glass cloth embedded between the coats. The total dry film thickness shall be approximately 1/16 inch. Duct insulation shall be continuous through sleeves and prepared openings. Duct insulation shall terminate at fire dampers and flexible connections.

3.3.3.1 Installation on Concealed Duct

a. For rectangular, oval and round ducts, insulation shall be attached by applying adhesive around the entire perimeter of the duct in 6 inch wide strips on 12 inch centers.

b. For rectangular and oval ducts 24 inches and larger, insulation shall be secured to the bottom of ducts by the use of mechanical fasteners. Fasteners shall be spaced on 18 inch centers and not more than 18 inches from duct corner.

c. For rectangular, oval and round ducts, mechanical fasteners shall be provided on sides of duct risers for all duct sizes. Fasteners shall be spaced on 18 inch centers and not more than 18 inches from duct corners.

d. The insulation shall be impaled on the mechanical fasteners where used. The insulation shall not be compressed to a thickness less than that specified. Insulation shall be carried over standing seams and trapeze-type hangers.

e. Self-locking washers shall be installed where mechanical fasteners are used and the pin trimmed and bent over.

f. Insulation jacket shall overlap not less than 2 inches at joints and the lap shall be secured and stapled on 4 inch centers.

3.3.3.2 Installation on Exposed Duct

a. For rectangular ducts, the rigid insulation shall be secured to the duct by the use of mechanical fasteners on all four sides of the duct, spaced not more than 16 inches apart and not more than 6 inches from the edges of the insulation joints. A minimum of two rows of fasteners shall be provided for each side of duct 12 inches and larger and a minimum of one row for each side of duct less than 12 inches.

b. Duct insulation with factory-applied jacket shall be formed with minimum jacket seams, and each piece of rigid insulation shall be fastened to the duct using mechanical fasteners. When the height of projection is less than the insulation thickness, insulation

shall be brought up to standing seams, reinforcing, and other vertical projections and shall not be carried over the projection. Jacket shall be continuous across seams, reinforcing, and projections. Where the height of projections is greater than the insulation thickness, insulation and jacket shall be carried over the projection.

c. Insulation shall be impaled on the fasteners; self-locking washers shall be installed and pin excess clipped and bent over.

d. Joints on jacketed insulation shall be sealed with a 4 inch wide strip of tape and brushed with vapor retarder coating.

e. Breaks and penetrations in the jacket material shall be covered with a patch of the same material as the jacket. Patches shall extend not less than 2 inches beyond the break or penetration and shall be secured with adhesive and stapled.

f. Insulation terminations and pin punctures shall be sealed with tape and brushed with vapor retarder coating.

g. Oval and round ducts, flexible type, shall be insulated with factory Type I jacket insulation, minimum density of 3/4 pcf attached by staples spaced not more than 16 inches and not more than 6 inches from the degrees of joints. Joints shall be sealed in accordance with item "d." above.

3.3.4 Ducts Handling Air for Dual Purpose

For air handling ducts for dual purpose below and above 60 degrees F, ducts shall be insulated as specified for cold air duct.

3.3.5 Insulation for Evaporative Cooling Duct

Evaporative cooling supply duct located in spaces not evaporatively cooled, shall be insulated. Material and installation requirements shall be as specified for duct insulation for warm air duct.

3.3.6 Duct Test Holes

After duct systems have been tested, adjusted, and balanced, breaks in the insulation and jacket shall be repaired in accordance with the applicable section of this specification for the type of duct insulation to be repaired.

3.3.7 Duct Exposed to Weather

3.3.7.1 Installation

Ducts exposed to weather shall be insulated and finished as specified for the applicable service for exposed duct inside the building. After the above is accomplished, the insulation shall then be further finished as detailed in the following subparagraphs.

3.3.7.2 Round Duct

Aluminum jacket with factory applied moisture retarder shall be applied with the joints lapped not less than 3 inches and secured with bands located at circumferential laps and at not more than 12 inch intervals

throughout. Horizontal joints shall lap down to shed water and located at 4 or 8 o'clock position. Joints shall be sealed with caulking to prevent moisture penetration. Where jacketing abuts an un-insulated surface, joints shall be sealed with caulking.

3.3.7.3 Fittings

Fittings and other irregular shapes shall be finished as specified for rectangular ducts.

3.3.7.4 Rectangular Ducts

Two coats of weather barrier mastic reinforced with fabric or mesh for outdoor application shall be applied to the entire surface. Each coat of weatherproof mastic shall be 1/16 inch minimum thickness. The exterior shall be a metal jacketing applied for mechanical abuse and weather protection, and secured with screws.

3.4 EQUIPMENT INSULATION INSTALLATION

3.4.1 General

Removable insulation sections shall be provided to cover parts of equipment that must be opened periodically for maintenance including vessel covers, fasteners, flanges and accessories. Equipment insulation shall be omitted on the following:

a. Hand-holes.

b. Boiler manholes.

c. Cleanouts.

d. ASME stamps.

e. Manufacturer's nameplates.

3.4.2 Insulation for Cold Equipment

Cold equipment below 60 degrees F: Insulation shall be furnished on equipment handling media below 60 degrees F including the following:

a. Pumps.

b. Refrigeration equipment parts that are not factory insulated.

c. Drip pans under chilled equipment.

d. Cold water storage tanks.

e. Water softeners.

f. Duct mounted coils.

g. Cold and chilled water pumps.

h. Pneumatic water tanks.

i. Roof drain bodies.

j. Air handling equipment parts that are not factory insulated.

k. Expansion and air separation tanks.

3.4.2.1 Insulation Type

Insulation shall be suitable for the temperature encountered. Thicknesses shall be as follows:

a. Equipment handling media between 35 and 60 degrees F: 1.5 inch thick cellular glass, 1 inch thick flexible elastomeric cellular, 1.5 inch thick phenolic foam, or 1 inch thick polyisocyanurate foam.

b. Equipment handling media between 0 degree F and 34 degrees F: 3 inch thick cellular glass, 1 1/2 inch flexible elastomeric cellular, 1 1/2 inch thick phenolic foam, or 1 1/2 inch thick polyisocyanurate foam.

c. Equipment handling media between minus 30 degrees F and 1 degree F: 3 1/2 inch thick cellular glass 1 3/4 inch thick flexible elastomeric cellular, 1 1/2 inch thick phenolic foam, or 1 1/2 inch thick polyisocyanurate foam.

3.4.2.2 Pump Insulation

a. Insulate pumps by forming a box around the pump housing. The box shall be constructed by forming the bottom and sides using joints that do not leave raw ends of insulation exposed. Joints between sides and between sides and bottom shall be joined by adhesive with lap strips for rigid mineral fiber and contact adhesive for flexible elastomeric cellular insulation. The box shall conform to the requirements of MICA Insulation Stds plate No. 49 when using flexible elastomeric cellular insulation. Joints between top cover and sides shall fit tightly forming a female shiplap joint on the side pieces and a male joint on the top cover, thus making the top cover removable.

b. Exposed insulation corners shall be protected with corner angles.

c. Upon completion of installation of the insulation, including removable sections, two coats of vapor retarder coating shall be applied with a layer of glass cloth embedded between the coats. The total dry thickness of the finish shall be 1/16 inch. A parting line shall be provided between the box and the removable sections allowing the removable sections to be removed without disturbing the insulation coating. Caulking shall be applied to parting line, between equipment and removable section insulation, and at all penetrations.

3.4.2.3 Other Equipment

a. Insulation shall be formed or fabricated to fit the equipment. To ensure a tight fit on round equipment, edges shall be beveled and joints shall be tightly butted and staggered.

b. Insulation shall be secured in place with bands or wires at intervals as recommended by the manufacturer but not more than 12

inch centers except flexible elastomeric cellular which shall be adhered. Insulation corners shall be protected under wires and bands with suitable corner angles.

c. Phenolic foam insulation shall be set in a coating of bedding compound and joints shall be sealed with bedding compound as recommended by the manufacturer. Cellular glass shall be installed in accordance with manufacturer's instructions. Joints and ends shall be sealed with joint sealant, and sealed with a vapor retarder coating.

d. Insulation on heads of heat exchangers shall be removable. Removable section joints shall be fabricated using a male-female shiplap type joint. The entire surface of the removable section shall be finished by applying two coats of vapor retarder coating with a layer of glass cloth embedded between the coats. The total dry thickness of the finish shall be 1/16 inch.

e. Exposed insulation corners shall be protected with corner angles.

f. Insulation on equipment with ribs shall be applied over 6 x 6 inches by 12 gauge welded wire fabric which has been cinched in place, or if approved by the Contracting Officer, spot welded to the equipment over the ribs. Insulation shall be secured to the fabric with J-hooks and 2 x 2 incheswashers or shall be securely banded or wired in place on 12 inch centers.

3.4.2.4 Vapor Retarder

Upon completion of installation of insulation, penetrations shall be caulked. Two coats of vapor retarder coating shall be applied over insulation, including removable sections, with a layer of open mesh synthetic fabric embedded between the coats. The total dry thickness of the finish shall be 1/16 inch. Caulking shall be applied to parting line between equipment and removable section insulation.

3.4.3 Insulation for Hot Equipment

Insulation shall be furnished on equipment handling media above 60 degrees F including the following:

a. Converters.

b. Heat exchangers.

c. Hot water generators.

d. Water heaters.

e. Pumps handling media above 130 degrees F.

f. Fuel oil heaters.

g. Hot water storage tanks.

h. Air separation tanks.

i. Surge tanks.

j. Flash tanks.

k. Feed-water heaters.

l. Unjacketed boilers or parts of boilers.

m. Boiler flue gas connection from boiler to stack (if inside).

n. Induced draft fans.

o. Fly ash and soot collectors.

p. Condensate receivers.

3.4.3.1 Insulation

Insulation shall be suitable for the temperature encountered. Shell and tube-type heat exchangers shall be insulated for the temperature of the shell medium.

Insulation thickness for hot equipment shall be determined using Table IV:

Legend

RMF: Rigid Mineral Fiber
FMF: Flexible Mineral Fiber
CS: Calcium Silicate
PL: Perlite
CG: Cellular Glass
FC: Flexible Elastomeric Cellular
PF: Phenolic Foam
PC: Polyisocyanurate Foam

TABLE IV
Insulation Thickness for Hot Equipment (mm)

Equipment handling steam or other media to indicated pressure or temperature limit	Material	Thickness
103.4 kPa	RMF	50 mm
or	FMF	50 mm
121 C	CS/PL	100 mm
	CG	75 mm
	PF	40 mm
	FC(<93 C)	25 mm
	PC	25 mm
1379.0kPa	RMF	75 mm
or	FMF	75 mm
204 C	CS/PL	100 mm
	CG	100 mm
316 C	RMF	125 mm
	FMF	150 mm

	CS/PL	150 mm
	CG	150 mm

316 C: Thickness necessary to limit the external temperature of the insulation to 50 C, except that diesel engine exhaust piping and mufflers shall be covered with 150 mm thick material suitable for 650 degrees C service. Heat transfer calculations shall be submitted to substantiate insulation and thickness selection.

TABLE IV
Insulation Thickness for Hot Equipment (Inches)

Equipment handling steam or media to indicated pressure or temperature limit:	Material	Thickness
15 psig	RMF	2.0 inches
or	FMF	2.0 inches
250F	CS/PL	4.0 inches
	CG	3.0 inches
	PF	1.5 inches
	FC (<200F)	1.0 inches
	PC	1.0 inches
200 psig	RMF	3.0 inches
or	FMF	3.0 inches
400 F	CS/PL	4.0 inches
	CG	4.0 inches
600 F	RMF	5.0 inches
	FMF	6.0 inches
	CS/PL	6.0 inches
	CG	6.0 inches

>600 F: Thickness necessary to limit the external temperature of the insulation to 120F, except that diesel engine exhaust piping and mufflers shall be covered with 6.0 inch thick material suitable for 1200 degrees F service. Heat transfer calculations shall be submitted to substantiate insulation and thickness selection.

3.4.3.2 Insulation of Pumps

Insulate pumps by forming a box around the pump housing. The box shall be constructed by forming the bottom and sides using joints that do not leave raw ends of insulation exposed. Bottom and sides shall be banded to form a rigid housing that does not rest on the pump. Joints between top cover and sides shall fit tightly. The top cover shall have a joint forming a female shiplap joint on the side pieces and a male joint on the top cover, making the top cover removable. Two coats of Class I adhesive shall be applied over insulation, including removable sections, with a layer of glass cloth embedded between the coats. A parting line shall be provided between the box and the removable sections allowing the removable sections to be removed without disturbing the insulation coating. The total dry thickness of the finish shall be 1/16 inch. Caulking shall be applied to parting line of the removable sections and penetrations.

3.4.3.3 Other Equipment

a. Insulation shall be formed or fabricated to fit the equipment. To ensure a tight fit on round equipment, edges shall be beveled and joints shall be tightly butted and staggered.

b. Insulation shall be secured in place with bands or wires at intervals as recommended by the manufacturer but not greater than 12 inch centers except flexible elastomeric cellular which shall be adhered. Insulation corners shall be protected under wires and bands with suitable corner angles.

c. On high vibration equipment, cellular glass insulation shall be set in a coating of bedding compound as recommended by the manufacturer, and joints shall be sealed with bedding compound. Mineral fiber joints shall be filled with finishing cement.

d. Insulation on heads of heat exchangers shall be removable. The removable section joint shall be fabricated using a male-female shiplap type joint. Entire surface of the removable section shall be finished as specified.

e. Exposed insulation corners shall be protected with corner angles.

f. On equipment with ribs, such as boiler flue gas connection, draft fans, and fly ash or soot collectors, insulation shall be applied over 6 x 6 inch by 12 gauge welded wire fabric which has been cinched in place, or if approved by the Contracting Officer, spot welded to the equipment over the ribs. Insulation shall be secured to the fabric with J-hooks and 2 x 2 inch washers or shall be securely banded or wired in place on 12 inch (maximum) centers.

g. On equipment handling media above 600 degrees F, insulation shall be applied in two or more layers with joints staggered.

h. Upon completion of installation of insulation, penetrations shall be caulked. Two coats of adhesive shall be applied over insulation, including removable sections, with a layer of glass cloth embedded between the coats. The total dry thickness of the finish shall be 1/16 inch. Caulking shall be applied to parting line between equipment and removable section insulation.

3.4.4 Equipment Handling Dual Temperature Media

Below and above 60 degrees F: equipment handling dual temperature media shall be insulated as specified for cold equipment.

3.4.5 Equipment Exposed to Weather

3.4.5.1 Installation

Equipment exposed to weather shall be insulated and finished in accordance with the requirements for ducts exposed to weather in paragraph DUCT INSULATION INSTALLATION.

3.4.5.2 Optional Panels

At the option of the Contractor, prefabricated metal insulation panels may be used in lieu of the insulation and finish previously specified. Thermal

performance shall be equal to or better than that specified for field applied insulation. Panels shall be the standard catalog product of a manufacturer of metal insulation panels. Fastenings, flashing, and support system shall conform to published recommendations of the manufacturer for weatherproof installation and shall prevent moisture from entering the insulation. Panels shall be designed to accommodate thermal expansion and to support a 250 pound walking load without permanent deformation or permanent damage to the insulation. Exterior metal cover sheet shall be aluminum and exposed fastenings shall be stainless steel or aluminum.

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SECTION 15400

PLUMBING SYSTEMS
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PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A112.36.2M	(1991) Cleanouts
ANSI A117.1	(1992) Buildings and Facilities Providing Accessibility and Usability for Physically Handicapped People
ANSI B16.23	(1992; Errata 1994) Cast Copper Alloy Solder Joint Drainage Fittings - DWV
ANSI Z21.22	(1986; Addenda 1990) Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A112.6.1M	(1988) Supports for the Off-the-Floor Plumbing Fixtures for Public Use
ASME A112.18.1M	(1996) Plumbing Fixture Fittings
ASME/ANSI A112.19.1M	(1994; Errata 1996) Enameled Cast Iron Plumbing Fixtures
ASME A112.19.2M	(1995) Vitreous China Plumbing Fixtures
ASME A112.21.1M	(1991) Floor Drains
ANSI/ASME B16.29	(1994) Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV
ANSI/ASME B16.32	(1992) Cast Copper Alloy Solder Joint Fittings for Solvent Drainage Systems

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1003	(1993; Errata 1993) Water Pressure Reducing Valves

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53	(1996) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless

ASTM A 74	(1996) Cast Iron Soil Pipe and Fittings
ASTM B 32	(1996) Solder Metal
ASTM B 88	(1996) Seamless Copper Water Tube
ASTM B 306	(1996) Copper Drainage Tube (DWV)
ASTM C 564	(1996) Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM C 1115	(1994) Dense Elastomeric Silicone Rubber Gaskets and Accessories
ASTM D 2665	(1996) Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM F 441/F 441M	(1996; Rev. B) Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C105/A21.5	(1993) Polyethylene Encasement for Ductile - Iron Pipe Systems
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 C115/A21.15	(1994) Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
AWWA C500	(1993; Addendum 1995) Metal-Seated Gate Valves for Water Supply Service
AWWA C651	(1992) Disinfecting Water Mains
AWWA C701	(1988) Cold-Water Meters - Turbine Type, for Customer Service

CAST IRON SOIL PIPE INSTITUTE (CISPI)

CISPI HSN	(1985) Neoprene Rubber Gaskets for Hub and Spigot Cast Iron Soil Pipe and Fittings
CISPI 301	(1995) Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
CISPI 310	(1995) Couplings Joint for Use in Connection with Hubless Cast Iron Soil Pipe and Fitting

INTERNATIONAL CODE COUNCIL (ICC)

ICC IPC	(1995; Supp. 1996) International Plumbing Code

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

MSS SP-58	(1993) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	(1996) Pipe Hangers and Supports - Selection and Application
MSS SP-70	(1990) Cast Iron Gate Valves, Flanged and Threaded Ends
MSS SP-71	(1990) Cast Iron Swing Check Valves, Flanged and Threaded Ends
MSS SP-80	(1997) Bronze Gate, Globe, Angle and Check Valves
MSS SP-85	(1994) Cast Iron Globe & Angle Valves Flanged and Threaded Ends
MSS SP-89	(1991) Pipe Hangers and Supports - Fabrication and Installation Practices

PLUMBING AND DRAINAGE INSTITUTE (PDI)

PDI WH201	(1992) Water Hammer Arrestors

1.2 SYSTEM DESCRIPTION

Provide new and modify existing 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 Plumbing Code ICC IPC. Plumbing systems include piping less than 5 feet outside of building walls and piping beyond 5 feet outside of building walls including connections to existing exterior distribution systems.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Pipe and fittings

Valves

Plumbing fixtures

Water heaters

Pipe hangers and supports

Pumps

Pressure gages

Water meters

Strainers

Drains

Water hammer arresters

Backflow preventers

Thermometers

For pumps, include certified pump test curves.

SD-06 Test Reports

Disinfection

SD-10 Operation and Maintenance Data

Water heaters

Pumps

1.4 QUALITY ASSURANCE

Plumbing systems including fixtures, equipment, materials, installation, and workmanship shall be in accordance with the Plumbing Code except as modified herein. In the Plumbing Code referred to herein, the advisory provisions shall be considered to be mandatory, as though the word "shall" had been substituted for the word "should" wherever it appears; reference to the "authority having jurisdiction," the Administrative Authority, the Plumbing Official, and the Design Engineer shall be interpreted to mean the Contracting Officer. Capacity of equipment shall be not less than that indicated.

PART 2 PRODUCTS

2.1 DRAIN, WASTE, AND VENT (DWV) PIPE AND FITTINGS

Unless noted otherwise on drawings, plastic pipe (PVC) shall be used for drainage systems under concrete slabs and inside of buildings. Fittings shall be long radius fittings, except fittings in vent piping may be short radius fittings. Minimum size piping shall be 2 inches for buried piping and 1.5 inches for aboveground piping. Buried piping shall not be more than 6 inchesaboveground or floor slab. Copper tubing can only be used for aboveground piping. Do not use polyvinyl chloride (PVC) in more than two-story buildings.

2.1.1 Cast-Iron Hubless Pipe and Fittings

CISPI 301 with CISPI 310 couplings.

2.1.2 Cast-Iron Hub and Spigot Pipe and Fittings

ASTM A 74 with ASTM C 564 or CISPI HSN rubber compression gasket joints.

2.1.3 Plastic Pipe, Fittings, and Solvent Cement

a. Polyvinyl Chloride (PVC) System: ASTM D 2665.

2.1.4 Copper Tubing

ASTM B 306, with ANSI B16.23, ANSI/ASME B16.29, or ANSI/ASME B16.32 solder joint fittings using ASTM B 32, 95-5 tin-antimony or Grade Sn96 tin-silver solder, and flux containing not more than 0.2 percent lead.

2.1.5 Cleanouts

ANSI A112.36.2M; provide threaded bronze or thermoplastic or PVC plastic cleanout plugs.

2.1.5.1 Floor Cleanouts

Provide cast-iron or ductile-iron floor cleanout with flange and floor plate with letters "CO" cast.

2.1.5.2 Wall Cleanouts

Provide polished stainless steel or chromium-plated copper alloy cover plate and secure to cleanout plug with countersunk stainless steel screw.

2.1.6 Drains

ASME A112.21.1M; provide cast-iron or ductile-iron drains and clamping rings for use with membrane waterproofing. Provide an adjustable collar and P-traps for each floor drain and double drainage flange. Drains of sizes 2, 3, and 4 inches shall have strainers with minimum free drainage area of 5, 11, and 18 square inches, respectively.

2.2 DOMESTIC WATER PIPE AND FITTINGS

2.2.1 Copper Tubing

ASTM B 88, Type L or M for aboveground piping, Type K for buried piping, with wrought copper fittings and ASTM B 32, Alloy Grade Sb5 solder and lead free (less than 0.20 percent lead) solder flux.

2.2.2 Omitted

2.2.3 Omitted

2.2.4 Water Valves

Provide valves suitable for minimum of 125 psig and minimum of 180 degrees F hot water. Valves shall have flanged end connections, except sizes smaller than 2.5 inches may have threaded end connections with a union on all but one side of the valve, or solder end connections for connections between bronze valves and copper tubing.

2.2.4.1 Gate Valves

MSS SP-80, Class 125, except sizes 2.5 inches and larger shall conform to MSS SP-70, Class 125.

2.2.4.2 Globe and Angle Valves

MSS SP-80, Class 125, except sizes 2.5 inches and larger shall conform to MSS SP-85, Class 125.

2.2.4.3 Check Valves

MSS SP-80, Class 125, swing check┼, except sizes 2.5 inches and larger shall conform to MSS SP-71, Class 125, swing check, cast-iron or bronze body ┼.

2.2.4.4 Ball Valves

Bronze or stainless steel body with stainless steel ball, except sizes 2.5 inches and larger shall be ductile-iron body or cast-iron body with chrome plated steel ball. Valves shall be full port design and have two-position lever handles, teflon seat and stuffing box ring and seals.

2.2.4.5 Hose Bibbs

Provide angle type copper alloy hose bibb with lockshield and removable handwheel or tee-handle. Inlet shall have internal threads. Outlet shall have vacuum breaker with 0.75 inch external hose threads.

2.2.4.6 Combination Pressure and Temperature Relief Valves

ANSI Z21.22 copper alloy body, automatic reseating, test lever, and discharge capacity based on AGA temperature steam rating.

2.2.4.7 Pressure Relief Valves

ANSI Z21.22 copper alloy body, automatic reseating with test lever.

2.2.4.8 Water Temperature Regulating Valves

Provide copper alloy or cast-iron body valve with adjustable range to allow settings between 110 and 180 degrees F.

2.2.4.9 Water Temperature Mixing Valves

Provide adjustable thermostatic or pressure equalizing valve of copper alloy or cast-iron body.

2.2.4.10 Water Pressure Reducing Valves

ASSE 1003.

2.2.5 Water Meters

AWWA C701 turbine type, with register reading in U.S. gallons.

2.2.6 Strainers

Strainers shall have blow off outlet with pipe nipple and gate valve and discharge pipe nipple. Copper alloy or cast-iron body. Provide stainless steel strainer element with perforations of 0.047 inch.

2.2.7 Pressure Gages

Provide single style pressure gage for water with 4.5 inchdial, brass or aluminum case, bronze tube, gage cock, pressure snubber, and syphon. Provide scale range suitable for the intended service.

2.2.8 Thermometers

Provide bi-metal dial type thermometers with stainless steel case, stem, and fixed thread connection; 5 inch diameter dial with glass face gasketed within the case; accuracy within 2 percent of scale range. Provide scale range suitable for the intended service.

2.2.9 Dielectric Connections

Provide at connections between copper and ferrous metal piping materials. ASTM F 441/F 441M, Schedule 80, CPVC threaded pipe nipples, 4 inch minimum length, may be provided for dielectric connections in pipe sizes 2 inches and smaller.

2.2.10 Water Hammer Arresters

PDI WH201.

2.2.11 Valve Boxes

For each buried valve provide cast-iron, ductile-iron, or plastic box of a suitable size. Provide cast-iron, ductile-iron, or plastic cover for the box with the word "WATER" cast on the cover. Plastic boxes shall be constructed of ABS plastic or inorganic fiber-reinforced black polyolefin plastic. Coat cast-iron and ductile-iron boxes with bituminous paint.

2.3 MISCELLANEOUS PIPING MATERIALS

2.3.1 Flanges

Provide forged steel flanges for use in ferrous piping and bronze flanges for use in copper tubing; with ASTM C 1115 full face flat type rubber gaskets.

2.3.2 Escutcheon Plates

Provide one piece or split hinge metal plates for piping entering floors, walls, and ceilings in exposed spaces. Provide chromium-plated or polished stainless steel finish on copper alloy plates in finished spaces. Provide paint finish on metal in unfinished spaces.

2.3.3 Pipe Sleeves

ASTM A 53, Schedule 40 or Standard Weight, hot-dip galvanized steel or ductile-iron or cast-iron pipe sleeves.

2.3.4 Pipe Hangers and Supports

Provide MSS SP-58 and MSS SP-69, Type 1 with adjustable type steel support rods, except as specified or indicated otherwise. Attach to steel joists with Type 19 or 23 clamps and retaining straps. Attach to Steel W or S beams with Type 21, 28, 29, or 30 clamps. Attach to steel angles and vertical web steel channels with Type 20 clamp with beam clamp channel

adapter. Attach to horizontal web steel channel and wood with drilled hole on centerline and double nut and washer. Attach to concrete with Type 18 insert or drilled expansion anchor. Provide Type 40 insulation protection shield for insulated piping.

2.4 PLUMBING FIXTURES, FITTINGS, ACCESSORIES, AND SUPPLIES

Provide control-stop valves in each supply to each fixture. The finish of fittings, accessories, and supplies exposed to view shall be chromium-plated per ASME A112.18.1M. Centerset faucets shall be top-mounted with inlets on not greater than 4 inch centers. For physical handicapped persons, provide plumbing fixtures in accordance with ANSI A117.1. For water closets, urinals, and shower heads, the outlet flushing flowrate shall not exceed the amount indicated.

2.4.1 Flush Valve Type Water Closets

ASME A112.19.2M, white vitreous china, floor-mounted, floor or wall outlet as indicated, siphon jet, elongated bowl, and black solid plastic elongated open-front seat with cover.

2.4.2 Flush Valve Type Urinals

ASME A112.19.2M, white vitreous china, wall-mounted, wall outlet, siphon jet, integral trap, and extended side shields.

2.4.3 Lavatories

ASME/ANSI A112.19.1M, white enameled cast-iron, or ASME A112.19.2Mwhite vitreous china with ASME A112.6.1M concealed arm carrier support, shelf back type, minimum dimensions of 20 inches wide by 18 inches front to rear. Provide ASME A112.18.1M copper alloy faucets with aerator, perforated grid strainers, and 1.25 inch adjustable P-traps.

2.4.4 Shower Supply Fittings

ASME A112.18.1M, ball joint, self-cleaning shower heads with 3 gpm flow control devices, connected to concealed pipe connected to copper alloy pressure balance single control type mixing valves with front access integral screwdriver stops. Anchor the mixing valves and the pipe to each shower head in wall to prevent movement.

PART 3 EXECUTION

3.1 INSTALLATION

Ream pipe and tube ends and remove burrs. Install plumbing systems including fixtures, equipment, materials, and accessories in accordance with the Plumbing Code, except as modified herein. When fixtures require both hot water and cold water supplies, provide the hot water supply to the left of the cold water supply. Plastic piping shall not penetrate fire walls or fire floors and shall be used on one side of fire walls and fire floors not closer than 6 inches to the penetration. Provide dielectric connections whenever jointing dissimilar metals in an accessible locations. Install piping to allow for expansion and contraction without stressing pipe joints or connected equipment. Slope water piping and arrange to drain at low points. Provide valves with close nipple and cap at low points. Provide concrete thrust blocks at the elbow where the buried piping turns up towards the floor, and restrain the pipe riser with steel

rods from the elbow to the flange above the floor. Aboveground piping shall have flanged end connections conforming to AWWA C115/A21.15 for flanged pipe and AWWA C110/A21.10 for flanged fittings.

3.1.1 Threaded Connections

Jointing compound for pipe threads shall be polytetrafluoroethylene (PTFE) pipe thread paste, pipe cement and oil, or PTFE powder and oil; apply only on male threads. Provide exposed ferrous pipe threads with one coat of primer applied to a minimum dry film thickness of 1.0 mil.

3.1.2 Solder End Valves

Remove stems and washers and other item subject to damage by heat during installation. Reassemble valve after soldering is completed. Valves without heat sensitive parts do not require disassembly but shall be opened at least two turns during soldering. Install brass male adapters each side of valves in copper piped system. Sweat solder adapters to pipe.

3.1.3 Pipe Supports (Hangers)

Comply with MSS SP-89. Provide additional supports at the concentrated loads in piping between supports, such as for inline water pumps and flanged valves.

3.1.3.1 Piping to Receive Insulation

Provide clearance for installation of insulation and access to valves and fittings. Provide temporary wood spacers between the insulation protection shield and the pipe in order to properly slope the piping and to establish final elevations.

3.1.4 Ductile Iron Pipe Aboveground

Provide flanged joints.

3.1.5 Encased Buried Piping

Where noted on drawings provide completely encase buried copper water piping and cast iron DWV and water piping with polyethylene tube or sheet in accordance with AWWA C105/A21.5.

3.1.6 Pipe Sleeves

Provide pipe sleeves where piping passes through walls, floors, roofs, and partitions. Provide sleeves of sufficient length to pass through entire thickness of walls, floors, roofs, and partitions. Provide not less than 0.25 inch space between exterior of piping or pipe insulation and interior of sleeve or core-drilled hole. Core drilling of masonry and concrete may be provided in lieu of pipe sleeves when cavities in the core-drilled hole are completely grouted smooth. Firmly pack space with mineral wool insulation. Seal at both ends of the sleeve or core-drilled hole with plastic waterproof cement which will dry to a firm but pliable mass, or provide a mechanically adjustable segmented elastomeric seal. Seal both ends of penetrations through fire walls and fire floors to maintain fire resistive integrity with UL listed fill, void, or cavity material. Extend sleeves in floor slabs 3 inches above the finished floor, except sleeves are not required where DWV piping passes through concrete floor slabs located on grade.

3.1.7 Copper Tube Extracted Joint

An extracted mechanical tee joint may be made in copper tube. Make joint 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, provide dimpled depth stops. Notch the branch tube for proper penetration into fitting to ensure a free flow joint. Braze extracted joints using a copper phosphorus classification brazing filler metal. Soldered joints shall not be permitted.

3.1.8 Service Connections

Provide new water service complete with water meter, a pressure reducing valve if required and a backflow preventer. Use tapping or drilling machine valve and mechanical joint type sleeves for connections to be made under pressure. Bolt sleeves around mains; bolt valve conforming to AWWA C500 to the branch. Open valve, attach drilling machine, make tap, close valve, and remove drilling machine, without interruption of service. Notify the Contracting Officer in writing at least 15 days prior to the date the connections are required; receive approval before any service is interrupted. Provide materials required to make connections into the existing water supply systems and perform excavating, backfilling, and other incidental labor as required. Furnish the labor and the tapping or drilling machine for making the actual connections to the existing systems.

3.2 FIELD QUALITY CONTROL

3.2.1 Inspections

Prior to initial operation, inspect piping system for compliance with drawings, specifications, and manufacturer's submittals.

3.2.2 Field Testing

Before final acceptance of the work, test each system as in service to demonstrate compliance with the contract requirements. Perform the following tests in addition to the tests specified in the Plumbing Code, except as modified herein. Correct defects in the work provided by the Contractor, and repeat tests until work is in compliance with contract requirements. Furnish water, electricity, instruments, connecting devices, and personnel for performing tests.

3.2.2.1 Domestic Water Piping

Before applying insulation, hydrostatically test each piping system at not less than 100 psig system working pressure with no leakage or reduction in gage pressure for 2 hours.

3.2.2.2 DWV Piping

Before the installation of fixtures, cap ends of each system, fill piping with water to the roof, and allow to stand until a thorough inspection has been made. If the system is tested in sections, each opening shall be plugged and each section tested with not less than a 10 foot head or water. After plumbing fixtures have been set and their traps filled with water, subject the entire sanitary system to a final air pressure test of not more than 1.0 inch of water column and a smoke or peppermint test. The entire

system shall be proven absolutely tight under such test.

3.2.2.3 Backflow Preventers

Backflow preventers shall be tested by a locally approved and certified backflow assembly tester. A copy of the test report shall be provided to the Contracting Officer prior to placing the domestic water system into operation, or no later than 5 days after the test.

3.3 DISINFECTION

Disinfect new water piping and existing water piping affected by Contractor's operations in accordance with AWWA C651. Fill piping systems with solution containing minimum of 50 parts per million of available chlorine and allow solution to stand for minimum of 24 hours. Flush solution from the systems with domestic water until maximum residual chlorine content is within the range of 0.2 to 0.5 parts per million, or the residual chlorine content of domestic water supply. Obtain at least two consecutive satisfactory bacteriological samples from new water piping, analyze by a certified laboratory, and submit the results prior to the new water piping being placed into service. Disinfection of systems supplied by nonpotable water is not required.

-- End of Section --

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SECTION 15653

AIR-CONDITIONING SYSTEM (UNITARY TYPE)

09/93

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SECTION 15653

AIR-CONDITIONING SYSTEM (UNITARY TYPE)
09/93

PART 1 GENERAL

1.1 REFERENCES

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

AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI 210/240	(1994) Unitary Air-Conditioning and Air-Source Heat Pump Equipment
ARI 340/360	(1993) Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment
ARI 700	(1995; Apx C) Specifications for Fluorocarbon and Other Refrigerants

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 117	(1997) Operating Salt Spray (Fog) Apparatus
ASTM D 520	(1984; R 1995el) Zinc Dust Pigment

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 15	(1994) Safety Code for Mechanical Refrigeration

ASME INTERNATIONAL (ASME)

ASME B31.5	(1992; B31.5a1994) Refrigeration Piping
ASME BPV VIII Div 1	(1998) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage
ASME BPV IX	(1998) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications

HYDRAULIC INSTITUTE (HI)

HI 1.1-1.5	(1994) Centrifugal Pumps

UNDERWRITERS LABORATORIES (UL)

UL 1995	(1995; Rev thru Jul 98) Heating and Cooling Equipment

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Air-Conditioning; G.

Manufacturer's standard catalog data, prior to the purchase or installation of a particular component, shall be highlighted to show brand name, model number, size, options, performance charts and curves, etc. in sufficient detail to demonstrate compliance with contract requirements. Data shall be submitted for each specified component. Data shall include manufacturer's recommended installation instructions and procedures. If vibration isolation is specified for a unit, vibration isolator literature shall be included containing catalog cuts and certification that the isolation characteristics of the isolators provided meet the manufacturer's recommendations.

Spare Parts Data.

Spare parts data for each different item of equipment specified, after approval of detail drawings and not later than 2 months prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, a recommended spare parts list for 1 year of operation, and a list of the parts recommended by the manufacturer to be replaced on a routine basis.

SD-02 Shop Drawings

Air-Conditioning.

Drawings shall provide adequate detail to demonstrate compliance with contract requirements. Drawings shall consist of:

(1) Equipment layouts which identify assembly and installation details.

(2) Piping layouts which identify valves and fittings.

(3) Plans and elevations which identify clearances required for maintenance and operation.

(4) Wiring diagrams which identify each component individually and interconnected or interlocked relationships between components.

(5) Foundation drawings, bolt-setting information, and foundation bolts prior to concrete foundation construction for equipment indicated or required to have concrete foundations.

(6) Details, if piping and equipment are to be supported other than as indicated, which include loadings and type of frames, brackets, stanchions, or other supports.

(7) Automatic temperature control diagrams and control sequences.

(8) Installation details which includes the amount of factory set superheat and corresponding refrigerant pressure/temperature.

SD-08 Manufacturer's Instructions

Framed Instructions.

Framed instructions for posting, at least 2 weeks prior to construction completion.

SD-06 Test Reports

Tests.

A letter, at least 10 working days in advance of each tests, advising the Contracting Officer of the test. Individual letters shall be submitted for the refrigerant system and the system performance tests. Each letter shall identify the date, time, and location for each test.

Demonstrations; G.

A letter, at least 14 working days prior to the date of the proposed training course, which identifies the date, time, and location for the training.

Verification of Dimensions.

A letter, at least 2 weeks prior to beginning construction, including the date the site was visited, conformation of existing conditions, and any discrepancies found.

System Performance Tests.

Six copies of the report shall be provided in bound 8-1/2 x 11 inch booklets. The report shall document compliance with the specified performance criteria upon completion and testing of the system. The report shall indicate the number of days covered by the tests and any conclusions as to the adequacy of the system. The report shall also include the following information and shall be taken at least three different times at outside dry-bulb temperatures that are at least 5 degrees F apart:

(1) Date and outside weather conditions.

(2) The load on the system based on the following:

(a) The refrigerant used in the system.
(b) Condensing temperature and pressure.
(c) Suction temperature and pressure.
(d) Ambient, condensing and coolant temperatures
(e) Running current, voltage and proper phase sequence for each phase of all motors.

(3) The actual on-site setting of operating and safety controls.

(4) Thermostatic expansion valve superheat - value as determined by field test

(5) Subcooling

(6) High and low refrigerant temperature switch set-points

(7) Low oil pressure switch set-point

(8) Defrost system timer and thermostat set-points

(9) Moisture content

(10) Capacity control set-points

(11) Field data and adjustments which affect unit performance and energy consumption.

(12) Field adjustments and settings which were not permanently marked as an integral part of a device.

SD-13 Certificates

Air-Conditioning/Heat Pump System.

Where the system, components, or equipment are specified to comply with requirements of ARI, ASHRAE, ASME, or UL, proof of such compliance shall be provided. The label or listing of the specified agency shall be acceptable evidence. In lieu of the label or listing, a written certificate from an approved, nationally recognized testing organization equipped to perform such services, stating that the items have been tested and conform to the requirements and testing methods of the specified agency may be submitted. When performance requirements of this project's drawings and specifications vary from standard ARI rating conditions, computer printouts, catalog, or other application data certified by ARI or a nationally recognized laboratory as described above shall be included. If ARI does not have a current certification program that encompasses such application data, the manufacturer may self certify that his application data complies with project performance requirements in accordance with the specified test standards.

Service Organizations.

A certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. The service organizations shall be reasonably convenient to the equipment installation and be able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

SD-19 Operation and Maintenance Manuals

Operation Manual.

Six complete copies of an operation manual in bound 8-1/2 x 11 inch booklets listing step-by-step procedures required for system startup, operation, and shutdown. The booklets shall include the manufacturer's name, model number, and parts list. The manuals shall include the manufacturer's name, model number, service manual, and a brief description of all equipment and their basic operating features.

Maintenance Manual.

Six complete copies of maintenance manual in bound 8-1/2 x 11 inch booklets

listing routine maintenance procedures, possible breakdowns and repairs, and a trouble shooting guide. The manuals shall include piping and equipment layouts and simplified wiring and control diagrams of the system as installed.

1.3 DELIVERY, STORAGE, AND HANDLING

Stored items shall be protected from the weather and contamination. Proper protection and care of all material before, during, and after installation shall be the Contractor's responsibility. Any materials found to be damaged shall be replaced at the Contractor's expense. During installation, piping and similar openings shall be capped to keep out dirt and other foreign matter.

1.4 PROJECT/SITE CONDITIONS

1.4.1 Verification of Dimensions

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

1.4.2 Drawings

Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. The Contractor shall carefully investigate the plumbing, fire protection, electrical, structural and finish conditions that would affect the work to be performed and arrange such work accordingly, furnishing required offsets, fittings, and accessories to meet such conditions. Equipment, ductwork, and piping arrangements shall fit into space allotted and allow adequate acceptable clearances for installation, replacement, entry, servicing, and maintenance.

PART 2 PRODUCTS

2.1 STANDARD COMMERCIAL PRODUCTS

Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacturing of such products, which are of a similar material, design and workmanship. The standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2 year use shall include applications of equipment and materials under similar circumstances and of similar size. The 2 years experience shall be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturer's catalogs, or brochures. Products having less than a 2 year field service record shall be acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown. Products shall be supported by a service organization. System components shall be environmentally suitable for the indicated locations.

2.2 NAMEPLATES

Major equipment including compressors, condensers, receivers, fans, pumps and motors shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the item of equipment. Plates shall be durable and legible throughout equipment

life and made of anodized aluminum or stainless steel. Plates shall be fixed in prominent locations with nonferrous screws or bolts.

2.3 AIR-CONDITIONERS FOR ELECTRONIC DATA PROCESSING (EDP) SPACES

Unit shall be a split-system with a remote condenser. Unit shall be designed and constructed for automatic control of space conditions. Unit shall be in accordance with ASHRAE 127 and UL 1995. Unit shall be rated in accordance with ARI 210/240 or ARI 340/360. ARI certification is not required. The system shall be designed and constructed for maximum reliability and ease of maintenance. Necessary redundancy, access to refrigeration circuits, means of troubleshooting, and malfunction alarms shall be provided. Unit shall be provided with necessary fans, air filters, coil frost protection, liquid receiver, internal dampers, mixing boxes, supplemental heat, and cabinet construction as specified in paragraph "System Components". Evaporator or supply fans shall be double-width, double inlet, forward curved centrifugal scroll type. Condenser or outdoor fans shall be manufacturer's standard for unit specified and may be either propeller or centrifugal scroll type. Fan and condenser motors shall have open or dripproof enclosures.

2.3.1 Compressor

Compressor shall be direct drive, semi-hermetic or hermetic reciprocating, or scroll type capable of operating at partial load conditions. Compressor shall be capable of continuous operation down to the lowest step of unloading as specified. Compressors of 7-1/2 tons and larger shall be provided with capacity reduction devices to produce automatic capacity reduction of at least 50 percent. If standard with the manufacturer, two or more compressors may be used in lieu of a single compressor with unloading capabilities, in which case the compressors will operate in sequence, and each compressor shall have an independent refrigeration circuit through the condenser and evaporator. Each compressor shall start in the unloaded position. Each compressor shall be provided with vibration isolators, crankcase heater, thermal overloads, and high and low pressure safety cutoffs and protection against short cycling.

2.3.2 Refrigeration Circuit

Refrigerant-containing components shall comply with ASHRAE 15 and be factory tested, cleaned, dehydrated, charged, and sealed. Refrigerant charging valves and connections, and pumpdown valves shall be provided for each circuit. Filter-drier shall be provided in each liquid line and be reversible-flow type.

2.3.3 Unit Controls

A unit's basic functions and space ambient conditions shall be controllable at one station. A temperature and humidity strip-chart recorder, integral or external to the unit, readable to specified control accuracy, shall be provided, complete with cartridge ink and chart supply for 1 year of operation.

2.3.3.1 Externally Accessible Controls

The following controls shall be externally accessible:

a. Start and stop total system functions.

b. Audible alarm silence.

c. Main power disconnect.

2.3.3.2 Status Indicators

The following status indicators shall be externally visible:

a. Power On.

b. System On.

c. Malfunction.

d. Provision for remote alarm status indication.

2.3.3.3 Alarmed Conditions

The following system status conditions shall be both audibly and visually alarmed:

a. Loss of air flow.

b. Dirty filters.

c. Compressor overload or lock-out (compressor high head pressure and low suction pressure).

d. High and low room temperature.

2.3.3.4 Space Temperature

Space temperature shall be controlled within plus or minus 1-1/2 degrees F of the set point over a range of 60 to 90 degrees F.

2.3.3.5 Safety Controls

Safety controls shall include the following:

a. Fused, unfused or line-break circuit breaker disconnects, as indicated or required.

b. Automatic pump-out or pump-down liquid flooding controls.

c. High refrigerant pressure cutout.

d. Low refrigerant pressure cutout where automatic pump-down is not provided.

e. Accessible hermetic and open compressor low oil pressure cutout.

f. Elapsed time meter for each compressor where load equalization is not incorporated.

g. Lead and lag compressor selector switch, when compatible with system.

2.3.4 Cabinet Construction

Cabinet shall be totally enclosed. Enclosure surfaces shall be pulsation free, with hinged and removable doors and panels for vertical side or front access to unit components. Routine maintenance access to compressor and system control components shall be possible without unit shut-down. Enclosure surfaces shall be thermally and acoustically insulated. Interior baffle and compartment surfaces shall be galvanized steel. Drain pans shall collect all condensate and be steel with external insulation as required. Surface mounting steel pads and vibration isolating pads shall be provided. Enclosure surfaces shall be prepared, primed and finished. Paint and finishes shall comply with the requirements specified in paragraph "Factory Coating". Cabinets shall be fitted with integral or separable, adjustable and lockable jacks to support the units from the structural slab at the raised-floor elevation.

2.4 SYSTEM COMPONENTS

2.4.1 Refrigerant and Oil

Refrigerant shall be one of the fluorocarbon gases. Refrigerants shall have number designations and safety classifications in accordance with ASHRAE 34. Refrigerants shall meet the requirements of ARI 700 as a minimum. Refrigerants shall have an Ozone Depletion Potential (ODP) of less than or equal to 0.05. Contractor shall provide and install a complete charge of refrigerant for the installed system as recommended by the manufacturer. Except for factory sealed units, two complete charges of lubricating oil for each compressor crankcase shall be furnished. One charge shall be used during the system performance testing period. Following the satisfactory completion of the performance testing, the oil shall be drained and replaced with a second charge. Lubricating oil shall be of a type and grade recommended by the manufacturer for each compressor. Where color leak indicator dye is incorporated, charge shall be in accordance with manufacturer's recommendation.

2.5 PUMPS

Pumps shall be the electrically driven, non-overloading, centrifugal type which conform to HI 1.1-1.5. Pump capacity, efficiency, motor size, and impeller type shall be as indicated on the drawings. Pumps shall be selected at or near peak efficiency. Pump curve shall rise continuously from maximum capacity to shutoff. Shutoff head shall be approximately 20 percent greater than design head. Pump motor shall be totally enclosed and have sufficient horsepower for the service required. Each pump motor shall be equipped with an across-the-line magnetic controller in a NEMA 250, Type 1 enclosure with "START-STOP" switch in the cover.

2.6 FACTORY COATINGS

Unless otherwise specified, equipment and component items, when fabricated from ferrous metal, shall be factory finished with the manufacturer's standard finish, except that items located outside of buildings shall have weather resistant finishes that will withstand 125 hours exposure to the salt spray test specified in ASTM B 117 using a 25 percent sodium chloride solution. Immediately after completion of the test, the specimen shall show no signs of blistering, wrinkling, cracking, or loss of adhesion and no sign of rust creepage beyond 1/8 inch on either side of the scratch mark. Cut edges of galvanized surfaces where hot-dip galvanized sheet steel is used shall be coated with a zinc-rich coating conforming to ASTM D

520, Type I.

PART 3 EXECUTION

3.1 INSTALLATION

Work shall be performed in accordance with the manufacturer's published diagrams, recommendations, and equipment warranty requirements. Where equipment is specified to conform to the requirements of ASME BPV VIII Div 1 and ASME BPV IX, the design, fabrication, and installation of the system shall conform to ASME BPV VIII Div 1 and ASME BPV IX.

3.1.1 Equipment

Refrigeration equipment and the installation thereof shall conform to ASHRAE 15. Necessary supports shall be provided for all equipment, appurtenances, and pipe as required, including frames or supports for compressors, pumps, condensers, and similar items. Compressors shall be isolated from the building structure. If mechanical vibration isolators are not provided, vibration absorbing foundations shall be provided.

3.1.2 Refrigeration Piping

Unless otherwise specified, pipe and fittings installation shall conform to requirements of ASME B31.5. Pipe shall be cut accurately to measurement established at the jobsite and worked into place without springing or forcing. Cutting or otherwise weakening of the building structure to facilitate piping installation will not be permitted without written approval. Pipes shall be cut square, shall have burrs removed by reaming, and shall be installed in a manner to permit free expansion and contraction without damage to joints or hangers. Filings, dust, or dirt shall be wiped from interior of pipe before connections are made.

3.1.3 Piping Supports

Refrigerant pipe supports shall be in accordance with ASME B31.5. 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.

3.2 TESTS

Tests shall be conducted in the presence of the Contracting Officer. Utilities for testing shall be provided as specified in the SPECIAL CONTRACT REQUIREMENTS. Water and electricity required for the tests will be furnished by the Government. Any material, equipment, instruments, and personnel required for the test shall be provided by the Contractor. The services of a qualified technician shall be provided as required to perform all tests and procedures indicated herein.

3.2.1 System Performance Tests

After the foregoing tests have been completed and before each refrigeration system is accepted, tests to demonstrate the general operating characteristics of all equipment shall be conducted by a registered

professional engineer or an approved manufacturer's start-up representative experienced in system start-up and testing, at such times as directed. Tests shall cover a period of not less than 48 hours for each system and demonstrate that the entire system is functioning in accordance with the drawings and specifications. Corrections and adjustments shall be made as necessary and tests shall be re-conducted to demonstrate that the entire system is functioning as specified. Prior to acceptance, service valve seal caps and blanks over gauge points shall be installed and tightened. Any refrigerant lost during the system startup shall be replaced. If tests do not demonstrate satisfactory system performance, deficiencies shall be corrected and the system shall be retested.

3.3 INSPECTIONS

At the conclusion of the one year period, cooling towers and condensers shall be inspected for problems due to corrosion, scale, and biological growth. If the cooling tower and condenser are found not to conform to the manufacturers recommended conditions, assuming the water treatment company recommendations have been followed; the water treatment company shall provide all chemicals and labor for cleaning or repairing the equipment as required by the manufacturer's recommendations.

3.4 CLEANING AND ADJUSTING

3.4.1 Piping

Prior to testing, pipes shall be cleaned free of scale and thoroughly flushed of all foreign matter. A temporary bypass shall be provided for water coils to prevent flushing water from passing through coils. Strainers and valves shall be thoroughly cleaned. Prior to testing and balancing, air shall be removed from each water system through the use of the air vents. Temporary measures, such as piping the overflow from vents to a collecting vessel shall be taken to avoid water damage during the venting process. Air vents shall be plugged or capped after the system has been vented.

3.4.2 Ductwork

Prior to testing, inside of ducts, plenums, and casing shall be thoroughly cleaned of all debris and blown free of small particles of rubbish and dust and then vacuum cleaned before installing outlet faces. Temporary filters shall be provided for fans that are operated during construction. New filters shall be installed after all construction dirt has been removed from the building and the ducts, plenum, casings, and other items specified have been vacuum cleaned. Fans shall be adjusted to the speed indicated by the manufacturer to meet specified conditions.

3.4.3 Equipment

Equipment shall be wiped clean, with all traces of oil, dust, dirt, or paint spots removed. System shall be maintained in this clean condition until final acceptance. Bearings shall be lubricated with oil or grease as recommended by the manufacturer. Belts shall be tightened to proper tension. Control valves and other miscellaneous equipment requiring adjustment shall be adjusted to setting indicated or directed.

3.4.4 Testing, Adjusting, and Balancing

Testing, adjusting, and balancing shall be as specified in Section 15990

TESTING, ADJUSTING AND BALANCING OF HVAC SYSTEMS.

3.5 DEMONSTRATIONS

Contractor shall conduct a training course for the operating staff as designated by the Contracting Officer. The training period shall consist of a total 8 hours of normal working time and start after the system is functionally completed but prior to final acceptance tests. The field instructions shall cover all of the items contained in the approved operation and maintenance manuals as well as demonstrations of routine maintenance operations.

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SECTION 15895

AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM
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PART 1 GENERAL

1.1 REFERENCES

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

AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI 260	(2001) Sound Rating of Ducted Air Moving and Conditioning Equipment
ARI 410	(1991) Forced-Circulation Air-Cooling and Air-Heating Coils
ARI 430	(1999) Central-Station Air-Handling Units
ARI 880	(1998) Air Terminals
ARI Guideline D	(1996) Application and Installation of Central Station Air-Handling Units

AIR CONDITIONING CONTRACTORS OF AMERICA (ACCA)

ACCA Manual 4	(2001) Installation Techniques for Perimeter Heating & Cooling; 11th Edition

AIR MOVEMENT AND CONTROL ASSOCIATION (AMCA)

AMCA 210	(1999) Laboratory Methods of Testing Fans for Aerodynamic Performance Rating
AMCA 300	(1996) Reverberant Room Method for Sound Testing of Fans

AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABMA)

ABMA 9	(1990; R 2000) Load Ratings and Fatigue Life for Ball Bearings
ABMA 11	(1990; R 1999) Load Ratings and Fatigue Life for Roller Bearings

ASTM INTERNATIONAL (ASTM)

ASTM A 47/A 47M	(1999) Ferritic Malleable Iron Castings
ASTM A 53/A 53M	(2001) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 106	(1999el) Seamless Carbon Steel Pipe for High-Temperature Service

ASTM A 123/A 123M	(2001a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 167	(1999) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 181/A 181M	(2001) Carbon Steel Forgings, for General-Purpose Piping
ASTM A 183	(1998) Carbon Steel Track Bolts and Nuts
ASTM A 193/A 193M	(2001b) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 234/A 234M	(2001a) Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
ASTM A 536	(1984; R 1999el) Ductile Iron Castings
ASTM A 733	(2001) Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
ASTM A 924/A 924M	(1999) General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM B 62	(1993) Composition Bronze or Ounce Metal Castings
ASTM B 75	(1999) Seamless Copper Tube
ASTM B 88	(1999el) Seamless Copper Water Tube
ASTM B 88M	(1999) Seamless Copper Water Tube (Metric)
ASTM B 117	(1997) Operating Salt Spray (Fog) Apparatus
ASTM B 650	(1995) Electrodeposited Engineering Chromium Coatings on Ferrous Substrates
ASTM B 813	(2000) Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube
ASTM C 916	(1985; R 1996el) Adhesives for Duct Thermal Insulation
ASTM C 1071	(2000) Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material)
ASTM D 520	(2000) Zinc Dust Pigment
ASTM D 1384	(2001) Corrosion Test for Engine Coolants in Glassware

ASTM D 1654	(1992; R 2000) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D 1785	(1999) Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2000	(2001) Rubber Products in Automotive Applications
ASTM D 2466	(2001) Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2564	(1996a) Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D 2855	(1996) Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D 3359	(1997) Measuring Adhesion by Tape Test
ASTM E 84	(2001) Surface Burning Characteristics of Building Materials
ASTM E 437	(1992; R 1997) Industrial Wire Cloth and Screens (Square Opening Series)
ASTM F 1199	(1988; R 1998) Cast (All Temperatures and Pressures) and Welded Pipe Line Strainers (150 psig and 150 degrees F Maximum)
ASTM F 1200	(1988; R 1998) Fabricated (Welded) Pipe Line Strainers (Above 150 psig and 150 degrees F)

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 68	(1997) Laboratory Method of Testing to Determine the Sound Power in a Duct
ASHRAE 70	(1991) Method of Testing for Rating the Performance of Air Outlets and Inlets
ASHRAE 84	(1991) Method of Testing Air-to-Air Heat Exchangers

ASME INTERNATIONAL (ASME)

ASME B1.20.1	(1983; R 2001) Pipe Threads, General Purpose, Inch
ASME B16.3	(1998) Malleable Iron Threaded Fittings
ASME B16.5	(1996) Pipe Flanges and Flanged Fittings
ASME B16.9	(2001) Factory-Made Wrought Steel Buttwelding Fittings

ASME B16.11	(2001) Forged Fittings, Socket-Welding and Threaded
ASME B16.18	(2001) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.22	(1995) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.26	(1988) Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B16.39	(1998) Malleable Iron Threaded Pipe Unions
ASME B31.1	(2001) Power Piping
ASME B40.1	(1991) Gauges - Pressure Indicating Dial Type - Elastic Element

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C606	(1997) Grooved and Shouldered Joints

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2000) Structural Welding Code - Steel

EXPANSION JOINT MANUFACTURERS ASSOCIATION (EJMA)

EJMA Stds	(1998; 7th Edition; Addenda 2000) EJMA Standards

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
MSS SP-70	(1998) Cast Iron Gate Valves, Flanged and Threaded Ends
MSS SP-71	(1997) Gray Iron Swing Check Valves, Flanged and Threaded Ends
MSS SP-72	(1999) Ball Valves with Flanged or Butt-Welding Ends for General Service
MSS SP-80	(1997) Bronze Gate, Globe, Angle and Check Valves

MSS SP-85	(1994) Cast Iron Globe & Angle Valves, Flanged and Threaded Ends
MSS SP-110	(1996) Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(1998) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A	(1999) Installation of Air Conditioning and Ventilating Systems

NORTH AMERICAN INSULATION MANUFACTURERS ASSOCIATION (NAIMA)

NAIMA AH115	(2001) Fibrous Glass Duct Construction Standards

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA HVAC Duct Const Stds	(1995; Addenda Nov 1997; 6th Printing 2001) HVAC Duct Construction Standards - Metal and Flexible
SMACNA Industry Practice	(1975; 8th Printing 1997) Accepted Industry Practice for Industrial Duct Construction
SMACNA Install Fire Damp HVAC	(1992; 2th Printing 1996) Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems
SMACNA Leakage Test Mnl	(1985; 6th Printing 1997) HVAC Air Duct Leakage Test Manual

UNDERWRITERS LABORATORIES (UL)

UL 181	(1996; Rev thru Dec 1998) Factory-Made Air Ducts and Air Connectors
UL 555	(1999; Rev thru Jan 2002) Fire Dampers
UL 586	(1996; Rev thru Apr 2000) High-Efficiency, Particulate, Air Filter Units
UL 723	(1996; Rev thru Sep 2001) Test for Surface Burning Characteristics of Building Materials
UL 900	(1994; Rev thru Oct 1999) Air Filter Units
UL Elec Const Dir	(2001) Electrical Construction Equipment Directory

UL Fire Resist Dir (2001) Fire Resistance Directory (2 Vol.)

1.2 COORDINATION OF TRADES

Ductwork, piping offsets, fittings, and accessories shall be furnished as required to provide a complete installation and to eliminate interference with other construction.

1.3 DELIVERY AND STORAGE

Equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Additionally, all pipes shall either be capped or plugged until installed.

1.4 FIELD MEASUREMENTS

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

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Drawings; G
Installation; G

Drawings showing equipment layout, including assembly and installation details and electrical connection diagrams; ductwork layout showing the location of all supports and hangers, typical hanger details, gauge reinforcement, reinforcement spacing rigidity classification, and static pressure and seal classifications; and piping layout showing the location of all guides and anchors, the load imposed on each support or anchor, and typical support details. Drawings shall include any information required to demonstrate that the system has been coordinated and will properly function as a unit and shall show equipment relationship to other parts of the work, including clearances required for operation and maintenance.

SD-03 Product Data

Components and Equipment; G

Manufacturer's catalog data included with the detail drawings for the following items. The data shall be highlighted to show model, size, options, etc., that are intended for consideration. Data shall be adequate to demonstrate compliance with contract requirements for the following:

a. Piping Components

b. Ductwork Components

c. Air Systems Equipment

d. Air Handling Units

e. Energy Recovery Devices

f. Terminal Units

Test Procedures

Proposed test procedures for piping hydrostatic test, ductwork leak test, and performance tests of systems, at least 2 weeks prior to the start of related testing.

Welding Procedures

A copy of qualified welding procedures, at least 2 weeks prior to the start of welding operations.

Diagrams

Proposed diagrams, at least 2 weeks prior to start of related testing. System diagrams that show the layout of equipment, piping, and ductwork, and typed condensed operation manuals explaining preventative maintenance procedures, methods of checking the system for normal, safe operation, and procedures for safely starting and stopping the system shall be framed under glass or laminated plastic. After approval, these items shall be posted where directed.

Manufacturer's Exerience

Statement demonstrating successful completion of similar services on at least 5 projects of similar size and scope, at least 2 weeks prior to submittal of other items required by this section.

Welded Joints

A list of names and identification symbols of qualified welders and welding operators, at least 2 weeks prior to the start of welding operations.

Performance Tests

Proposed test schedules for hydrostatic test of piping, ductwork leak test, and performance tests, at least 2 weeks prior to the start of related testing.

Field Training

Proposed schedule for field training, at least 2 weeks prior to the start of related training.

SD-06 Test Reports

Performance Tests
Testing, Adjusting, and Balancing; G

Test reports for the piping hydrostatic test, ductwork leak test, and performance tests in booklet form, upon completion of testing. Reports shall document phases of tests performed including initial test summary, repairs/adjustments made, and final test results.

SD-07 Certificates

Bolts

Written certification from the bolt manufacturer that the bolts furnished comply with the requirements of this specification. The certification shall include illustrations of product markings, and the number of each type of bolt to be furnished.

SD-10 Operation and Maintenance Data

Operating and Maintenance Instructions

Six manuals listing step-by-step procedures required for system startup, operation, shutdown, and routine maintenance, at least 2 weeks prior to field training. The manuals shall include the manufacturer's name, model number, parts list, list of parts and tools that should be kept in stock by the owner for routine maintenance including the name of a local supplier, simplified wiring and controls diagrams, troubleshooting guide, and recommended service organization (including address and telephone number) for each item of equipment. Each service organization submitted shall be capable of providing 4 hour onsite response to a service call on an emergency basis.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Components and equipment shall be standard products of a manufacturer regularly engaged in the manufacturing of products that are of a similar material, design and workmanship. The standard products shall have been in satisfactory commercial or industrial use for 2 years before bid opening. The 2-year manufacturer's experience shall include applications of components and equipment under similar circumstances and of similar size. The 2 years must be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures. Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown. The equipment items shall be supported by a service organization.

2.2 ASBESTOS PROHIBITION

Asbestos and asbestos-containing products shall not be used.

2.3 NAMEPLATES

Equipment shall have a nameplate installed by the manufacturer that

identifies the manufacturer's name, address, type or style, model or serial number, and catalog number.

2.4 EQUIPMENT GUARDS AND ACCESS

Belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts exposed to personnel contact shall be fully enclosed or guarded according to OSHA requirements. High temperature equipment and piping exposed to contact by personnel or where it creates a potential fire hazard shall be properly guarded or covered with insulation of a type specified.

2.5 PIPING COMPONENTS

2.5.1 Steel Pipe

Steel pipe shall conform to ASTM A 53/A 53M, Schedule 40, Grade A or B, Type E or S.

2.5.2 Joints and Fittings For Steel Pipe

Joints shall be welded, flanged, threaded, or grooved as indicated. If not otherwise indicated, piping 1 inch and smaller shall be threaded; piping larger than 1 inch and smaller than 3 inches shall be either threaded, grooved, or welded; and piping 3 inches and larger shall be grooved, welded, or flanged. Rigid grooved mechanical joints and fittings may only be used in serviceable aboveground locations where the temperature of the circulating medium does not exceed 230 degrees F. Flexible grooved joints shall be used only as a flexible connector with grooved pipe system. Unless otherwise specified, grooved piping components shall meet the corresponding criteria specified for the similar welded, flanged, or threaded component specified herein. The manufacturer of each fitting shall be permanently identified on the body of the fitting according to MSS SP-25.

2.5.2.1 Welded Joints and Fittings

Welded fittings shall conform to ASTM A 234/A 234M, and shall be identified with the appropriate grade and marking symbol. Butt-welded fittings shall conform to ASME B16.9. Socket-welded fittings shall conform to ASME B16.11.

2.5.2.2 Flanged Joints and Fittings

Flanges shall conform to ASTM A 181/A 181M and ASME B16.5, Class 150. Gaskets shall be nonasbestos compressed material according to 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). Bolts, nuts, and bolt patterns shall conform to ASME B16.5. Bolts shall be high or intermediate strength material conforming to ASTM A 193/A 193M.

2.5.2.3 Threaded Joints and Fittings

Threads shall conform to ASME B1.20.1. Unions shall conform to ASME B16.39, Class 150. Nipples shall conform to ASTM A 733. Malleable iron fittings shall conform to ASME B16.3, type as required to match piping.

2.5.2.4 Dielectric Waterways

Dielectric waterways shall have temperature and pressure rating equal to or greater than that specified for the connecting piping. Waterways shall have metal connections on both ends suited to match connecting piping. Dielectric waterways shall be internally lined with an insulator specifically designed to prevent current flow between dissimilar metals. Dielectric flanges shall meet the performance requirements described herein for dielectric waterways.

2.5.2.5 Grooved Mechanical Joints and Fittings

Joints and fittings shall be designed for not less than 125 psig service and shall be the product of the same manufacturer. Fitting and coupling houses shall be malleable iron conforming to ASTM A 47/A 47M, Grade 32510; ductile iron conforming to ASTM A 536, Grade 65-45-12; or steel conforming to ASTM A 106, Grade B or ASTM A 53/A 53M. Gaskets shall be molded synthetic rubber with central cavity, pressure responsive configuration and shall conform to ASTM D 2000 Grade No. 2CA615A15B44F17Z for circulating medium up to 230 degrees F or Grade No. M3BA610A15B44Z for circulating medium up to 200 degrees F. Grooved joints shall conform to AWWA C606. Coupling nuts and bolts shall be steel and shall conform to ASTM A 183.

2.5.3 Copper Tube

Copper tube shall conform to ASTM B 88, and ASTM B 88M, Type K or L.

2.5.4 Joints and Fittings For Copper Tube

Wrought copper and bronze solder-joint pressure fittings shall conform to ASME B16.22 and ASTM B 75. Cast copper alloy solder-joint pressure fittings shall conform to ASME B16.18. Cast copper alloy fittings for flared copper tube shall conform to ASME B16.26 and ASTM B 62. Brass or bronze adapters for brazed tubing may be used for connecting tubing to flanges and to threaded ends of valves and equipment. Extracted brazed tee joints produced with an acceptable tool and installed as recommended by the manufacturer may be used. Grooved mechanical joints and fittings shall be designed for not less than 125 psig service and shall be the product of the same manufacturer. Grooved fitting and mechanical coupling housing shall be ductile iron conforming to ASTM A 536. Gaskets for use in grooved joints shall be molded synthetic polymer of pressure responsive design and shall conform to ASTM D 2000 for circulating medium up to 230 degrees F. Grooved joints shall conform to AWWA C606. Coupling nuts and bolts for use in grooved joints shall be steel and shall conform to ASTM A 183.

2.5.5 Valves

Valves shall be Class 125 and shall be suitable for the intended application. Valves shall meet the material, fabrication and operating requirements of ASME B31.1. Chain operators shall be provided for valves located 10 feet or higher above the floor. Valves in sizes larger than 1 inch and used on steel pipe systems, may be provided with rigid grooved mechanical joint ends. Such grooved end valves shall be subject to the same requirements as rigid grooved mechanical joints and fittings and, shall be provided by the same manufacturer as the grooved pipe joint and fitting system.

2.5.5.1 Gate Valves

Gate valves 2-1/2 inches and smaller shall conform to MSS SP-80 and shall

be bronze with rising stem and threaded, solder, or flanged ends. Gate valves 3 inches and larger shall conform to MSS SP-70 and shall be cast iron with bronze trim, outside screw and yoke, and flanged or threaded ends.

2.5.5.2 Globe Valves

Globe valves 2-1/2 inches and smaller shall conform to MSS SP-80, bronze, threaded, soldered, or flanged ends. Globe valves 3 inches and larger shall conform to MSS SP-85 and shall be cast iron with bronze trim and flanged, or threaded ends.

2.5.5.3 Check Valves

Check valves 2-1/2 inches and smaller shall conform to MSS SP-80 and shall be bronze with threaded, soldered, or flanged ends. Check valves 3 inches and larger shall conform to MSS SP-71 and shall be cast iron with bronze trim and flanged or threaded ends.

2.5.5.4 Angle Valves

Angle valves 2-1/2 inches and smaller shall conform to MSS SP-80 and shall be bronze with threaded, soldered, or flanged ends. Angle valves 3 inches and larger shall conform to MSS SP-85 and shall be cast iron with bronze trim and flanged, or threaded ends.

2.5.5.5 Ball Valves

Ball valves 1/2 inch and larger shall conform to MSS SP-72 or MSS SP-110, and shall be ductile iron or bronze with threaded, soldered, or flanged ends.

2.5.5.6 Butterfly Valves

Butterfly valves shall be 2 flange or lug wafer type, and shall be bubble-tight at 150 psig. Valve bodies shall be cast iron, malleable iron, or steel ASTM A 167, Type 404 or Type 316, corrosion resisting steel stems, bronze or corrosion resisting steel discs, and synthetic rubber seats shall be provided. Valves smaller than 8 inches shall have throttling handles with a minimum of seven locking positions. Valves 8 inches and larger shall have totally enclosed manual gear operators with adjustable balance return stops and position indicators. Valves in insulated lines shall have extended neck to accommodate insulation thickness.

2.5.5.7 Balancing Valves

Balancing valves 2 inches or smaller shall be bronze with NPT connections for black steel pipe and brazed connections for copper tubing. Valves 1 inch or larger may be all iron with threaded or flanged ends. The valves shall have a square head or similar device and an indicator arc and shall be designed for 250 degrees F. Iron valves shall be lubricated, nonlubricated, or tetrafluoroethylene resin-coated plug valves. In lieu of plug valves, ball valves may be used. Plug valves and ball valves 8 inches or larger shall be provided with manual gear operators with position indicators. In lieu of balancing valves specified, automatic flow control valves may be provided to maintain constant flow, and shall be designed to be sensitive to pressure differential across the valve to provide the required opening. Valves shall be selected for the flow required and provided with a permanent nameplate or tag carrying a permanent record of the factory-determined flow rate and flow control pressure levels. Valves

shall control the flow within 5 percent of the tag rating. Valves shall be suitable for the maximum operating pressure of 125 psig or 150 percent of the system operating pressure, whichever is the greater. Where the available system pressure is not adequate to provide the minimum pressure differential that still allows flow control, the system pump head capability shall be appropriately increased. Where flow readings are provided by remote or portable meters, valve bodies shall be provided with tapped openings and pipe extensions with shutoff valves outside of pipe insulation. The pipe extensions shall be provided with quick connecting hose fittings for a portable meter to measure the pressure differential across the automatic flow control valve. A portable meter furnished with accessory kit as recommended by the automatic valve manufacturer shall be provided. Automatic flow control valve specified may be substituted for venturi tubes or orifice plate flow measuring devices.

2.5.5.8 Air Vents

Manual air vents shall be brass or bronze valves or cocks suitable for pressure rating of piping system and furnished with threaded plugs or caps. Automatic air vents shall be float type, cast iron, stainless steel, or forged steel construction, suitable for pressure rating of piping system.

2.5.6 Strainers

Strainer shall be in accordance with ASTM F 1199 or ASTM F 1200, except as modified herein. Strainer shall be the cleanable, basket or "Y" type, the same size as the pipeline. The strainer bodies shall be fabricated of cast iron with bottoms drilled, and tapped. The bodies shall have arrows clearly cast on the sides indicating the direction of flow. Each strainer shall be equipped with removable cover and sediment screen. The screen shall be made of minimum 22 gauge brass sheet, monel, corrosion-resistant steel, with small perforations numbering not less than 400 per square inch to provide a net free area through the basket of at least 3.3 times that of the entering pipe. The flow shall be into the screen and out through the perforations.

2.5.7 Glycol

The glycol shall be tested according to ASTM D 1384 and shall cause less than 0.5 mils penetration per year for all system metals. The glycol shall contain corrosion inhibitors. Silicon based inhibitors shall not be used. The solution shall be compatible with all wetted items within the system.

2.5.8 Backflow Preventers

Backflow preventers shall be according to Section 15400A PLUMBING, GENERAL PURPOSE.

2.5.9 Flexible Pipe Connectors

Flexible pipe connectors shall be designed for 125 psi or 150 psi service as appropriate for the static head plus the system head, and 230 degrees F for grooved end flexible connectors. The flexible section shall be constructed of rubber, tetrafluoroethylene resin, or corrosion-resisting steel, bronze, monel, or galvanized steel. The flexible section shall be suitable for intended service with end connections to match adjacent piping. Flanged assemblies shall be equipped with limit bolts to restrict maximum travel to the manufacturer's standard limits. Unless otherwise indicated, the length of the flexible connectors shall be as recommended by

the manufacturer for the service intended. Internal sleeves or liners, compatible with circulating medium, shall be provided when recommended by the manufacturer. Covers to protect the bellows shall be provided where indicated.

2.5.10 Pressure Gauges

Gauges shall conform to ASME B40.1 and shall be provided with throttling type needle valve or a pulsation dampener and shut-off valve. Gauge shall be a minimum of 3-1/2 inches in diameter and shall have a range from 0 psig to approximately 1.5 times the maximum system working pressure.

2.5.11 Thermometers

Thermometers shall have brass, malleable iron, or aluminum alloy case and frame, clear protective face, permanently stabilized glass tube with indicating-fluid column, white face, black numbers, and a 9 inch scale, and shall have rigid stems with straight, angular, or inclined pattern.

2.5.12 Escutcheons

Escutcheons shall be chromium-plated iron or chromium-plated brass, either one piece or split pattern, held in place by internal spring tension or setscrews.

2.5.13 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69.

2.5.14 Expansion Joints

2.5.14.1 Slip Joints

Expansion joints shall provide for either single or double slip of the connected pipes, as required or indicated, and for not less than the traverse indicated. The joints shall be designed for working temperature and pressure suitable for the application, but not less than 150 psig, and shall be according to applicable requirements of EJMA Stds and ASME B31.1. End connections shall be flanged or beveled for welding as indicated. Joint shall be provided with an anchor base where required or indicated. Where adjoining pipe is carbon steel, the sliding slip shall be seamless steel plated with a minimum of 2 mils of hard chrome according to ASTM B 650. All joint components shall be suitable for the intended service. Initial setting shall be made according to the manufacturer's recommendations to compensate for ambient temperature at time of installation. Pipe alignment guides shall be installed as recommended by the joint manufacturer, but in any case shall be not more than 4 inches or smaller, guides shall be installed not more than 2 feet from the joint. Service outlets shall be provided where indicated.

2.5.14.2 Flexible Ball Joints

Flexible ball joints shall conform to EJMA Stds and ASME B31.1 and be constructed of alloys as appropriate for the service intended. Where so indicated, the ball joint shall be designed for packing injection under full line pressure to contain leakage. The joint ends shall be threaded to 2 inches only, grooved, flanged, or beveled for welding as indicated or required and shall be capable of absorbing a minimum of 15-degree angular flex and 360 degree rotation. Balls and sockets shall be suitable for the

intended service. The exterior spherical surface of carbon steel balls shall be plated with mils of hard chrome according to ASTM B 650. The ball type joints shall be designed and constructed according to EJMA Stds and ASME B31.1 where applicable. Where required, flanges shall conform to ASME B16.5.

2.5.14.3 Bellows Type Joints

Bellows type joints shall be flexible, guided expansion joints. The expansion element shall be stabilized corrosion resistant steel. Bellows type expansion joints shall conform to the applicable requirements of EJMA Stds with internal sleeves. Guiding of piping on both sides of expansion joint shall be according to the published recommendations of the manufacturer of the expansion joint. The joints shall be designed for the working temperature and pressure suitable for the application but not less than 150 psig.

2.5.15 Insulation

Shop and field applied insulation shall be as specified in Section 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.5.16 Condensate Drain Lines

Condensate drainage shall be provided for each item of equipment that generates condensate as specified for drain, waste, and vent piping systems in Section 15400A PLUMBING, GENERAL PURPOSE.

2.6 ELECTRICAL WORK

Electrical motor-driven equipment specified shall be provided complete with motor, motor starter, and controls. Electrical characteristics and enclosure type shall be as shown. Unless otherwise indicated, motors of 1 hp and above shall be high efficiency type. Motor starters shall be provided complete with thermal overload protection and other appurtenances necessary. Each motor shall be according to NEMA MG 1 and shall be of sufficient size to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor. Manual or automatic control and protective or signal devices required for the operation specified, and any control wiring required for controls and devices, but not shown, shall be provided. Where two-speed or variable-speed motors are indicated, solid-state variable-speed controller may be provided to accomplish the same function. Solid-state variable-speed controllers shall be utilized for motors rated 10 hp or less. Adjustable frequency drives shall be used for larger motors.

2.7 Omitted

2.8 DUCTWORK COMPONENTS

2.8.1 Metal Ductwork

All aspects of metal ductwork construction, including all fittings and components, shall comply with SMACNA HVAC Duct Const Stds, hot dipped galvanized unless otherwise specified. Elbows shall be radius type with a centerline radius of 1.5 times the width or diameter of the duct where space permits. Otherwise, elbows having a minimum radius equal to the width or diameter of the duct or square elbows with factory fabricated turning vanes may be used. Static pressure 1/2, 1, and 2 inch w.g.

ductwork shall meet the requirements of Seal Class C. 3 through 10 inch w. g. shall meet the requirements of Seal Class A. All ductwork in VAV systems upstream of the VAV boxes shall meet the requirements of Seal Class A. Sealants shall conform to fire hazard classification specified in Section 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS and shall be suitable for the range of air distribution and ambient temperatures that it will be exposed to. Pressure sensitive tape shall not be used as a sealant. Spiral lock seam duct, and flat oval shall be made with duct sealant and locked with not less than 3 equally spaced drive screws or other approved methods indicated in SMACNA HVAC Duct Const Stds. The sealant shall be applied to the exposed male part of the fitting collar so that the sealer will be on the inside of the joint and fully protected by the metal of the duct fitting. One brush coat of the sealant shall be applied over the outside of the joint to at least 2 inch band width covering all screw heads and joint gap. Dents in the male portion of the slip fitting collar will not be acceptable. Outdoor air intake ducts and plenums shall be fabricated with watertight soldered or brazed joints and seams.

2.8.2 Fibrous Glass Ductwork

Fibrous glass ductwork may be provided in lieu of sheet metal ductwork except that fibrous glass ductwork will not be allowed in fan and equipment rooms, where subject to traffic or weather damage, for outside air intakes, for risers of more than two stories, in kitchen or fume exhaust ducts, to convey solids or corrosive gases, in concrete, for burial below grade, as casings or housings, or in systems used for life support systems. Fibrous glass ductwork, including all components, shall be fabricated according to NAIMA AH115 where the velocity and the static pressure are within its scope. Where the velocity or static pressure exceeds these limits, the ductwork manufacturer shall certify that the ductwork is intended for the velocities and pressures to be encountered, and that the proposed installation meets all performance criteria specified herein for metal ductwork. Fibrous glass ductwork shall have the thermal equivalent of the insulation specified for metal ductwork in Section 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS. Field or factory fabricated fibrous glass ductwork shall conform to UL 181, Class 1. Duct wall penetrations, transverse joints and longitudinal seams shall be sealed as instructed by the manufacturer by one of the methods prescribed by NAIMA AH115, where applicable, except that pressure sensitive tape shall not be used as a sealant. All items necessary for a complete installation shall be provided as specified for sheet metal duct systems.

2.8.3 Ductwork Accessories

2.8.3.1 Duct Access Doors

Access doors shall be provided in ductwork and plenums where indicated and at all air flow measuring primaries, automatic dampers, fire dampers, coils, thermostats, and other apparatus requiring service and inspection in the duct system, and unless otherwise shown, shall conform to SMACNA HVAC Duct Const Stds. Access doors shall be provided upstream and downstream of air flow measuring primaries and heating and cooling coils. Doors shall be minimum 15 x 18 inches, unless otherwise shown. Where duct size will not accommodate this size door, the doors shall be made as large as practicable. Doors 24 x 24 inches or larger shall be provided with fasteners operable from both sides. Doors in insulated ducts shall be the insulated type.

2.8.3.2 Fire Dampers

Fire dampers shall be 1.5 hour fire rated unless otherwise indicated. Fire dampers shall conform to the requirements of NFPA 90A and UL 555. The Contractor shall perform the fire damper test as outlined in NFPA 90A. A pressure relief damper shall be provided upstream of the fire damper. If the ductwork connected to the fire damper is to be insulated then this pressure relief damper shall be factory insulated. Fire dampers shall be automatic operating type and shall have a dynamic rating suitable for the maximum air velocity and pressure differential to which it will be subjected. Fire dampers shall be approved for the specific application, and shall be installed according to their listing. Fire dampers shall be equipped with a steel sleeve or adequately sized frame installed in such a manner that disruption of the attached ductwork, if any, will not impair the operation of the damper. Sleeves or frames shall be equipped with perimeter mounting angles attached on both sides of the wall or floor opening. Ductwork in fire-rated floor-ceiling or roof-ceiling assembly systems with air ducts that pierce the ceiling of the assemblies shall be constructed in conformance with UL Fire Resist Dir. Dampers shall not reduce the duct or the air transfer opening cross-sectional area. Dampers shall be installed so that the centerline of the damper depth or thickness is located in the centerline of the wall, partition or floor slab depth or thickness. Unless otherwise indicated, the installation details given in SMACNA Install Fire Damp HVAC and in manufacturer's instructions for fire dampers shall be followed. Acceptance testing of fire dampers shall be performed per paragraph Fire Damper Acceptance Test and NFPA 90A.

2.8.3.3 Splitters and Manual Balancing Dampers

Splitters and manual balancing dampers shall be furnished with accessible operating mechanisms. Where operators occur in finished portions of the building, operators shall be chromium plated with all exposed edges rounded. Splitters shall be operated by quadrant operators or 3/16 inch rod brought through the side of the duct with locking setscrew and bushing. Two rods are required on splitters over 8 inches. Manual volume control dampers shall be operated by locking-type quadrant operators. Dampers and splitters shall be 2 gauges heavier than the duct in which installed. Unless otherwise indicated, multileaf dampers shall be opposed blade type with maximum blade width of 12 inches. Access doors or panels shall be provided for all concealed damper operators and locking setscrews. Unless otherwise indicated, the locking-type quadrant operators for dampers, when installed on ducts to be thermally insulated, shall be provided with stand-off mounting brackets, bases, or adapters to provide clearance between the duct surface and the operator not less than the thickness of the insulation. Stand-off mounting items shall be integral with the operator or standard accessory of the damper manufacturer. Volume dampers shall be provided where indicated.

2.8.3.4 Air Deflectors and Branch Connections

Air deflectors shall be provided at duct mounted supply outlets, at takeoff or extension collars to supply outlets, at duct branch takeoff connections, and at 90 degree elbows, as well as at locations as indicated on the drawings or otherwise specified. Conical branch connections or 45 degree entry connections may be used in lieu of deflectors or extractors for branch connections. All air deflectors, except those installed in 90 degree elbows, shall be provided with an approved means of adjustment. Adjustment shall be made from easily accessible means inside the duct or from an adjustment with sturdy lock on the face of the duct. When

installed on ducts to be thermally insulated, external adjustments shall be provided with stand-off mounting brackets, integral with the adjustment device, to provide clearance between the duct surface and the adjustment device not less than the thickness of the thermal insulation. Air deflectors shall be factory-fabricated units consisting of curved turning vanes or louver blades designed to provide uniform air distribution and change of direction with minimum turbulence or pressure loss. Air deflectors shall be factory or field assembled. Blade air deflectors, also called blade air extractors, shall be approved factory fabricated units consisting of equalizing grid and adjustable blade and lock. Adjustment shall be easily made from the face of the diffuser or by position adjustment and lock external to the duct. Stand-off brackets shall be provided on insulated ducts and are described herein. Fixed air deflectors, also called turning vanes, shall be provided in 90 degree elbows.

2.8.4 Duct Sleeves, Framed Prepared Openings, Closure Collars

2.8.4.1 Duct Sleeves

Duct sleeves shall be provided for round ducts 15 inches in diameter or less passing through floors, walls, ceilings, or roof, and installed during construction of the floor, wall, ceiling, or roof. Round ducts larger than 15 inches in diameter and square, rectangular, and oval ducts passing through floors, walls, ceilings, or roof shall be installed through framed prepared openings. The Contractor shall be responsible for the proper size and location of sleeves and prepared openings. Sleeves and framed openings are also required where grilles, registers, and diffusers are installed at the openings. Framed prepared openings shall be fabricated from 20 gauge galvanized steel, unless otherwise indicated. Where sleeves are installed in bearing walls or partitions, black steel pipe, ASTM A 53/A 53M, Schedule 20 shall be used. Sleeve shall provide 1 inch clearance between the duct and the sleeve or 1 inch clearance between the insulation and the sleeve for insulated ducts.

2.8.4.2 Framed Prepared Openings

Openings shall have 1 inch clearance between the duct and the opening or 1 inch clearance between the insulation and the opening for insulated ducts.

2.8.4.3 Closure Collars

Collars shall be fabricated of galvanized sheet metal not less than 4 inches wide, unless otherwise indicated, and shall be installed on exposed ducts on each side of walls or floors where sleeves or prepared openings are provided. Collars shall be installed tight against surfaces. Collars shall fit snugly around the duct or insulation. Sharp edges of the collar around insulated duct shall be ground smooth to preclude tearing or puncturing the insulation covering or vapor barrier. Collars for round ducts 15 inches in diameter or less shall be fabricated from 20 gauge galvanized steel. Collars for round ducts larger than 15 inches and square, and rectangular ducts shall be fabricated from 18 gauge galvanized steel. Collars shall be installed with fasteners on maximum 6 inch centers, except that not less than 4 fasteners shall be used.

2.8.5 Plenums and Casings for Field-Fabricated Units

2.8.5.1 Plenum and Casings

Plenums and casings shall be fabricated and erected as shown in SMACNA HVAC Duct Const Stds, as applicable. Unless otherwise indicated, system casing shall be constructed of not less than 16 gauge galvanized sheet steel. Cooling coil drain pans with 1 inch threaded outlet shall be provided to collect condensation from the cooling coils. Drain pans shall be fabricated of not lighter than 16 gauge steel, galvanized after fabrication or of 18 gauge corrosion-resisting sheet steel conforming to ASTM A 167, Type 304, welded and stiffened. Drain pans exposed to the atmosphere shall be thermally insulated to prevent condensation. Insulation shall be coated with a flame resistant waterproofing material. Separate drain pans shall be provided for each vertical coil section, and a separate drain line shall be provided for each pan. Pans shall be generously sized to ensure capture of entrained moisture on the downstream-air side of the coil. Openings in the casing, such as for piping connections, shall be sealed and covered to prevent air leakage. Water seal for the drain shall provide at least 2 inch water gauge greater than the maximum negative pressure in the coil space.

2.8.5.2 Casing

Casings shall be terminated at the curb line and anchored by the use of galvanized angle iron sealed and bolted to the curb, as indicated in SMACNA HVAC Duct Const Stds.

2.8.5.3 Access Doors

Access doors shall be provided in each section of the casing. Door frames shall be welded in place, and each door shall be neoprene gasketed, hinged with minimum of two brass hinges, and fastened with a minimum of two brass tension fasteners operable from inside and outside of the casing. Where possible, doors shall be 36 x 18 inches located 18 inches above the floor. Where the space available will not accommodate doors of this size, doors as large as the space will accommodate shall be provided. Doors shall swing so that fan suction or pressure holds door in closed position, and shall be airtight. A push-button station to stop the supply fan shall be located inside the casing where indicated.

2.8.5.4 Factory-Fabricated Insulated Sheet Metal Panels

Factory-fabricated components may be used for field-assembled units, provided all requirements specified for field-fabricated plenums and casings are met. Panels shall be of modular design, pretested for structural strength, thermal control, condensation control, and acoustical control. Panel joints shall be sealed and insulated access doors shall be provided and gasketed to prevent air leakage. Panel construction shall be not less than 20 gauge galvanized sheet steel and shall be assembled with fasteners treated against corrosion. Standard length panels shall deflect not more than 1/2 inch under operation. Details of construction, including joint sealing, not specifically covered shall be as indicated in SMACNA HVAC Duct Const Stds. The plenums and casings shall be constructed to withstand the specified internal pressure of the air systems.

2.8.5.5 Duct Liner

Unless otherwise specified, duct liner shall conform to ASTM C 1071, Type I

or II.

2.8.6 Sound Attenuation Equipment

a. Systems With Total Pressure Above 4 Inches Water Gauge:

Sound attenuators shall be provided on the discharge duct of each fan operating at a total pressure above 4 inch water gauge, and, when indicated, at the intake of each fan system. Sound attenuators shall be provided elsewhere as indicated. The sound attenuators shall be factory fabricated and shall be tested by an independent laboratory for sound and performance characteristics. Net sound reduction shall be as indicated. Maximum permissible pressure drop shall not exceed 0.63 inch water gauge. Traps shall be constructed to be airtight when operating under an internal static pressure of 10 inch water gauge. Air-side surface shall be capable of withstanding air velocity of 10,000 fpm. The Contractor shall certify that the sound reduction values specified will be obtained after the equipment is installed in the system and coordinated with the sound information of the system fan to be provided. Sound absorbing material shall conform to ASTM C 1071, Type I or II. Sound absorbing material shall meet the fire hazard rating requirements for insulation specified in Section 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS. A duct transition section shall be provided for connection to ductwork. Factory fabricated double-walled internally insulated spiral lock seam and round duct and fittings designed for high pressure air system may be provided in lieu of factory fabricated sound attenuators, and shall comply with requirements specified for factory fabricated sound attenuators. The double-walled duct and fittings shall be constructed of an outer metal pressure shell of zinc-coated steel sheet, 1 inch thick acoustical blanket insulation, and an internal perforated zinc-coated metal liner. Sufficient length of run shall be provided to obtain the noise reduction coefficient specified. The Contractor shall certify that the sound reduction value specified will be obtained within the length of duct run provided. The outer sheet metal of the double-walled duct shall have welded, or spiral lock, seams to prevent water vapor penetration. The outer sheet of the duct and fittings shall conform to the metal thickness of high pressure spiral and round ducts and fittings shown in SMACNA HVAC Duct Const Stds. The acoustical insulation shall have a thermal conductivity "k" of not more than 0.27 Btu/inch/square foot/hour/degree F at 75 degrees F mean temperature. The internal perforated zinc-coated metal liner shall be not less than 24 gauge with perforations not larger than 1/4 inch in diameter providing a net open area not less than 10 percent of the surface.

b. System With Total Pressure of 4 Inch Water Gauge and Lower:

Sound attenuators shall be provided only where indicated, or in lieu of lined ducts. Factory fabricated sound attenuators shall be constructed of galvanized steel sheets. Outer casing shall be not less than 22 gauge. Acoustical fill shall be fibrous glass. Net sound reduction shall be as indicated. Values shall be obtained on a test unit not less than 24 by 24 inches outside dimensions made by a certified nationally recognized independent acoustical laboratory. Air flow capacity shall be as indicated or required. Pressure drop through the attenuator shall not exceed the value indicated, or shall not be in excess of 15 percent of the total external static pressure of the air handling system, whichever is less. Sound attenuators shall be acoustically tested with metal duct inlet and outlet sections while under the rated air flow conditions. Noise reduction data shall include the effects of flanking paths and vibration transmission. Sound attenuators shall be constructed to be airtight when

operating at the internal static pressure indicated or specified for the duct system, but in no case less than 2 inch water gauge.

c. Acoustical Duct Liner:

Acoustical duct lining shall be fibrous glass designed exclusively for lining ductwork and shall conform to the requirements of ASTM C 1071, Type I and II. Liner composition may be uniform density, graduated density, or dual density, as standard with the manufacturer. Lining shall be coated, not less than 1 inch thick. Where acoustical duct liner is used, liner or combination of liner and insulation applied to the exterior of the ductwork shall be the thermal equivalent of the insulation specified in Section 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS. Duct sizes shown shall be increased to compensate for the thickness of the lining used. In lieu of sheet metal duct with field-applied acoustical lining, acoustically equivalent lengths of fibrous glass duct or factory fabricated double-walled internally insulated duct with perforated liner may be provided. Net insertion loss value, static pressure drop, and air flow velocity capacity data shall be certified by a nationally recognized independent acoustical laboratory.

2.8.7 Diffusers, Registers, and Grilles

Units shall be factory-fabricated of steel, corrosion-resistant steel, or aluminum and shall distribute the specified quantity of air evenly over space intended without causing noticeable drafts, air movement faster than 50 fpm in occupied zone, or dead spots anywhere in the conditioned area. Outlets for diffusion, spread, throw, and noise level shall be as required for specified performance. Performance shall be certified according to ASHRAE 70. Inlets and outlets shall be sound rated and certified according to ASHRAE 70. Sound power level shall be as indicated. Diffusers and registers shall be provided with volume damper with accessible operator, unless otherwise indicated; or if standard with the manufacturer, an automatically controlled device will be acceptable. Volume dampers shall be opposed blade type for all diffusers and registers, except linear slot diffusers. Linear slot diffusers shall be provided with round or elliptical balancing dampers. Where the inlet and outlet openings are located less than 7 feet above the floor, they shall be protected by a grille or screen according to NFPA 90A.

2.8.7.1 Diffusers

Diffuser types shall be as indicated. Ceiling mounted units shall be furnished with anti-smudge devices, unless the diffuser unit minimizes ceiling smudging through design features. Diffusers shall be provided with air deflectors of the type indicated. Air handling troffers or combination light and ceiling diffusers shall conform to the requirements of UL Elec Const Dir for the interchangeable use as cooled or heated air supply diffusers or return air units. Ceiling mounted units shall be installed with rims tight against ceiling. Sponge rubber gaskets shall be provided between ceiling and surface mounted diffusers for air leakage control. Suitable trim shall be provided for flush mounted diffusers. Duct collar connecting the duct to diffuser shall be airtight and shall not interfere with volume controller. Return or exhaust units shall be similar to supply diffusers.

2.8.7.2 Registers and Grilles

Units shall be four-way directional-control type, except that return and

exhaust registers may be fixed horizontal or vertical louver type similar in appearance to the supply register face. Registers shall be provided with sponge-rubber gasket between flanges and wall or ceiling. Wall supply registers shall be installed at least 6 inches below the ceiling unless otherwise indicated. Return and exhaust registers shall be located 6 inches above the floor unless otherwise indicated. Four-way directional control may be achieved by a grille face which can be rotated in 4 positions or by adjustment of horizontal and vertical vanes. Grilles shall be as specified for registers, without volume control damper.

2.8.8 Louvers

Louvers for installation in exterior walls which are associated with the air supply and distribution system shall be as specified in Section 07600A SHEET METALWORK, GENERAL.

2.8.9 Air Vents, Penthouses, and Goosenecks

Air vents, penthouses, and goosenecks shall be fabricated from galvanized steel or aluminum sheets with galvanized ~~(~~or aluminum~~)~~ structural shapes. Sheet metal thickness, reinforcement, and fabrication shall conform to SMACNA HVAC Duct Const Stds. Louver blades shall be accurately fitted and secured to frames. Edges of louver blades shall be folded or beaded for rigidity and baffled to exclude driving rain. Air vents, penthouses, and goosenecks shall be provided with bird screen.

2.8.10 Bird Screens and Frames

Bird screens shall conform to ASTM E 437, No. 2 mesh, aluminum or stainless steel. Aluminum screens shall be rated "medium-light". Stainless steel screens shall be rated "light". Frames shall be removable type, or stainless steel or extruded aluminum.

2.8.11 Radon Exhaust Ductwork

Radon exhaust ductwork installed in or beneath slabs shall be fabricated from Schedule 40 PVC pipe that conforms to ASTM D 1785. Fittings shall conform to ASTM D 2466. Solvent cement used to make joints shall conform to ASTM D 2564. Otherwise radon exhaust ductwork shall be metal as specified herein.

2.9 AIR SYSTEMS EQUIPMENT

2.9.1 Fans

Fans shall be tested and rated according to AMCA 210. Fans may be connected to the motors either directly or indirectly with V-belt drive. V-belt drives shall be designed for not less than 150 percent of the connected driving capacity. Motor sheaves shall be variable pitch for 15 hp and below and fixed pitch as defined by ARI Guideline D. Variable pitch sheaves shall be selected to drive the fan at a speed which will produce the specified capacity when set at the approximate midpoint of the sheave adjustment. When fixed pitch sheaves are furnished, a replaceable sheave shall be provided when needed to achieve system air balance. Motors for V-belt drives shall be provided with adjustable rails or bases. Removable metal guards shall be provided for all exposed V-belt drives, and speed-test openings shall be provided at the center of all rotating shafts. Fans shall be provided with personnel screens or guards on both suction and supply ends, except that the screens need not be provided, unless

otherwise indicated, where ducts are connected to the fan. Fan and motor assemblies shall be provided with vibration-isolation supports or mountings as indicated. Vibration-isolation units shall be standard products with published loading ratings. Each fan shall be selected to produce the capacity required at the fan static pressure indicated. Sound power level shall be as indicated. The sound power level values shall be obtained according to AMCA 300. Standard AMCA arrangement, rotation, and discharge shall be as indicated.

2.9.1.1 Centrifugal Fans

Centrifugal fans shall be fully enclosed, single-width single-inlet, or double-width double-inlet, AMCA Pressure Class I, II, or III as required or indicated for the design system pressure. Impeller wheels shall be rigidly constructed, accurately balanced both statically and dynamically. Fan wheels over 36 inches in diameter shall have overhung pulleys and a bearing on each side of the wheel. Fan wheels 36 inches or less in diameter may have one or more extra long bearings between the fan wheel and the drive. Bearings shall be sleeve type, self-aligning and self-oiling with oil reservoirs, or precision self-aligning roller or ball-type with accessible grease fittings or permanently lubricated type. Grease fittings shall be connected to tubing and serviceable from a single accessible point. Bearing life shall be L50 rated at not less than 200,000 hours as defined by ABMA 9 and ABMA 11. Fan shafts shall be steel, accurately finished, and shall be provided with key seats and keys for impeller hubs and fan pulleys. Each fan outlet shall be of ample proportions and shall be designed for the attachment of angles and bolts for attaching flexible connections. Motors, unless otherwise indicated, shall not exceed 1800 rpm.

2.9.1.2 In-Line Centrifugal Fans

In-line fans shall have centrifugal backward inclined blades, stationary discharge conversion vanes, internal and external belt guards, and adjustable motor mounts. Fans shall be mounted in a welded tubular casing. Air shall enter and leave the fan axially. Inlets shall be streamlined with conversion vanes to eliminate turbulence and provide smooth discharge air flow. Fan bearings and drive shafts shall be enclosed and isolated from the air stream. Fan bearings shall be sealed against dust and dirt and shall be permanently lubricated, and shall be precision self aligning ball or roller type. Bearing life shall be L50 rated at not less than 200,000 hours as defined by ABMA 9 and ABMA 11.

2.9.1.3 Axial Flow Fans

Axial flow fans shall be complete with drive components and belt guard, and shall have a steel housing, cast fan wheel, cast or welded steel diffusers, fan shaft, bearings, and mounting frame as a factory-assembled unit. Fan wheels shall have radially projecting blades of airfoil cross section and shall be dynamically balanced and keyed to the fan shaft. Fan bearings and drive shafts shall be enclosed and isolated from the air stream. Fan bearings shall be sealed against dust and dirt, shall be permanently lubricated or with accessible grease fittings, and shall be precision self-aligning ball or roller type. Bearing life shall be L50 rated at not less than 200,000 hours of operation as defined by ABMA 9 and ABMA 11. Fan inlets shall be provided with an aerodynamically shaped bell and an inlet cone. Diffuser or straightening vanes shall be provided at the fan discharge to minimize turbulence and provide smooth discharge air flow.

2.9.1.4 Panel Type Power Wall Ventilators

Fans shall be propeller type, assembled on a reinforced metal panel with venturi opening spun into panel. Fans with wheels less than 24 inches in diameter shall be direct or V-belt driven and fans with wheels 24 inches diameter and larger shall be V-belt drive type. Fans shall be furnished with wall mounting collar. Lubricated bearings shall be provided. Fans shall be fitted with wheel and motor side metal or wire guards which have a corrosion-resistant finish.

2.9.1.5 Centrifugal Type Power Wall Ventilators

Fans shall be direct or V-belt driven centrifugal type with backward inclined, non-overloading wheel. Motor housing shall be removable and weatherproof. Unit housing shall be designed for sealing to building surface and for discharge and condensate drippage away from building surface. Housing shall be constructed of heavy gauge aluminum. Unit shall be fitted with an aluminum or plated steel wire discharge bird screen, wall grille, manufacturer's standard damper, an airtight and liquid-tight metallic wall sleeve.

2.9.1.6 Centrifugal Type Power Roof Ventilators

Fans shall be direct or V-belt driven with backward inclined, non-overloading wheel. Motor compartment housing shall be hinged or removable and weatherproof, constructed of heavy gauge aluminum. Fans shall be provided with birdscreen, disconnect switch, dampers, roof curb, and extended base. Lubricated bearings shall be provided.

2.9.1.7 Ceiling Exhaust Fans

Suspended cabinet-type ceiling exhaust fans shall be centrifugal type, direct-driven. Fans shall have acoustically insulated housing. Integral backdraft damper shall be chatter-proof. The integral face grille shall be of egg-crate design or louver design. Fan motors shall be mounted on vibration isolators. Unit shall be provided with mounting flange for hanging unit from above. Fans shall be U.L. listed.

2.9.2 Coils

Coils shall be fin-and-tube type constructed of seamless copper or red brass tubes and aluminum or copper fins mechanically bonded or soldered to the tubes. Casing and tube support sheets shall be not lighter than 16 gauge galvanized steel, formed to provide structural strength. When required, multiple tube supports shall be provided to prevent tube sag. Each coil shall be tested at the factory under water at not less than 400 psi air pressure and shall be suitable for 200 psi working pressure. Coils shall be mounted for counterflow service. Coils shall be rated and certified according to ARI 410.

2.9.3 Air Filters

Air filters shall be listed according to requirements of UL 900, except high efficiency particulate air filters of 99.97 percent efficiency by the DOP Test method shall be as listed under the Label Service and shall meet the requirements of UL 586.

2.9.3.1 Holding Frames

Frames shall be fabricated from not lighter than 16 gauge sheet steel with rust-inhibitor coating. Each holding frame shall be equipped with suitable filter holding devices. Holding frame seats shall be gasketed. All joints shall be airtight.

2.9.3.2 Filter Gauges

Filter gauges shall be dial type, diaphragm actuated draft and shall be provided for all filter stations, including those filters which are furnished as integral parts of factory fabricated air handling units. Each gauge shall incorporate a screw operated zero adjustment and shall be furnished complete with two static pressure tips with integral compression fittings, two molded plastic vent valves, two 5 foot minimum lengths of 1/4 inch diameter tubing, and all hardware and accessories for gauge mounting.

2.10 AIR HANDLING UNITS

2.10.1 Field-Fabricated Air Handling Units

Built-up units shall be as specified in paragraph DUCTWORK COMPONENTS. Fans, coils spray-coil dehumidifiers, and air filters shall be as specified in paragraph AIR SYSTEMS EQUIPMENT for types indicated.

2.10.2 Factory-Fabricated Air Handling Units

Air handling unit shall have published ratings based on tests performed according to ARI 430.

2.10.2.1 Casings

Casing sections shall be constructed of a minimum 18 gauge galvanized steel, or 18 gauge steel outer casing protected with a corrosion resistant paint finish according to paragraph FACTORY PAINTING. Casing shall be designed and constructed with an integral insulated structural steel frame such that exterior panels are non-load bearing. Exterior panels shall be individually removable. Removal shall not affect the structural integrity of the unit. Casings shall be provided with inspection doors, access sections, and access doors as indicated. Inspection and access doors shall be insulated, fully gasketed, double-wall type, of a minimum 18 gauge outer and 20 gauge inner panels. Doors shall be rigid and provided with heavy duty hinges and latches. Inspection doors shall be a minimum 12 inches wide by 12 inches high. Access doors shall be minimum 24 inches wide and shall be the full height of the unit casing or a minimum of 6 foot, whichever is less. Drain pan shall be double-wall insulated type constructed of 16 gauge stainless steel, pitched to the drain connection. Drain pans shall be constructed water tight, treated to prevent corrosion, and designed for positive condensate drainage. When 2 or more cooling coils are used, with one stacked above the other, condensate from the upper coils shall not flow across the face of lower coils. Intermediate drain pans or condensate collection channels and downspouts shall be provided, as required to carry condensate to the unit drain pan out of the air stream and without moisture carryover. Drain pan shall be constructed so that the pan may be visually inspected easily including underneath the coil without removal of the coil and so that the pan may be physically cleaned completely and easily underneath the coil without removal of the coil. Casing insulation shall conform to NFPA 90A Single-wall casing sections handling conditioned air shall be insulated with not less than 1 inch

thick, 1-1/2 pound density coated fibrous glass material having a thermal conductivity not greater than 0.23 Btu/hr-sf-F. Double-wall casing sections handling conditioned air shall be insulated with not less than 2 inches of the same insulation specified for single-wall casings. Foil-faced insulation shall not be an acceptable substitute for use with double wall casing. Double wall insulation must be completely sealed by inner and outer panels. Factory applied fibrous glass insulation shall conform to ASTM C 1071, except that the minimum thickness and density requirements do not apply, and shall meet the requirements of NFPA 90A. Air handling unit casing insulation shall be uniform over the entire casing. Foil-faced insulation shall not be an acceptable substitute for use on double-wall access doors and inspections doors. Duct liner material, coating, and adhesive shall conform to fire-hazard requirements specified in Section 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS. Exposed insulation edges and joints where insulation panels are butted together shall be protected with a metal nosing strip or shall be coated to conform to meet erosion resistance requirements of ASTM C 1071. A latched and hinged inspection door, shall be provided in the fan and coil sections.

2.10.2.2 Heating and Cooling Coils

Coils shall be provided as specified in paragraph AIR SYSTEMS EQUIPMENT, for types indicated.

2.10.2.3 Cooling Coils, Spray Type

Cooling coils shall be of the copper finned type as specified in paragraph AIR SYSTEMS EQUIPMENT furnished complete with water sprays. All horizontal units and vertical units with coil face velocities of 550 fpm or above, shall be provided with moisture eliminators. Sprays shall have all bronze, brass, or stainless steel centrifugal type nozzles, with removable caps designed and arranged for uniform wetting of the entire coil face area. Nozzles shall be supplied by standard weight galvanized steel piping and a centrifugal type circulating pump furnished as an integral part of the unit. Eliminators shall be not lighter than 24 gauge corrosion-resistant steel, removable for maintenance and coil inspection. No water shall carry over into the fan section or supply ducts from the air handling unit provided with or without eliminators.

2.10.2.4 Air Filters

Air filters shall be as specified in paragraph AIR SYSTEMS EQUIPMENT for types and thickness indicated.

2.10.2.5 Fans

Fans shall be double-inlet, centrifugal type with each fan in a separate scroll. Fans and shafts shall be dynamically balanced prior to installation into air handling unit, then the entire fan assembly shall be statically and dynamically balanced at the factory after it has been installed in the air handling unit. Fans shall be mounted on steel shafts accurately ground and finished. Fan bearings shall be sealed against dust and dirt and shall be precision self-aligning ball or roller type. Bearing life shall be L50 rated at not less than 200,000 hours as defined by ABMA 9 and ABMA 11. Bearings shall be permanently lubricated or lubricated type with lubrication fittings readily accessible at the drive side of the unit. Bearings shall be supported by structural shapes, or die formed sheet structural members, or support plates securely attached to the unit casing. Bearings may not be fastened directly to the unit sheet metal casing.

Fans and scrolls shall be furnished with coating indicated. Fans shall be driven by a unit-mounted or a floor-mounted motor connected to fans by V-belt drive complete with belt guard for externally mounted motors. Belt guards shall be the three sided enclosed type with solid or expanded metal face. Belt drives shall be designed for not less than a 1.3 service factor based on motor nameplate rating. Where fixed sheaves are required, variable pitch sheaves may be used during air balance, but shall be replaced with an appropriate fixed sheave after air balance is completed. Variable pitch sheaves shall be selected to drive the fan at a speed that will produce the specified capacity when set at the approximate midpoint of the sheave adjustment. Motors for V-belt drives shall be provided with adjustable bases. Unit fan or fans shall be selected to produce the required capacity at the fan static pressure. Sound power level shall be as indicated. The sound power level values shall be obtained according to AMCA 300, ASHRAE 68, or ARI 260.

2.10.2.6 Access Sections and Filter/Mixing Boxes

Access sections shall be provided where indicated and shall be furnished with access doors as shown. Access sections and filter/mixing boxes shall be constructed in a manner identical to the remainder of the unit casing and shall be equipped with access doors. Mixing boxes shall be designed to minimize air stratification and to promote thorough mixing of the air streams.

2.10.2.7 Diffuser Sections

Diffuser sections shall be furnished between the discharge of all housed supply fans and cooling coils of blow-through single zone units and filter sections of those units with high efficiency filters located immediately downstream of the air handling unit fan section. Diffuser sections shall be fabricated by the unit manufacturer in a manner identical to the remainder of the unit casing, shall be designed to be airtight under positive static pressures up to 8 inches water gauge and shall have an access door on each side for inspection purposes. Diffuser section shall contain a perforated diffusion plate, fabricated of galvanized steel, Type 316 stainless steel, aluminum, or steel treated for corrosion with manufacturer's standard corrosion-resisting finish.

2.10.2.8 Dampers

Dampers shall be as specified in paragraph CONTROLS.

2.11 TERMINAL UNITS

2.11.1 Variable Air Volume (VAV) and Dual Duct Terminal Units

VAV and dual duct terminal units shall be the type, size, and capacity shown and shall be mounted in the ceiling or wall cavity and shall be suitable for single or dual duct system applications. Actuators and controls shall be as specified in paragraph CONTROLS. Unit enclosures shall be constructed of galvanized steel not lighter than 22 gauge or aluminum sheet not lighter than 18 gauge. Single or multiple discharge outlets shall be provided as required. Units with flow limiters are not acceptable. Unit air volume shall be factory preset and readily field adjustable without special tools. Reheat coils shall be provided as indicated. A flow chart shall be attached to each unit. Acoustic performance of the terminal units shall be based upon units tested according to ARI 880. Sound power level shall be as indicated. Acoustical

lining shall be according to NFPA 90A.

2.11.1.1 Constant Volume, Single Duct

Constant volume, single duct, terminal units shall contain within the casing, a mechanical or pneumatic constant volume regulator. Volume regulators shall control air delivery to within plus or minus 5 percent of specified air flow subjected to inlet pressure from 3/4 to 6 inch water gauge.

2.11.1.2 Variable Volume, Single Duct

Variable volume, single duct, terminal units shall be provided with a calibrated air volume sensing device, air valve or damper, actuator, and accessory relays. Units shall control air volume to within plus or minus 5 percent of each air set point volume as determined by the thermostat with variations in inlet pressures from 3/4 to 6 inch water gauge. Internal resistance of units shall not exceed 0.4 inch water gauge at maximum flow range. External differential pressure taps separate from the control pressure taps shall be provided for air flow measurement with a 0 to 1 inch water gauge range. Unit volume controller shall be normally ~~[~~open~~] [closed]~~ upon loss of pneumatic pressure.

2.11.1.3 Variable Volume, Single Duct, Fan-Powered

Variable volume, single duct, fan-powered terminal units shall be provided with a calibrated air volume sensing device, air valve or damper, actuator, fan and motor, and accessory relays. Units shall control primary air volume to within plus or minus 5 percent of each air set point as determined by the thermostat with variations in inlet pressure from 3/4 to 6 inch water gauge. Unit fan shall be centrifugal, direct-driven, double-inlet type with forward curved blades. Fan motor shall be either single speed with speed controller or three-speed, permanently lubricated, permanent split-capacitor type. Fan/motor assembly shall be isolated from the casing to minimize vibration transmission. Fan control shall be factory furnished and wired into the unit control system. A factory-mounted pressure switch shall be furnished to operate the unit fan whenever pressure exists at the unit primary air inlet or when the control system fan operates.

2.11.1.4 Reheat Units

a. Hot Water Coils: Hot-water coils shall be fin-and-tube type constructed of seamless copper tubes and copper or aluminum fins mechanically bonded or soldered to the tubes. Headers shall be constructed of cast iron, welded steel or copper. Casing and tube support sheets shall be 16 gauge, galvanized steel, formed to provide structural strength. Tubes shall be correctly circuited for proper water velocity without excessive pressure drop and they shall be drainable where required or indicated. At the factory, each coil shall be tested at not less than 250 psi air pressure and shall be suitable for 200 psi working pressure. Drainable coils shall be installed in the air handling units with a pitch of not less than 1/8 inch per foot of tube length toward the drain end. Coils shall conform to the provisions of ARI 410.

2.12 ENERGY RECOVERY DEVICES

2.12.1 Rotary Wheel

Unit shall be a factory fabricated and tested assembly for air-to-air energy recovery by transfer of sensible heat from exhaust air to supply air stream. Device performance shall be according to ASHRAE 84. Exchange media shall be chemically inert, moisture-resistant, fire-retardant, laminated, nonmetallic material which complies with NFPA 90A. Exhaust and supply streams shall be isolated by seals which are static, field adjustable, and replaceable. Chain drive mechanisms shall be fitted with ratcheting torque limiter or slip-clutch protective device. Enclosure shall be fabricated from galvanized steel and shall include maintenance access provisions. Recovery control and rotation failure provisions shall be as indicated.

2.13 FACTORY PAINTING

Units which are not of galvanized construction according to ASTM A 123/A 123M or ASTM A 924/A 924M shall be factory painted with a corrosion resisting paint finish. Internal and external ferrous metal surfaces shall be cleaned, phosphatized and coated with a paint finish which has been tested according to ASTM B 117, ASTM D 1654, and ASTM D 3359. Evidence of satisfactory paint performance for a minimum of 125 hours for units to be installed indoors and 500 hours for units to be installed outdoors shall be submitted. Rating of failure at the scribe mark shall be not less than 6, average creepage not greater than 1/8 inch. Rating of the inscribed area shall not be less than 10, no failure. On units constructed of galvanized steel which have been welded, exterior surfaces of welds or welds that have burned through from the interior shall receive a final shop docket of zinc-rich protective paint according to ASTM D 520 Type I.

PART 3 EXECUTION

3.1 INSTALLATION

Work shall be installed as shown and according to the manufacturer's diagrams and recommendations.

3.1.1 Piping

Pipe and fitting installation shall conform to the requirements of ASME B31.1. Pipe shall be cut accurately to measurements established at the jobsite, and worked into place without springing or forcing, completely clearing all windows, doors, and other openings. Cutting or other weakening of the building structure to facilitate piping installation will not be permitted without written approval. Pipe or tubing shall be cut square, shall have burrs removed by reaming, and shall permit free expansion and contraction without causing damage to the building structure, pipe, joints, or hangers. Changes in direction shall be made with fittings, except that bending of pipe 4 inches and smaller will be permitted, provided a pipe bender is used and wide sweep bends are formed. The centerline radius of bends shall not be less than 6 diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be accepted. Horizontal supply mains shall pitch down in the direction of flow as indicated. The grade shall be not less than 1 inch in 40 feet. Reducing fittings shall be used for changes in pipe sizes. Open ends of pipelines and equipment shall be capped or plugged during installation to keep dirt or other foreign materials out of

the system. Pipe not otherwise specified shall be uncoated. Connections to appliances shall be made with malleable iron unions for steel pipe 2-1/2 inches or less in diameter, and with flanges for pipe 3 inches and larger. Connections between ferrous and copper piping shall be electrically isolated from each other with dielectric unions or flanges. All piping located in air plenums shall conform to NFPA 90A requirements. Pipe and fittings installed in inaccessible conduits or trenches under concrete floor slabs shall be welded.

3.1.1.1 Joints

a. Threaded Joints: Threaded joints shall be made with tapered threads and made tight with a stiff mixture of graphite and oil or polytetrafluoroethylene tape or equivalent thread joint compound or material, applied to the male threads only.

b. Soldered Joints: Joints in copper tubing shall be cut square with ends reamed, and all filings and dust wiped from interior of pipe. Joints shall be soldered with 95/5 solder or brazed with silver solder applied and drawn through the full fitting length. Care shall be taken to prevent annealing of tube or fittings when making connections. Joints 2-1/2 inches and larger shall be made with heat uniformly around the entire circumference of the joint with a multi-flame torch. Connections in floor slabs shall be brazed. Excess solder shall be wiped from joint before solder hardens. Solder flux shall be liquid or paste form, non-corrosive and conform to ASTM B 813.

c. Welded Joints : Welded joints shall be fusion welded unless otherwise required. 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 connections may be made with either welding tees or branch outlet fittings. Branch outlet fittings shall be forged, flared for improvement of flow where attached to the run, and reinforced against external strains. 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. Electrodes shall be stored and dried according to AWS D1.1/D1.1M or as recommended by the manufacturer. Electrodes that have been wetted or that have lost any of their coating shall not be used.

3.1.1.2 Grooved Mechanical Joints

Grooves shall be prepared according to the coupling manufacturer's instructions. Grooved fittings, couplings, and grooving tools shall be products of the same manufacturer. Pipe and groove dimensions shall comply with the tolerances specified by the coupling manufacturer. The diameter of grooves made in the field shall be measured using a "go/no-go" gauge, vernier or dial caliper, narrow-land micrometer, or other method specifically approved by the coupling manufacturer for the intended application. Groove width and dimension of groove from end of pipe shall be measured and recorded for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances. Grooved joints shall not be used in concealed locations, such as behind solid walls or ceilings, unless an access panel is shown on the drawings for servicing or adjusting the joint.

3.1.1.3 Flanges and Unions

Except where copper tubing is used, union or flanged joints shall be provided in each line immediately preceding the connection to each piece of equipment or material requiring maintenance such as coils, pumps, control valves, and other similar items.

3.1.2 Supports

3.1.2.1 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. Supports shall not be attached to the underside of concrete filled floors or concrete roof decks unless approved by the Contracting Officer.

3.1.2.2 Seismic Requirements (Pipe Supports and Structural Bracing)

Piping and attached valves shall be supported and braced to resist seismic loads as specified under Sections 13080 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT and 15070A SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT. Structural steel required for reinforcement to properly support piping, headers, and equipment but not shown shall be provided under this section.

3.1.2.3 Pipe Hangers, Inserts and Supports

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69, except as modified herein. Types 5, 12, and 26 shall not be used.

a. Hangers: Type 3 shall not be used on insulated piping.

b. Inserts: 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.

c. C-Clamps: Type 19 and 23 C-clamps shall be torqued per MSS SP-69 and have both locknuts and retaining devices, furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.

d. Angle Attachments: Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.

e. Hangers: Type 24 may be used only on trapeze hanger systems or on fabricated frames.

f. Type 39 saddles shall be used on all insulated pipe 4 inches and larger when the temperature of the medium is above 60 degrees F. Type 39 saddles shall be welded to the pipe.

g. Type 40 shields shall:

(1) be used on all insulated pipes less than 4 inches.

(2) be used on all insulated pipes 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 when the insulation shows signs of being visibly compressed, or when the insulation or jacket shows visible signs of distortion at or near the type 40 shield. High density inserts shall have a density of 9 pcf or greater.

h. Horizontal Pipe Supports: Horizontal pipe supports shall be spaced as specified in MSS SP-69 and a support shall be installed not over 1 foot from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 5 feet apart at valves.

i. Vertical Pipe Supports: Vertical pipe shall be supported at each floor, except at slab-on-grade, and at intervals of not more than 15 feet, not more than 8 feet from end of risers, and at vent terminations.

j. Pipe Guides: Type 35 guides using steel reinforced polytetrafluoroethylene (PTFE) or graphite slides shall be provided where required to allow longitudinal pipe movement. Lateral restraints shall be provided as required. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered.

k. Steel Slides: Where steel slides do not require provisions for restraint of lateral movement, an alternate guide method may be used. On piping 4 inches and larger with medium 60 degrees F or greater, a Type 39 saddle may be welded to the pipe and freely rest on a steel plate. On piping under 4 inches, a Type 40 protection shield may be attached to the pipe or insulation and freely rest on a steel slide plate.

l. High Temperature Guides with Cradles: 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.

m. Insulated Pipe: Insulation on horizontal pipe shall be continuous through hangers for hot and cold piping. Other requirements on insulated pipe are specified in Section 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.1.3 Anchors

Anchors shall be provided wherever necessary or indicated to localize expansion or to prevent undue strain on piping. Anchors shall consist of heavy steel collars with lugs and bolts for clamping and attaching anchor braces, unless otherwise indicated. Anchor braces shall be installed in the most effective manner to secure the desired results using turnbuckles where required. Supports, anchors, or stays shall not be attached where they will injure the structure or adjacent construction during installation

or by the weight of expansion of the pipeline.

3.1.4 Pipe Sleeves

Sleeves shall not be installed in structural members except where indicated or approved. Rectangular and square openings shall be as detailed. Each sleeve shall extend through its respective wall, floor, or roof, and shall be cut flush with each surface. Pipes passing through concrete or masonry wall or concrete floors or roofs shall be provided with pipe sleeves fitted into place at the time of construction. Unless otherwise indicated, sleeves shall provide a minimum of 1/4 inch all-around clearance between bare pipe and sleeves or between jacket over insulation and sleeves. Sleeves in bearing walls, waterproofing membrane floors, and wet areas shall be steel pipe or cast iron pipe. Sleeves in non-bearing walls, floors, or ceilings may be steel pipe, cast iron pipe, galvanized sheet metal with lock-type longitudinal seam and of the metal thickness indicated, or moisture resistant fiber or plastic. Except in pipe chases or interior walls, the annular space between pipe and sleeve or between jacket over insulation and sleeve, in non-fire rated walls, shall be sealed as indicated and specified in Section 07900A JOINT SEALING. Pipes passing through wall waterproofing membrane shall be sleeved as specified above, and a waterproofing clamping flange shall be installed as indicated.

3.1.4.1 Roof and Floor Sleeves

Pipes passing through roof or floor waterproofing membrane shall be installed through a 17-ounce copper sleeve or a 0.032 inch thick aluminum sleeve, each within an integral skirt or flange. Flashing sleeve shall be suitably formed, and skirt or flange shall extend not less than 8 inches from the pipe and shall be set over the roof or floor membrane in a troweled coating of bituminous cement. Unless otherwise shown, the flashing sleeve shall extend up the pipe a minimum of 2 inches above highest floor level or a minimum of 10 inches above the roof. The annular space between the flashing sleeve and the bare pipe or between the flashing sleeve and the metal-jacket-covered insulation shall be sealed as indicated. Pipes up to and including 10 inches in diameter passing through roof or floor waterproofing membrane may be installed through a cast iron sleeve with caulking recess, anchor lugs, flashing clamp device, and pressure ring with brass bolts. Waterproofing membrane shall be clamped into place and sealant shall be placed in the caulking recess. In lieu of a waterproofing clamping flange and caulking and sealing of annular space between pipe and sleeve or conduit and sleeve, a modular mechanical type sealing assembly may be installed. Seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe/conduit and sleeve with corrosion protected carbon steel bolts, nuts, and pressure plates. Links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and each nut. After the seal assembly is properly positioned in the sleeve, tightening of the bolt shall cause the rubber sealing elements to expand and provide a watertight seal between the pipe/conduit and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe/conduit and sleeve involved.

3.1.4.2 Fire Seal

Where pipes pass through firewalls, fire partitions, or floors, a fire seal shall be provided as specified in Section 07840A FIRESTOPPING.

3.1.4.3 Escutcheons

Escutcheons shall be provided at finished surfaces where exposed piping, bare or insulated, passes through floors, walls, or ceilings except in boiler, utility, or equipment rooms. Where sleeves project slightly from floors, special deep-type escutcheons shall be used. Escutcheons shall be secured to pipe or pipe covering.

3.1.5 Condensate Drain Lines

Water seals shall be provided in the condensate drain from all ~~[~~units.~~]~~ ~~[units except room [fan-coil units] [and] [coil-induction units]].~~ The depth of each seal shall be 2 inches plus the number of inches, measured in water gauge, of the total static pressure rating of the unit to which the drain is connected. Water seals shall be constructed of 2 tees and an appropriate U-bend with the open end of each tee plugged. Pipe cap or plug cleanouts shall be provided where indicated. Drains indicated to connect to the sanitary waste system shall be connected by an indirect waste fitting. Air conditioner drain lines shall be insulated as specified in Section 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.1.6 Pipe-Alignment Guides

Pipe-alignment guides shall be provided where indicated for expansion loops, offsets, and bends and as recommended by the manufacturer for expansion joints, not to exceed 5 feet on each side of each expansion joint, and in lines 4 inches or smaller not more than 2 feet on each side of the joint.

3.1.7 Air Vents and Drains

3.1.7.1 Vents

Air vents shall be provided at high points, on water coils, and where indicated to ensure adequate venting of the piping system.

3.1.7.2 Drains

Drains shall be provided at low points and where indicated to ensure complete drainage of the piping. Drains shall be accessible, and shall consist of nipples and caps or plugged tees unless otherwise indicated.

3.1.8 Valves

Isolation gate or ball valves shall be installed on each side of each piece of equipment such as pumps, heaters, heating or cooling coils, and other similar items, at the midpoint of all looped mains, and at any other points indicated or required for draining, isolating, or sectionalizing purposes. Isolation valves may be omitted where balancing cocks are installed to provide both balancing and isolation functions. Each valve except check valves shall be identified. Valves in horizontal lines shall be installed with stems horizontal or above.

3.1.9 Equipment and Installation

Frames and supports shall be provided for tanks, compressors, pumps, valves, air handling units, fans, coils, dampers, and other similar items requiring supports. Air handling units shall be floor mounted or ceiling hung, as indicated. The method of anchoring and fastening shall be as

detailed. Floor-mounted equipment, unless otherwise indicated, shall be set on not less than 6 inch concrete pads or curbs doweled in place. Concrete foundations for circulating pumps shall be heavy enough to minimize the intensity of the vibrations transmitted to the piping and the surrounding structure, as recommended in writing by the pump manufacturer. In lieu of a concrete pad foundation, a concrete pedestal block with isolators placed between the pedestal block and the floor may be provided. The concrete foundation or concrete pedestal block shall be of a mass not less than three times the weight of the components to be supported. Lines connected to the pump mounted on pedestal blocks shall be provided with flexible connectors. Foundation drawings, bolt-setting information, and foundation bolts shall be furnished prior to concrete foundation construction for all equipment indicated or required to have concrete foundations. Concrete for foundations shall be as specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE.

3.1.10 Access Panels

Access panels shall be provided for concealed valves, vents, controls, dampers, and items requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced and maintained or completely removed and replaced. Access panels shall be as specified in Section 05500A MISCELLANEOUS METALS.

3.1.11 Flexible Connectors

Pre-insulated flexible connectors and flexible duct shall be attached to other components in accordance with the latest printed instructions of the manufacturer to ensure a vapor tight joint. Hangers, when required to suspend the connectors, shall be of the type recommended by the connector or duct manufacturer and shall be provided at the intervals recommended.

3.1.12 Sleeved and Framed Openings

Space between the sleeved or framed opening and the duct or the duct insulation shall be packed as specified in Section 07840A FIRESTOPPING for fire rated penetrations. For non-fire rated penetrations, the space shall be packed as specified in Section 07900A JOINT SEALING.

3.1.13 Metal Ductwork

Installation shall be according to SMACNA HVAC Duct Const Stds unless otherwise indicated. Duct supports for sheet metal ductwork shall be according to SMACNA HVAC Duct Const Stds, unless otherwise specified. Friction beam clamps indicated in SMACNA HVAC Duct Const Stds shall not be used. Risers on high velocity ducts shall be anchored in the center of the vertical run to allow ends of riser to move due to thermal expansion. Supports on the risers shall allow free vertical movement of the duct. Supports shall be attached only to structural framing members and concrete slabs. Supports shall not be anchored to metal decking unless a means is provided and approved for preventing the anchor from puncturing the metal decking. Where supports are required between structural framing members, suitable intermediate metal framing shall be provided. Where C-clamps are used, retainer clips shall be provided.

3.1.13.1 Underground Ductwork

Underground ductwork shall be PVC plastisol coated galvanized steel with coating on interior and exterior surfaces and watertight joints. Ductwork

shall be installed as indicated, according to ACCA Manual 4 and manufacturer's instructions. Maximum burial depth shall be 6 feet.

3.1.13.2 Radon Exhaust Ductwork

Subslab suction piping shall be perforated where indicated. PVC joints shall be installed as specified in ASTM D 2855.

3.1.13.3 Light Duty Corrosive Exhaust Ductwork

Light duty corrosive exhaust ductwork shall be PVC plastisol coated galvanized steel with PVC coating on interior ~~[surfaces.] [~~and exterior surfaces~~] [and epoxy wash primer coating on exterior surfaces]~~.

3.1.14 Fibrous Glass Ductwork

Installation shall be according to the manufacturer's written recommendations unless otherwise required in NAIMA AH115. Duct supports for fibrous glass ductwork shall conform to NAIMA AH115. In those cases not covered in NAIMA AH115, the written recommendation of the fibrous duct manufacturer shall be followed.

3.1.15 FRP Ductwork

Fibrous glass reinforced plastic ducting and related structures shall conform to SMACNA Industry Practice. Flanged joints shall be provided where indicated. Crevice-free butt lay-up joints are acceptable where flanged joints are not indicated. When ambient temperatures are lower than 50 degrees F, joints shall be heat cured by exothermic reaction heat packs.

3.1.16 Acoustical Duct Lining

Lining shall be applied in cut-to-size pieces attached to the interior of the duct with nonflammable fire resistant adhesive conforming to ASTM C 916, Type I, NFPA 90A, UL 723, and ASTM E 84. Top and bottom pieces shall lap the side pieces and shall be secured with welded pins, adhered clips of metal, nylon, or high impact plastic, and speed washers or welding cup-head pins installed according to SMACNA HVAC Duct Const Stds. Welded pins, cup-head pins, or adhered clips shall not distort the duct, burn through, nor mar the finish or the surface of the duct. Pins and washers shall be flush with the surfaces of the duct liner and all breaks and punctures of the duct liner coating shall be sealed with the nonflammable, fire resistant adhesive. Exposed edges of the liner at the duct ends and at other joints where the lining will be subject to erosion shall be coated with a heavy brush coat of the nonflammable, fire resistant adhesive, to prevent delamination of glass fibers. Duct liner may be applied to flat sheet metal prior to forming duct through the sheet metal brake. Lining at the top and bottom surfaces of the duct shall be additionally secured by welded pins or adhered clips as specified for cut-to-size pieces. Other methods indicated in SMACNA HVAC Duct Const Stds to obtain proper installation of duct liners in sheet metal ducts, including adhesives and fasteners, will be acceptable.

3.1.17 Dust Control

To prevent the accumulation of dust, debris and foreign material during construction, temporary dust control protection shall be provided. The distribution system (supply and return) shall be protected with temporary seal-offs at all inlets and outlets at the end of each day's work.

Temporary protection shall remain in place until system is ready for startup.

3.1.18 Insulation

Thickness and application of insulation materials for ductwork, piping, and equipment shall be according to Section 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS. Outdoor air intake ducts and plenums shall be externally insulated up to the point where the outdoor air reaches the conditioning unit or up to the point where the outdoor air mixes with the outside air stream.

3.1.19 Duct Test Holes

Holes with closures or threaded holes with plugs shall be provided in ducts and plenums as indicated or where necessary for the use of pitot tube in balancing the air system. Extensions, complete with cap or plug, shall be provided where the ducts are insulated.

3.1.20 Power Roof Ventilator Mounting

Foamed 1/2 inch thick, closed-cell, flexible elastomer insulation shall cover width of roof curb mounting flange. Where wood nailers are used, holes shall be pre-drilled for fasteners.

3.1.21 Power Transmission Components Adjustment

V-belts and sheaves shall be tested for proper alignment and tension prior to operation and after 72 hours of operation at final speed. Belts on drive side shall be uniformly loaded, not bouncing. Alignment of direct driven couplings shall be to within 50 percent of manufacturer's maximum allowable range of misalignment.

3.2 FIELD PAINTING AND IDENTIFICATION SYSTEMS

3.2.1 Identification Tags

Identification tags made of brass, engraved laminated plastic, or engraved anodized aluminum, indicating service and item number shall be installed on all valves and dampers. 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.

3.2.2 Finish Painting and Pipe Color Code Marking

Finish painting of items only primed at the factory, surfaces not specifically noted otherwise, and color code marking for piping shall be as specified in Section 09900 PAINTS AND COATINGS.

3.2.3 Color Coding Scheme for Locating Hidden Utility Components

Scheme shall be provided in buildings having suspended grid ceilings. The color coding scheme shall identify points of access for maintenance and operation of components and equipment that are not visible from the finished space and are accessible from the ceiling grid. The color coding scheme shall consist of a color code board and colored metal disks. Each colored metal disk shall be approximately 3/8 inch diameter and secured to removable ceiling panels with fasteners. Each fastener shall be inserted

into the ceiling panel so as to be concealed from view. The fasteners shall be manually removable without the use of tools and shall not separate from the ceiling panels when the panels are dropped from ceiling height. Installation of colored metal disks shall follow completion of the finished surface on which the disks are to be fastened. The color code board shall be approximately 3 foot wide, 30 inches high, and 1/2 inches thick. The board shall be made of wood fiberboard and framed under glass or 1/16 inch transparent plastic cover. The color code symbols shall be approximately 3/4 inch in diameter and the related lettering in 1/2 inch high capital letters.

3.3 PIPING HYDROSTATIC TEST

After cleaning, water piping shall be hydrostatically tested at a pressure equal to 150 percent of the total system operating pressure for period of time sufficient to inspect every joint in the system and in no case less than 2 hours. Leaks shall be repaired and piping retested until test is successful. No loss of pressure will be allowed. Leaks shall be repaired by re-welding or replacing pipe or fittings. Caulking of joints will not be permitted. Concealed and insulated piping shall be tested in place before covering or concealing.

3.4 DUCTWORK LEAK TEST

Ductwork leak test shall be performed for the entire air distribution and exhaust system, including fans, coils, filters, etc. Test procedure, apparatus, and report shall conform to SMACNA Leakage Test Mnl. Ductwork leak test shall be completed with satisfactory results prior to applying insulation to ductwork exterior.

3.5 DAMPER ACCEPTANCE TEST

All fire dampers and smoke dampers shall be operated under normal operating conditions, prior to the occupancy of a building to determine that they function properly. Fire dampers equipped with fusible links shall be tested by having the fusible link cut in place. Dynamic fire dampers shall be tested with the air handling and distribution system running. All fire dampers shall be reset with the fusible links replaced after acceptance testing. To ensure optimum operation and performance, the damper must be installed so it is square and free from racking.

3.6 TESTING, ADJUSTING, AND BALANCING

Testing, adjusting, and balancing shall be as specified in Section 15990A TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS. Testing, adjusting, and balancing shall begin only when the air supply and distribution, including controls, has been completed, with the exception of performance tests.

3.7 PERFORMANCE TESTS

After testing, adjusting, and balancing has been completed as specified, each system shall be tested as a whole to see that all items perform as integral parts of the system and temperatures and conditions are evenly controlled throughout the building. Corrections and adjustments shall be made as necessary to produce the conditions indicated or specified. Capacity tests and general operating tests shall be conducted by an experienced engineer. Coincidental chart recordings shall be made at points indicated on the drawings for the duration of the time period and shall record the temperature at space thermostats or space sensors, the

humidity at space humidistats or space sensors and the ambient temperature and humidity in a shaded and weather protected area.

3.8 CLEANING AND ADJUSTING

Pipes shall be cleaned free of scale and thoroughly flushed of foreign matter. A temporary bypass shall be provided for water coils to prevent flushing water from passing through coils. Strainers and valves shall be thoroughly cleaned. Prior to testing and balancing, air shall be removed from water systems by operating the air vents. Temporary measures, such as piping the overflow from vents to a collecting vessel shall be taken to avoid water damage during the venting process. Air vents shall be plugged or capped after the system has been vented. Inside of fan-coil units, air terminal units, ducts, plenums, and casing shall be thoroughly cleaned of debris and blown free of small particles of rubbish and dust and then shall be vacuum cleaned before installing outlet faces. Equipment shall be wiped clean, with traces of oil, dust, dirt, or paint spots removed. Temporary filters shall be provided prior to startup of all fans that are operated during construction, and new filters shall be installed after all construction dirt has been removed from the building, and the ducts, plenums, casings, and other items specified have been vacuum cleaned. System shall be maintained in this clean condition until final acceptance. Bearings shall be properly lubricated with oil or grease as recommended by the manufacturer. Belts shall be tightened to proper tension. Control valves and other miscellaneous equipment requiring adjustment shall be adjusted to setting indicated or directed. Fans shall be adjusted to the speed indicated by the manufacturer to meet specified conditions.

3.9 FIELD TRAINING

The Contractor shall conduct a training course for operating and maintenance personnel as designated by the Contracting Officer. Training shall be provided for a period of 8 hours of normal working time and shall start after the system is functionally complete but prior to the performance tests. The field instruction shall cover all of the items contained in the approved Operating and Maintenance Instructions.

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SECTION 15990

TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS

08/97

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SECTION 15990

TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS
08/97

PART 1 GENERAL

1.1 REFERENCES

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

ASSOCIATED AIR BALANCE COUNCIL (AABC)

AABC MN-1	(1989) National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems

NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)

NEBB Procedural Stds	(1991) Procedural Standards for Testing Adjusting Balancing of Environmental Systems

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

TAB Related HVAC Submittals;

A list of the TAB Related HVAC Submittals, no later than 7 days after the approval of the TAB Specialist.

SD-02 Shop Drawings

TAB Schematic Drawings and Report Forms; G.

Three copies of the TAB Schematic Drawings and Report Forms, no later than 21 days prior to the start of TAB field measurements.

SD-08 Manufacturer's Instructions

TAB Procedures; G.

Proposed procedures for TAB, submitted with the TAB Schematic Drawings and Report Forms.

SD-05 Design Data

Systems Readiness Check;

Proposed date and time to begin the Systems Readiness Check, no later than

7 days prior to the start of the Systems Readiness Check.

TAB Execution;

Proposed date and time to begin field measurements, making adjustments, etc., for the TAB Report, submitted with the Systems Readiness Check Report.

TAB Verification; G.

Proposed date and time to begin the TAB Verification, submitted with the TAB Report.

SD-06 Test Reports

Design Review Report; G.

A copy of the Design Review Report, no later than 14 days after approval of the TAB Firm and the TAB Specialist.

Systems Readiness Check Report; G.

A copy of completed checklists for each system, each signed by the TAB Specialist, at least 7 days prior to the start of TAB Execution. All items in the Systems Readiness Check Report shall be signed by the TAB Specialist and shall bear the seal of the Professional Society or National Association used as the TAB Standard.

TAB Report; G.

Three copies of the completed TAB Reports, no later that 7 days after the execution of TAB. All items in the TAB Report shall be signed by the TAB Specialist and shall bear the seal of the Professional Society or National Association used as the TAB Standard.

TAB Verification Report; G.

Three copies of the completed TAB Verification Report, no later that 7 days after the execution of TAB Verification. All items in the TAB Verification Report shall be signed by the TAB Specialist and shall bear the seal of the Professional Society or National Association used as the TAB Standard.

SD-07 Certificates

TAB Firm; G.

Certification of the proposed TAB Firm's qualifications by either AABC or NEBB to perform the duties specified herein and in other related Sections, no later than 21 days after the Notice to Proceed. The documentation shall include the date that the Certification was initially granted and the date that the current Certification expires. Any lapses in Certification of the proposed TAB Firm or disciplinary action taken by AABC or NEBB against the proposed TAB Firm shall be described in detail.

TAB Specialist; G.

Certification of the proposed TAB Specialist's qualifications by either AABC or NEBB to perform the duties specified herein and in other related Sections, no later than 21 days after the Notice to Proceed. The

documentation shall include the date that the Certification was initially granted and the date that the current Certification expires. Any lapses in Certification of the proposed TAB Specialist or disciplinary action taken by AABC or NEBB against the proposed TAB Specialist shall be described in detail.

Instrument Calibration;

List of each instrument to be used during TAB, stating calibration requirements required or recommended by both the TAB Standard and the instrument manufacturer and the actual calibration history of the instrument, submitted with the TAB Procedures. The calibration history shall include dates calibrated, the qualifications of the calibration laboratory, and the calibration procedures used.

Ductwork Leak Testing;

A written statement signed by the TAB Specialist certifying that the TAB Specialist witnessed the Ductwork Leak Testing, it was successfully completed, and that there are no known deficiencies related to the ductwork installation that will prevent TAB from producing satisfactory results.

1.3 SIMILAR TERMS

In some instances, terminology differs between the Contract and the TAB Standard primarily because the intent of this Section is to use the industry standards specified, along with additional requirements listed herein to produce optimal results. The following table of similar terms is provided for clarification only. Contract requirements take precedent over the corresponding AABC or NEBB requirements where differences exist.

SIMILAR TERMS

Contract Term	AABC Term	NEBB Term
TAB Standard	National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems	Procedural Standards for Testing Adjusting Balancing of Environmental Systems.
TAB Specialist	TAB Engineer	TAB Supervisor
Systems Readiness Check	Construction Phase Inspection	Field Readiness Check & Preliminary Field Procedures.

1.4 TAB STANDARD

TAB shall be performed in accordance with the requirements of the standard under which the TAB Firm's qualifications are approved, i.e., AABC MN-1or NEBB Procedural Stds, unless otherwise specified herein. All recommendations and suggested practices contained in the TAB Standard shall be considered mandatory. The provisions of the TAB Standard, including checklists, report forms, etc., shall, as nearly as practical, be used to satisfy the Contract requirements. The TAB Standard shall be used for all aspects of TAB, including qualifications for the TAB Firm and Specialist

and calibration of TAB instruments. Where the instrument manufacturer calibration recommendations are more stringent than those listed in the TAB Standard, the manufacturer's recommendations shall be adhered to. All quality assurance provisions of the TAB Standard such as performance guarantees shall be part of this contract. For systems or system components not covered in the TAB Standard, TAB procedures shall be developed by the TAB Specialist. Where new procedures, requirements, etc., applicable to the Contract requirements have been published or adopted by the body responsible for the TAB Standard used (AABC or NEBB), the requirements and recommendations contained in these procedures and requirements shall be considered mandatory.

1.5 QUALIFICATIONS

1.5.1 TAB Firm

The TAB Firm shall be either a member of AABC or certified by the NEBB and certified in all categories and functions where measurements or performance are specified on the plans and specifications, including TAB of environmental systems building systems commissioning and the measuring of sound and vibration in environmental systems. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the firm loses subject certification during this period, the Contractor shall immediately notify the Contracting Officer and submit another TAB Firm for approval. Any firm that has been the subject of disciplinary action by either the AABC or the NEBB within the five years preceding Contract Award shall not be eligible to perform any duties related to the HVAC systems, including TAB. All work specified in this Section and in other related Sections to be performed by the TAB Firm shall be considered invalid if the TAB Firm loses its certification prior to Contract completion and must be performed by an approved successor. These TAB services are to assist the prime Contractor in performing the quality oversight for which it is responsible. The TAB Firm shall be a subcontractor of the prime Contractor, and shall report to and be paid by the prime Contractor.

1.5.2 TAB Specialist

The TAB Specialist shall be either a member of AABC or an experienced technician of the Firm certified by the NEBB. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the Specialist loses subject certification during this period, the Contractor shall immediately notify the Contracting Officer and submit another TAB Specialist for approval. Any individual that has been the subject of disciplinary action by either the AABC or the NEBB within the five years preceding Contract Award shall not be eligible to perform any duties related to the HVAC systems, including TAB. All work specified in this Section and in other related Sections performed by the TAB Specialist shall be considered invalid if the TAB Specialist loses its certification prior to Contract completion and must be performed by the approved successor.

1.6 TAB SPECIALIST RESPONSIBILITIES

All TAB work specified herein and in related sections shall be performed under the direct guidance of the TAB Specialist. The TAB Specialist shall participate in the commissioning process specified in Section 15995 COMMISSIONING OF HVAC SYSTEMS.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 DESIGN REVIEW

The TAB Specialist shall review the Contract Plans and Specifications and advise the Contracting Officer of any deficiencies that would prevent the HVAC systems from effectively operating in accordance with the sequence of operation specified or prevent the effective and accurate TAB of the system. The TAB Specialist shall provide a Design Review Report individually listing each deficiency and the corresponding proposed corrective action necessary for proper system operation.

3.2 TAB RELATED HVAC SUBMITTALS

The TAB Specialist shall prepare a list of the submittals from the Contract Submittal Register that relate to the successful accomplishment of all HVAC TAB. The submittals identified on this list shall be accompanied by a letter of approval signed and dated by the TAB Specialist when submitted to the Government. The TAB Specialist shall also ensure that the location and details of ports, terminals, connections, etc., necessary to perform TAB are identified on the submittals.

3.3 TAB SCHEMATIC DRAWINGS AND REPORT FORMS

A schematic drawing showing each system component, including balancing devices, shall be provided for each system. Each drawing shall be accompanied by a copy of all report forms required by the TAB Standard used for that system. Where applicable, the acceptable range of operation or appropriate setting for each component shall be included on the forms or as an attachment to the forms. The schematic drawings shall identify all testing points and cross reference these points to the report forms and procedures.

3.4 DUCTWORK LEAK TESTING

The TAB Specialist shall witness the Ductwork Leak Testing specified in Section 15895 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM and approve the results as specified in Paragraph TAB RELATED HVAC SUBMITTALS.

3.5 TESTING, ADJUSTING, AND BALANCING

3.5.1 TAB Procedures

Step by step procedures for each measurement required during TAB Execution shall be provided. The procedures shall be oriented such that there is a separate section for each system. The procedures shall include measures to ensure that each system performs as specified in all operating modes, interactions with other components (such as exhaust fans, kitchen hoods, fume hoods, relief vents, etc.) and systems, and with all seasonal operating differences, diversity, simulated loads, and pressure relationships required.

3.5.2 Systems Readiness Check

The TAB Specialist shall inspect each system to ensure that it is complete, including installation and operation of controls, and that all aspects of the facility that have any bearing on the HVAC systems, including

installation of ceilings, walls, windows, doors, and partitions, are complete to the extent that TAB results will not be affected by any detail or touch-up work remaining. The TAB Specialist shall also verify that all items such as ductwork and piping ports, terminals, connections, etc., necessary to perform TAB shall be complete during the Systems Readiness Check.

3.5.3 Preparation of TAB Report

Preparation of the TAB Report shall begin only when the Systems Readiness Report has been approved. The Report shall be oriented so that there is a separate section for each system. The Report shall include a copy of the appropriate approved Schematic Drawings and TAB Related Submittals, such as pump curves, fan curves, etc., along with the completed report forms for each system. The operating points measured during successful TAB Execution and the theoretical operating points listed in the approved submittals shall be marked on the performance curves and tables. Where possible, adjustments shall be made using an "industry standard" technique which would result in the greatest energy savings, such as adjusting the speed of a fan instead of throttling the flow. Any deficiencies outside of the realm of normal adjustments and balancing during TAB Execution shall be noted along with a description of corrective action performed to bring the measurement into the specified range. If, for any reason, the TAB Specialist determines during TAB Execution that any Contract requirement cannot be met, the TAB Specialist shall immediately provide a written description of the deficiency and the corresponding proposed corrective action necessary for proper system operation to the Contracting Officer.

3.5.4 TAB Verification

The TAB Specialist shall recheck ten percent of the measurements listed in the Tab Report and prepare a TAB Verification Report. The measurements selected for verification and the individuals that witness the verification will be selected by the Contracting Officer's Representative (COR). The measurements will be recorded in the same manner as required for the TAB Report. All measurements that fall outside the acceptable operating range specified shall be accompanied by an explanation as to why the measurement does not correlate with that listed in the TAB Report and a description of corrective action performed to bring the measurement into the specified range. The TAB Specialist shall update the original TAB report to reflect any changes or differences noted in the TAB verification report and submit the updated TAB report. If over 20 percent of the measurements selected by the COR for verification fall outside of the acceptable operating range specified, the COR will select an additional ten percent for verification. If over 20 percent of the total tested (including both test groups) fall outside of the acceptable range, the TAB Report shall be considered invalid and all contract TAB work shall be repeated beginning with the Systems Readiness Check.

3.5.5 Marking of Setting

Following approval of TAB Verification Report, the setting of all HVAC adjustment devices including valves, splitters, and dampers shall be permanently marked by the TAB Specialist so that adjustment can be restored if disturbed at any time.

3.5.6 Identification of Test Ports

The TAB Specialist shall permanently and legibly identify the location

points of duct test ports. If the ductwork has exterior insulation, the identification shall be made on the exterior side of the insulation. All penetrations through ductwork and ductwork insulation shall be sealed to prevent air leakage or to maintain integrity of vapor barrier.

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SECTION 16264A

GENERATOR SET, STANDBY APPLICATIONS
06/02

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C12.11	(1987; R 1993) Instrument Transformers for Revenue Metering, 10 kV BIL through 350 kV BIL (0.6 kV NSV through 69 kV NSV)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 106	(1999el) Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A 135	(1997c) Electric-Resistance-Welded Steel Pipe
ASTM A 181/A 181M	(2000) Carbon Steel Forgings for General-Purpose Piping
ASTM A 234/A 234M	(2000) Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service

ASME INTERNATIONAL (ASME)

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 B16.11	(1996) Forged Fittings, Socket-Welding and Threaded
ASME B31.1	(1998) Power Piping

ELECTRICAL GENERATING SYSTEMS ASSOCIATION (EGSA)

EGSA 101P	(1995a) Engine Driven Generator Sets

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(~~1997~~2002) National Electrical Safety Code
IEEE Std 1	(~~1986; R 1992~~2000) General Principles for Temperature Limits in the Rating of Electric Equipment and for the Evaluation

	of Electrical Insulation
IEEE Std 81	(1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Part 1)
IEEE Std 100	(~~1997~~2000) IEEE Standard Dictionary of Electrical and Electronics Terms
IEEE Std 120	(1989) Electrical Measurements in Power Circuits
IEEE Std 519	(1992) Harmonic Control in Electrical Power Systems

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

MSS SP-58	(1993) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	(1996) Pipe Hangers and Supports - Selection and Application
MSS SP-80	(1997) Bronze Gate, Globe, Angle and Check Valves

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA AB 1	(1993) Molded Case Circuit Breakers and Molded Case Switches
NEMA ICS 6	(1993) Industrial Control and Systems, Enclosures
NEMA MG 1	(1998) Motors and Generators
NEMA PB 1	(1995) Panelboards
NEMA SG 3	(1995) Power Switching Equipment

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 30	(1996; Errata TIA 96-2) Flammable and Combustible Liquids Code
NFPA 37	(1998) Installation and Use of Stationary Combustion Engines and Gas Turbines
NFPA 70	(~~1999~~2002) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 489	(1996; Rev thru Dec 1998) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures

UL 1236 (1994; Rev thru Mar 1999) Battery Chargers for Charging Engine-Starter Batteries

1.2 SYSTEM DESCRIPTION

Each engine-generator set shall be provided and installed complete and totally functional, with all necessary ancillary equipment to include air filtration; starting system; generator controls, protection, and isolation; instrumentation; lubrication; fuel system; cooling system; and engine exhaust system. Each engine generator set shall satisfy the requirements specified in the Engine Generator Parameter Schedule.

1.2.1 Engine-Generator Parameter Schedule

ENGINE GENERATOR PARAMETER SCHEDULE

Service Load	Per Drawings
Power Factor	0.8 lagging
Maximum Speed	1800 rpm
Engine-Generator Application	stand-alone
Engine Cooling Type	water/ethylene glycol
Governor Type	Droop
Frequency Regulation (droop) (No load to full load)	3% (max.)
Phases	3 Phase, Wye

1.2.2 Output Capacity

Each generator set shall provide power equal to the sum of service load plus the machine's efficiency loss and associated ancillary equipment loads. Rated output capacity shall also consider engine and/or generator oversizing required to meet requirements in paragraph Engine-Generator Parameter Schedule.

1.2.3 Power Rating

Standby ratings shall be in accordance with EGSA 101P.

1.3 GENERAL REQUIREMENTS

1.3.1 Engine-Generator Set

Each set shall consist of one engine, one generator, and one exciter, mounted, assembled, and aligned on one base; and all other necessary ancillary equipment which may be mounted separately. Sets shall be assembled and attached to the base prior to shipping. Set components shall be environmentally suitable for the locations shown and shall be the manufacturer's standard product offered in catalogs for commercial or industrial use. A generator strip heater shall be provided for moisture control when the generator is not operating.

1.3.2 Nameplates

Each major component of this specification shall have the manufacturer's name, type or style, model or serial number, and rating number on a plate secured to the equipment. As a minimum, nameplates shall be provided for: Engines; Relays; Generators; s; Transformers (CT & PT); Regulators; Pumps and pump motors; Governors; Generator Breaker; Economizers; Heat exchangers (other than base-mounted).

Engines	Relays
Generators	s
Transformers (CT & PT)	Regulators
Pumps and pump motors	Governors
Generator Breaker	Economizers
Heat exchangers (other than base-mounted)	

Where the following equipment is provided as a standard component by the natural gas-engine generator set manufacturer, the nameplate information may be provided in the maintenance manual in lieu of nameplates.

Battery charger	Heaters
Exhaust mufflers	Exciters
Switchgear	Silencers
Battery	

1.3.3 Personnel Safety Device

Exposed moving parts, parts that produce high operating temperatures, parts which may be electrically energized, and parts that may be a hazard to operating personnel during normal operation shall be insulated, fully enclosed, guarded, or fitted with other types of safety devices. The safety devices shall be installed so that proper operation of the equipment is not impaired.

1.3.4 Verification of Dimensions

Before performing work, the premises shall be visited and details of the work verified. The Contracting Officer shall be advised in writing of any discrepancies before performing any work.

1.3.5 Conformance to Codes and Standards

Where equipment is specified to conform to requirements of any code or standard such as UL, the design, fabrication and installation shall conform to the code.

1.3.6 Site Welding

For all welding procedures and welders shall be qualified in accordance with ASME BPV IX. Welding procedures qualified by others, and welders and welding operators qualified by a previously qualified employer may be accepted as permitted by ASME B31.1. Welder qualification tests shall be performed for each welder whose qualifications are not in compliance with the referenced standards. The Contracting Officer shall be notified 24

hours in advance of qualification tests. The qualification tests shall be performed at the work site if practical. The welder or welding operator shall apply the assigned personal symbol near each weld made as a permanent record

1.3.7 Engine Generator Set Enclosure

The engine generator set enclosure shall be corrosion resistant and fully weather resistant. The enclosure shall contain all set components and provide ventilation to permit operation at rated load under secured conditions. Doors shall be provided for access to all controls and equipment requiring periodic maintenance or adjustment. Removable panels shall be provided for access to components requiring periodic replacement. The enclosure shall be capable of being removed without disassembly of the engine-generator set or removal of components other than exhaust system. The enclosure shall reduce the noise of the generator set to within the limits specified in the paragraph SOUND LIMITATIONS.

1.3.8 Vibration Isolation

The maximum engine-generator set vibration in the horizontal, vertical and axial directions shall be limited to 6 mils (peak-peak RMS), for all speeds through 110% of rated speed.

1.3.9 Experience

Each component manufacturer shall have a minimum of 3 years experience in the manufacture, assembly and sale of components used with stationary natural gas engine-generator sets for commercial and industrial use. The engine-generator set manufacture/assembler shall have a minimum of 3 years experience in the manufacture, assembly and sale of stationary natural gas engine-generator sets for commercial and industrial use.

1.3.10 Field Engineer

The engine-generator set manufacturer or assembler shall furnish a qualified field engineer to supervise the complete installation of the engine-generator set, assist in the performance of the onsite tests, and instruct personnel as to the operational and maintenance features of the equipment. The field engineer shall have attended the engine-generator manufacturer's training courses on installation and operation and maintenance for engine generator sets.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Equipment Performance; G.

Calculations of the engine and generator output power capability, including efficiency and parasitic load data.

Sound Power Level; G

Sound power level data for the packaged unit operating at 100% load in a free field environment. The data should demonstrate compliance with the sound limitation requirements of this specification.

Generator Data; G.

Each generator KW rating and short circuit capacity (both symmetric and asymmetric).

Power Factor Capability Curve; .

Generator capability curve showing generator kVA output (kW vs. kvar) for both leading and lagging power factors ranging from 0 to 1.0.

Heat Rejected to Engine-Generator Space;

Manufacturers data to quantify heat rejected to the space with the engine generator set at rated capacity.

Alarm Setpoints;

The magnitude of monitored values which define alarm or action setpoints, and the tolerance (plus and/or minus) at which the device activates the alarm or action.

Manufacturer's Catalog Data;

Manufacturer's standard catalog data describing and depicting each engine-generator set and all ancillary equipment in sufficient detail to demonstrate specification compliance.

Vibration-Isolation;

Vibration isolation system performance data for the range of frequencies generated by the engine-generator set during operation from no load to full load and the maximum vibration transmitted to the floor. Description of seismic qualification of the engine-generator mounting, base, and vibration isolation.

SD-02 Shop Drawings

Layout and Shop Drawings;

a. Base-mounted equipment, complete with base and attachments including anchor bolt template and recommended clearances for maintenance and operation.

b. Starting system.

c. Fuel system.

d. Cooling system.

e. Exhaust system.

f. Electric wiring of relays, breakers, programmable controllers, and switches including single line and wiring diagrams.

g. Lubrication system, including piping, pumps, strainers, filters,

heat exchangers for lube oil and turbocharger cooling, electric heater, controls and wiring.

h. Location, type, and description of vibration isolation devices.

i. The safety system, including wiring schematics.

j. One-line schematic and wiring diagrams of the generator, exciter, regulator, governor, and all instrumentation.

k. Panel layouts.

l. Mounting and support for each panel and major piece of electrical equipment.

m. Engine-generator set rigging points and lifting instructions.

As-Built Drawings;

Drawings which accurately depict the as-built configuration of the installation, upon acceptance of the natural gas-generator set installation. Layout drawings shall be revised to reflect the as-built conditions and submitted with the as-built drawings.

SD-08 Manufacturer's Instructions

Posted Data;

Posted data including wiring and control diagrams showing the key mechanical and electrical control elements, and a diagrammatic layout of the system.

Instructions;

Instructions including: the manufacturer's pre-start checklist and precautions; startup procedures for test mode, manual-start mode, and automatic-start mode, (as applicable); running checks, procedures, and precautions; and shutdown procedures, checks, and precautions. Instructions shall include procedures for interrelated equipment (such as heat recovery systems, co-generation, load-shedding, and automatic transfer switches). Instructions shall be weatherproof, laminated in plastic, framed, and posted where directed.

SD-06 Test Reports

Onsite Test;

a. A letter giving notice of the proposed dates of all onsite inspections and tests at least 14 days prior to beginning tests.

b. A detailed description of the Contractor's proposed procedures for onsite tests including the test including the test plan and a listing of equipment necessary to perform the tests. Submission shall be at least 7 days prior to beginning tests.

c. Six copies of the onsite test data described below in 8-1/2 x 11 inch 3-ring binders with a separate section for each test. Sections shall be separated by dividers with tabs. Data plots shall be full size 8-1/2 x 11 inches minimum), showing all grid

lines, with full resolution.

(1) A description of the procedures for onsite tests.

(2) A list of equipment used, with calibration certifications.

(3) A copy of measurements taken, with required plots and graphs.

(4) The date of testing.

(5) The parameters verified.

(6) The condition specified for the parameter.

(7) The test results, signed and dated.

(8) A description of all adjustments made.

SD-07 Certificates

Component Manufacturer;

Statement showing that each component manufacturer has a minimum of 3 years experience in the manufacture, assembly and sale of components used with stationary natural gas-engine generator sets for commercial and industrial use.

Manufacturer/Assembler;

Statement showing that the engine-generator set manufacturer/assembler has a minimum of 3 years experience in the manufacture, assembly and sale of stationary natural gas engine-generator sets for commercial and industrial use.

Cooling System;

Certification that the engine-generator set and cooling system function properly in the ambient temperatures specified.

Field Engineer;

A letter listing the qualifications, schools, formal training, and experience of the field engineer.

Welder Qualification;

A letter listing the welder qualifying procedures for each welder, complete with supporting data such as test procedures used, what was tested to, and a list of the names of all welders and their qualifications symbols.

Installation Procedures;

A complete copy of the manufacturer's installation procedures. A detailed description of the manufacturer's recommended break-in procedure.

Torsional Vibration;

Torsional analysis including prototype testing or calculations which certify and demonstrate that no damaging or dangerous torsional vibrations will occur when the prime mover is connected to the generator, at synchronous speeds, plus/minus 10%.

Prototype Tests;

Manufacturer's standard certification that prototype tests were performed for the generator model proposed.

Reliability and Durability;

Documentation which cites engines and generators in similar service to demonstrate compliance with the requirements of this specification. Certification does not exclude annual technological improvements made by a manufacturer in the basic standard model set on which experience was obtained, provided parts interchangeability has not been substantially affected and the current standard model meets all the performance requirements of this specification. For each different set, 2 like sets shall have performed satisfactorily in a stationary power application, independent and separate from the physical location of the manufacturer's and assembler's facilities, for a minimum of 2 consecutive years without any failure to start, including periodic exercise. The certification shall state that for the set proposed to meet this specification, there were no failures resulting in downtime for repairs in excess of 72 hours or any failure due to overheating during 2 consecutive years of service. Like sets are of the same model, speed, bore, stroke, number and configuration of cylinders, and output power rating. Like generators are of the same model, speed, pitch, cooling, exciter, voltage regulator and output power rating. A list shall be provided with the name of the installations, completion dates, and name and telephone number of a point of contact.

Emissions;

A certification from the engine manufacturer stating that the engine exhaust emissions meet federal, state, and local regulations and restrictions specified. At a minimum, this certification shall include emission factors for criteria pollutants including nitrogen oxides, carbon monoxide, particulate matter, sulfur dioxide, non-methane hydrocarbon, and for hazardous air pollutants (HAPs).

Sound limitation;

A certification from the manufacturer stating that the sound emissions meet the specification.

Site Visit;

A site visit letter stating the date the site was visited and listing discrepancies found.

Flywheel Balance;

Manufacturer's certification that the flywheel has been statically and dynamically balanced and is capable of being rotated at 125% of rated speed without vibration or damage.

Standards Compliance;

A letter stating that where materials or equipment are specified to comply with requirements of UL, or other standards, written proof of such compliance has been obtained. The label or listing of the specified agency, or a written certificate from an approved, nationally recognized testing organization equipped to perform such services, stating that the items have been tested and conform to the requirements and testing methods of the specified agency are acceptable as proof.

Factory Tests;

A certification that each engine generator set passed the factory tests and inspections and a list of the test and inspections.

Functional Facilities;

A letter certifying that all facilities are complete and functional, that each system is fully functional, and that each item of equipment is complete, free from damage, adjusted, and ready for beneficial use.

1.5 STORAGE AND INSTALLATION

The Contractor shall properly protect material and equipment in accordance with the manufacturers recommended storage procedures, before, during, and after installation. Stored items shall be protected from the weather and contamination. During installation, piping and similar openings shall be capped to keep out dirt and other foreign matter.

1.6 OPERATION AND MAINTENANCE MANUALS

The operation and maintenance manuals shall be submitted and approved prior to commencing onsite tests.

1.6.1 Operation Manual

Three copies of the manufacturers standard operation manual. The manual shall include:

a. Step-by-step procedures for system startup, operation, and shutdown;

b. Drawings, diagrams, and single-line schematics to illustrate and define the electrical, mechanical, and hydraulic systems with their controls, alarms, and safety systems;

c. Procedures for interface and interaction with related systems to include automatic transfer switches load shedding systems.

1.6.2 Maintenance Manual

Three copies of the manufacturers standard maintenance manual.

a. Procedures for each routine maintenance item. Procedures for troubleshooting. Factory-service, take-down overhaul, and repair service manuals, with parts lists.

b. The manufacturer's recommended maintenance schedule.

c. A component list which includes the manufacturer's name, address, type or style, model or serial number, rating, and catalog number

for the major components listed in paragraph GENERAL REQUIREMENTS.

d. A list of spare parts for each piece of equipment and a complete list of materials and supplies needed for operation.

1.7 SPECIAL TOOLS AND FILTERS

Two sets of special tools and two sets of filters required for maintenance shall be provided. Special tools are those that only the manufacturer provides, for special purposes, or to reach otherwise inaccessible parts. One handset shall be provided for each electronic governor when required to indicate and/or change governor response settings. Two complete sets of filters shall be supplied in a suitable storage box. these filters shall be in addition to filters replaced after testing.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Materials and equipment shall be as specified.

2.1.1 Circuit Breakers, Low Voltage

NEMA AB 1, UL 489, and NEMA SG 3.

2.1.2 Filter Elements (natural gas, Lubricating-oil, and Combustion-air)

Manufacturer's standard.

2.1.3 Instrument Transformers

ANSI C12.11.

2.1.4 Pipe (Sleeves, Fuel/Lube-oil, Compressed-Air, Coolant and Exhaust)

ASTM A 53, ASTM A 106 or ASTM A 135, steel pipe. Pipe smaller than 2 inches shall be Schedule 80. Pipe 2 inches and larger shall be Schedule 40.

2.1.5 Pipe Flanges and Fittings

a. Pipe Flanges and Flanged Fittings: ASTM A 181/A 181M, Class 60, or ASME B16.5, Grade 1, Class 150.

b. Pipe Welding Fittings: ASTM A 234/A 234M, Grade WPB or WPC, Class 150, or ASME B16.11, 3000 lb.

c. Threaded Fittings: ASME B16.3, Class 150.

d. Valves: MSS SP-80, Class 150.

e. Gaskets: Manufacturers Standard.

2.1.6 Pipe Hangers

MSS SP-58 and MSS SP-69.

2.1.7 Electrical Enclosures

2.1.7.1 General

NEMA ICS 6.

2.1.7.2 Panelboards

NEMA PB 1.

2.1.8 Electric Motors

Electric motors shall conform to the requirements of NEMA MG 1. Motors shall have sealed ball bearings, a maximum speed of 1800 rpm and integral automatic or manual reset thermal overload protectors. Motors used indoors shall have drip proof frames; those used outside shall be totally enclosed.

2.2 ENGINE

Each engine shall operate on natural gas, shall be designed for stationary applications and shall be complete with ancilliaries. The engine shall be a standard production model described in the manufacturer's catalog. The engine shall be naturally aspirated, scavenged, supercharged or turbocharged. The engine shall be two- or four-stroke-cycle and compression-ignition type. The engine shall be vertical inline, V-, or opposed-piston type, with a solid cast block or individually cast cylinders. The engine shall have a minimum of two cylinders. Opposed-piston type engines shall have no less than four cylinders. Each block shall have a coolant drain port. Each engine shall be equipped with an overspeed sensor.

2.3 Omitted

2.4 LUBRICATION

Each engine shall have a separate lube-oil system conforming to NFPA 30 and NFPA 37. Each system shall be pressurized by engine-driven oil pumps. Each system shall be furnished with a relief valve for oil pressure regulation (for closed systems) and a dip-stick for oil level indications. The crankcase shall be vented in accordance with the manufacturer's recommendation except that it shall not be vented to the engine exhaust system. Crankcase breathers, if provided on engines installed in buildings or enclosures, shall be piped to vent to the outside. The system shall be readily accessible for service such as draining, refilling, etc. Each system shall permit addition of oil and have oil-level indication with the set operating. The system shall utilize an oil cooler as recommended by the engine manufacturer.

2.4.1 Filter

One full-flow filter shall be provided for each pump. The filter shall be readily accessible and capable of being changed without disconnecting the piping or disturbing other components. The filter shall have inlet and outlet connections plainly marked.

2.4.2 Lube-Oil Sensors

Each engine shall be equipped with lube-oil pressure sensors. Pressure sensors shall be located downstream of the filters and provide signals for

required indication and alarms.

2.5 COOLING

Each engine cooling system shall operate automatically while the engine is running. Each cooling system shall be sized for the maximum summer outdoor design temperature and site elevation. Water-cooled system coolant shall use a combination of water and ethylene-glycol sufficient for freeze protection at the minimum winter outdoor temperature specified. The maximum temperature rise of the coolant across the engine shall be no more than that recommended and submitted in accordance with paragraph SUBMITTALS.

2.5.1 Coolant Pumps

Coolant pumps shall be the centrifugal type. Each engine shall have an engine-driven primary pump. Secondary pumps shall be electric motor driven and have automatic controllers.

2.5.2 Expansion Tank

The cooling system shall include an air expansion tank which will accommodate the expanded water of the system generated within the normal operating temperature range, limiting the pressure increase at all components in the system to the maximum allowable pressure at those components. The tank shall be suitable for an operating temperature of 250 degrees F and a working pressure of 125 psi. The tank shall be constructed of welded steel, tested and stamped in accordance with ASME BPV VIII Div 1 for the stated working pressure. A bladder type tank shall not be used. The tank shall be supported by steel legs or bases for vertical installation or steel saddles for horizontal installation.

2.5.3 Temperature Sensors

Each engine shall be equipped with coolant temperature sensors. Temperature sensors shall provide signals for pre-high and high indication and alarms.

2.6 AIR INTAKE EQUIPMENT

Filters and silencers shall be provided in locations that are convenient for servicing. The silencer shall be of the high-frequency filter type, located in the air intake system as recommended by the engine manufacturer. A combined filter-silencer unit meeting requirements for the separate filter and silencer items may be provided.

2.7 EXHAUST SYSTEM

The system shall be separate and complete for each engine. Piping shall be supported so as to minimize vibration. Where a V-type engine is provided, a V-type connector with necessary flexible sections and hardware shall connect the engine exhaust outlets.

2.7.1 Flexible Sections and Expansion Joints

A flexible section at each engine and an expansion joint at each muffler shall be provided. Flexible sections and expansion joints shall have flanged connections. Flexible sections shall be made of convoluted seamless tube without joints or packing. Expansion joints shall be the bellows type. Expansion and flexible elements shall be stainless steel

suitable for natural gas-engine exhaust gas at the maximum exhaust temperature that is specified by the engine manufacturer. Expansion and flexible elements shall be capable of absorbing vibration from the engine and compensation for thermal expansion and contraction.

2.7.2 Exhaust Muffler

A chamber type exhaust muffler shall be provided. The muffler shall be constructed of welded steel and designed for outside mounting. Eyebolts, lugs, flanges, or other items shall be provided as necessary for support in the location and position indicated. Pressure drop through the muffler shall not exceed the recommendations of the engine manufacturer. Outside mufflers shall be zinc coated or painted with high temperature 400 degrees F resisting paint. The muffler and exhaust piping together shall reduce the noise level to less than the maximum acceptable level. The muffler shall have a drain valve, nipple, and cap at the low-point of the muffler.

2.7.3 Exhaust Piping

Horizontal sections of exhaust piping shall be sloped downward away from the engine to a condensate trap and drain valve. Changes in direction shall be long-radius. Exhaust piping, mufflers and silencers installed inside any building shall be insulated in accordance with paragraph THERMAL INSULATION and covered to protect personnel. Vertical exhaust piping shall be provided with a hinged, gravity operated, self-closing, rain cover.

2.8 EMISSIONS

The finished installation shall comply with Federal, state, and local regulations and restrictions regarding the limits of emissions.

2.9 STARTING SYSTEM

The starting system for standby engine generator sets used in emergency applications shall be in accordance with NFPA 99 and NFPA 110 and as follows.

2.9.1 Controls

An engine control switch shall be provided with functions including: run/start (manual), off/reset, and automatic mode. Start-stop logic shall be provided for adjustable cycle cranking and cool down operation. The logic shall be arranged for manual starting and fully automatic starting in accordance with paragraph AUTOMATIC ENGINE-GENERATOR SET SYSTEM OPERATION. Electrical starting systems shall be provided with an adjustable cranking limit device to limit cranking periods from 1 second up to the maximum duration.

2.9.2 Capacity

The starting system shall be of sufficient capacity, at the maximum outdoor summer temperature specified to crank the engine without damage or overheating. The system shall be capable of providing a minimum of three cranking periods with 15-second intervals between cranks. Each cranking period shall have a maximum duration of 15 seconds.

2.9.3 Functional Requirements

Starting system shall be manufacturers recommended dc system utilizing a

negative circuit ground. Starting motors shall be in accordance with SAE ARP 892.

2.9.4 Battery

A starting battery system shall be provided and shall include the battery, battery rack, intercell connectors, and spacers. The battery shall be in accordance with SAE J 537. Critical system components (rack, protection, etc.) shall be sized to withstand the seismic acceleration forces specified. Valve-regulated lead-acid batteries are not acceptable.

2.9.5 Battery Charger

A current-limiting battery charger, conforming to UL 1236, shall be provided and shall automatically recharge the batteries. The charger shall be capable of an equalize charging rate for recharging fully depleted batteries within 24 hours and a float charge rate for maintaining the batteries in prime starting condition. An ammeter shall be provided to indicate charging rate. A timer shall be provided for the equalize charging rate setting. A battery is considered to be fully depleted when the output voltage falls to a value which will not operate the engine generator set and its components.

2.9.6 Starting Aids

The manufacturer shall provide one or more of the following methods to assist engine starting.

2.9.6.1 Glow Plugs

Glow plugs shall be designed to provide sufficient heat for combustion of fuel within the cylinders to guarantee starting at an ambient temperature of minus 25 degrees F.

2.9.6.2 Jacket-Coolant Heaters

A thermostatically controlled electric heater shall be mounted in the engine coolant jacketing to automatically maintain the coolant within plus or minus 3 degrees of the control temperature. The heater shall operate independently of engine operation so that starting times are minimized. The control temperature shall be the temperature recommended by the engine manufacturer to meet the starting time specified.

2.10 GOVERNOR

Each engine shall be provided with a governor which maintains the frequency within a bandwidth of the rated frequency, over a steady-state load range of zero to 100% of rated output capacity. The governor shall be configured for safe manual adjustment of the speed/frequency during operation of the engine generator set, without special tools, from 90 to 110 % of the rated speed/frequency, over a steady state load range of zero to 100% of rated capacity.

2.11 GENERATOR

Each generator shall be of the synchronous type, one or two bearing, conforming to NEMA MG 1, equipped with winding terminal housings in accordance with NEMA MG 1, equipped with an amortisseur winding, and directly connected to the engine. Generator design shall protect against

mechanical, electrical and thermal damage due to vibration, 25 percent overspeeds, or voltages and temperatures at a rated output capacity of 100 percent. Generator ancillary equipment shall meet the short circuit requirements of NEMA MG 1. Frames shall be the drip-proof type.

2.11.1 Current Balance

At 100 percent rated load, and load impedance equal for each of the three phases, the permissible current difference between any two phases shall not exceed 2 percent of the largest current on either of the two phases.

2.11.2 Voltage Balance

At any balanced load between 75 and 100 percent of rated load, the difference in line-to-neutral voltage among the three phases shall not exceed 1 percent of the average line-to-neutral voltage. For a single-phase load condition, consisting of 25 percent load at unity power factor placed between any phase and neutral with no load on the other two phases, the maximum simultaneous difference in line-to-neutral voltage between the phases shall not exceed 3 percent of rated line to neutral voltage. The single-phase load requirement shall be valid utilizing normal exciter and regulator control. The interpretation of the 25 percent load for single phase load conditions means 25 percent of rated current at rated phase voltage and unity power factor.

2.11.3 Waveform

The deviation factor of the line-to-line voltage at zero load and at balanced full rated load at 0.8 power factor shall not exceed 10%. The RMS of all harmonics shall be less than 5.0% and that of any one harmonic less than 3.0% at full rated load. Each engine-generator shall be designed and configured to meet the total harmonic distortion limits of IEEE Std 519.

2.12 EXCITER

The generator exciter shall be of the brushless type. Semiconductor rectifiers shall have a minimum safety factor of 300% for peak inverse voltage and forward current ratings for all operating conditions, including 110% generator output at 104 degrees F ambient. The exciter and regulator in combination shall maintain generator-output voltage within the limits specified.

2.13 VOLTAGE REGULATOR

Each generator shall be provided with a solid-state voltage regulator, separate from the exciter. The regulator shall maintain the voltage within a bandwidth of the rated voltage, over a steady-state load range of zero to 100% of rated output capacity. Regulator shall be configured for safe manual adjustment of the engine generator voltage output without special tools, during operation from 90 to 110% of the rated voltage over the steady state load range of zero to 100% of rated output capacity. Regulation drift shall not exceed plus or minus 0.5% for an ambient temperature change of 36 degrees F.

2.13.1 Steady State Performance (Regulation or Voltage Droop).

The voltage regulator shall have a maximum droop of 2% of rated voltage over a load range from 0 to 100% of rated output capacity and automatically maintain the generator output voltage within the specified operational

bandwidth.

2.14 GENERATOR PROTECTION

Short circuit and overload protection for the generator shall be provided. The generator circuit breaker (IEEE Device 52) ratings shall be consistent with the generator rated voltage and frequency, with continuous, short circuit and interrupting current ratings to match the generator capacity. The manufacturer shall determine the short circuit current interrupting rating of the breaker. The breaker shall be engine generator base mounted by the engine-generator set manufacturer. Molded case breakers shall be provided with shunt trip. Surge protection shall be provided for each phase of the generator, to be mounted at the generator terminals.

2.15 SAFETY SYSTEM

Devices, wiring, remote panels, local panels, etc., shall be provided and installed as a complete system to automatically activate the appropriate signals and initiate the appropriate actions. The safety system shall be provided with a self-test method to verify its operability. Alarm signals shall have manual acknowledgement and reset devices. The alarm signal systems shall reactivate for new signals after acknowledgment is given to any signal. The systems shall be configured so that loss of any monitoring device shall be dealt with as an alarm on that system element.

2.16 ENGINE GENERATOR SET CONTROLS AND INSTRUMENTATION

Devices, wiring, remote panels, local panels, etc., shall be provided and installed as a complete system to automatically activate the appropriate signals and initiate the appropriate actions.

2.16.1 Controls

A local control panel shall be provided with controls in accordance with NFPA 110 level 1.

2.17 AUTOMATIC ENGINE-GENERATOR-SET SYSTEM OPERATION

Fully automatic operation shall be provided for the following operations: engine-generator set starting and source transfer upon loss of normal source; retransfer upon restoration of the normal source; sequential starting; and stopping of each engine-generator set after cool down. Devices shall automatically reset after termination of their function.

2.17.1 Automatic Transfer Switch

Automatic transfer switches shall be in accordance with Section 16410 AUTOMATIC TRANSFER AND BY-PASS/ISOLATION SWITCHES.

2.17.2 Monitoring and Transfer

Devices shall be provided to monitor voltage and frequency for the normal power source and each engine generator set, and control transfer from the normal source and retransfer upon restoration of the normal source. Functions, actuation, and time delays shall be as described in Section 16410 AUTOMATIC TRANSFER AND BY-PASS/ISOLATION SWITCHES.

2.18 MANUAL ENGINE-GENERATOR SET SYSTEM OPERATION

Complete facilities shall be provided for manual starting and testing of each set without load, loading and unloading of each set.

2.19 BASE

The base shall be constructed of steel. The base shall be designed to rigidly support the engine-generator set, ensure permanent alignment of all rotating parts, be arranged to provide easy access to allow changing of lube-oil, and ensure that alignment will be maintained during shipping and normal operation. The base shall permit skidding in any direction during installation and shall be provided with suitable holes for foundation bolts. The base shall also withstand and mitigate the effects of synchronous vibration of the engine and generator.

2.20 PAINTING AND FINISHING

The engine-generator set shall be cleaned, primed and painted in accordance with the manufacturer's standard color and practice.

2.21 FACTORY INSPECTION AND TESTS

Factory inspection and tests shall be performed on each engine-generator set proposed to meet this specification section. Inspections shall be completed and necessary repairs made prior to testing. Inspectors shall look for leaks, looseness, defects in components, and proper assembly. Factory tests shall be NEMA MG 1 routine tests and the manufacturers routine tests.

PART 3 EXECUTION

3.1 GENERAL

Installation shall provide clear space for operation and maintenance in accordance with NFPA 70 and IEEE C2. Installation of pipe, duct, conduit, and ancillary equipment shall be configured to facilitate easy removal and replacement of major components and parts of the engine-generator set.

3.2 PIPING INSTALLATION

3.2.1 General

Piping shall be welded. Connections at valves shall be flanged. Connections at equipment shall be flanged except that connections to the natural gas engine may be threaded if the natural gas-engine manufacturer's standard connection is threaded. Except as otherwise specified, flanged fittings shall be utilized to allow for complete dismantling and removal of each piping system from the facility without disconnecting or removing any portion of any other system's equipment or piping. Connections to all equipment shall be made with flexible connectors. Pipes extending through the roof shall be properly flashed. Piping shall be installed clear of windows, doors, and openings to permit thermal expansion and contraction without damage to joints or hangers, and with a 1/2 inch drain valve at each low point.

3.2.2 Supports

Hangers, inserts, and supports shall be of sufficient size to accommodate

any insulation and shall conform to MSS SP-58 and MSS SP-69. Supports shall be spaced not more than 7 feet on center for pipes 2 inches in diameter or less, not more than 12 feet on center for pipes larger than 2 inches but no larger than 4 inches, and not more than 17 feet on center for pipes larger than 4 inches in diameter. Supports shall be provided at pipe bends or change of direction.

3.2.2.1 Ceiling and Roof

Exhaust piping shall be supported with appropriately sized type 41 single pipe roll and threaded rods; all other piping shall be supported with appropriately sized type 1 clevis and threaded rods.

3.2.2.2 Wall

Wall supports for pipe shall be made by suspending the pipe from appropriately sized type 33 brackets with the appropriate ceiling and roof pipe supports.

3.2.3 Flanged Joints

Flanges shall be 125 pound type, drilled, and of the proper size and configuration to match equipment and natural gas-engine connections. Gaskets shall be factory cut in one piece 1/16 inch thick.

3.2.4 Cleaning

After fabrication and before assembly, piping interiors shall be manually wiped clean of all debris.

3.2.5 Pipe Sleeves

Pipes passing through construction such as ceilings, floors, or walls shall be fitted with sleeves. Each sleeve shall extend through and be securely fastened in its respective structure and shall be cut flush with each surface. The structure shall be built tightly to the sleeve. The inside diameter of each sleeve shall be 1/2 inch, and where pipes pass through combustible materials, 1 inch larger than the outside diameter of the passing pipe or pipe covering.

3.3 ELECTRICAL INSTALLATION

Electrical installation shall comply with NFPA 70, IEEE C2, and Section 16415 ELECTRICAL WORK, INTERIOR.

3.3.1 Vibration Isolation

Flexible fittings shall be provided for all conduit, cable trays, and raceways attached to engine-generator sets. Metallic conductor cables installed on the engine generator set and from the engine generator set to equipment not mounted on the engine generator set shall be flexible stranded conductor. Terminations of conductors on the engine generator set shall be crimp-type terminals or lugs.

3.4 FIELD PAINTING

Field painting shall be as specified in Section 09900 PAINTING, GENERAL.

3.5 ONSITE INSPECTION AND TESTS

3.5.1 Test Conditions

3.5.1.1 Data

Measurements shall be made and recorded of parameters necessary to verify that each set meets specified parameters. If the results of any test step are not satisfactory, adjustments or replacements shall be made and the step repeated until satisfactory results are obtained. Unless otherwise indicated, data shall be taken during engine-generator set operation and recorded in 15 minute intervals and shall include: readings of engine-generator set meters and gauges for electrical and power parameters; oil pressure; ambient temperature; and engine temperatures available from meters and gauges supplied as permanent equipment on the engine-generator set. In the following tests where measurements are to be recorded after stabilization of an engine-generator set parameter (voltage, frequency, current, temperature, etc.), stabilization is considered to have occurred when measurements are maintained within the specified bandwidths or tolerances, for a minimum of four consecutive readings.Electrical measurements shall be performed in accordance with IEEE Std 120. Definitions and terms are in accordance with IEEE Std 100. Temperature limits in the rating of electrical equipment and for the evaluation of electrical insulation shall be in accordance with IEEE Std 1.

3.5.1.2 Power Factor

Engine-generator set operating tests shall be made utilizing a load with the power factor specified in the engine generator set parameter schedule.

3.5.1.3 Contractor Supplied Items

The Contractor shall provide all equipment and supplies required for inspections and tests including fuel, test instruments, and loadbanks at the specified power factors.

3.5.1.4 Instruments

Readings of panel gauges, meters, displays, and instruments, provided under this specification shall be verified during test runs by test instruments of precision and accuracy greater than the tested items. Test instrument accuracy shall be at least as follows: current, 1.5%; voltage, 1.5%; real power, 1.5%; reactive power, 1.5%; power factor, 3%; frequency, 0.5%. Test instruments shall be calibrated by a recognized standards laboratory within 30 days prior to testing.

3.5.1.5 Sequence

The sequence of testing shall be as specified in the approved testing plan unless variance in authorized by the Contracting Officer. Field testing shall be performed in the presence of the Contracting Officer. Tests may be scheduled and sequenced in order to optimize run-time periods; however the following general order of testing shall be followed: Construction Tests; Inspections; Safety run Tests; and Performance Tests and Final Inspection.

3.5.2 Construction Tests

Individual component and equipment functional tests for fuel piping,

coolant piping, and lubricating-oil piping, electrical circuit continuity, insulation resistance, circuit protective devices, and equipment not provided by the engine-generator set manufacturer shall be performed prior to connection to the engine-generator set.

3.5.2.1 Omitted

3.5.2.2 Electrical Equipment Tests

a. Low-voltage cable insulation integrity tests shall be performed for cables connecting the generator breaker to the automatic transfer switch. Low-voltage cable, complete with splices, shall be tested for insulation resistance after the cables are installed, in their final configuration, ready for connection to the equipment, and prior to energization. The test voltage shall be 500 volts dc, applied for one minute between each conductor and ground and between all possible combinations conductors in the same trench, duct, or cable, with all other conductors in the same trench, duct, or conduit. The minimum value of insulation shall be:

   R in megohms = (rated voltage in kV + 1) x 304,800/(length of cable in meters).

   (R in megohms = (rated voltage in kV + 1) x 1000/(length of cable in feet)

   Each cable failing this test shall be repaired or replaced. The repaired cable shall be retested until failures have been eliminated.

b. Ground-Resistance Tests. The resistance of each grounding electrode shall be measured using the fall-of-potential method defined in IEEE Std 81. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

   1) Single rod electrode - 25 ohms.

d. Circuit breakers and switchgear shall be examined and tested in accordance with manufacturer's published instructions for functional testing.

3.5.3 Inspections

The following inspections shall be performed jointly by the Contracting Officer and the Contractor, after complete installation of each engine-generator set and its associated equipment, and prior to startup of the engine-generator set. Checks applicable to the installation shall be performed. The results of those which are physical inspections (I) shall be documented by the Contractor and submitted in accordance with paragraph SUBMITTALS. The Contractor shall present manufacturer's data for the inspections designated (D) at the time of inspection. Inspections shall verify that equipment type, features, accessibility, installation and

condition are in accordance with the contract specification. Manufacturer's statements shall certify provision of features which cannot be verified visually.

1. Drive belts. (I)
2. Governor type and features. (I)
3. Engine timing mark. (I)
4. Starting motor. (I)
5. Starting aids. (I)
6. Coolant type and concentration. (D)
7. Radiator drains. (I)
8. Block coolant drains. (I)
9. Coolant fill level. (I)
10. Coolant line connections. (I)
11. Coolant hoses. (I)
12. Combustion air filter. (I)
13. Intake air silencer. (I)
14. Lube oil type. (D)
15. Lube oil drain. (I)
16. Lube-oil filter. (I)
17. Lube-oil-fill level. (I)
18. Lube-oil line connections. (I)
19. Lube-oil lines. (I)
20. Fuel type. (D)
21. Fuel-level. (I)
22. Fuel-line connections. (I)
23. Fuel lines. (I)
24. Fuel filter. (I)
25. Access for maintenance. (I)
26. Voltage regulator. (I)
27. Battery-charger connections. (I)
28. Wiring & terminations. (I)
29. Instrumentation. (I)
30. Hazards to personnel. (I)
31. Base. (I)
32. Nameplates. (I)
33. Paint. (I)
34. Exhaust system. (I)
35. Access provided to controls. (I)
36. Enclosure. (I)
37. Engine & generator mounting bolts (proper application). (I)

3.5.4 Safety Run Tests

a. Perform and record engine manufacturer's recommended prestarting checks and inspections.

b. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period.

c. Activate the manual emergency stop switch and verify that the engine stops.

d. Remove the high and pre-high lubricating oil temperature sensing elements from the engine and temporarily install temperature gauge in their normal locations on the engine (required for safety, not for recorded data). Where necessary, provide temporary wiring harness to connect the sensing elements to their permanent

electrical leads.

e. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections and operate the engine generator-set at no load until the output voltage and frequency stabilize. Monitor the temporarily installed temperature gauges. If temperature reading exceeds the value for an alarm condition, activate the manual emergency stop switch.

f. Immerse the elements in a vessel containing controlled-temperature hot oil and record the temperature at which the pre-high alarm activates and the temperature at which the engine shuts down. Remove the temporary temperature gauges and reinstall the temperature sensors on the engine.

g. Remove the high and pre-high coolant temperature sensing elements from the engine and temporarily seal their normal location on the engine and temporarily install temperature gauges in their normal locations on the engine (required for safety, not for recorded data). Where necessary provide temporary wiring harness to connect the sensing elements to their permanent electrical leads.

h. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections and operate the engine generator-set at no load until the output voltage and frequency stabilize.

i. Immerse the elements in a vessel containing controlled-temperature hot oil and record the temperature at which the pre-high alarm activates and the temperature at which the engine shuts down. Remove the temporary temperature gauges and reinstall the temperature sensors on the engine.

j. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period.

k. Operate the engine generator-set for at least 30 minutes at 100 percent of service load.

l. Verify proper operation of the governor and voltage regulator.

m. Verify proper operation and setpoints of gauges and instruments.

n. Verify proper operation of ancillary equipment.

o. Manually adjust the governor to increase engine speed past the overspeed limit. Record the RPM at which the engine shuts down.

p. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections and operate the engine generator-set for at least 15 minutes at 75 percent of rated load.

q. Omitted

r. Shut down the engine. Remove the time-delay low lube oil pressure alarm bypass and try to start the engine. Record the results.

s. Attach a manifold to the engine oil system (at the oil sensor pressure port) that contains a shutoff valve in series with a connection for the engine's oil pressure sensor followed by an oil pressure gauge ending with a bleed valve. The engine's oil pressure sensor shall be moved from the engine to the manifold and its normal location on the engine temporarily sealed. The manifold shutoff valve shall be open and bleed valve closed.

t. Start the engine, record the starting time, make and record all engine manufacturer's after-starting checks and inspections and operate the engine generator-set for at least 15 minutes at 75 percent of service load.

u. Close the manifold shutoff valve. Slowly allow the pressure in the manifold to bleed off through the bleed valve while watching the pressure gauge. Record the pressure at which the engine shuts down. Catch oil spillage from the bleed valve in a container. Add the oil from the container back to the engine, remove the manifold, and reinstall the engine's oil pressure sensor on the engine.

v. Start the engine, record the starting time, make and record all engine manufacturer's after-starting checks and inspections and operate the engine generator-set for at least 15 minutes at 100% of service load. Record the maximum sound level in each frequency band at a distance of 75 feet from the end of the exhaust and air intake piping directly along the path of intake and discharge horizontal piping; or at a radius of 75 feet from the engine at 45 degrees apart in all directions for vertical piping. The measurements should comply with the paragraph SOUND LIMITATIONS.

3.5.5 Performance Tests

3.5.5.1 Continuous Engine Load Run Test

The engine-generator set and ancillary systems shall be tested at service load to: demonstrate durability; verify that heat of extended operation does not adversely affect or cause failure in any part of the system; and check all parts of the system. If the engine load run test is interrupted for any reason, the entire test shall be repeated. After each change in load in the following test, measure the vibration at the end bearings (front and back of engine, outboard end of generator) in the horizontal, vertical, and axial directions. Verify that the vibration is within the allowable range. Measurements are to be recorded after stabilization of an engine-generator set parameter (voltage, frequency, current, temperature, etc.). Stabilization is considered to have occurred when measurements are maintained within the specified bandwidths or tolerances, for a minimum of four consecutive readings. Data taken at 15 minutes intervals shall include the following:

a. Electrical: Output amperes, voltage, real and reactive power, power factor, frequency.

b. Pressure: Lube-oil.

c. Temperature: Coolant.
Lube-oil.
Ambient.

(1) Perform and record engine manufacturer's recommended prestarting checks and inspections. Include as a minimum checking of coolant fluid, fuel, and lube-oil levels.

(2) Start the engine; make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period.

(3) Operate the engine generator-set for at least 2 hours at 75 percent of service load.

(4) Increase load to 100%of service load and operate the engine generator-set for at least 2 hours.

(5) Remove load from the engine-generator set.

3.5.5.2 Load Acceptance Test

Engine manufacturer's recommended prestarting checks and inspections shall be performed and recorded. The engine shall be started, and engine manufacturer's after-starting checks and inspections made and recorded during a reasonable warm-up period. For the following steps, the output line-line and line-neutral voltages and frequency shall be recorded after performing each step instruction (after stabilization of voltage and frequency). Stabilization is considered to have occurred when measurements are maintained within the specified bandwidths or tolerances, for a minimum of four consecutive readings.

a. Apply load in steps no larger than the Maximum Step Load Increase to load the engine-generator set to 100 of Service Load.

b. Verify that the engine-generator set responds to the load addition and that the output voltage returns to and stabilizes within the rated bandwidths.

3.5.6 Automatic Operation Tests for Stand-Alone Operation

The automatic loading system shall be tested to demonstrate automatic starting, and loading and unloading of each engine-generator set. The loads for this test shall utilize the actual loads to be served, and the loading sequence shall be the indicated sequence. Perform this test for a minimum of two successive, successful tests. Data taken shall include the following:

a. Ambient temperature (at 15 minute intervals).

b. Generator output current (before and after load changes).

c Generator output voltage (before and after load changes).

d. Generator output frequency (before and after load changes.)

1. Initiate loss of the primary power source and verify automatic sequence of operation.

2. Restore the primary power source and verify sequence of operation.

3. Verify resetting of controls to normal.

3.6 FINAL INSPECTION AND TESTING

a. Start the engine, record the starting time, make and record all engine manufacturer's after-starting checks and inspections during a reasonable warm-up period.

b. Increase the load in steps no greater than the maximum step load increase to 100% of service load, and operate the engine-generator set for at least 30 minutes. Measure the vibration at the end bearings (front and back of engine, outboard end of generator) in the horizontal, vertical, and axial directions. Verify that the vibration is within the same range as previous measurements and is within the required range.

c. Remove load and shut down the engine-generator set after the recommended cool down period. Perform the pre-test inspections and take necessary corrective actions.

d. Remove the lube oil filter and have the oil and filter examined by the engine manufacturer for excessive metal, abrasive foreign particles, etc. Any corrective action shall be verified for effectiveness by running the engine for 4 hours at service load, then re-examining the oil and filter.

e. Remove the fuel filter and examine the filter for trash, abrasive foreign particles, etc.

f. Visually inspect and check engine and generator mounting bolts for tightness and visible damage.

g. Replace air, oil, and fuel filters with new filters.

3.7 MANUFACTURER'S FIELD SERVICE

3.7.1 Onsite Training

The Contractor shall conduct training course for operating staff as designated by the Contracting Officer. The training period shall consist of a total 4 hours of normal working time and shall start after the system is functionally completed but prior to final acceptance. The course instructions shall cover pertinent points involved in operating, starting, stopping, servicing the equipment, as well as all major elements of the operation and maintenance manuals. Additionally, the course instructions shall demonstrate all routine maintenance operations such as oil change, oil filter change, and air filter change.

3.7.2 Manufacturer's Representative

The engine generator-set manufacturer shall furnish a qualified representative to supervise the installation of the engine generator-set, assist in the performance of the onsite tests, and instruct personnel as to the operational and maintenance features of the equipment.

3.8 INSTRUCTIONS

Two sets of instructions shall be typed and framed under weatherproof laminated plastic, and posted side-by-side where directed before acceptance. First set of instructions shall include a one-line diagram,

wiring and control diagrams and a complete layout of the system. Second set of instructions shall include the condensed operating instructions describing manufacturer's pre-start checklist and precautions; start procedures for test-mode, manual-start mode, and automatic-start mode (as applicable); running checks, procedures, and precautions; and shutdown procedures, checks, and precautions. Instructions shall include procedures for interrelated equipment (such as heat recovery systems, co-generation, load-shedding, and automatic transfer switches).

3.9 ACCEPTANCE

Final acceptance of the engine-generator set will not be given until the Contractor has successfully completed all tests and after all defects in installation material or operation have been corrected.

-- End of Section --

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SECTION 16265A

UNINTERRUPTIBLE POWER SUPPLY (UPS) SYSTEM ABOVE 15 KVA CAPACITY

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SECTION 16265A

UNINTERRUPTIBLE POWER SUPPLY (UPS) SYSTEM ABOVE 15 KVA CAPACITY
09/98

PART 1 GENERAL

1.1 REFERENCES

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

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE ANSI/IEEE C57.110	(1998) Establishing Transformer Capability When Supplying Nonsinusoidal Load Currents
IEEE C62.41	(1991; R 1995) Surge Voltages in Low-Voltage AC Power Circuits
IEEE Std 450	(1995) Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications
IEEE Std 485	(1997) Recommended Practice for Sizing Large Lead Storage Batteries for Generating Stations and Substations

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION

NEMA PE 1	(1992) Uninterruptible Power Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

UPS System; G
Installation;

Detail drawings consisting of a complete list of equipment and materials, manufacturer's descriptive and technical literature, battery sizing calculations per IEEE Std 485, installation instructions, single-line diagrams, ladder-type schematic diagrams, elevations, layout drawings, and details required to demonstrate that the system has been coordinated and will function properly as a unit.

SD-03 Product Data

Performance Requirements; G

Pertinent performance data for the UPS system, using a copy of the data sheets supplied with this specification. Data sheets shall be certified by a responsible officer of the UPS manufacturer.

Spare Parts;

Spare parts data for each different item of material and equipment specified, not later than the date of beneficial occupancy. The data shall include a complete list of parts and supplies with current unit prices and source of supply and an itemized price breakdown of spare parts recommended for stocking. The recommended spare parts selected shall be those which, in the manufacturer's judgment, will be involved in the majority of maintenance difficulties encountered.

Field Training; G

Lesson plans and training manuals for the training phases, including type of training to be provided and proposed dates, with a list of reference materials.

SD-06 Test Reports

Factory Testing;
Field Supervision, Startup and Testing;

A detailed description of proposed factory test and field test procedures, including proposed dates and steps outlining each test, how it is to be performed, what it accomplishes, and its duration, not later than 2 months prior to the date of each test.

Factory and field test reports in booklet form tabulating factory and field tests and measurements performed, upon completion and testing of the installed system. Factory and field test reports shall be signed by an official authorized to certify on behalf of the manufacturer of the UPS system that the system meets specified requirements. The reports shall be dated after the award of this contract, shall state the Contractor's name and address, shall name the project and location, and shall list the specific requirements which are being certified.

1.3 SYSTEM DESCRIPTION

The UPS system shall consist of UPS module, battery system, battery protective device, system cabinet, static bypass transfer switch, controls and monitoring. Input ac power shall be connected to the normal source ac input of the UPS module. The battery shall be connected to the dc input of the UPS module through the battery protective device. The ac output of the UPS system shall be connected to the critical loads.

1.3.1 UPS Module and Battery System

UPS module shall contain required input isolation transformer, rectifier/charger unit, inverter unit and controls, battery protective device, and any other specified equipment/devices. Battery system shall

contain the battery cells, racks, battery disconnect, battery monitor and cabinet, if required.

1.3.2 Cabinet, Static Bypass Transfer Switch, Control and Monitoring

The UPS system shall include the system cabinet, static bypass transfer switch, system protective devices, monitoring and controls, means of isolating the system from the critical load, and remote monitoring interfaces.

1.3.3 Design Requirements

1.3.3.1 Parts and Materials

Parts and materials comprising the UPS system shall be new, of current manufacture, of a high grade and free of defects and imperfections, and shall not have been in prior service except as required during aging and factory testing.

1.3.3.2 Components

Active electronic devices shall be solid state. Semiconductor devices shall be sealed. Relays shall be dust-tight.

1.3.3.3 Semiconductor Fusing

Power semiconductors shall be fused to prevent cascaded or sequential semiconductor failures. Indicator lamp denoting blown fuse conditions shall be readily observable by the operator without removing panels or opening cabinet doors.

1.3.3.4 Interchangeability

The subassemblies in one UPS module shall be interchangeable with the corresponding modules within the same UPS, and from one UPS system to another of identical systems.

1.3.3.5 Control Power

Control power shall be derived from two sources, input and output, with automatic selective control. The control power circuit shall have suitable protection, appropriately marked and located in the immediate vicinity of the input protective device.

1.3.3.6 EMI/RFI Protection

The components and the system shall be designed to minimize the emission of electromagnetic waves that may cause interference with other equipment.

1.3.3.7 Wiring

Wiring practices, materials, and coding shall be in accordance with the requirements of NFPA 70 and other applicable standards. Wire runs shall be protected in a manner which separates power and control wiring. Control wiring shall be minimum No. 16 AWG extra-flexible stranded copper. Logic-circuit wiring may be smaller. Ribbon cables shall be minimum No. 22 AWG. Control wiring shall have permanently attached wire numbers.

1.3.3.8 Terminations

Terminals shall be supplied for making power and control connections. Terminal blocks shall be provided for field wiring terminals. Terminal blocks shall be heavy-duty, strap-screw type. Terminal blocks for field wiring shall be located in one place in each module and in the system cabinet. Control wiring shall be extended to the terminal block location. No more than two wires shall land on any terminal point. Where control wiring is attached to the same point as power wiring, a separate terminal shall be provided. If bus duct is used, bus stubs shall be provided where bus duct enters cabinets.

1.3.3.9 Internal Assembly

The subassemblies shall be mounted in pull-out and/or swing-out trays where feasible. Cable connections to the trays shall be sufficiently long to allow easy access to all components. Where not feasible to mount subassemblies in pull-out or swing-out trays, they shall be firmly mounted inside the enclosure. Test points or logic indicators shall be labeled and located on the front edge of the control logic cards, if used.

1.3.3.10 Cabinet Structure

UPS system shall be installed in cabinets of heavy-duty structure meeting the NEMA PE 1 standards for floor mounting. UPS module cabinet shall be structurally adequate for forklift handling or lifting. Removable lifting eyes shall be provided on top of each cabinet. UPS module cabinet shall have hinged and lockable doors on the front only, with assemblies and components accessible from the front. Doors shall be key lockable. Operating controls shall be located outside the locked doors. Input, output, and battery cables shall be installed through the top or bottom of the cabinet.

1.3.3.11 Cabinet Finish

Equipment cabinet shall be cleaned, primed and painted in the manufacturer's standard colors, in accordance with accepted industry standards.

1.3.3.12 Mimic Bus

If painted, mimic bus and other front-panel markings (such as those showing circuit breakers or switches and fuses) shall be painted with durable acrylic-based paint.

1.3.3.13 Live Parts (300 Volts and Above)

Live parts (300 volts and above) that are exposed when front access doors are open shall be adequately protected or covered to minimize the chance of accidental contact.

1.3.3.14 Drawout Assemblies

Drawout assemblies weighing 50 lbs or more shall be provided with a means of lifting, either an overhead device or a hoisting device.

1.3.3.15 Safety

UPS shall be equipped with instruction plates including warnings and

cautions, suitably located, describing any special or important procedures to be followed in operating and servicing the equipment.

1.3.4 Performance Requirements

1.3.4.1 Normal Operation

The UPS module rectifier/charger shall convert the incoming ac input power to dc power for the inverter and for float charging the battery. The inverter shall supply ac power continuously. Inverter output shall be synchronized with the bypass ac power source, provided that the bypass ac power source is within the specified frequency range. The UPS system shall supply ac power to the critical loads.

1.3.4.2 Loss of ac Input Power

The battery shall supply dc power to the inverter so that there is no interruption of ac power to the critical load whenever the ac input power source deviates from the specified tolerances or fails completely. The battery shall continue to supply power to the inverter for the specified protection time. At the same time, an alarm shall sound to alert operating personnel, allowing startup of a secondary power source or orderly shutdown of the critical load.

1.3.4.3 Return of ac Input Power Source

The rectifier/charger shall start and assume the dc load from the battery when the ac input power source returns. The rectifier/charger shall then simultaneously supply the inverter with dc power and recharge the battery. This shall be an automatic function and shall cause no disturbance to the critical load.

1.3.4.4 Failure of ac Input Power to Return

Should the ac input power fail to return before the battery voltage reaches the discharge limit, the UPS system shall disconnect from the critical load to safeguard the battery.

1.3.4.5 Failure of a Module

In a redundant configuration, failure of one module shall cause that module to be disconnected from the system critical load bus by its internal protective devices and its individual output protective device. The remaining module shall continue to carry the load. Upon restoration of the failed module, it shall be possible to reconnect the failed module to the critical load bus to resume redundant operation without disruption of the critical load.

1.3.4.6 Transfer to Bypass ac Power Source

When the static bypass switch senses an overload, two or more inverter shutdown signals, or degradation of the inverter output, the bypass switch shall automatically transfer the critical load from the inverter output to the bypass ac power source without an interruption of power only if the connected load exceeds the capacity of the remaining on-line modules. If the bypass ac power source is out of normal tolerance limits, the UPS and the critical load shall shut down.

1.3.4.7 Retransfer to Inverter

The static bypass switch shall be capable of automatically retransferring the load back to the inverter output after the inverter output has returned to normal conditions. Retransfer shall not occur if the two sources are not synchronized.

1.3.4.8 UPS Module Maintenance

UPS modules shall be capable of manual disconnection from the critical load bus for maintenance without disturbing the critical load bus.

1.3.4.9 UPS System Maintenance

Manual closure of the maintenance bypass switch shall transfer the critical load from the inverter output to the bypass ac power source without disturbing the critical load bus. UPS module shall be capable of manual return to normal operation after completion of maintenance.

1.3.4.10 Battery Maintenance

The battery protective device shall provide the means of disconnecting the battery from the rectifier/charger and inverter for maintenance. The UPS module shall continue to function and meet the performance criteria specified except for the battery function.

1.4 QUALITY ASSURANCE

1.4.1 Reliability

UPS shall have a minimum acceptable system Mean Time Between Failures (MTBF) of 200,000 hours. A failure is defined as any interruption to or degradation of the UPS output. Automatic switching to bypass due to a problem with the UPS system does not constitute a failure, provided that the critical load is not disturbed.

1.4.2 Maintainability

UPS shall have a maximum acceptable system Mean Time To Repair (MTTR) of 30 minutes. Repair time is defined as the clock time from the arrival of the service technician to the time when the UPS is restored to service either by repair or substitution of the failed component.

1.5 DELIVERY AND STORAGE

Equipment placed in storage shall be protected from humidity and temperature variations, dirt, dust, or other contaminants.

1.6 PROJECT/SITE CONDITIONS

1.6.1 Environmental Conditions

The UPS and battery system shall be capable of withstanding any combination of the following external environmental conditions without mechanical or electrical damage or degradation of operating characteristics.

a. Operating altitude: Sea level to 4,000 feet. (Systems applied at higher altitudes shall be derated in accordance with the manufacturer's instructions).

b. Non-operating altitude: Sea level to 40,000 ft.

c. Operating ambient temperature range: 32 to 122 degrees F.

d. Non-operating and storage ambient temperature range: Minus 4 to plus 140 degrees F.

e. Operating relative humidity: 0 to 95 percent, without condensation.

1.6.2 Sound Pressure Levels

Sound pressure levels produced by the UPS, when operating under full rated load, at a distance of 5 feet in any direction from the perimeter of the unit, shall not exceed 75 dB as measured on the A scale of a standard sound level meter at slow response.

1.6.3 Verification of Dimensions

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

1.7 NAME PLATES

Each major item of equipment shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the item of equipment.

1.8 SPECIAL TOOLS

One set of special tools, calibration devices, and instruments required for operation, calibration, and maintenance of the equipment shall be provided.

1.9 OPERATION AND MAINTENANCE MANUALS

Six complete copies of operation manuals for the UPS System outlining the step-by-step procedures required for system startup, operation and shutdown shall be provided. The instructions shall include the manufacturer's name, equipment model number, service manual, parts list, and brief description of equipment and its basic operational features. Six complete copies of maintenance manuals listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides shall be provided. Corrective maintenance procedures shall identify the most probable failures and the appropriate repairs. Test measurement levels shall be referenced to specific test points on the installed equipment. Operation and maintenance manuals may be either combined or separate.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Equipment shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site.

2.2 Omitted

2.3 UPS SYSTEM RATINGS

Unless stated otherwise, the parameters listed are under full output load at 0.8 power factor, with batteries fully charged and floating on the dc bus and with nominal input voltage.

2.3.1 Battery Capacity

Discharge time to end voltage: 15 minutes, at 77 degrees F. Battery shall be capable of delivering 125 percent of full rated UPS load at initial start-up.

2.3.2 Static Switch

Sized per the size of unit capacity.

2.3.3 ac Input

a. Voltage as shown on drawings.

b. Number of phases: 3-phase, 3-wire, plus ground.

c. Voltage Range: Plus 10 percent, minus 15 percent, without affecting battery float voltage or output voltage.

d. Frequency: 60 Hz, plus or minus 5 percent.

e. Power walk-in: 20 percent to 100 percent over 15 to 24 seconds.

f. Total harmonic current distortion (THD) reflected into the primary line: 10 percent maximum.

g. Transformer sub-cycle inrush: 4 to 8 times full load rating.

2.3.4 ac Output

a. Voltage 208 volts line-to-line, 120 volts line-to-neutral.

b. Number of phases: 3-phase, 4-wire, plus ground.

c. Voltage regulation:

(1) Balanced load: Plus or minus 1.0 percent.

(2) 50 percent load imbalance, phase-to-phase: Plus or minus 2 percent.

(3) No-load voltage modulation: Plus or minus 1 percent.

(4) Voltage drift: Plus or minus 1 percent over any 30 day interval (or length of test) at stated ambient conditions.

d. Voltage adjustment: Plus or minus 5 percent manually.

e. Frequency: 60 Hz.

f. Frequency regulation: Plus or minus 0.1 percent.

g. Frequency drift: Plus or minus 0.1 percent over any 24 hour interval (or length of test) at stated ambient conditions when on internal oscillator.

h. Harmonic content (RMS voltage): 3 percent single harmonic, maximum; 5 percent total maximum with linear load. Voltage THD shall be less than 7 percent with up to 50 percent nonlinear load and a crest factor of less than 3 to 1.

i. Load power factor operating range: 1.0 to 0.8 lagging.

j. Phase displacement:

(1) Balanced load: Plus or minus 1 degree of bypass input.

(2) 50 percent load imbalance phase-to-phase: Plus or minus 3 degrees of bypass input.

k. Wave-form deviation factor: 5 percent at no load.

l. Overload capability (at full voltage) (excluding battery):

(1) 125 percent load for 10 minutes.

(2) 150 percent load for 30 seconds.

(3) 300 percent load for one cycle after which it shall be current limited to 150 percent until fault is cleared or UPS goes to bypass.

m. Load sharing of parallel modules: Plus or minus 5 percent of average load per module.

2.3.5 Transient Response

2.3.5.1 Voltage Transients

a. 50 percent load step/0 percent to 50 percent load: Plus or minus 8 percent.

b. 50 percent load step/50 percent to 100 percent load: Plus or minus 8 percent.

c. Loss or return of ac input: Plus or minus 1 percent.

d. Loss or return of redundant module:

(1) Manually: Plus or minus 8 percent.

(2) Automatically: Plus or minus 8 percent.

e. Automatic transfer of load from UPS to bypass: Plus or minus 4 percent.

f. Manual retransfer of load from bypass to UPS: Plus or minus 4 percent.

g. Response time: Recovery to 99 percent steady-state condition within 50 milliseconds after any of the above transients.

2.3.5.2 Frequency

a. Transients: Plus or minus 0.5 Hz maximum.

b. Slew Rate: 1.0 Hz maximum per second.

2.3.6 Efficiency

a. Minimum Single-Module Efficiency: 90 percent at full load kW.

b. Minimum System Efficiency: 89 percent at full system load kW.

2.4 UPS MODULE

2.4.1 General Description

UPS module shall consist of a rectifier/charger unit and a 3-phase inverter unit with their associated transformers, synchronizing equipment, protective devices and accessories as required for operation.

2.4.2 Rectifier/Charger Unit

Rectifier/charger unit shall be solid state and shall provide direct current to the dc bus.

2.4.2.1 Input Protective Device

Rectifier/charger unit shall be provided with an input protective device. The protective device shall be sized to accept simultaneously the full-rated load and the battery recharge current. The protective device shall be capable of shunt tripping the contractor calculated symmetrical interrupting capacity. The protective device shall have provision for locking in the "off" position. A surge suppression device shall be installed at the UPS input to protect against lightning and switching surges.

2.4.2.2 Power Transformer

A dry-type, isolated-winding power transformer shall be used for the rectifier unit. The transformer's hottest spot winding temperature shall not exceed the temperature limit of the transformer insulation material when operating at full load. The transformer insulation shall be Class H, 150 degrees C rise. Transformer connections shall be accessible from the front.

2.4.2.3 Power Walk-In

Rectifier/charger unit shall be protected by a power walk-in feature such that when ac power is returned to the ac input bus, the total initial power requirement will not exceed 20 percent of the rated full load current. This demand shall increase gradually to 100 percent of the rated full load current plus the battery charging current over the specified time interval.

2.4.2.4 Sizing

Rectifier/charger unit shall be sized for the following two simultaneous

operating conditions:

a. Supplying the full rated load current to the inverter.

b. Recharging a fully-discharged battery to 95 percent of rated ampere-hour capacity within ten times the discharge time after normal ac power is restored, with the input protective device closed.

2.4.2.5 Battery Charging Current

a. Primary current limiting: Battery-charging current shall be voltage regulated and current limited. The battery-charging current limit shall be separately adjustable from 2 percent to 25 percent of the maximum discharge current. After the battery is recharged, the rectifier/charger unit shall maintain the battery at full float charge until the next operation under input power failure. Battery charger shall be capable of providing equalizing charge to the battery.

b. Second step current limiting: The rectifier/charger unit shall also have a second-step battery current limit. This second-step current limit shall sense actual battery current and reduce the input power demand for battery recharging to 50 percent (adjustable from 30 percent to 70 percent) of the normal rate without affecting the system's ability to supply full-rated power to the connected load. The second-step current-limit circuit shall be activated by a dry contact signal from the generator set controls and shall prevent normal rate battery recharging until utility power is restored.

2.4.2.6 Output Filter

Rectifier/charger unit shall have an output filter to minimize ripple current supplied to the battery; the ripple current into the battery shall not exceed 3 percent RMS.

2.4.2.7 dc Voltage Adjustment

Rectifier/charger unit shall have manual means for adjusting dc voltage for battery equalization, to provide voltage within plus 10 percent of nominal float voltage.

2.4.2.8 Battery Isolation Protective Device

Module shall have a dc protective device to isolate the module from the battery system. The protective device size and interrupting rating shall be as required by system capacity and shall incorporate a shunt trip as required by circuit design. The protective device shall have provision for locking in the "off" position.

2.4.3 Inverter Unit

Inverter unit shall be a solid-state device capable of accepting power from the dc bus and providing ac power within specified limits.

2.4.3.1 Output Overload

The inverter shall be able to sustain an overload as specified across its

output terminals. The inverter shall not shut off, but shall continue to operate within rated parameters, with inverse-time overload shutdown protection.

2.4.3.2 Synchronism

The inverter shall normally operate in phase-lock and synchronism with the bypass source. Should the bypass source frequency deviate beyond 60 Hz by more than 0.5 Hz, the internal frequency oscillators contained in the power module shall be used to derive the new frequency reference. Upon restoration of the bypass source within the required tolerance, the inverter shall resynchronize with that source at a slew rate not exceeding the specified rate. The oscillator shall be temperature compensated and shall be manually adjustable. The design of the oscillator and synchronizing circuits shall be such that failure of any associated component, connector pin, terminal lead wire or dc power source in either the open or shorted mode shall affect only one inverter leg. Such failure shall not cause transient disturbance of the critical load in excess of the stated limits.

2.4.3.3 Phase Balance

Electronic controls shall be incorporated to provide individual phase voltage compensation to obtain phase balance.

2.4.3.4 Modular Construction

Each control logic printed circuit board shall be electrically and physically packaged on an individual plug-in module with separate indication and adjustments.

2.4.3.5 Output Protective Device

The output protective device shall be capable of shunt tripping and shall have interrupting capacity as specified. Protective device shall have provision for locking in the "off" position.

2.4.3.6 Output Transformer

The inverter output transformer shall be similar to the input transformer and shall be capable of handling up to K-13 nonlinear loads as described in IEEE ANSI/IEEE C57.110.

2.4.3.7 Modular Inverter Isolation

Each inverter in the UPS system shall have fault sensing and static isolation as well as an output protective device, to remove a faulted module from the system without affecting the critical load bus beyond the stated limits.

2.4.4 External Protection

UPS module shall have built-in self-protection against undervoltage, overvoltage, overcurrent and surges introduced on the ac input source and/or the bypass source. The UPS system shall sustain input surges without damage in accordance with IEEE C62.41. The UPS shall also have built-in self-protection against overvoltage and voltage surges introduced at the output terminals by paralleled sources, load switching, or circuit breaker operation in the critical load distribution system.

2.4.5 Internal Protection

UPS module shall be self-protected against overcurrent, sudden changes in output load and short circuits at the output terminals. UPS module shall be provided with output reverse power detection which shall cause that module to be disconnected from the critical load bus when output reverse power is present. UPS module shall have built-in protection against permanent damage to itself and the connected load for predictable types of failure within itself and the connected load. At the end of battery discharge limit, the module shall shut down without damage to internal components.

2.4.6 Parallel Operation

For parallel operation, the protection system shall have control logic capable of isolating only the faulted module, and shall not shut down the entire UPS system upon a fault in one module. Open protective devices shall be indicated by an alarm and indicator light.

2.5 STATIC BYPASS TRANSFER SWITCH

A static bypass transfer switch shall be provided as an integral part of the UPS and shall consist of a static switch and a bypass protective device or bypass switch. The control logic shall contain an automatic transfer circuit that senses the status of the inverter logic signals and alarm conditions and provides an uninterrupted transfer of the load to the bypass ac power source, without exceeding the transient limits specified herein, when a malfunction occurs in the UPS or when an external overload condition occurs. The power section of the static bypass transfer switch shall be provided as a plug-in type assembly to facilitate maintenance. The static bypass transfer switch shall be used to connect the bypass ac power source or the UPS inverter output to the critical load when required, and shall have the following features:

2.5.1 Uninterrupted Transfer

The static bypass transfer switch shall automatically cause the bypass ac power source to assume the critical load without interruption when the bypass control logic senses one of the following conditions and the UPS inverter output is synchronized to the bypass ac power source:

a. Inverter overload exceeds unit's rating.

b. Battery protection period is expired and bypass is available.

c. Inverter failure.

2.5.2 Interrupted Transfer

If an overload occurs and the UPS inverter output is not synchronized to the bypass ac power source, the UPS inverter output shall current-limit for 200 milliseconds minimum. The inverter shall then turn off and an interrupted transfer to the bypass ac power source shall be made. If the bypass ac power source is beyond the conditions stated below, an interrupted transfer shall be made upon detection of a fault condition:

a. Bypass voltage greater than plus or minus 10 percent from the UPS rated output voltage.

b. Bypass frequency greater than plus or minus 0.5 Hz from the UPS rated output frequency.

c. Phase differential of ac bypass voltage to UPS output voltage greater than plus or minus 3 degrees.

2.5.3 Manual Transfer

It shall be possible to make a manually-initiated static transfer from the system status and control panel by turning the UPS inverter off.

2.5.4 Automatic Uninterrupted Forward Transfer

The static bypass transfer switch shall automatically forward transfer, without interruption after the UPS inverter is turned "on", or after an instantaneous overload-induced reverse transfer has occurred and the load current has returned to less than the unit's 100 percent rating.

2.5.5 Forced Transfer

The control logic circuitry shall provide the means of making a forced or reverse transfer of the static bypass transfer switch on an interrupted basis. Minimum interruption shall be 200 milliseconds when the UPS inverter is not synchronized to the bypass ac power source.

2.5.6 Overload Ratings

The static bypass transfer switch shall withstand the following overload conditions:

a. 2000 percent of UPS output rating for two cycles.

b. 200 percent of UPS output rating for 5 minutes.

c. 125 percent of UPS output rating for 10 minutes.

2.5.7 Static Switch Disconnect

A static switch disconnect shall be incorporated to isolate the static bypass transfer switch assembly so it can be removed for servicing. The switch shall be equipped with auxiliary contacts and provision for padlocking in either the "on" or "off" position.

2.6 MAINTENANCE BYPASS SWITCH

2.6.1 General

A maintenance bypass switch shall be provided as an integral part of the UPS and located within the UPS module. The maintenance bypass switch shall provide the capability to continuously support the critical load from the bypass ac power source while the UPS is isolated for maintenance. The maintenance bypass switch shall be housed in an isolated compartment inside the UPS cabinet in such a way that service personnel will not be exposed to electrically live parts while maintaining the unit. Switch shall contain a maintenance bypass protective device and a module isolation protective device.

2.6.2 Load Transfer

The maintenance bypass switch shall provide the capability of transferring the critical load from the UPS static bypass transfer switch to maintenance bypass and then back to the UPS static bypass transfer switch with no interruption to the critical load.

2.6.3 Load Bank Protective Device

A load bank protective device shall be provided to allow the UPS system to be tested using a portable load bank. The load bank protective device shall be connected on the line side of the maintenance bypass switch isolation protective device.

2.7 MODULE CONTROL PANEL

The UPS module shall be provided with a control/indicator panel. The panel shall be on the front of the UPS module. Controls, meters, alarms and indicators for operation of the UPS module shall be on this panel.

2.7.1 Module Meters

2.7.1.1 Monitored Functions

The following functions shall be monitored and displayed:

a. Input voltage, phase-to-phase (all three phases).

b. Input current, all three phases.

c. Input frequency.

d. Battery voltage.

e. Battery current (charge/discharge).

f. Output voltage, phase-to-phase and phase-to-neutral (all three phases).

g. Output current, all three phases.

h. Output frequency.

i. Output kilowatts.

j. Elapsed time meter to indicate hours of operation, 6 digits.

k. Bypass voltage, phase-to-phase and phase-to-neutral (all three phases).

l. Output kilovars.

m. Output kilowatt hours, with 15-minute demand attachment.

2.7.1.2 Meter Construction

Meters shall have 1 percent accuracy and shall be digital type (minimum 4 significant digits).

2.7.2 Module Controls

Module shall have the following controls:

a. Lamp test/reset pushbutton.

b. Alarm test/reset pushbutton.

c. Module input protective device trip pushbutton, with guard.

d. Module output protective device trip pushbutton, with guard.

e. Battery protective device trip pushbutton, with guard.

f. Emergency off pushbutton, with guard.

g. dc voltage adjustment potentiometer, with locking guard.

h. Control power off switch.

i. UPS/bypass transfer selector switch.

j. Static bypass transfer switch enable/disable selector switch.

2.7.3 Module Alarm Indicators

Module shall have indicators for the following alarm items. Any one of these conditions shall turn on an audible alarm and the appropriate summary indicator. Each new alarm shall register without affecting any previous alarm.

a. Input ac power source failure.

b. Input protective device open.

c. Output protective device open.

d. Overload.

e. Overload shutdown.

f. dc overvoltage.

g. dc ground fault.

h. Low battery.

i. Battery discharged.

j. Battery protective device open.

k. Blower failure.

l. Input transformer overtemperature.

m. Inverter transformer overtemperature.

n. Equipment overtemperature.

o. Operating on internal oscillator.

p. Fuse blown.

q. Control power failure.

r. Charger off.

s. Inverter off.

t. Emergency off.

u. UPS on battery.

v. Critical load on static bypass.

w. Static bypass transfer switch disabled.

x. Inverter output overvoltage.

y. Inverter output undervoltage.

z. Inverter output overfrequency.

aa. Inverter output underfrequency.

bb. Bypass source overvoltage.

cc. Bypass source undervoltage.

dd. Bypass source overfrequency.

ee. Bypass source underfrequency.

ff. Bypass source to inverter out of synchronization.

2.7.4 Module Mimic Panel

UPS module shall have a mimic panel in the format of a module single-line diagram, with status indicators for input, output, battery protective devices, and battery disconnect switch. Each protective device shall have indicators for open (green) and closed (red), to give positive indication. The mimic panel shall provide indication of the following additional functions:

a. Charger on (functional).

b. UPS on-line (inverter furnishing load power).

c. UPS on-bypass (static switch operating).

d. System alarm (flashes for abnormalities, minor or major faults).

2.7.5 Module Emergency Off Button

Pressing the emergency off button shall cause the affected module to be disconnected from the system, via its input protective device, output protective device, and battery protective device. Activation of this button shall not affect the operation of the remainder of the system.

2.8 SYSTEM CONTROL CABINET

2.8.1 General Description

The multi-module UPS system shall be provided with a separate control cabinet for system output, summary monitoring, and control. This unit shall contain; bus bar connections to collect the output from each module, the static switch and its bypass breaker, the UPS system output protective device, and the UPS output switchgear.

2.8.2 UPS Output Switchgear

The UPS output switchgear shall consist of a main protective device feeding the UPS output switchgear critical load bus, a load bank protective device (connected on the line side of the main protective device), a maintenance bypass protective device and associated feeder protective devices for the critical loads.

2.8.2.1 Interlocking

The main protective device and the load bank protective device shall be interlocked to prevent both being closed at the same time. The maintenance bypass protective device shall be interlocked with the UPS system output protective device and the static bypass switch. The maintenance bypass protective device shall not be capable of closing until the static bypass switch is closed and the UPS system output protective device is open. Once the maintenance bypass protective device is closed, the UPS output switchgear main protective device shall be capable of opening to isolate the critical loads from the UPS output. The load bank protective device as well as the UPS system output protective device shall then be capable of closing to permit load bank testing.

2.8.2.2 Switchgear

UPS output switchgear shall be provided in accordance with Section 16475 COORDINATED POWER SYSTEM PROTECTION.

2.8.3 System Control Panel

A separate control panel shall be provided for the overall UPS system. The panel shall be on the front surface of the system cabinet. The controls, meters, alarms and indicators for operation of the UPS system shall be on this panel.

2.8.3.1 System Meters

Meters shall have 1 percent accuracy and shall be digital type (minimum 4 significant digits). ac voltages shall be measured as true RMS voltages.

The following functions shall be monitored:

a. Output voltage, phase-to-phase and phase-to-ground (all three phases).

b. Output current, all three phases.

c. Output frequency.

d. Bypass voltage, phase-to-phase and phase-to-ground (all three phases).

e. Output kilowatts.

f. Output kilovars.

g. Output kVA.

h. Output kilowatt-hours, with demand attachment.

i. Maintenance bypass voltage, phase-to-phase and phase-to-ground (all three phases).

2.8.3.2 System Controls

The system cabinet shall include the following controls:

a. Lamp test/reset.

b. Alarm test/reset.

c. Voltage adjustment potentiometer.

d. Emergency off pushbutton with protective cover.

e. UPS/bypass transfer selector switch.

f. Static switch enable/disable selector switch.

g. Control power off switch.

2.8.3.3 System Alarm Indicators

The system control panel shall contain indicators for the following additional alarm items. Any one of these alarm conditions shall also activate the audible alarm. Each new alarm shall register without affecting previous alarms.

a. Module summary alarm, one for each UPS module.

b. UPS on battery.

c. Low battery voltage.

d. Critical load on bypass.

e. Static switch disable.

f. Output overvoltage.

g. Output undervoltage.

h. Output overfrequency.

i. Output underfrequency.

j. Overload.

k. Bypass source overvoltage.

l. Bypass source undervoltage.

m. Bypass source overfrequency.

n. Bypass source underfrequency.

o. Bypass source to inverter out of synchronization.

p. Equipment overtemperature.

q. Control power failure.

2.8.3.4 System Mimic Panel

The system control panel shall contain a mimic panel in the format of a single-line diagram, with status indicators for the following items:

a. Module on-line, one per UPS module.

b. UPS output protective device status, one for closed (red), one for open (green), and one for withdrawn (amber).

c. Static bypass protective device status, one for closed (red), one for open (green), and one for withdrawn (amber).

d. Static switch status, one for connected (red), and one for disconnected (green).

2.8.3.5 Emergency Off

Pressing the emergency off button shall cause the module input, output, and battery circuit breakers to open, completely isolating the UPS system from sources of power. The critical load shall be transferred to the bypass source when this occurs.

2.9 SELF-DIAGNOSTIC CIRCUITS

The control logic shall include status indicators for trouble-shooting the control circuits. These indicators shall be mounted on the circuit card edge or face such that they will be visible without repositioning the card, and shall be labeled with the function name.

2.10 REMOTE MONITORING PANEL

A remote monitoring panel shall be provided to monitor system status. The panel shall be designed for wall mounting near the critical load.

2.10.1 Indicators

Minimum display shall include the following indicators:

a. Load on UPS.

b. Load on battery.

c. Load on bypass.

d. Low battery.

e. Summary alarm.

f. New alarm (to alert the operator that a second summary alarm condition has occurred).

2.10.2 Audible Alarm

Any single indicator shall also turn on the audible alarm. An audible alarm test/reset button and lamp test/reset button shall be included. This reset button shall not affect nor reset the alarm on the module or on the system cabinet.

2.11 COMMUNICATIONS AND DATA ACQUISITION PORT

An RS 232C and RS 485 communications and data acquisition port shall be provided. This port shall allow the system parameters, status, alarm indication and control panel functions specified to be remotely monitored and controlled.

2.12 TEMPERATURE CONTROL

2.12.1 General

Cabinet and enclosure ventilation shall be adequate to ensure that components are operated within their ratings. Forced-air cooled rectifier, inverter, and control unit will be acceptable. The cooling fans shall continue operation if UPS input power is lost. Redundancy shall be provided so that failure of one fan or associated circuit breaker will not cause an overheat condition. Cooling air shall enter the lower front of the cabinets and exhaust at the top. Blower power failure shall be indicated as a visual and audible alarm on the control panel. Air inlets shall have filters that can be replaced without opening the cabinet doors.

2.12.2 Blower Power Source

Blower power source shall be internally derived from the input and output sides of UPS module, with automatic transfer arrangement.

2.12.3 Temperature Sensors

Temperature sensors shall be provided to monitor the air temperature. Separate sensors shall monitor the temperature of rectifier and inverter heat sinks. Separate sensors shall also monitor the transformer temperature.

2.13 BATTERY SYSTEM

2.13.1 General

A storage battery with sufficient ampere-hour rating to maintain UPS output at full capacity for the specified duration shall be provided for each UPS module. The battery shall be of heavy-duty, industrial design suitable for UPS service. The cells shall be provided with flame arrestor vents, intercell connectors and cables, cell-lifting straps, cell-numbering sets, and terminal grease. Intercell connectors shall be sized to maintain terminal voltage within voltage window limits when supplying full load under power failure conditions. Cell and connector hardware shall be

stainless steel of a type capable of resisting corrosion from the electrolyte used.

2.14 FACTORY TESTING

The UPS system shall be factory tested to meet the requirements specified using a test battery (not the battery to be supplied with the system). UPS module shall be factory load tested as an independent assembly with 3-phase ac input power and with battery power for a minimum of 8 hours, with meter readings taken every 30 minutes. Load shall be balanced at rated kVA and rated power factor. Factory tests for the UPS module shall be run under full load, and will be witnessed by the Government. Should a malfunction occur, the problem shall be corrected and the test shall be repeated. As a minimum, the factory tests shall include the parameters described in paragraphs ac Input, ac Output, Transient Response and Efficiency. The tests shall encompass all aspects of operation, such as module failure, static bypass operation, battery failure, input power failure and overload ratings. The Government shall be notified in writing at least 2 weeks before testing. Factory-test time shall not be used for system debugging and/or checkout. Such work shall be done prior to notifying the Government that the system is ready for testing. Factory tests shall be performed during normal business hours. The system shall be interconnected and tested for an additional 8 hours to ensure proper wiring and performance.

2.14.1 Transient Tests

Transient tests shall be conducted using high-speed oscillograph type recorders to demonstrate the operation of the components to the satisfaction of the Government. These tests shall include 50 percent to 100 percent load changes, manual transfer, manual retransfer, low dc bus initiated transfer and low ac output bus transfer. A recording instrument equipped with an event marker shall be used.

2.14.2 Efficiency Tests

Testing for efficiency shall be performed at zero output up to 100 percent of stated kVA output in 25 percent steps, 0.8 power factor, with battery fully charged and floating on the dc bus, with nominal input voltage, and with modules connected to the system to represent actual operating conditions.

2.15 INSPECTION

Inspection before shipment is required. The manufacturer shall notify the Government at least 2 weeks before shipping date so that an inspection can be made.

PART 3 EXECUTION

3.1 INSTALLATION

The UPS system shall be set in place, wired and connected in accordance with the approved shop drawings and manufacturer's instructions. The UPS battery shall be shipped to the site dry.

3.2 FIELD SUPERVISION, STARTUP AND TESTING

The 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. The representative shall check the wiring between equipment, start up the system, and field test the functions, interlocks and protective devices to ensure that the total system is functioning according to the intent of the design. The field tests shall be performed under the supervision of a factory-trained representative of the equipment manufacturer and witnessed by the Government. The Government shall be given 2 weeks written advance notice of the date and time when testing will be conducted.

3.2.1 Field Tests

As a minimum, the startup and field test procedures shall include the following:

a. Ensure that shipping members have been removed.

b. Check for damage (dents, scratches, frame misalignment, damage to panel devices, etc).

c. Ensure that interiors are free of foreign materials, tools and dirt.

d. Attach a phase rotation meter to the UPS input, output and bypass buses, and observe proper phase sequences.

e. Torque test bus connections at shipping splits. Also torque test battery connections.

f. Check each electrical bus for proper phasing and identification.

g. Check and test selector switches and meters for proper operation.

h. Check doors for proper alignment and operation.

i. Check and test each protective device for proper mechanical and electrical operation.

j. Check protective device overcurrent trip settings.

k. Check and test indicating lights for proper operation and color.

l. Perform onsite field test procedures.

m. Demonstrate to the Government that the specified functions and interlocks have been implemented.

n. Provide IEEE Std 450 battery installation certification.

o. Check key interlock key numbers, if used, to ensure agreement with interlocking scheme.

3.2.2 Load Test

The installed system shall be load tested for a continuous 24 hour period by means of resistive load banks. The system shall be continuously tested at 1/2 load for 8 hours, 3/4 load for 8 hours and full load for 8 hours. Load banks will be available onsite and shall be connected to UPS equipment by the Contractor. Instrument readings shall be recorded every half hour

for the following:

a. Input voltage (all three phases, for each module).

b. Input current (all three phases, for each module).

c. Input frequency.

d. Battery voltage for each module.

e. Output voltage (all three phases, for each module).

f. Output current (all three phases, for each module).

g. Output kilowatts for each module.

h. Output frequency.

i. Output voltage (all three phases - system output).

j. Output current (all three phases - system output).

k. Output kilowatts (system output).

3.2.3 Full Load Burn In Test

The installed system shall undergo an additional full load burn-in period of 24 continuous hours. If a failure occurs during the burn-in period, the tests shall be repeated. Instrument readings shall be recorded every half hour as above. During the burn-in period, the following tests shall be performed:

a. With the UPS carrying maximum continuous design load and supplied from the normal source, switch 100 percent load on and off a minimum of five times within the burn-in period.

b. With the UPS carrying maximum continuous design load and supplied from the emergency source, repeat the switching operations described in step a. Also, verify that the UPS module rectifier charger unit(s) go into the second-step current limit mode.

c. With the UPS carrying maximum continuous design load and operating on battery power, repeat the switching operations described in step a above.

d. Continue operation on battery power for 1 minute, then restore normal power.

The Contractor shall furnish a high-speed dual trace oscillograph to monitor ten or more cycles of the above tests at the ON and OFF transitions and two typical steady-state periods, one shortly after the load is energized (at 30 to 60 seconds) and one after operation has stabilized (at 8 to 10 minutes). Four copies of the traces shall be delivered to the Contracting Officer.

3.2.4 Battery Discharge Test

With the battery fully charged, the system shall undergo a complete battery discharge test to full depletion and a recharge to nominal conditions.

Instrument readings shall be recorded every minute during discharge for the following:

a. Battery voltage for each module.

b. Battery current for each module.

c. Output voltage (all three phases) for each module.

d. Output current (all three phases) for each module.

e. Output kilowatts for each module.

f. Output voltage (all three phases - system output).

g. Output current (all three phases - system output).

h. Output kilowatts (system output).

i. Output frequency.

3.3 POSTING FRAMED DATA AND INSTRUCTIONS

Framed data and instructions containing wiring and control diagrams under glass or in laminated plastic shall be posted where directed. Condensed operating instructions, prepared in typed form, shall be framed as specified above and posted beside the diagrams. The framed instructions shall be posted before acceptance testing of the system.

3.4 FIELD TRAINING

A field training course shall be provided for designated operating and maintenance staff members. Training shall be provided for a total period of 12 hours of normal working time and shall start after the system is functionally complete but prior to final acceptance test. Field training shall cover the items contained in the operating and maintenance manuals. The 12 hours shall be divided into two sessions of 6 hours each. Each session shall be conducted on a different day. Field training shall be videotaped and the tape shall be left with the Contracting Officer or a factory training videotape shall be provided as part of the training materials.

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SECTION 16410A

AUTOMATIC TRANSFER SWITCH AND BY-PASS/ISOLATION SWITCH
07/01

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 117	(1997) Operating Salt Spray (Fog) Apparatus

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C37.13	(1990; R 1995) Low-Voltage AC Power Circuit Breakers Used in Enclosures
IEEE C37.90.1	(1989; R 1994) IEEE Standard Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems
IEEE C62.41	(1991; R 1995) Surge Voltages in Low-Voltage AC Power Circuits
IEEE Std 602	(1996) Electric Systems in Health Care Facilities

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 1	(1993) Industrial Controls and Systems
NEMA ICS 2	(1993) Industrial Controls and Systems Controllers, Contactors, and Overload Relays Rated Not More Than 2,000 Volts AC or 750 Volts DC
NEMA ICS 4	(1997) Industrial Control and Systems Terminal Blocks
NEMA ICS 6	(1993) Industrial Control and Systems, Enclosures
NEMA ICS 10	(1999) Industrial Control and Systems: AC Transfer Switch Equipment - Part 2: Static AC Transfer Equipment

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2002) National Electrical Code
NFPA 110	(2002) Emergency and Standby Power Systems

UNDERWRITERS LABORATORIES (UL)

UL 1008	(1996; Rev thru Feb 1999) Transfer Switch Equipment
UL 1066	(1997) Low-Voltage AC and DC Power Circuit Breakers Used in Enclosures

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Switches; G

Schematic, external connection, one-line schematic and wiring diagram of each ATS assembly. Interface equipment connection diagram showing conduit and wiring between ATS and related equipment. Device, nameplate, and item numbers shown in list of equipment and material shall appear on drawings wherever that item appears. Diagrams shall show interlocking provisions and cautionary notes, if any. Operating instructions shall be shown either on one-line diagram or separately. Unless otherwise approved, one-line and elementary or schematic diagrams shall appear on same drawing.

Equipment;
Installation;

Dimensioned plans, sections and elevations showing minimum clearances, weights, and conduit entry provisions for each ATS.

SD-03 Product Data

Material;
Equipment;

List of proposed equipment and material, containing a description of each separate item.

SD-06 Test Reports

Testing; G

A description of proposed field test procedures, including proposed date and steps describing each test, its duration and expected results, not less than 2 weeks prior to test date.

Certified factory and field test reports, within 14 days following completion of tests. Reports shall be certified and dated and shall demonstrate that tests were successfully completed prior to shipment of equipment.

SD-07 Certificates

Equipment;
Material;

Certificates of compliance showing evidence of UL listing and conformance with applicable NEMA standards. Such certificates are not required if manufacturer's published data, submitted and approved, reflect UL listing or conformance with applicable NEMA standards.

Switching Equipment;

Evidence that ATS withstand current rating (WCR) has been coordinated with upstream protective devices as required by UL 1008. Upon request, manufacturer shall also provide notarized letter certifying compliance with requirements of this specification, including withstand current rating.

SD-10 Operation and Maintenance Data

Switching Equipment;
Instructions;

Six copies of operating manual outlining step-by-step procedures for system startup, operation, and shutdown. Manual shall include manufacturer's name, model number, service manual, parts list, and brief description of equipment and basic operating features. Manufacturer's spare parts data shall be included with supply source and current cost of recommended spare parts. Six copies of maintenance manual listing routine maintenance, possible breakdowns, repairs, and troubleshooting guide. Manual shall include simplified wiring and control diagrams for system as installed.

1.3 GENERAL REQUIREMENTS

1.3.1 Standard Product

Material and equipment shall be standard products of a manufacturer regularly engaged in manufacturing the products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. The experience use shall include applications in similar circumstances and of same design and rating as specified ATS. Equipment shall be capable of being serviced by a manufacturer-authorized and trained organization that is, in the Contracting Officer's opinion, reasonably convenient to the site.

1.3.2 Nameplate

Nameplate showing manufacturer's name and equipment ratings shall be made of corrosion-resistant material with not less than 1/8 inch tall characters. Nameplate shall be mounted to front of enclosure and shall comply with nameplate requirements of NEMA ICS 2.

1.4 SERVICE CONDITIONS

Seismic requirements shall be as specified in Sections 13080 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT, 15070 SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT and 16070 SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT.

PART 2 PRODUCTS

2.1 AUTOMATIC TRANSFER SWITCH (ATS)

ATS shall be electrically operated and mechanically held in both operating positions. ATS shall be suitable for use in emergency systems described in NFPA 70. ATS shall be UL listed. ATS shall be manufactured and tested in accordance with applicable requirements of IEEE C37.90.1, IEEE C37.13, IEEE C62.41, IEEE Std 602, NEMA ICS 1, NEMA ICS 2, NEMA ICS 10, UL 1008 and UL 1066. ATS shall conform to NFPA 110. To facilitate maintenance, manufacturer's instruction manual shall provide typical maximum contact voltage drop readings under specified conditions for use during periodic maintenance. Manufacturer shall provide instructions for determination of contact integrity. ATS shall be rated for continuous duty at specified continuous current rating. ATS shall be fully compatible and approved for use with BP/IS specified. BP/IS shall be considered part of ATS system.

2.1.1 Override Time Delay

Time delay to override monitored source deviation shall be adjustable from 0.5 to 6 seconds and factory set at 1 second. ATS shall monitor phase conductors to detect and respond to sustained voltage drop of 25 percent of nominal between any two normal source conductors and initiate transfer action to alternate source and start engine driven generator after set time period. Pickup voltage shall be adjustable from 85 to 100 percent of nominal and factory set at 90 percent. Dropout voltage shall be adjustable from 75 to 98 percent of pickup value and factory set at 85 percent of nominal.

2.1.2 Transfer Time Delay

Time delay before transfer to emergency power source shall be adjustable from 0 to 5 minutes and factory set at 0 minutes. ATS shall monitor frequency and voltage of emergency power source and transfer when frequency and voltage are stabilized. Pickup voltage shall be adjustable from 85 to 100 percent of nominal and factory set at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal and factory set at 90 percent.

2.1.3 Return Time Delay

Time delay before return transfer to normal power source shall be adjustable from 0 to 30 minutes and factory set at 30 minutes. Time delay shall be automatically defeated upon loss or sustained undervoltage of emergency power source, provided that normal supply has been restored.

2.1.4 Engine Shutdown Time Delay

Time delay shall be adjustable from 0 to 30 minutes and shall be factory set at 10 minutes.

2.1.5 Exerciser

Provide a generator exerciser timer. Run times shall be user programmable. The generator exerciser shall be selectable between load transfer and enginer run only, and shall have a fail-safe feature that will retransfer the ATS to normal during the exercise period.

2.1.6 Auxiliary Contacts

Two normally open and two normally closed auxiliary contacts rated at 10 amperes at 120 volts shall operate when ATS is connected to normal power source, and two normally open and two normally closed contacts shall operate when ATS is connected to emergency source.

2.1.7 Supplemental Features

ATS shall be furnished with the following:

a. Engine start contact.

b. Emergency source monitor.

c. Test switch to simulate normal power outage.

d. Voltage sensing. Pickup voltage adjustable from 85 to 100 percent of nominal; dropout adjustable from 75 to 98 percent of pickup.

e. Time delay bypass switch to override return time delay to normal.

f. Manual return-to-normal switch.

g. Means shall be provided in the ATS to insure that motor/transformer load inrush currents do not exceed normal starting currents. This shall be accomplished with either in-phase monitoring, time-delay transition, or load voltage decay sensing methods. If manufacturer supplies an in-phase monitoring system, the manufacturer shall indicate under what conditions a transfer cannot be accomplished. If the manufacturer supplies a time-delay transition system, the manufacturer shall supply recommendations for establishing time delay. If load voltage decay sensing is supplied, the load voltage setting shall be user programmable.

2.1.8 Operator

Manual operator conforming to UL 1008 shall be provided, and shall incorporate features to prevent operation by unauthorized personnel. ATS shall be designed for safe manual operation under full load conditions. If manual operation is accomplished by opening the door, then a dead-front shall be supplied for operator safety.

2.1.9 Override Switch

Override switch shall bypass automatic transfer controls so ATS will transfer and remain connected to emergency power source, regardless of condition of normal source. If emergency source fails and normal source is available, ATS shall automatically retransfer to normal source.

2.1.10 Green Indicating Light

A green indicating light shall supervise/provide normal power source switch position indication and shall have a nameplate engraved NORMAL.

2.1.11 Red Indicating Light

A red indicating light shall supervise/provide emergency power source

switch position indication and shall have a nameplate engraved emergency.

2.2 BY-PASS/ISOLATION SWITCH (BP/IS)

2.2.1 Design

Bypass/isolation switch (BP/IS) shall permit load by-pass to either normal or emergency power source and complete isolation of associated ATS, independent of ATS operating position. BP/IS and associated ATS shall be products of same manufacturer and shall be completely interconnected and tested at factory and at project site as specified. BP/IS shall be manufactured, listed, and tested in accordance with paragraph AUTOMATIC TRANSFER SWITCH (ATS) and shall have electrical ratings that exceed or equal comparable ratings specified for ATS. Operating handles shall be externally operated and arranged so that one person can perform the bypass and isolation functions through the operation of a maximum of two handles within 5 seconds. The ATS shall have provisions for locking in the isolation position. Handle for manual operation shall be permanently attached to operating mechanism. BP/IS operation shall be accomplished without disconnecting switch load terminal conductors. Isolation handle positions shall be marked with engraved plates or other approved means to indicate position or operating condition of associated ATS, as follows:

a. Indication shall be provided to show that ATS section is providing power to the load.

b. Indication shall be provided of ATS isolation. The ATS controls shall remain functional with the ATS isolated or in bypass mode to permit monitoring of the normal power source and automatic starting of the generator in the event of a loss of the normal power source. In the isolated mode, the bypass section shall be capable of functioning as a manual transfer switch to transfer the load to either power source. The ATS shall be capable of undergoing functional operation testing without service interruption. The ATS may also be completely removed from the enclosure, if required for maintenance or repair, while the bypass section continues to power the load.

2.2.2 Switch Construction

Bypass/isolation switch shall be constructed for convenient removal of parts from front of switch enclosure without removal of other parts or disconnection of external power conductors. Contacts shall be as specified for associated ATS, including provisions for inspection of contacts without disassembly of BP/IS or removal of entire contact enclosure. To facilitate maintenance, manufacturer shall provide instructions for determination of contact integrity. BP/IS and associated ATS shall be interconnected with suitably sized copper bus bars silver-plated at each connection point, and braced to withstand magnetic and thermal forces created at WCR specified for associated ATS.

2.3 ENCLOSURE

ATS and accessories shall be installed in free-standing, floor-mounted, ventilated NEMA ICS 6, smooth sheet metal enclosure constructed in accordance with applicable requirements of UL 1066 and/or UL 1008. Metal gauge shall be not less than No. 14. Enclosure shall be equipped with at least two approved grounding lugs for grounding enclosure to facility ground system using No. 4 AWG copper conductors. Factory wiring within

enclosure and field wiring terminating within enclosure shall comply with NFPA 70. If wiring is not color coded, wire shall be permanently tagged or marked near terminal at each end with wire number shown on approved detail drawing. Terminal block shall conform to NEMA ICS 4.

2.3.1 Construction

Enclosure shall be constructed for ease of removal and replacement of ATS components and control devices from front without disconnection of external power conductors or removal or disassembly of major components. Enclosure of ATS with BP/IS shall be constructed to protect personnel from energized BP/IS components during ATS maintenance.

2.3.2 Cleaning and Painting

Both the inside and outside surfaces of an enclosure, including means for fastening, shall be protected against corrosion by enameling, galvanizing, plating, powder coating, or other equivalent means. Protection is not required for metal parts that are inherently resistant to corrosion, bearings, sliding surfaces of hinges, or other parts where such protection is impractical. Finish shall be manufacturer's standard material, process, and color and shall be free from runs, sags, peeling, or other defects. An enclosure marked Type 1, 3R, 4 or 12 shall be acceptable if there is no visible rust at the conclusion of a salt spray (fog) test using the test method in ASTM B 117, employing a 5 percent by weight, salt solution for 24 hours. Type 4X enclosures are acceptable following performance of the above test with an exposure time of 200 hours.

2.4 TESTING

2.4.1 Factory Testing

A prototype of specified ATS shall be factory tested in accordance with UL 1008. In addition, factory tests shall be performed on each ATS as follows:

a. Insulation resistance test to ensure integrity and continuity of entire system.

b. Main switch contact resistance test.

c. Visual inspection to verify that each ATS is as specified.

d. Mechanical test to verify that ATS sections are free of mechanical hindrances.

e. Electrical tests to verify complete system electrical operation and to set up time delays and voltage sensing settings.

2.4.2 Factory Test Reports

Manufacturer shall provide three certified copies of factory test reports.

PART 3 EXECUTION

3.1 INSTALLATION

ATS shall be installed as shown and in accordance with approved manufacturer's instructions.

3.2 INSTRUCTIONS

Manufacturer's approved operating instructions shall be permanently secured to cabinet where operator can see them. One-line and elementary or schematic diagram shall be permanently secured to inside of front enclosure door.

3.3 SITE TESTING

Following completion of ATS installation and after making proper adjustments and settings, site tests shall be performed in accordance with manufacturer's written instructions to demonstrate that each ATS functions satisfactorily and as specified. Contractor shall advise Contracting Officer not less than 5 working days prior to scheduled date for site testing, and shall provide certified field test reports within 2 calendar weeks following successful completion of site tests. Test reports shall describe adjustments and settings made and site tests performed. Minimum operational tests shall include the following:

a. Insulation resistance shall be tested, both phase-to-phase and phase-to-ground.

b. Power failure of normal source shall be simulated by opening upstream protective device. This test shall be performed a minimum of five times.

c. Power failure of emergency source with normal source available shall be simulated by opening upstream protective device for emergency source. This test shall be performed a minimum of five times.

d. Low phase-to-ground voltage shall be simulated for each phase of normal source.

e. Operation and settings shall be verified for specified ATS features, such as override time delay, transfer time delay, return time delay, engine shutdown time delay, exerciser, auxiliary contacts, and supplemental features.

f. Manual and automatic ATS and BP/IS functions shall be verified.

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SECTION 16415A

ELECTRICAL WORK
06/02

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C12.1	(1995) Code for Electricity Metering
ANSI C12.10	(1997) Electromechanical Watthour Meters
ANSI C12.4	(1984; R 1996) Mechanical Demand Registers
ANSI C39.1	(1981; R 1992) Requirements for Electrical Analog Indicating Instruments
ANSI C80.5	(1995) Rigid Aluminum Conduit
ANSI C82.1	(1997) Specifications for Fluorescent Lamp Ballasts \$18.00$\F\X Addenda D & E
ANSI C82.4	(1992) Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 1	(1995) Hard-Drawn Copper Wire
ASTM B 8	(1999) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM D 709	(2000) Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41	(1991; R 1995) Surge Voltages in Low-Voltage AC Power Circuits
IEEE Std 242	(1986; R 1991) Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
IEEE Std 399	(1997) Recommended Practice for Industrial and Commercial Power Systems Analysis
IEEE Std 81	(1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Part 1) \$31.00$\F

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(1997) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA AB 1	(1993) Molded Case Circuit Breakers and Molded Case Switches
NEMA FU 1	(1986) Low Voltage Cartridge Fuses
NEMA ICS 1	(1993) Industrial Control and Systems
NEMA ICS 2	(1993) Industrial Controls and Systems Controllers, Contactors, and Overload Relays Rated Not More Than 2,000 Volts AC or 750 Volts DC
NEMA ICS 3	(1993) Industrial Control and Systems Factory Built Assemblies
NEMA ICS 6	(1993) Industrial Control and Systems, Enclosures
NEMA LE 4	(1987) Recessed Luminaires, Ceiling Compatibility
NEMA MG 1	(1998) Motors and Generators
NEMA MG 10	(1994) Energy Management Guide for Selection and Use of Polyphase Motors
NEMA OS 1	(1996) Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports
NEMA OS 2	(1998) Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports
NEMA PB 1	(1995) Panelboards
NEMA PB 2	(1995) Deadfront Distribution Switchboards
NEMA RN 1	(1998) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA TC 13	(1993) Electrical Nonmetallic Tubing (ENT)
NEMA TC 2	(1998) Electrical Polyvinyl Chloride (PVC) Tubing (EPT) and Conduit (EPC-40 and EPC-80)
NEMA VE 1	(1996) Metal Cable Tray Systems
NEMA WD 1	(1999) General Requirements for Wiring Devices
NEMA WD 6	(1997) Wiring Devices - Dimensional Requirements

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101	(2000) Life Safety Code
NFPA 70	(2002) National Electrical Code

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

47 CFR 18	Industrial, Scientific, and Medical Equipment

UNDERWRITERS LABORATORIES (UL)

UL 1	(2000) Flexible Metal Conduit
UL 1004	(1994; Rev thru Nov 1999) Electric Motors
UL 1029	(1994; Rev thru Dec 1997) High-Intensity-Discharge Lamp Ballasts
UL 1242	(1996; Rev Mar 1998) Intermediate Metal Conduit
UL 1449	(1996; Rev thru Dec 1999) Transient Voltage Surge Suppressors
UL 1569	(1999; Rev thru Jan 2000) Metal-Clad Cables
UL 1571	(1995; Rev thru Nov 1999) Incandescent Lighting Fixtures
UL 1572	(1995; Rev thru Nov 1999) High Intensity Discharge Lighting Fixtures
UL 1660	(2000) Liquid-Tight Flexible Nonmetallic Conduit
UL 198B	(1995) Class H Fuses
UL 198C	(1986; Rev thru Feb 1998) High-Interrupting-Capacity Fuses, Current-Limiting Types
UL 198D	(1995) Class K Fuses
UL 198E	(1988; Rev Jul 1988) Class R Fuses
UL 198G	(1988; Rev May 1988) Fuses for Supplementary Overcurrent Protection
UL 198H	(1988; Rev thru Nov 1993) Class T Fuses
UL 198L	(1995; Rev May 1995) D-C Fuses for Industrial Use
UL 20	(1995; Rev thru Oct 1998) General-Use Snap Switches

UL 360	(1996; Rev thru Oct 1997) Liquid-Tight Flexible Steel Conduit
UL 4	(1996) Armored Cable
UL 467	(1993; Rev thru Apr 1999) Grounding and Bonding Equipment
UL 486A	(1997; Rev thru Dec 1998) Wire Connectors and Soldering Lugs for Use with Copper Conductors
UL 486C	(1997; Rev thru Aug 1998) Splicing Wire Connectors
UL 486E	(1994; Rev thru Feb 1997) Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors
UL 489	(1996; Rev thru Dec 1998) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 498	(1996; Rev thru Jan 1999) Attachment Plugs and Receptacles
UL 5	(1996) Surface Metal Raceways and Fittings
UL 50	(1995; Rev thru Nov 1999) Enclosures for Electrical Equipment
UL 508	(1999) Industrial Control Equipment
UL 510	(1994; Rev thru Apr 1998) Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape
UL 512	(1993; Rev thru Mar 1999) Fuseholders
UL 514A	(1996; Rev Dec 1999) Metallic Outlet Boxes
UL 514B	(1997; Rev Oct 1998) Fittings for Cable and Conduit
UL 514C	(1996; Rev thru Dec 1999) Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL 542	(1999) Lampholders, Starters, and Starter Holders for Fluorescent Lamps
UL 6	(1997) Rigid Metal Conduit
UL 651	(1995; Rev thru Oct 1998) Schedule 40 and 80 Rigid PVC Conduit
UL 651A	(1995; Rev thru Apr 1998) Type EB and A Rigid PVC Conduit and HDPE Conduit

UL 67	(1993; Rev thru Oct 1999) Panelboards
UL 674	(1994; Rev thru Oct 1998) Electric Motors and Generators for Use in Division 1 Hazardous (Classified) Locations
UL 698	(1995; Rev thru Mar 1999) Industrial Control Equipment for Use in Hazardous (Classified) Locations
UL 719	(1996; Rev Jul 1999) Nonmetallic-Sheathed Cables
UL 797	(1993; Rev thru Mar 1997) Electrical Metallic Tubing
UL 817	(1994; Rev thru May 1999) Cord Sets and Power-
UL 83	(1998; Rev thru Sep 1999) Thermoplastic-Insulated Wires and Cables
UL 844	(1995; Rev thru Mar 1999) Electric Lighting Fixtures for Use in Hazardous (Classified) Locations
UL 845	(1995; Rev thru Nov 1999) Motor Control Centers
UL 854	(1996; Rev Oct 1999) Service-Entrance Cables
UL 869A	(1998) Reference Standard for Service Equipment
UL 877	(1993; Rev thru Nov 1999) Circuit Breakers and Circuit-Breaker Enclosures for Use in Hazardous (Classified) Locations
UL 886	(1994; Rev thru Apr 1999) Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations
UL 891	(1994; Rev thru Jan 1995) Dead-Front Switchboards
UL 924	(1995; Rev thru Oct 97) Emergency Lighting and Power Equipment
UL 935	(1995; Rev thru Oct 1998) Fluorescent-Lamp Ballasts
UL 943	(1993; Rev thru May 1998) Ground-Fault Circuit-Interrupters
UL 98	(1994; Rev thru Jun 1998) Enclosed and Dead-Front Switches
UL Elec Const Dir	(1999) Electrical Construction Equipment

Directory

1.2 GENERAL

1.2.1 Rules

The installation shall conform to the requirements of NFPA 70 and NFPA 101, unless more stringent requirements are indicated or shown.

1.2.2 Coordination

The drawings indicate the extent and the general location and arrangement of equipment, conduit, and wiring. The Contractor shall become familiar with all details of the work and verify all dimensions in the field so that the outlets and equipment shall be properly located and readily accessible. Lighting fixtures, outlets, and other equipment and materials shall be located to avoid interference with mechanical or structural features; otherwise, lighting fixtures shall be symmetrically located according to the room arrangement when uniform illumination is required, or asymmetrically located to suit conditions fixed by design and shown. Raceways, junction and outlet boxes, and lighting fixtures shall not be supported from sheet metal roof decks. If any conflicts occur necessitating departures from the drawings, details of and reasons for departures shall be submitted and approved prior to implementing any change. The Contractor shall coordinate electrical work with the HVAC and electrical drawings and specifications and provide power related wiring.

1.2.3 Special Environments

1.2.3.1 Weatherproof Locations

Wiring, Fixtures, and equipment in designated locations shall conform to NFPA 70 requirements for installation in damp or wet locations.

1.2.3.2 Ducts, Plenums and Other Air-Handling Spaces

Wiring and equipment in ducts, plenums and other air-handling spaces shall be installed using materials and methods in conformance with NFPA 70unless more stringent requirements are indicated in this specification or on the contract drawings.

1.2.4 Standard Products

Material and equipment shall be a standard product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

1.2.5 NAMEPLATES

1.2.5.1 Identification Nameplates

Major items of electrical equipment and major components shall be permanently marked with an identification name to identify the equipment by type or function and specific unit number as indicated. Designation of motors shall coincide with their designation in the motor control center or panel. Unless otherwise specified, identification nameplates shall be made of laminated plastic in accordance with ASTM D 709 with black outer layers and a white core. Edges shall be chamfered. Plates shall be fastened with

black-finished round-head drive screws, except motors, or approved nonadhesive metal fasteners. When the nameplate is to be installed on an irregular-shaped object, the Contractor shall devise an approved support suitable for the application and ensure the proper installation of the supports and nameplates. In all instances, the nameplate shall be installed in a conspicuous location. At the option of the Contractor, the equipment manufacturer's standard embossed nameplate material with black paint-filled letters may be furnished in lieu of laminated plastic. The front of each panelboard, motor control center, switchgear, and switchboard shall have a nameplate to indicate the phase letter, corresponding color and arrangement of the phase conductors. The following equipment, as a minimum, shall be provided with identification nameplates:

Minimum 1/4 inch High Letters	Minimum 1/8 inch High Letters
Panelboards	Control Power Transformers
Starters	Control Devices
Safety Switches	Instrument Transformers
Motor Control Centers	
Transformers	
Equipment Enclosures	
Switchgear	
Switchboards	
Motors	

Each panel, section, or unit in motor control centers, switchgear or similar assemblies shall be provided with a nameplate in addition to nameplates listed above, which shall be provided for individual compartments in the respective assembly, including nameplates which identify "future," "spare," and "dedicated" or "equipped spaces."

1.2.5.2 Liquid-Filled Transformer Nameplates

Power transformers shall be provided with Nameplate C information in accordance with IEEE ANSI/IEEE C57.12.00. Nameplates shall indicate percent impedance, voltage, kVA, frequency, number of phases, cooling class, insulation class, temperature rise, the number of gallons and composition of liquid-dielectric, and shall be permanently marked with a statement that the transformer dielectric to be supplied is non-polychlorinated biphenyl. The Contractor shall furnish manufacturer's certification for each transformer that the dielectric is non-PCB classified. Certifications shall be related to serial numbers on transformer nameplates.

1.2.6 As-Built Drawings

Following the project completion or turnover, within 30 days the Contractor shall furnish 2 sets of as-built drawings to the Contracting Officer.

1.2.7 Recessed Light Fixtures (RLF) Option

The Contractor has the option to substitute inch-pound (I-P) RLF to metric RLF. This option shall be coordinated with Section \=09510=\ ACOUSTICAL CEILINGS.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation;

submittals not having a "G" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Fault Current and Protective Device Coordination Study; G.

The study shall be submitted along with protective device equipment submittals. No time extensions or similar contract modifications will be granted for work arising out of the requirements for this study. Approval of protective devices proposed shall be based on recommendations of this study, The Government shall not be held responsible for any changes to equipment, device ratings, settings, or additional labor for installation of equipment or devices ordered and/or procured prior to approval of the study.

Manufacturer's Catalog; G.

Data composed of catalog cuts, brochures, circulars, specifications, product data, and printed information in sufficient detail and scope to verify compliance with the requirements of the contract documents.

Material, Equipment, and Fixture Lists; G.

A complete itemized listing of equipment and materials proposed for incorporation into the work. Each entry shall include an item number, the quantity of items proposed, and the name of the manufacturer of each item.

Installation Procedures;

Installation procedures for rotating equipment, transformers, switchgear, battery systems, voltage regulators, and grounding resistors. Procedures shall include diagrams, instructions, and precautions required to install, adjust, calibrate, and test devices and equipment.

SD-02 Shop Drawings

Interior Electrical Equipment;

Detail drawings consisting of equipment drawings, illustrations, schedules, instructions, diagrams, and other information necessary to define the installation. Detail drawings shall show the rating of items and systems and how the components of an item and system are assembled, function together, and how they will be installed on the project. Data and drawings for component parts of an item or system shall be coordinated and submitted as a unit. Data and drawings shall be coordinated and included in a single submission. Multiple submissions for the same equipment or system are not acceptable except where prior approval has been obtained from the Contracting Officer. In such cases, a list of data to be submitted later shall be included with the first submission. Detail drawings shall show physical arrangement, construction details, connections, finishes, materials used in fabrication, provisions for conduit or busway entrance, access requirements for installation and maintenance, physical size, electrical characteristics, foundation and support details, and equipment weight. Drawings shall be drawn to scale and/or dimensioned. Optional items shall be clearly identified as included or excluded. Detail drawings shall as a minimum include:

a. Transformers.

b. Switchgear.

c. Motors and rotating machinery.

e. Single line electrical diagrams including primary, metering, sensing and relaying, control wiring, and control logic.

f. Sway bracing for suspended luminaires.

Structural drawings showing the structural or physical features of major equipment items, components, assemblies, and structures, including foundations or other types of supports for equipment and conductors. These drawings shall include accurately scaled or dimensioned outline and arrangement or layout drawings to show the physical size of equipment and components and the relative arrangement and physical connection of related components. Weights of equipment, components and assemblies shall be provided when required to verify the adequacy of design and proposed construction of foundations or other types of supports. Dynamic forces shall be stated for switching devices when such forces must be considered in the design of support structures. The appropriate detail drawings shall show the provisions for leveling, anchoring, and connecting all items during installation, and shall include any recommendations made by the manufacturer.

Electrical drawings including single-line and three-line diagrams, and schematics or elementary diagrams of each electrical system; internal wiring and field connection diagrams of each electrical device when published by the manufacturer; wiring diagrams of cabinets, panels, units, or separate mountings; interconnection diagrams that show the wiring between separate components of assemblies; field connection diagrams that show the termination of wiring routed between separate items of equipment; internal wiring diagrams of equipment showing wiring as actually provided for this project. Field wiring connections shall be clearly identified.

If departures from the contract drawings are deemed necessary by the Contractor, complete details of such departures, including changes in related portions of the project and the reasons why, shall be submitted with the detail drawings. Approved departures shall be made at no additional cost to the Government.

As-Built Drawings;

The as-built drawings shall be a record of the construction as installed. The drawings shall include all the information shown on the contract drawings, deviations, modifications, and changes from the contract drawings, however minor. The as-built drawings shall be kept at the job site and updated daily. The as-built drawings shall be a full-sized set of prints marked to reflect all deviations, changes, and modifications. The as-built drawings shall be complete and show the location, size, dimensions, part identification, and other information. Additional sheets may be added. The as-built drawings shall be jointly inspected for accuracy and completeness by the Contractor's quality control representative and by the Contracting Officer prior to the submission of each monthly pay estimate. Upon completion of the work, the Contractor shall submit three full sized sets of the marked prints to the Contracting Officer for approval. If upon review, the as-built drawings are found to contain errors and/or omissions, they will be returned to the Contractor

for correction. The Contractor shall correct and return the as-built drawings to the Contracting Officer for approval within ten calendar days from the time the drawings are returned to the Contractor.

Onsite Test; G.

A detailed description of the Contractor's proposed procedures for on-site tests.

SD-06 Test Reports

Factory Test Reports; .

Six copies of the information described below in 8 1/2 x 11 inch binders having a minimum of 5 rings from which material may readily be removed and replaced, including a separate section for each test. Sections shall be separated by heavy plastic dividers with tabs.

a. A list of equipment used, with calibration certifications.

b. A copy of measurements taken.

c. The dates of testing.

d. The equipment and values to be verified.

e. The conditions specified for the test.

f. The test results, signed and dated.

g. A description of adjustments made.

Field Test Plan; G.

A detailed description of the Contractor's proposed procedures for onsite test submitted 20 days prior to testing the installed system. No field test will be performed until the test plan is approved. The test plan shall consist of complete field test procedures including tests to be performed, test equipment required, and tolerance limits.

Field Test Reports; G.

Six copies of the information described below in 8 1/2 x 11 inch binders having a minimum of 5 rings from which material may readily be removed and replaced, including a separate section for each test. Sections shall be separated by heavy plastic dividers with tabs.

a. A list of equipment used, with calibration certifications.

b. A copy of measurements taken.

c. The dates of testing.

d. The equipment and values to be verified.

e. The conditions specified for the test.

f. The test results, signed and dated.

g. A description of adjustments made.

h. Final position of controls and device settings.

SD-07 Certificates

Materials and Equipment;

The label or listing of the Underwriters Laboratories, Inc., will be accepted as evidence that the materials or equipment conform to the applicable standards of that agency. In lieu of this label or listing, a statement from a nationally recognized, adequately equipped testing agency indicating that the items have been tested in accordance with required procedures and that the materials and equipment comply with all contract requirements will be accepted. However, materials and equipment installed in hazardous locations must bear the UL label unless the data submitted from other testing agency is specifically approved in writing by the Contracting Officer. Items which are required to be listed and labeled in accordance with Underwriters Laboratories must be affixed with a UL label that states that it is UL listed. No exceptions or waivers will be granted to this requirement. Materials and equipment will be approved based on the manufacturer's published data.

For other than equipment and materials specified to conform to UL publications, a manufacturer's statement indicating complete compliance with the applicable standard of the American Society for Testing and Materials, National Electrical Manufacturers Association, or other commercial standard, is acceptable.

1.4 WORKMANSHIP

Materials and equipment shall be installed in accordance with NFPA 70, recommendations of the manufacturer, and as shown.

PART 2 PRODUCTS

Products shall conform to the respective publications and other requirements specified below. Materials and equipment not listed below shall be as specified elsewhere in this section. Items of the same classification shall be identical including equipment, assemblies, parts, and components.

2.1 CABLES AND WIRES

Conductors No. 8 AWG and larger diameter shall be stranded. Conductors No. 10 AWG and smaller diameter shall be solid, except that conductors for remote control, alarm, and signal circuits, classes 1, 2, and 3, shall be stranded unless specifically indicated otherwise. Conductor sizes and ampacities shown are based on copper, unless indicated otherwise. All conductors shall be copper.

2.1.1 Equipment Manufacturer Requirements

When manufacturer's equipment requires copper conductors at the terminations or requires copper conductors to be provided between components of equipment, provide copper conductors or splices, splice boxes, and other work required to meet manufacturer's requirements.

2.1.2 OMITTED

2.1.3 Insulation

Unless indicated otherwise, or required by NFPA 70, power and lighting wires shall be 600-volt, Type THWN, THHN, or THW conforming to UL 83, except that grounding wire may be type TW conforming to UL 83; remote-control and signal circuits shall be Type TW, THW or TF, conforming to UL 83. Where lighting fixtures require 90-degree Centigrade (C) conductors, provide only conductors with 90-degree C insulation or better.

2.1.4 Bonding Conductors

ASTM B 1, solid bare copper wire for sizes No. 8 AWG and smaller diameter; ASTM B 8, Class B, stranded bare copper wire for sizes No. 6 AWG and larger diameter.

2.1.5 Service Entrance Cables

Service entrance (SE) and underground service entrance (USE) cables, UL 854.

2.1.6 Non-metallic Sheathed Cable

UL 719, type NM or NMC.

2.1.7 Metal-Clad Cable

UL 1569; NFPA 70, Type MC cable.

2.1.8 Armored Cable

UL 4; NFPA 70, Type AC cable.

2.1.9 Mineral-Insulated, Metal-Sheathed Cable

UL listed NFPA 70, type MI cable. Sheathing containing asbestos fibers shall not be used.

2.1.10 Flat Conductor Cable

UL listed NFPA 70, type FCC.

2.1.11 Tray Cable or Power Limited Tray Cable

UL listed; Type TC or PLTC.

2.1.12 Cord Sets and Power-Supply Cords

UL 817.

2.2 CABLE TRAYS

NEMA VE 1 and a NEMA weight rating of Class 8C (100 lbs./ft.) cable trays shall form a wireway system, and shall be depth as indicated on drawings. Cable trays shall be constructed of ferrous metal . Trays shall include splice and end plates, dropouts, and miscellaneous hardware. Edges, fittings, and hardware shall be finished free from burrs and sharp edges. Fittings shall have not less than the load-carrying ability of straight tray sections and shall have manufacturer's minimum standard radius.24

inches.

2.3 TRANSIENT VOLTAGE SURGE PROTECTION

Transient voltage surge suppressors shall be provided as indicated. Surge suppressors shall meet the requirements of IEEE C62.41 and be UL listed and labeled as having been tested in accordance with UL 1449.

2.4 CIRCUIT BREAKERS

2.4.1 MOLDED-CASE CIRCUIT BREAKERS

Molded-case circuit breakers shall conform to NEMA AB 1 and UL 489and UL 877 for circuit breakers and circuit breaker enclosures located in hazardous (classified) locations. Circuit breakers may be installed in panelboards, switchboards, enclosures, motor control centers, or combination motor controllers.

2.4.1.1 Construction

Circuit breakers shall be suitable for mounting and operating in any position. Lug shall be listed for copper conductors only in accordance with UL 486E. Single-pole circuit breakers shall be full module size with not more than one pole per module. Multi-pole circuit breakers shall be of the common-trip type having a single operating handle such that an overload or short circuit on any one pole will result in all poles opening simultaneously. Sizes of 100 amperes or less may consist of single-pole breakers permanently factory assembled into a multi-pole unit having an internal, mechanical, nontamperable common-trip mechanism and external handle ties. All circuit breakers shall have a quick-make, quick-break overcenter toggle-type mechanism, and the handle mechanism shall be trip-free to prevent holding the contacts closed against a short-circuit or sustained overload. All circuit breaker handles shall assume a position between "ON" and "OFF" when tripped automatically. All ratings shall be clearly visible.

2.4.1.2 Ratings

Voltage ratings shall be not less than the applicable circuit voltage. The interrupting rating of the circuit breakers shall be at least equal to the available short-circuit current at the line terminals of the circuit breaker and correspond to the UL listed integrated short-circuit current rating specified for the panelboards and switchboards. Molded-case circuit breakers shall have nominal voltage ratings, maximum continuous-current ratings, and maximum short-circuit interrupting ratings in accordance with NEMA AB 1. Ratings shall be coordinated with system X/R ratio.

2.4.1.3 Cascade System Ratings

Circuit breakers used in series combinations shall not be allowed to be used.

2.4.1.4 Thermal-Magnetic Trip Elements

Thermal magnetic circuit breakers shall be provided as shown. Automatic operation shall be obtained by means of thermal-magnetic tripping devices located in each pole providing inverse time delay and instantaneous circuit protection. The instantaneous magnetic trip shall be adjustable and accessible from the front of all circuit breakers on frame sizes above 150

amperes.

2.4.2 Solid-State Trip Elements

Solid-state circuit breakers shall be provided as shown. All electronics shall be self-contained and require no external relaying, power supply, or accessories. Printed circuit cards shall be treated to resist moisture absorption, fungus growth, and signal leakage. All electronics shall be housed in an enclosure which provides protection against arcs, magnetic interference, dust, and other contaminants. Solid-state sensing shall measure true RMS current with error less than one percent on systems with distortions through the 13th harmonic. Peak or average actuating devices are not acceptable. Current sensors shall be torodial construction, encased in a plastic housing filled with epoxy to protect against damage and moisture and shall be integrally mounted on the breaker. Where indicated on the drawings, circuit breaker frames shall be rated for 100 percent continuous duty.

2.5 CONDUIT AND TUBING

2.5.1 Electrical, Zinc-Coated Steel Metallic Tubing (EMT)

UL 797

2.5.2 Electrical Nonmetallic Tubing (ENT)

NEMA TC 13.

2.5.3 Electrical Plastic Tubing and Conduit

NEMA TC 2.

2.5.4 Flexible Conduit, Steel and Plastic

General-purpose type, UL 1; liquid tight, UL 360, and UL 1660.

2.5.5 Intermediate Metal Conduit

UL 1242.

2.5.6 PVC Coated Rigid Steel Conduit

NEMA RN 1.

2.5.7 Rigid Aluminum Conduit

ANSI C80.5 and UL 6.

2.5.8 Rigid Metal Conduit

UL 6.

2.5.9 Rigid Plastic

NEMA TC 2, UL 651 and UL 651A.

2.5.10 Surface Metal Electrical Raceways and Fittings

UL 5.

2.6 CONDUIT AND DEVICE BOXES AND FITTINGS

2.6.1 Boxes, Metallic Outlet

NEMA OS 1 and UL 514C.

2.6.2 Boxes, Nonmetallic, Outlet and Flush-Device Boxes and Covers

NEMA OS 2 and UL 514C.

2.6.3 Boxes, Outlet for Use in Hazardous (Classified) Locations

UL 886.

2.6.4 Boxes, Switch (Enclosed), Surface-Mounted

UL 98.

2.6.5 Fittings for Conduit and Outlet Boxes

UL 514B.

2.6.6 Fittings For Use in Hazardous (Classified) Locations

UL 886.

2.6.7 Fittings, PVC, for Use with Rigid PVC Conduit and Tubing

UL 514B.

2.7 CONDUIT COATINGS PLASTIC RESIN SYSTEM

NEMA RN 1, Type A-40.

2.8 CONNECTORS, WIRE PRESSURE

2.8.1 For Use With Copper Conductors

UL 486A.

2.9 ELECTRICAL GROUNDING AND BONDING EQUIPMENT

UL 467.

2.9.1 Ground Rods

Ground rods shall be of copper-clad steel conforming to UL 467 not less than 3/4 inch in diameter by 8 feet in length of the sectional type driven full length into the earth.

2.9.2 Ground Bus

The ground bus shall be bare conductor or flat copper in one piece, if practicable.

2.10 ENCLOSURES

NEMA ICS 6 or NEMA 250 or UL 698 for use in hazardous (classified)

locations, unless otherwise specified.

2.10.1 Cabinets and Boxes

Cabinets and boxes with volume greater than 100 cubic inches shall be in accordance with UL 50, hot-dip, zinc-coated, if sheet steel.

2.10.2 Circuit Breaker Enclosures

UL 489.

2.10.3 Circuit Breaker Enclosures for Use in Hazardous (Classified) Locations

UL 877.

2.11 FIXTURES, LIGHTING AND FIXTURE ACCESSORIES/COMPONENTS

Standard Drawing 40-06-04 sheets referenced hereinafter are shown on contract drawings, if any, and UL 844 for fixtures to be installed in hazardous (classified) locations. Fixtures, accessories and components, including ballasts, lampholders, lamps, starters and starter holders, shall conform to industry standards specified below.

2.11.1 Fixture, Auxiliary or Emergency

UL 924.

2.11.2 Incandescent Fixture

NEMA LE 4 for ceiling compatibility of recessed fixtures and UL 1571.

2.11.3 Fluorescent

2.11.3.1 Ballasts and Transformers

Ballasts or transformers shall be designed to operate the designated lamps within their optimum specifications, without derating the lamps. Lamp and ballast combinations shall be certified as acceptable by the lamp manufacturer.

a. Low voltage incandescent transformers shall be Class II UL listed 120/12 volt or 120/24 volt step-down transformers as required for the lamps shown. Transformers shall be high power factor type and shall be rated for continuous operation under the specified load. Transformers shall be encased or encased and potted, and mounted integrally within the lighting fixture unless otherwise shown.

b. Fluorescent ballasts shall comply with ANSI C82.1 and shall be mounted integrally within fluorescent fixture housing unless otherwise shown. Ballasts shall have maximum current crest factor of 1.7; high power factor; Class A sound rating; maximum operating case temperature of 77 degrees F above ambient; and shall be rated Class P. Unless otherwise indicated, the minimum number of ballasts shall be used to serve each individual fixture. A single ballast may be used to serve multiple fixtures if they are continuously mounted, identically controlled and factory manufactured for that installation with an integral wireway.

(1) Compact fluorescent ballasts shall comply with IEEE C62.41 Category A transient voltage variation requirements and shall be mounted integrally within compact fluorescent fixture housing unless otherwise shown. Ballasts shall have minimum ballast factor of 0.95; maximum current crest factor of 1.6; high power factor; maximum operating case temperature of 77 degrees F above ambient; shall be rated Class P; and shall have a sound rating of Class A. Ballasts shall meet FCC Class A specifications for EMI/RFI emissions. Ballasts shall operate from nominal line voltage of 120 or 277 volts, as indicated on drawings at 60 Hz and maintain constant light output over a line voltage variation of ± 10%. Ballasts shall have an end-of-lamp-life detection and shut-down circuit. Ballasts shall be UL listed and shall contain no PCBs. Ballasts shall contain potting to secure PC board, provide lead strain relief, and provide a moisture barrier.

(2) Electronic fluorescent ballasts shall comply with 47 CFR 18 for electromagnetic interference. Ballasts shall withstand line transients per IEEE C62.41, Category A. Ballasts shall have total harmonic distortion below 10%; minimum frequency of 20,000 Hz; filament voltage between 2.5 and 4.5 volts; maximum starting inrush current of 20 amperes; and shall comply with the minimum Ballast Efficacy Factors shown in the table below. Minimum starting temperature shall be 50 degrees F. Ballasts shall carry a manufacturer's full warranty of three years, including a minimum $10 labor allowance per ballast.

ELECTRONIC FLUORESCENT BALLAST EFFICACY FACTORS

LAMP TYPE	TYPE OF STARTER & LAMP	NOMINAL OPERATIONAL VOLTAGE	NUMBER OF LAMPS	MINIMUM BALLAST EFFICACY FACTOR
32W T8	rapid start linear & U-tubes	120 or 277 V	1	2.54
			2	1.44
			3	0.93
			4	0.73
34W T12	rapid start linear & U-tubes	120 or 277 V	1	2.64
			2	1.41
			3	0.93
59W T8	rapid start linear	120 or 277 V	2	0.80
60W T12	rapid start linear	120 or 277 V	2	0.80

(3) Magnetic fluorescent ballasts shall be energy-saving, automatic resetting type, approved for the application by the Certified Ballast Manufacturers and complying with ANSI C82.1 and

UL 935. Minimum ballast starting temperature shall be 40 degrees F for normal service and 0 degrees F where cold temperature service is required. Magnetic fluorescent ballasts shall have a ballast factor not less than shown in the following table:

MAGNETIC FLUORESCENT BALLAST FACTORS*

Design starting temperature above 40 degrees F with 60 Hz input frequency

LAMP TYPE	NUMBER OF LAMPS	NOMINAL OPERATIONAL INPUT VOLTAGE	TYPE OF STARTER & LAMP	MIN. BALLAST FACTOR
25W F25T8	1	120v	rapid start	.96
	1	277v		.96
	2	120v		.95
	2	277v		.94
32W F32T8	1	120v	rapid start	.96
	1	277v		.95
	2	120v		.85
	2	277v		.96
96W F96T8	1	120 or 277v	instant start	1.10
	2			.85

* For ballasts not specifically designed for use with dimming controls.

(4) Dimming fluorescent ballasts shall be electronic and shall comply with the applicable electronic ballast specifications shown above. Dimming ballasts shall be compatible with the specified dimming control equipment and shall operate the lamps shown in the range from full rated light output to 20 percent of full rated light output. Dimming ballasts shall provide smooth square law dimming such that perceived dimming action is proportionate to the motion of the dimming control. Single or two-lamp dimming ballasts shall be used. Multi-lamp dimming ballasts shall be designed to operate lamps of the same length and current rating.

(5) Dimming compact fluorescent ballasts shall be electronic and shall comply with the applicable compact fluorescent and dimming ballast specifications shown above. Ballasts shall operate the lamps shown in the range from full rated light output to 5 percent of full rated light output. Ballast power factor shall be <90% throughout dimming range. THD shall be <10% at maximum light output and <20% at minimum light output. Ballast shall ignite the lamps at any light output setting selected.

c. High intensity discharge ballasts shall comply with UL 1029 and, if multiple supply types, with ANSI C82.4. Ballasts shall have minimum ballast factor of 0.9; high power factor; Class A sound rating; and maximum operating case temperature of 77 degrees F above ambient.

(1) Electronic high intensity discharge ballasts shall be constant wattage autotransformer type; shall have less than 10% ballast loss; shall have total harmonic distortion between 10 and 20%; and shall have a minimum starting temperature of 0 degrees F.

(2) Magnetic high intensity discharge ballasts shall have a minimum starting temperature of -20 degrees F.

d. Lampholders, Starters, and Starter Holders: UL 542.

e. Emergency lighting fixtures and accessories shall be constructed and independently tested to meet the requirements of applicable codes. Batteries shall be Nicad or equal with no required maintenance, and shall have a minimum life expectancy of five years and warranty period of three years.

f. Exit Signs

Exit signs shall be ENERGY STAR compliant, thereby meeting the following requirements. Input power shall be less than 5 watts per face. Letter size and spacing shall adhere to NFPA 101. Luminance contrast shall be greater than 0.8. Average luminance shall be greater than 15 cd/m^2 measured at normal (0 degree) and 45 degree viewing angles. Minimum luminance shall be greater than 8.6 cd/m^2 measured at normal and 45 degree viewing angles. Maximum to minimum luminance shall be less than 20:1 measured at normal and 45 degree viewing angles. The manufacturer warranty for defective parts shall be at least 5 years.

2.11.4 Ultrasonic, and Passive Infrared Occupancy Sensors

UL 916

2.11.5 High-Intensity-Discharge

a. Fixture: NEMA LE 4 for ceiling compatibility of recessed fixtures and UL 1572.

b. Ballasts: ANSI C82.4 for multiple supply types and UL 1029.

c. High intensity discharge fixture shall comply with UL 1572. Recessed ceiling fixtures shall comply with NEMA LE 4. Reflectors shall be anodized aluminum. Fixtures for horizontal lamps shall have position oriented lampholders. Lampholders shall be pulse-rated to 5,000 volts. Fixtures indicated as classified or rated for hazardous locations or special service shall be designed and independently tested for the environment in which they are installed. Recessed lens fixtures shall have extruded aluminum lens frames. Ballasts shall be integral to fixtures and shall be accessible without the use of special tools. Remote ballasts shall be encased and potted. Lamps shall be shielded from direct view with a UV absorbing material such as tempered glass, and shall be circuited through a cut-off switch which will shut off the lamp circuit if the lens is not in place.

2.12 LOW-VOLTAGE FUSES AND FUSEHOLDERS

2.12.1 Fuses, Low Voltage Cartridge Type

NEMA FU 1.

2.12.2 Fuses, High-Interrupting-Capacity, Current-Limiting Type

Fuses, Class G, J, L and CC shall be in accordance with UL 198C.

2.12.3 Fuses, Class K, High-Interrupting-Capacity Type

UL 198D.

2.12.4 Fuses, Class H

UL 198B.

2.12.5 Fuses, Class R

UL 198E.

2.12.6 Fuses, Class T

UL 198H.

2.12.7 Fuses for Supplementary Overcurrent Protection

UL 198G.

2.12.8 Fuses, D-C for Industrial Use

UL 198L.

2.12.9 Fuseholders

UL 512.

2.13 INSTRUMENTS, ELECTRICAL INDICATING

ANSI C39.1.

2.14 MOTORS, AC, FRACTIONAL AND INTEGRAL

Motors, ac, fractional and integral horsepower, 500 hp and smaller shall conform to NEMA MG 1 and UL 1004for motors; NEMA MG 10 for energy management selection of polyphase motors; and UL 674 for use of motors in hazardous (classified) locations.

2.14.1 Rating

The horsepower rating of motors should be limited to no more than 125 percent of the maximum load being served unless a NEMA standard size does not fall within this range. In this case, the next larger NEMA standard motor size should be used.

2.14.2 Motor Efficiencies

All permanently wired polyphase motors of 1 hp or more shall meet the minimum full-load efficiencies as indicated in the following table, and as specified in this specification. Motors of 1 hp or more with open, drip proof or totally enclosed fan cooled enclosures shall be high efficiency type, unless otherwise indicated. Motors provided as an integral part of motor driven equipment are excluded from this requirement if a minimum seasonal or overall efficiency requirement is indicated for that equipment by the provisions of another section.

Minimum Motor Efficiencies

HP	Std. Efficiency	High Efficiency
1	77.0	85.5
1.5	78.5	85.5
2	78.5	85.5
3	78.5	88.5
5	82.5	88.5
7.5	84.0	90.0
10	85.5	90.0
15	85.5	91.0
20	87.5	92.0
25	88.5	92.0
30	88.5	92.0
40	88.5	92.0
50	89.0	92.5
60	89.0	92.5
75	89.0	95.5
100	90.0	93.5
125	91.0	94.5
150	91.0	94.5
200	91.0	94.5
250	91.0	94.5
300	91.0	94.5
350	91.0	94.5
400	91.0	94.5
500	91.0	94.5

2.15 MOTOR CONTROLS AND MOTOR CONTROL CENTERS

2.15.1 General

NEMA ICS 1, NEMA ICS 2, NEMA ICS 3 and NEMA ICS 6, and UL 508 and UL 845. Panelboards supplying non-linear loads shall have neutrals sized for 200 percent of rated current.

2.15.2 Motor Starters

Combination starters shall be provided with circuit breakers, and fusible switches, and switches equipped with high-interrupting-capacity current-limiting fuses as required.

2.15.2.1 Reduced-Voltage Starters

Reduced-voltage starters shall be provided for polyphase motors 100 hp or larger. Reduced-voltage starters shall be of the single-step autotransformer, reactor, or resistor type having an adjustable time interval between application of reduced and full voltages to the motors. Wye-delta reduced voltage starter or part winding increment starter having an adjustable time delay between application of voltage to first and second winding of motor may be used in lieu of the reduced voltage starters specified above for starting of motor-generator sets, centrifugally operated equipment or reciprocating compressors provided with automatic unloaders.

2.15.3 Thermal-Overload Protection

Each motor of 1/8 hp or larger shall be provided with thermal-overload protection. Polyphase motors shall have overload protection in each ungrounded conductor. The overload-protection device shall be provided either integral with the motor or controller, or shall be mounted in a separate enclosure. Unless otherwise specified, the protective device shall be of the manually reset type. Single or double pole tumbler switches specifically designed for alternating-current operation only may be used as manual controllers for single-phase motors having a current rating not in excess of 80 percent of the switch rating.

2.15.4 Low-Voltage Motor Overload Relays

2.15.4.1 General

Thermal and magnetic current overload relays shall conform to NEMA ICS 2 and UL 508. Overload protection shall be provided either integral with the motor or motor controller, and shall be rated in accordance with the requirements of NFPA 70.

2.15.4.2 Construction

Manual reset type thermal relay shall be melting alloy or bimetallic construction. Automatic reset type thermal relays shall be bimetallic construction. Magnetic current relays shall consist of a contact mechanism and a dash pot mounted on a common frame.

2.15.4.3 Ratings

Voltage ratings shall be not less than the applicable circuit voltage. Trip current ratings shall be established by selection of the replaceable overload device and shall not be adjustable. Where the controller is remotely-located or difficult to reach, an automatic reset, non-compensated overload relay shall be provided. Manual reset overload relays shall be provided otherwise, and at all locations where automatic starting is provided. Where the motor is located in a constant ambient temperature, and the thermal device is located in an ambient temperature that regularly varies by more than minus 18 degrees F, an ambient temperature-compensated overload relay shall be provided.

2.15.5 Automatic Control Devices

2.15.5.1 Direct Control

Automatic control devices (such as thermostats, float or pressure switches) which control the starting and stopping of motors directly shall be designed for that purpose and have an adequate horsepower rating.

2.15.5.2 Pilot-Relay Control

Where the automatic-control device does not have such a rating, a magnetic starter shall be used, with the automatic-control device actuating the pilot-control circuit.

2.15.5.3 Manual/Automatic Selection

a. Where combination manual and automatic control is specified and the automatic-control device operates the motor directly, a

double-throw, three-position tumbler or rotary switch (marked MANUAL-OFF-AUTOMATIC) shall be provided for the manual control.

b. Where combination manual and automatic control is specified and the automatic-control device actuates the pilot control circuit of a magnetic starter, the magnetic starter shall be provided with a three-position selector switch marked MANUAL-OFF-AUTOMATIC.

c. Connections to the selector switch shall be such that; only the normal automatic regulatory control devices will be bypassed when the switch is in the Manual position; all safety control devices, such as low-or high-pressure cutouts, high-temperature cutouts, and motor-overload protective devices, shall be connected in the motor-control circuit in both the Manual and the Automatic positions of the selector switch. Control circuit connections to any MANUAL-OFF-AUTOMATIC switch or to more than one automatic regulatory control device shall be made in accordance with wiring diagram approved by the Contracting Officer unless such diagram is included on the drawings. All controls shall be 120 volts or less unless otherwise indicated.

2.15.6 Motor Control Centers

Control centers shall conform to the requirements of NEMA ICS 1, NEMA ICS 2, NEMA ICS 3 and NEMA ICS 6, and UL 508 and UL 845. Control centers shall be indoor type and shall contain combination starters and other equipment as indicated. Control centers shall be NEMA ICS 2. Each control center shall be mounted on floor sills or mounting channels. Each circuit shall have a suitable metal or laminated plastic nameplate with white cut letters. Motor control centers shall be provided with a full-length ground bus bar.

2.16 PANELBOARDS

Dead-front construction, NEMA PB 1 and UL 67.

2.17 RECEPTACLES

2.17.1 Omitted

2.17.2 Heavy Duty Grade

NEMA WD 1. Devices shall conform to all requirements for heavy duty receptacles.

2.17.3 Standard Grade

UL 498.

2.17.4 Ground Fault Interrupters

UL 943, Class A or B.

2.17.5 NEMA Standard Receptacle Configurations

NEMA WD 6.

a. Single and Duplex, 15-Ampere and 20-Ampere, 125 Volt

15-ampere, non-locking: NEMA type 5-15R, locking: NEMA type L5-15R,

20-ampere, non-locking: NEMA type 5-20R, locking: NEMA type L5-20R.

b. 15-Ampere, 250 Volt

Two-pole, 3-wire grounding, non-locking: NEMA type 6-15R, locking: NEMA type L6-15R. Three-pole, 4-wire grounding, non-locking: NEMA type 15-15R, locking: NEMA type L15-15R.

c. 20-Ampere, 250 Volt

Two-pole, 3-wire grounding, non-locking: NEMA type 6-20R, locking: NEMA type L6-20R. Three-pole, 4-wire grounding, non-locking: NEMA type 15-20R, locking: NEMA type L15-20R.

d. 30-Ampere, 125/250 Volt

Three-pole, 3-wire, non-locking: NEMA type 10-30R, locking: NEMA type L10-30R. Three-pole, 4-wire grounding, non-locking: NEMA type 14-30R, locking: NEMA type L14-30R.

e. 30-Ampere, 250 Volt

Two-pole, 3-wire grounding, non-locking: NEMA type 6-30R, locking: NEMA type L6-30R. Three-pole, 4-wire grounding, non-locking: NEMA type 15-30R, locking: NEMA type L15-30R.

f. 50-Ampere, 125/250 Volt

Three-pole, 3-wire: NEMA type 10-50R. Three-pole, 4-wire grounding: NEMA type 14-50R.

g. 50-Ampere, 250 Volt

Two-pole, 3-wire grounding: NEMA type 6-50R. Three-pole, 4-wire grounding: NEMA type 15-50R.

2.18 Service Entrance Equipment

UL 869A.

2.19 SPLICE, CONDUCTOR

UL 486C.

2.20 POWER-SWITCHGEAR ASSEMBLIES INCLUDING SWITCHBOARDS

Assemblies shall be metal-enclosed, freestanding general-purpose type in accordance with NEMA PB 2, UL 891, and IEEE ANSI/IEEE C37.20.1 and shall be installed to provide front and rear access. Busses shall be copper. Assembly shall be approximately 90 inches high; arrangement of circuit breakers and other items specified shall be as indicated. The withstand rating and interrupting capacity of the switchboards and circuit breakers fuses shall be based on the maximum fault current available.

2.21 SNAP SWITCHES

UL 20.

2.22 TAPES

2.22.1 Plastic Tape

UL 510.

2.22.2 Rubber Tape

UL 510.

2.23 TRANSFORMERS

Single- and three-phase transformers shall have two windings per phase. Full-capacity standard NEMA taps shall be provided in the primary windings of transformers unless otherwise indicated. Three-phase transformers shall be configured with delta-wye windings, except as indicated. "T" connections may be used for transformers rated 15 kVA or below. Transformers supplying non-linear loads shall be UL listed as suitable for supplying such loads with a total K-factor not to exceed K-9 and have neutrals sized for 200 percent of rated current.

2.23.1 Transformers, Dry-Type

Transformers shall have 220 degrees C insulation system for transformers 15 kVA and greater, and shall have 180 degrees C insulation system for transformers rated 10 kVA and less, with temperature rise not exceeding 150 degrees C under full-rated load in maximum ambient temperature of 40 degrees C. Transformer of 150 degrees C temperature rise shall be capable of carrying continuously 100 percent of nameplate kVA without exceeding insulation rating. Windings shall be copper.

2.23.2 Average Sound Level

The average sound level in decibels (dB) of transformers shall not exceed the following dB level at 12 inches for the applicable kVA rating range listed unless otherwise indicated:

kVA Range	dB Sound Level
1-50	50
51-150	55
151-300	58
301-500	60

2.24 WATTHOUR METERS, UTILITY REVENUE

Watthour meters shall conform to ANSI C12.1 and ANSI C12.10, except numbered terminal wiring sequence and case size may be the manufacturer's standard. Watthour meters shall be of the socket-mounted outdoor type having a 15-minute, cumulative form, demand register meeting ANSI C12.4 and provided with not less than two and one-half stators. Watthour demand meters shall have factory-installed electronic pulse initiators meeting the requirements of ANSI C12.1. Pulse initiators shall be solid-state devices incorporating light-emitting diodes, phototransistors, and power transistors, except that mercury-wetted output contacts are acceptable. Initiators shall be totally contained within watthour demand meter enclosures, shall be capable of operating up to speeds of 500 pulses per minute with no false pulses, and shall require no field adjustments. Initiators shall be calibrated for a pulse rate output of one pulse per 1/4

disc revolution of the associated meter and shall be compatible with the indicated equipment.

2.25 WIRING DEVICES

NEMA WD 1 for wiring devices, and NEMA WD 6 for dimensional requirements of wiring devices.

2.26 COORDINATED POWER SYSTEM PROTECTION

Analyses shall be prepared to demonstrate that the equipment and system constructed meet the specified requirements for equipment ratings, coordination, and protection. They shall include a load flow analysis, a fault current analysis, and protective device coordination study. The studies shall be performed by a registered professional engineer with demonstrated experience in power system coordination in the last three years. The Contractor shall provide a list of references complete with points of contact, addresses and telephone numbers. The selection of the engineer is subject to the approval of the Contracting Officer.

2.26.1 Scope of Analyses

The fault current analysis, and protective device coordination study shall begin at: the source bus and extended through the secondary side of transformers for medium voltage distribution feeders.

2.26.2 Determination of Facts

The time-current characteristics, features, and nameplate data for each existing protective device shall be determined and documented. The Contractor shall utilize infinity for source fault current availability for fault current studies.

2.26.3 Single Line Diagram

A single line diagram shall be prepared to show the electrical system buses, devices, transformation points, and all sources of fault current (including generator and motor contributions). A fault-impedance diagram or a computer analysis diagram may be provided. Each bus, device or transformation point shall have a unique identifier. If a fault-impedance diagram is provide, impedance data shall be shown. Locations of switches, breakers, and circuit interrupting devices shall be shown on the diagram together with available fault data, and the device interrupting rating.

2.26.4 Fault Current Analysis

2.26.4.1 Method

The fault current analysis shall be performed in accordance with methods described in IEEE Std 242, and IEEE Std 399.

2.26.4.2 Data

Actual data shall be utilized in fault calculations. Bus characteristics and transformer impedances shall be those proposed. Data shall be documented in the report.

2.26.4.3 Fault Current Availability

Balanced three-phase fault, bolted line-to-line fault, and line-to-ground fault current values shall be provided at each voltage transformation point and at each power distribution bus. The maximum and minimum values of fault available at each location shall be shown in tabular form on the diagram or in the report.

2.26.5 Coordination Study

The study shall demonstrate that the maximum possible degree of selectivity has been obtained between devices specified, consistent with protection of equipment and conductors from damage from overloads and fault conditions. The study shall include a description of the coordination of the protective devices in this project. Provide a written narrative that describes: which devices may operate in the event of a fault at each bus; the logic used to arrive at device ratings and settings; situation where system coordination is not achievable due to device limitations (an analysis of any device curves which order overlap); coordination between upstream and downstream devices; and relay settings. Recommendations to improve or enhance system reliability, and detail where such changes would involve additions or modifications to the contract and cost changes (addition or reduction) shall be provided. Composite coordination plots shall be provided on log-log graph paper.

2.26.6 Study Report

a. The report shall include a narrative: the analyses performed; the bases and methods used; and the desired method of coordinated protection of the power system.

b. The study shall include descriptive and technical data for existing devices and new protective devices proposed. The data shall include manufacturers published data, nameplate data, and definition of the fixed or adjustable features of the existing or new protective devices.

c. The report shall document utility company data including system voltages, fault MVA, system X/R ratio, time-current characteristic curves, current transformer ratios, and relay device curves and protective device ratings and settings.

d. The report shall contain fully coordinated composite time-current characteristic curves for each bus in the system, as required to ensure coordinated power system protection between protective devices or equipment. The report shall include recommended ratings and settings of all protective devices in tabulated form.

e. The report shall provide the calculations performed for the analyses, including computer analysis programs utilized. The name of the software package, developer, and version number shall be provided.

PART 3 EXECUTION

3.1 GROUNDING

Grounding shall be in conformance with NFPA 70, the contract drawings, and the following specifications.

3.1.1 Ground Rods

The resistance to ground shall be measured using the fall-of-potential method described in IEEE Std 81. The maximum resistance of a driven ground shall not exceed 25 ohms under normally dry conditions. In high-ground-resistance, UL listed chemically charged ground rods may be used. If the resultant resistance exceeds 25 ohms measured not less than 48 hours after rainfall, the Contracting Officer shall be notified immediately. Connections below grade shall be fusion welded. Connections above grade shall be fusion welded or shall use UL 467 approved connectors.

3.1.2 Omitted

3.1.3 Grounding Conductors

A green equipment grounding conductor, sized in accordance with NFPA 70 shall be provided, regardless of the type of conduit. Equipment grounding bars shall be provided in all panelboards. The equipment grounding conductor shall be carried back to the service entrance grounding connection or separately derived grounding connection. All equipment grounding conductors, including metallic raceway systems used as such, shall be bonded or joined together in each wiring box or equipment enclosure. Metallic raceways and grounding conductors shall be checked to assure that they are wired or bonded into a common junction. Metallic boxes and enclosures, if used, shall also be bonded to these grounding conductors by an approved means per NFPA 70. When boxes for receptacles, switches, or other utilization devices are installed, any designated grounding terminal on these devices shall also be bonded to the equipment grounding conductor junction with a short jumper.

3.2 WIRING METHODS

Wiring shall conform to NFPA 70, the contract drawings, and the following specifications. Wire fill in conduits shall be based on NFPA 70 for the type of conduit and wire insulations specified. Wire fill in conduits located in Class I or II hazardous areas shall be limited to 25 percent of the cross sectional area of the conduit.

3.2.1 Conduit and Tubing Systems

Conduit and tubing systems shall be installed as indicated. Conduit sizes shown are based on use of copper conductors with insulation types as described in paragraph WIRING METHODS. Minimum size of raceways shall be 1/2 inch. Only metal conduits will be permitted when conduits are required for shielding or other special purposes indicated, or when required by conformance to NFPA 70. Nonmetallic conduit and tubing may be used in damp, wet or corrosive locations when permitted by NFPA 70 and the conduit or tubing system is provided with appropriate boxes, covers, clamps, screws or other appropriate type of fittings. Electrical metallic tubing (EMT) may be installed only within buildings. EMT may be installed in concrete and grout in dry locations. EMT installed in concrete or grout shall be provided with concrete tight fittings. EMT shall not be installed in damp or wet locations, or the air space of exterior masonry cavity walls. Bushings, manufactured fittings or boxes providing equivalent means of protection shall be installed on the ends of all conduits and shall be of the insulating type, where required by NFPA 70. Only UL listed adapters shall be used to connect EMT to rigid metal conduit, cast boxes, and conduit bodies. Aluminum conduit may be used only where installed exposed

in dry locations. Nonaluminum sleeves shall be used where aluminum conduit passes through concrete floors and firewalls. Penetrations of above grade floor slabs, time-rated partitions and fire walls shall be firestopped in accordance with Section 07270 FIRESTOPPING. Except as otherwise specified, IMC may be used as an option for rigid steel conduit in areas as permitted by NFPA 70. Raceways shall not be installed under the firepits of boilers and furnaces and shall be kept 6 inches away from parallel runs of flues, steam pipes and hot-water pipes. Raceways shall be concealed within finished walls, ceilings, and floors unless otherwise shown. Raceways crossing structural expansion joints or seismic joints shall be provided with suitable expansion fittings or other suitable means to compensate for the building expansion and contraction and to provide for continuity of grounding.

3.2.1.1 Pull Wires

A pull wire shall be inserted in each empty raceway in which wiring is to be installed if the raceway is more than 50 feet in length and contains more than the equivalent of two 90-degree bends, or where the raceway is more than 150 feet in length. The pull wire shall be of No. 14 AWG zinc-coated steel, or of plastic having not less than 200 pounds per square inch tensile strength. Not less than 10 inches of slack shall be left at each end of the pull wire.

3.2.1.2 Conduit Stub-Ups

Where conduits are to be stubbed up through concrete floors, a short elbow shall be installed below grade to transition from the horizontal run of conduit to a vertical run. A conduit coupling fitting, threaded on the inside shall be installed, to allow terminating the conduit flush with the finished floor. Wiring shall be extended in rigid threaded conduit to equipment, except that where required, flexible conduit may be used 6 inches above the floor. Empty or spare conduit stub-ups shall be plugged flush with the finished floor with a threaded, recessed plug.

3.2.1.3 Below Slab-on-Grade or in the Ground

Electrical wiring below slab-on-grade shall be protected by a conduit system. Conduit passing vertically through slabs-on-grade shall be rigid steel or IMC. Rigid steel or IMC conduits installed below slab-on-grade or in the earth shall be field wrapped with 0.010 inch thick pipe-wrapping plastic tape applied with a 50 percent overlay, or shall have a factory-applied polyvinyl chloride, plastic resin, or epoxy coating system.

3.2.1.4 Installing in Slabs Including Slabs on Grade

Conduit installed in slabs-on-grade shall be rigid steel or IMC. Conduits shall be installed as close to the middle of concrete slabs as practicable without disturbing the reinforcement. Outside diameter shall not exceed 1/3 of the slab thickness and conduits shall be spaced not closer than 3 diameters on centers except at cabinet locations where the slab thickness shall be increased as approved by the Contracting Officer. Where conduit is run parallel to reinforcing steel, the conduit shall be spaced a minimum of one conduit diameter away but not less than one inch from the reinforcing steel.

3.2.1.5 Changes in Direction of Runs

Changes in direction of runs shall be made with symmetrical bends or

cast-metal fittings. Field-made bends and offsets shall be made with an approved hickey or conduit-bending machine. Crushed or deformed raceways shall not be installed. Trapped raceways in damp and wet locations shall be avoided where possible. Lodgment of plaster, dirt, or trash in raceways, boxes, fittings and equipment shall be prevented during the course of construction. Clogged raceways shall be cleared of obstructions or shall be replaced.

3.2.1.6 Supports

Metallic conduits and tubing,and the support system to which they are attached, shall be securely and rigidly fastened in place to prevent vertical and horizontal movement at intervals of not more than 10 feet and within 3 feet of boxes, cabinets, and fittings, with approved pipe straps, wall brackets, conduit clamps, conduit hangers, threaded C-clamps, beam clamps, or ceiling trapeze. Loads and supports shall be coordinated with supporting structure to prevent damage or deformation to the structure. Loads shall not be applied to joist bridging. Attachment shall be by wood screws or screw-type nails to wood; by toggle bolts on hollow masonry units; by expansion bolts on concrete or brick; by machine screws, welded threaded studs, heat-treated or spring-steel-tension clamps on steel work. Nail-type nylon anchors or threaded studs driven in by a powder charge and provided with lock washers and nuts may be used in lieu of expansion bolts or machine screws. Raceways or pipe straps shall not be welded to steel structures. Cutting the main reinforcing bars in reinforced concrete beams or joists shall be avoided when drilling holes for support anchors. Holes drilled for support anchors, but not used, shall be filled. In partitions of light steel construction, sheet-metal screws may be used. Raceways shall not be supported using wire or nylon ties. Raceways shall be independently supported from the structure. Upper raceways shall not be used as a means of support for lower raceways. Supporting means shall not be shared between electrical raceways and mechanical piping or ducts. Cables and raceways shall not be supported by ceiling grids. Except where permitted by NFPA 70, wiring shall not be supported by ceiling support systems. Conduits shall be fastened to sheet-metal boxes and cabinets with two locknuts where required by NFPA 70, where insulating bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, a single locknut and bushing may be used. Threadless fittings for electrical metallic tubing shall be of a type approved for the conditions encountered. Additional support for horizontal runs is not required when EMT rests on steel stud cutouts.

3.2.1.7 Exposed Raceways

Exposed raceways shall be installed parallel or perpendicular to walls, structural members, or intersections of vertical planes and ceilings. Raceways under raised floors and above accessible ceilings shall be considered as exposed installations in accordance with NFPA 70 definitions.

3.2.1.8 Exposed Risers

Exposed risers in wire shafts of multistory buildings shall be supported by U-clamp hangers at each floor level, and at intervals not to exceed 10 feet.

3.2.1.9 Omitted

3.2.1.10 Communications Raceways

Communications raceways indicated shall be installed in accordance with the previous requirements for conduit and tubing and with the additional requirement that no length of run shall exceed 50 feet for 1/2 inch and 3/4 inch sizes, and 100 feet for 1 inch or larger sizes, and shall not contain more than two 90-degree bends or the equivalent. Additional pull or junction boxes shall be installed to comply with these limitations whether or not indicated. Inside radii of bends in conduits of 1 inch size or larger shall not be less than ten times the nominal diameter.

3.2.2 Busway Systems

Busway systems shall be of the voltage, capacity, and phase characteristics indicated. Vertical runs of busways within 6 feet of the floor shall have solid enclosures. Busways shall be supported at intervals not exceeding 5 feet, and shall be braced properly to prevent lateral movement. Busways penetrating walls or floors shall be provided with flanges to completely close wall or floor openings.

3.2.3 Cable Trays

Cable trays shall be supported in accordance with the recommendations of the manufacturer but at no more than 6 foot intervals. Contact surfaces of aluminum connections shall be coated with an antioxidant compound prior to assembly. Adjacent cable tray sections shall be bonded together by connector plates of an identical type as the cable tray sections. The Contractor shall submit the manufacturer's certification that the cable tray system meets all requirements of Article 318 of NFPA 70. The cable tray shall be installed and grounded in accordance with the provisions of Article 318 of NFPA 70. Data submitted by the Contractor shall demonstrate that the completed cable tray systems will comply with the specified requirements. Cable trays shall terminate 10 inches from both sides of smoke and fire partitions. Conductors run through smoke and fire partitions shall be installed in 4 inch rigid steel conduits with grounding bushings, extending 12 inches beyond each side of the partitions. The installation shall be sealed to preserve the smoke and fire rating of the partitions. Penetrations shall be firestopped in accordance with Section 07270 FIRESTOPPING.

3.2.4 Cables and Conductors

Installation shall conform to the requirements of NFPA 70. Covered, bare or insulated conductors of circuits rated over 600 volts shall not occupy the same equipment wiring enclosure, cable, or raceway with conductors of circuits rated 600 volts or less.

3.2.4.1 Sizing

Unless otherwise noted, all sizes are based on copper conductors and the insulation types indicated. Sizes shall be not less than indicated. Branch-circuit conductors shall be not smaller than No. 12 AWG. Conductors for branch circuits of 120 volts more than 100 feet long and of 277 volts more than 230 feet long, from panel to load center, shall be no smaller than No. 10 AWG. Class 1 remote control and signal circuit conductors shall be not less than No. 14 AWG. Class 2 remote control and signal circuit conductors shall be not less than No. 16 AWG. Class 3 low-energy,

remote-control and signal circuits shall be not less than No. 22 AWG.

3.2.4.2 Use of Aluminum Conductors in Lieu of Copper

Aluminum conductors shall not be used.

3.2.4.3 Cable Systems

Cable systems shall be installed where indicated. Cables shall be installed concealed behind ceiling or wall finish where practicable. Cables shall be threaded through holes bored on the approximate centerline of wood members; notching of surfaces will not be permitted. Sleeves shall be provided through bond beams of masonry-block walls for threading cables through hollow spaces. Exposed cables shall be installed parallel or at right angles to walls or structural members. In rooms or areas not provided with ceiling or wall finish, cables and outlets shall be installed so that a room finish may be applied in the future without disturbing the cables or resetting the boxes. Exposed nonmetallic-sheathed cables less than 4 feet above floors shall be protected from mechanical injury by installation in conduit or tubing.

3.2.4.4 Mineral-Insulated Cable

Mineral-insulated, metal-sheathed cable system, Type MI, may be used in lieu of exposed conduit and wiring. Conductor sizes shall be not less than those indicated for the conduit installation. Cables shall be fastened within 12 inches of each turn or offset and at intervals of not more than 6 feet. Cable terminations shall be made in accordance with manufacturer's recommendations.

3.2.4.5 Cable Splicing

Splices shall be made in an accessible location. Crimping tools and dies shall be approved by the connector manufacturer for use with the type of connector and conductor.

a. Copper Conductors, 600 Volt and Under: Splices in conductors No. 10 AWG and smaller diameter shall be made with an insulated, pressure-type connector. Splices in conductors No. 8 AWG and larger diameter shall be made with a solderless connector and insulated with tape or heat-shrink type insulating material equivalent to the conductor insulation.

b. Aluminum Conductors, 600 Volt and Under: Splices of aluminum conductors shall be made with a UL listed, solderless, compression-type, aluminum bodied connector, stamped for AL or AL/CU. Aluminum contact surfaces of conductors shall be cleaned with a wire brush and covered with anti-oxidant joint compound prior to making of connections. Any excess joint compound shall be wiped away after installing the connector. Insulate the connection with tape or heat-shrink type insulating material equivalent to the conductor insulation.

c. Greater Than 600 Volt: Cable splices shall be made in accordance with the cable manufacturer's recommendations and Section 16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND.

3.2.4.6 Conductor Identification and Tagging

Power, control, and signal circuit conductor identification shall be provided within each enclosure where a tap, splice, or termination is made. Where several feeders pass through a common pull box, the feeders shall be tagged to indicate clearly the electrical characteristics, circuit number, and panel designation. Phase conductors of low voltage power circuits shall be identified by color coding. Phase identification by a particular color shall be maintained continuously for the length of a circuit, including junctions.

a. Color coding shall be provided for service, feeder, branch, and ground conductors. Color shall be green for grounding conductors and white for neutrals; except where neutrals of more than one system are installed in the same raceway or box, other neutral shall be white with colored (not green) stripe. The color coding for 3-phase and single-phase low voltage systems shall be as follows:

   120/208-volt, 3-phase: Black(A), red(B), and blue(C).
   277/480-volt, 3-phase: Brown(A), orange(B), and yellow(C).
   120/240-volt, 1-phase: Black and red.

b. Conductor phase and voltage identification shall be made by color-coded insulation for all conductors smaller than No. 6 AWG. For conductors No. 6 AWG and larger, identification shall be made by color-coded insulation, or conductors with black insulation may be furnished and identified by the use of half-lapped bands of colored electrical tape wrapped around the insulation for a minimum of 3 inches of length near the end, or other method as submitted by the Contractor and approved by the Contracting Officer.

c. Control and signal circuit conductor identification shall be made by color-coded insulated conductors, plastic-coated self-sticking printed markers, permanently attached stamped metal foil markers, or equivalent means as approved. Control circuit terminals of equipment shall be properly identified. Terminal and conductor identification shall match that shown on approved detail drawings. Hand lettering or marking is not acceptable.

3.3 BOXES AND SUPPORTS

Boxes shall be provided in the wiring or raceway systems where required by NFPA 70 for pulling of wires, making connections, and mounting of devices or fixtures. Pull boxes shall be furnished with screw-fastened covers. Indicated elevations are approximate, except where minimum mounting heights for hazardous areas are required by NFPA 70. Unless otherwise indicated, boxes for wall switches shall be mounted 48 inches above finished floors. Switch and outlet boxes located on opposite sides of fire rated walls shall be separated by a minimum horizontal distance of 24 inches. The total combined area of all box openings in fire rated walls shall not exceed 100 square inches per 100 square feet. Maximum box areas for individual boxes in fire rated walls vary with the manufacturer and shall not exceed the maximum specified for that box in UL Elec Const Dir. Only boxes listed in UL Elec Const Dir shall be used in fire rated walls.

3.3.1 Box Applications

Each box shall have not less than the volume required by NFPA 70 for number of conductors enclosed in box. Boxes for metallic raceways, 4 by 4 inch nominal size and smaller, shall be of the cast-metal hub type when located in normally wet locations, when flush and surface mounted on outside of exterior surfaces, or when located in hazardous areas. Cast-metal boxes installed in wet locations and boxes installed flush with the outside of exterior surfaces shall be gasketed. Boxes for mounting lighting fixtures shall be not less than 4 inches square, or octagonal, except smaller boxes may be installed as required by fixture configuration, as approved. Cast-metal boxes with 3/32 inch wall thickness are acceptable. Boxes in other locations shall be sheet steel except that aluminum boxes may be used with aluminum conduit, and nonmetallic boxes may be used with nonmetallic conduit and tubing or nonmetallic sheathed cable system, when permitted by NFPA 70. Boxes for use in masonry-block or tile walls shall be square-cornered, tile-type, or standard boxes having square-cornered, tile-type covers.

3.3.2 Brackets and Fasteners

Boxes and supports shall be fastened to wood with wood screws or screw-type nails of equal holding strength, with bolts and metal expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screw or welded studs on steel work. Threaded studs driven in by powder charge and provided with lockwashers and nuts, or nail-type nylon anchors may be used in lieu of expansion shields, or machine screws. Penetration of more than 1-1/2 inches into reinforced-concrete beams or more than 3/4 inch into reinforced-concrete joists shall avoid cutting any main reinforcing steel. The use of brackets which depend on gypsum wallboard or plasterboard for primary support will not be permitted. In partitions of light steel construction, bar hangers with 1 inch long studs, mounted between metal wall studs or metal box mounting brackets shall be used to secure boxes to the building structure. When metal box mounting brackets are used, additional box support shall be provided on the side of the box opposite the brackets. This additional box support shall consist of a minimum 12 inch long section of wall stud, bracketed to the opposite side of the box and secured by two screws through the wallboard on each side of the stud. Metal screws may be used in lieu of the metal box mounting brackets.

3.3.3 Mounting in Walls, Ceilings, or Recessed Locations

In walls or ceilings of concrete, tile, or other non-combustible material, boxes shall be installed so that the edge of the box is not recessed more than 1/4 inch from the finished surface. Boxes mounted in combustible walls or ceiling material shall be mounted flush with the finished surface. The use of gypsum or plasterboard as a means of supporting boxes will not be permitted. Boxes installed for concealed wiring shall be provided with suitable extension rings or plaster covers, as required. The bottom of boxes installed in masonry-block walls for concealed wiring shall be mounted flush with the top of a block to minimize cutting of the blocks, and boxes shall be located horizontally to avoid cutting webs of block. Separate boxes shall be provided for flush or recessed fixtures when required by the fixture terminal operating temperature, and fixtures shall be readily removable for access to the boxes unless ceiling access panels are provided.

3.3.4 Installation in Overhead Spaces

In open overhead spaces, cast-metal boxes threaded to raceways need not be separately supported except where used for fixture support; cast-metal boxes having threadless connectors and sheet metal boxes shall be supported directly from the building structure or by bar hangers. Hangers shall not be fastened to or supported from joist bridging. Where bar hangers are used, the bar shall be attached to raceways on opposite sides of the box and the raceway shall be supported with an approved type fastener not more than 24 inches from the box.

3.4 DEVICE PLATES

One-piece type device plates shall be provided for all outlets and fittings. Plates on unfinished walls and on fittings shall be of zinc-coated sheet steel, cast-metal, or impact resistant plastic having rounded or beveled edges. Plates on finished walls shall be of steel with baked enamel finish or impact-resistant plastic and shall be ivory. Screws shall be of metal with countersunk heads, in a color to match the finish of the plate. Plates shall be installed with all four edges in continuous contact with finished wall surfaces without the use of mats or similar devices. Plaster fillings will not be permitted. Plates shall be installed with an alignment tolerance of 1/16 inch. The use of sectional-type device plates will not be permitted. Plates installed in wet locations shall be gasketed and provided with a hinged, gasketed cover, unless otherwise specified.

3.5 RECEPTACLES

3.5.1 Single and Duplex, 15 or 20-ampere, 125 volt

Single and duplex receptacles shall be rated 20 amperes, 125 volts, two-pole, three-wire, grounding type with polarized parallel slots. Bodies shall be of ivory to match color of switch handles in the same room or to harmonize with the color of the respective wall, and supported by mounting strap having plaster ears. Contact arrangement shall be such that contact is made on two sides of an inserted blade. Receptacle shall be side- or back-wired with two screws per terminal. The third grounding pole shall be connected to the metal mounting yoke. Switched receptacles shall be the same as other receptacles specified except that the ungrounded pole of each suitable receptacle shall be provided with a separate terminal. Only the top receptacle of a duplex receptacle shall be wired for switching application. Receptacles with ground fault circuit interrupters shall have the current rating as indicated, and shall be UL Class A type unless otherwise shown. Ground fault circuit protection shall be provided as required by NFPA 70 and as indicated on the drawings.

3.5.2 Omitted

3.5.3 Omitted

3.5.4 Weatherproof Applications

Weatherproof receptacles shall be suitable for the environment, damp or wet as applicable, and the housings shall be labeled to identify the allowable use. Receptacles shall be marked in accordance with UL 514A for the type of use indicated; "Damp locations", "Wet Locations", "Wet Location Only When Cover Closed". Assemblies shall be installed in accordance with the manufacturer's recommendations.

3.5.4.1 Damp Locations

Receptacles in damp locations shall be mounted in an outlet box with a gasketed, weatherproof, cast-metal cover plate (device plate, box cover) and a gasketed cap (hood, receptacle cover) over each receptacle opening. The cap shall be either a screw-on type permanently attached to the cover plate by a short length of bead chain or shall be a flap type attached to the cover with a spring loaded hinge.

3.5.4.2 Wet Locations

Receptacles in wet locations shall be installed in an assembly rated for such use whether the plug is inserted or withdrawn, unless otherwise indicated. In a duplex installation, the receptacle cover shall be configured to shield the connections whether one or both receptacles are in use.

3.6 WALL SWITCHES

Wall switches shall be of the totally enclosed tumbler type. The wall switch handle and switch plate color 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 15-ampere for use on alternating current only. Pilot lights indicated shall consist of yoke-mounted candelabra-base sockets rated at 75 watts, 125 volts, and fitted with glass or plastic jewels. A clear 6-watt lamp shall be furnished and installed in each pilot switch. Jewels for use with switches controlling motors shall be green, and jewels for other purposes shall be red. Dimming switches shall be solid-state flush mounted, sized for the loads.

3.7 SERVICE EQUIPMENT

Service-disconnecting means shall be of the type indicated with an external handle for manual operation. When service disconnecting means is a part of an assembly, the assembly shall be listed as suitable for service entrance equipment. Enclosures shall be sheet metal with hinged cover for surface mounting unless otherwise indicated.

3.8 PANELBOARDS AND LOADCENTERS

Circuit breakers and switches used as a motor disconnecting means shall be capable of being locked in the open position. Door locks shall be keyed alike. Nameplates shall be as approved. Directories shall be typed to indicate loads served by each circuit and mounted in a holder behind a clear protective covering. Busses shall be copper.

3.8.1 Loadcenters

Loadcenters shall be circuit breaker equipped.

3.8.2 Panelboards

Panelboards shall be circuit breaker or fusible switch equipped as indicated on the drawings.

3.9 FUSES

Equipment provided under this contract shall be provided with a complete set of properly rated fuses when the equipment manufacturer utilize fuses in the manufacture of the equipment, or if current-limiting fuses are required to be installed to limit the ampere-interrupting capacity of circuit breakers or equipment to less than the maximum available fault current at the location of the equipment to be installed. Fuses shall have a voltage rating of not less than the phase-to-phase circuit voltage, and shall have the time-current characteristics required for effective power system coordination.

3.10 MOTORS

Each motor shall conform to the hp and voltage ratings indicated, and shall have a service factor and other characteristics that are essential to the proper application and performance of the motors under conditions shown or specified. Three-phase motors for use on 3-phase 208-volt systems shall have a nameplate rating of 200 volts. Unless otherwise specified, all motors shall have open frames, and continuous-duty classification based on a 40 degree C ambient temperature reference. Polyphase motors shall be squirrel-cage type, having normal-starting-torque and low-starting-current characteristics, unless other characteristics are specified in other sections of these specifications or shown on contract drawings. The Contractor shall be responsible for selecting the actual horsepower ratings and other motor requirements necessary for the applications indicated. When electrically driven equipment furnished under other sections of these specifications materially differs from the design, the Contractor shall make the necessary adjustments to the wiring, disconnect devices and branch-circuit protection to accommodate the equipment actually installed.

3.11 MOTOR CONTROL

Each motor or group of motors requiring a single control shall be provided under other sections of these specifications with a suitable controller and devices that will perform the functions as specified for the respective motors. Each motor of 1/8 hp or larger shall be provided with thermal-overload protection. Polyphase motors shall have overload protection in each ungrounded conductor. The overload-protection device shall be provided either integral with the motor or controller, or shall be mounted in a separate enclosure. Unless otherwise specified, the protective device shall be of the manually reset type. Single or double pole tumbler switches specifically designed for alternating-current operation only may be used as manual controllers for single-phase motors having a current rating not in excess of 80 percent of the switch rating. Automatic control devices such as thermostats, float or pressure switches may control the starting and stopping of motors directly, provided the devices used are designed for that purpose and have an adequate horsepower rating. When the automatic-control device does not have such a rating, a magnetic starter shall be used, with the automatic-control device actuating the pilot-control circuit. When combination manual and automatic control is specified and the automatic-control device operates the motor directly, a double-throw, three-position tumbler or rotary switch shall be provided for the manual control; when the automatic-control device actuates the pilot control circuit of a magnetic starter, the latter shall be provided with a three-position selector switch marked MANUAL-OFF-AUTOMATIC. Connections to the selector switch shall be such that only the normal automatic regulatory control devices will be bypassed when the switch is in

the Manual position; all safety control devices, such as low- or high-pressure cutouts, high-temperature cutouts, and motor-overload protective devices, shall be connected in the motor-control circuit in both the Manual and the Automatic positions of the selector switch. Control circuit connections to any MANUAL-OFF-AUTOMATIC switch or to more than one automatic regulatory control device shall be made in accordance with wiring diagram approved by the Contracting Officer unless such diagram is included on the drawings. All controls shall be 120 volts or less unless otherwise indicated.

3.12 MOTOR-DISCONNECT MEANS

Each motor shall be provided with a disconnecting means when required by NFPA 70 even though not indicated. For single-phase motors, a single or double pole toggle switch, rated only for alternating current, will be acceptable for capacities less than 30 amperes, provided the ampere rating of the switch is at least 125 percent of the motor rating. Switches shall disconnect all ungrounded conductors.

3.13 LAMPS AND LIGHTING FIXTURES

Ballasted fixtures shall have ballasts which are compatible with the specific type and rating of lamps indicated and shall comply with the applicable provisions of the publications referenced.

3.13.1 Lamps

Lamps of the type, wattage, and voltage rating indicated shall be delivered to the project in the original cartons and installed in the fixtures just prior to the completion of the project.

3.13.1.1 Incandescent

Incandescent lamps shall be for 125-volt operation unless otherwise indicated.

3.13.1.2 Fluorescent

Fluorescent lamps for magnetic ballasts shall be as indicated and shall be of a type that will not require starter switches. Lamps shall be of the rapid-start type unless otherwise shown or approved. Fluorescent lamps for electronic ballasts shall be as indicated.

3.13.1.3 High-Intensity-Discharge

High-intensity-discharge lamps shall be the high-pressure sodium type unless otherwise indicated, shown, or approved.

3.13.2 Fixtures

Fixtures shall be as shown and shall conform to the following specifications and shall be as detailed on Standard Drawing No. 40-06-04, Sheets. Illustrations shown on these sheets are indicative of the general type desired and are not intended to restrict selection to fixtures of any particular manufacturer. Fixtures of similar designs and equivalent energy efficiency, light distribution and brightness characteristics, and of equal finish and quality will be acceptable if approved. In suspended acoustical ceilings with fluorescent fixtures, the fluorescent emergency light fixtures shall be furnished with self-contained battery packs.

3.13.2.1 Accessories

Accessories such as straps, mounting plates, nipples, or brackets shall be provided for proper installation. Open type fluorescent fixtures with exposed lamps shall have a wire-basket type guard.

3.13.2.2 Suspended Fixtures

Suspended fixtures shall be provided with swivel hangers in order to ensure a plumb installation. Pendants, rods, or chains 4 feet or longer excluding fixture, shall be braced to limit swinging. Bracing shall be 3 directional, 120 degrees apart. Single unit suspended fluorescent fixtures shall have twin-stem hangers. Multiple unit or continuous-row fluorescent units shall have a tubing or stem for wiring at one point, and a tubing or rod suspension provided for each length of chassis including one at each end. Maximum distance between adjacent tubing or stems shall be 10 feet. Rods shall be of not less than 3/16 inch diameter. Flexible raceway shall be installed to each fixture from an overhead junction box. Fixture to fixture wiring installation is allowed only when fixtures are installed end to end in a continuous run.

3.13.2.3 Ceiling Fixtures

Ceiling fixtures shall be coordinated with and suitable for installation in, on, or from the suspended ceiling provided under other sections of these specifications. Installation and support of fixtures shall be in accordance with the NFPA 70 and manufacturer's recommendations. Recessed fixtures shall have adjustable fittings to permit alignment with ceiling panels. Recessed fixtures installed in fire-resistive type of suspended ceiling construction shall have the same fire rating as the ceiling or shall be provided with fireproofing boxes having materials of the same fire rating as the ceiling panels, in conformance with UL Elec Const Dir. Surface-mounted fixtures shall be suitable for fastening to the structural support for ceiling panels.

3.13.2.4 Sockets

Sockets of industrial, strip, and other open type fluorescent fixtures shall be of the type requiring a forced movement along the longitudinal axis of the lamp for insertion and removal of the lamp.

3.13.3 Emergency Light Sets

Emergency light sets shall conform to UL 924 with the number of heads as indicated. Sets shall be permanently connected to the wiring system by conductors installed in short lengths of flexible conduit.

3.14 PAINTING AND FINISHING

Field-applied paint on exposed surfaces shall be provided under Section 09900 PAINTING, GENERAL.

3.15 FIELD TESTING

Field testing shall be performed in the presence of the Contracting Officer. The Contractor shall notify the Contracting Officer 5 days prior to conducting tests. The Contractor shall furnish all materials, labor, and equipment necessary to conduct field tests. The Contractor shall

perform all tests and inspection recommended by the manufacturer unless specifically waived by the Contracting Officer. The Contractor shall maintain a written record of all tests which includes date, test performed, personnel involved, devices tested, serial number and name of test equipment, and test results. All field test reports will be signed and dated by the Contractor.

3.15.1 Safety

The Contractor shall provide and use safety devices such as rubber gloves, protective barriers, and danger signs to protect and warn personnel in the test vicinity. The Contractor shall replace any devices or equipment which are damaged due to improper test procedures or handling.

3.15.2 Ground-Resistance Tests

The resistance of each grounding electrode shall be measured using the fall-of-potential method defined in IEEE Std 81. Soil resistivity in the area of the grid shall be measured concurrently with the grid measurements. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

a. Single rod electrode - 25 ohms.

3.15.3 Cable Tests

The Contractor shall be responsible for identifying all equipment and devices that could be damaged by application of the test voltage and ensuring that they have been properly disconnected prior to performing insulation resistance testing. An insulation resistance test shall be performed on all low and medium voltage cables after the cables are installed in their final configuration and prior to energization. The test voltage shall be 500 volts DC applied for one minute between each conductor and ground and between all possible combinations of conductors. The minimum value of resistance shall be:

R in megohms = (rated voltage in kV + 1) x 1000/(length of cable in feet)

Each cable failing this test shall be repaired or replaced. The repaired cable system shall then be retested until failures have been eliminated.

3.15.4 Motor Tests

a. Phase rotation test to ensure proper directions.

b. Operation and sequence of reduced voltage starters.

c. High potential test on each winding to ground.

d. Insulation resistance of each winding to ground.

e. Vibration test.

3.16 OPERATING TESTS

After the installation is completed, and at such time as the Contracting Officer may direct, the Contractor shall conduct operating tests for approval. The equipment shall be demonstrated to operate in accordance with the specified requirements. An operating test report shall be submitted in accordance with paragraph FIELD TEST REPORTS.

3.17 ACCEPTANCE

Final acceptance of the facility will not be given until the Contractor has successfully completed all tests and after all defects in installation, material or operation have been corrected.

-- End of Section --

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DIVISION 16 - ELECTRICAL

SECTION 16475A

COORDINATED POWER SYSTEM PROTECTION

08/02

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SECTION 16475A

COORDINATED POWER SYSTEM PROTECTION
08/02

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C37.16	(2000) Low-Voltage Power Circuit Breakers and AC Power Circuit Protectors - Preferred Ratings, Related Requirements, and Application Recommendations
ANSI C37.50	(1989; R 1995) Switchgear, Low-Voltage AC Power Circuit Breakers Used in Enclosures - Test Procedures

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2002) National Electrical Safety Code
IEEE C37.13	(1990; R 1995) Low-Voltage AC Power Circuit Breakers Used in Enclosures
IEEE C37.2	(1996) Electrical Power System Device Function Numbers and Contact Designations
IEEE C37.90	(1989) Relays and Relay Systems Associated with Electric Power Apparatus
IEEE C57.13	(1993) Instrument Transformers
IEEE Std 242	(2001) Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems - Buff Book
IEEE Std 399	(1997) Recommended Practice for Industrial and Commercial Power Systems Analysis - Brown Book

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA AB 1	(1999) Molded Case Circuit Breakers and Molded Case Switches
NEMA FU 1	(1986; R 1996) Low Voltage Cartridge Fuses
NEMA ICS 1	(2001) Industrial Control and Systems
NEMA ICS 2	(2002) Industrial Controls and Systems Controllers, Contactors, and Overload

	Relays Rated Not More Than 2,000 Volts AC or 750 Volts DC
NEMA ICS 3	(1993) Industrial Control and Systems Factory Built Assemblies
NEMA ICS 6	(1993; R 2001) Industrial Control and Systems, Enclosures
NEMA SG 3	(1995) Power Switching Equipment
NEMA SG 5	(1995) Power Switchgear Assemblies

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2002) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 198B	(1995) Class H Fuses
UL 198C	(1986; Rev thru Feb 1998) High-Interrupting-Capacity Fuses, Current-Limiting Types
UL 198D	(1995) Class K Fuses
UL 198E	(1988; Rev Jul 1988) Class R Fuses
UL 198H	(1988; Rev thru Nov 1993) Class T Fuses
UL 486E	(1994; Rev thru May 2000) Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors
UL 489	(1996; Rev thru Mar 2000) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 508	(1999; Rev thru Dec 2001) Industrial Control Equipment
UL 845	(1995; Rev thru May 2000) Motor Control Centers
UL 877	(1993; Rev thru Nov 1999) Circuit Breakers and Circuit-Breaker Enclosures for Use in Hazardous (Classified) Locations

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Fault Current Analysis; G, RE
Protective Device Coordination Study; G, RE

The study along with protective device equipment submittals. No time extensions or similar contact modifications will be granted for work arising out of the requirements for this study. Approval of protective devices proposed will be based on recommendations of this study. The Government shall not be held responsible for any changes to equipment, device ratings, settings, or additional labor for installation of equipment or devices ordered and/or procured prior to approval of the study.

Equipment;

Data consisting of manufacturer's time-current characteristic curves for individual protective devices, recommended settings of adjustable protective devices, and recommended ratings of non-adjustable protective devices.

System Coordinator;

Verification of experience and license number, of a registered Professional Engineer with at least 3 years of current experience in the design of coordinated power system protection. Experience data shall include at least five references for work of a magnitude comparable to this contract, including points of contact, addresses and telephone numbers. This engineer must perform items required by this section to be performed by a registered Professional Engineer.

Protective Relays;

Data shall including calibration and testing procedures and instructions pertaining to the frequency of calibration, inspection, adjustment, cleaning, and lubrication.

Installation;

Procedures including diagrams, instructions, and precautions required to properly install, adjust, calibrate, and test the devices and equipment.

SD-06 Test Reports

Field Testing;

The proposed test plan, prior to field tests. Plan shall consist of complete field test procedure including tests to be performed, test equipment required, and tolerance limits, including complete testing and verification of the ground fault protection equipment, where used. Performance test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall indicate the final position of controls.

SD-07 Certificates

Devices and Equipment;

Certificates certifying that all devices or equipment meet the requirements of the contract documents.

1.3 SYSTEM DESCRIPTION

The power system covered by this specification consists of the total low voltage distribution system.

1.4 QUALIFICATIONS

1.4.1 System Coordinator

System coordination, recommended ratings and settings of protective devices, and design analysis shall be accomplished by a registered professional electrical power engineer with a minimum of 3 years of current experience in the coordination of electrical power systems.

1.4.2 System Installer

Calibration, testing, adjustment, and placing into service of the protective devices shall be accomplished by a manufacturer's product field service engineer or independent testing company with a minimum of two years of current product experience in protective devices.

1.5 DELIVERY, STORAGE, AND HANDLING

Devices and equipment shall be visually inspected when received and prior to acceptance from conveyance. Stored items shall be protected from the environment in accordance with the manufacturer's published instructions. Damaged items shall be replaced.

1.6 PROJECT/SITE CONDITIONS

Devices and equipment furnished under this section shall be suitable for the following site conditions. Seismic details shall be as indicated.

1.7 EXTRA MATERIALS

The spare fuses or spare fuse elements shall be delivered to the Contracting officer when the electrical system is accepted.

PART 2 PRODUCTS

2.1 STANDARD PRODUCT

Protective devices and equipment shall be the standard product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory utility type use for at least two years prior to bid opening.

2.2 NAMEPLATES

Nameplates shall be provided to identify all protective devices and equipment. Nameplate information shall be in accordance with NEMA AB 1, NEMA SG 3, or NEMA SG 5 as applicable.

2.3 CORROSION PROTECTION

Metallic materials shall be protected against corrosion. Ferrous metal hardware shall be zinc or chrome-plated.

2.4 MOTOR CONTROLS AND MOTOR CONTROL CENTERS

Motor controls and motor control centers shall be in accordance with NEMA ICS 1, NEMA ICS 2, NEMA ICS 3 and NEMA ICS 6, and UL 508and UL 845.

2.4.1 Motor Starters

Combination starters shall be provided with circuit breakers and fusible switches.

2.4.2 Reduced-Voltage Starters

Reduced-voltage starters shall be provided for polyphase motors 75 hp or larger. Reduced-voltage starters shall be of the single-step autotransformer, reactor, or resistor type having an adjustable time interval between application of reduced and full voltages to the motors. Wye-delta reduced voltage starter or part winding increment starters having an adjustable time delay between application of voltage to first and second winding of motor, may be used in lieu of the reduced voltage starters specified above for starting of motor-generator sets, centrifugally operated equipment or reciprocating compressors provided with automatic unloaders.

2.4.3 Thermal-Overload Protection

Each motor of 1/8 hp or larger shall be provided with thermal-overload protection. Polyphase motors shall have overload protection in each ungrounded conductor. The overload-protection device shall be provided either integral with the motor or controller, or shall be mounted in a separate enclosure. Unless otherwise specified, the protective device shall be of the manually reset type. Single or double pole tumbler switches specifically designed for alternating-current operation only may be used as manual controllers for single-phase motors having a current rating not in excess of 80 percent of the switch rating.

2.4.4 Low-Voltage Motor Overload Relays

2.4.4.1 General

Thermal and magnetic current overload relays shall conform to NEMA ICS 2 and UL 508. Overload protection shall be provided either integral with the motor or controller, and shall be rated in accordance with the requirements of NFPA 70.

2.4.4.2 Construction

Manual reset type thermal relays shall be melting alloy or bimetallic construction. Automatic reset type relays shall be bimetallic construction. Magnetic current relays shall consist of a contact mechanism and a dash pot mounted on a common frame.

2.4.4.3 Ratings

Voltage ratings shall be not less than the applicable circuit voltage.

Trip current ratings shall be established by selection of the replaceable overload device and shall not be adjustable. Where the controller is remotely-located or difficult to reach, an automatic reset, non-compensated overload relay shall be provided. Manual reset overload relays shall be provided otherwise, and at all locations where automatic starting is provided. Where the motor is located in a constant ambient temperature, and the thermal device is located in an ambient temperature that regularly varies by more than 14 degrees F, an ambient temperature-compensated overload relay shall be provided.

2.4.5 Automatic Control Devices

2.4.5.1 Direct Control

Automatic control devices (such as thermostats, float or pressure switches) which control the starting and stopping of motors directly shall be designed for that purpose and have an adequate horsepowerrating.

2.4.5.2 Pilot-Relay Control

Where the automatic-control device does not have such a rating, a magnetic starter shall be used, with the automatic-control device actuating the pilot-control circuit.

2.4.5.3 Manual/Automatic Selection

a. Where combination manual and automatic control is specified and the automatic-control device actuates the pilot control circuit of a magnetic starter, the magnetic starter shall be provided with a three-position selector switch marked MANUAL-OFF-AUTOMATIC.

b. Connections to the selector switch shall only allow the normal automatic regulatory control devices to be bypassed when the switch is in the Manual position; all safety control devices, such as low-or high-pressure cutouts, high-temperature cutouts, and motor-overload protective devices, shall be connected in the motor-control circuit in both the Manual and the Automatic positions of the selector switch. Control circuit connections to any MANUAL-OFF-AUTOMATIC switch or to more than one automatic regulatory control device shall be made in accordance with wiring diagram approved by the contracting Officer unless such diagram is included on the drawings. All controls shall be 120 volts or less unless otherwise indicated.

2.4.6 Motor Control Centers

Control centers shall be indoor type and shall contain combination starters and other equipment as indicated. Control centers shall be NEMA ICS 2. Each control center shall be mounted on floor sills or mounting channels. Each circuit shall have a suitable metal or laminated plastic nameplate with white cut letters. Motor control centers shall be provided with a full-length ground bus bar.

2.5 LOW-VOLTAGE FUSES

2.5.1 General

Low-voltage fuses shall conform to NEMA FU 1. Equipment provided under this contract shall be provided with a complete set of properly rated fuses

when the equipment manufacturer utilizes fuses in the manufacture of the equipment, or if current-limiting fuses are required to be installed to limit the ampere-interrupting capacity of circuit breakers or equipment to less than the maximum available fault current at the location of the equipment to be installed. Fuses shall have a voltage rating of not less than the phase-to-phase circuit voltage, and shall have the time-current characteristics requires for effective power system coordination.

2.5.2 Cartridge Fuses; Noncurrent-Limiting Type

Cartridge fuses of the noncurrent-limiting type shall be Class H, nonrenewable, dual element, time lag type and shall have interrupting capacity of 10,000 amperes. Class H Fuses shall conform to UL 198B. At 500 percent current, cartridge fuses shall not blow in less than 10 seconds. Cartridge fuses shall be used for circuits rated in excess of 30 amperes, 125 volts, except where current-limiting fuses are indicated.

2.5.3 Cartridge Fuses; Current-Limiting Type

Cartridge fuses, current-limiting type, shall have tested interrupting capacity not less than 100,000 amperes. Fuse holders shall be the type that will reject Class H fuses.

a. Class G, J, L, & CC fuses shall conform to UL 198C.

b. Class K fuses shall conform to UL 198D.

c. Class R fuses shall conform to UL 198E.

d. Class T fuses shall conform to UL 198H.

2.5.3.1 Continuous Current Ratings (600 amperes and smaller)

Service entrance and feeder circuit fuses (600 amperes and smaller) shall be time-delay, with 200,000 amperes interrupting capacity.

2.5.3.2 Continuous Current Ratings (greater than 600 amperes)

Service entrance and feeder circuit fuses (greater than 600 amperes) shall be Class L, current-limiting, time-delay with 200,000 amperes interrupting capacity.

2.5.3.3 Motor and Transformer Circuit Fuses

Motor, motor controller, transformer, and inductive circuit fuses shall be Class RK1 or RK5, current-limiting, time-delay with 200,000 amperes interrupting capacity.

2.6 Omitted

2.7 MOTOR SHORT-CIRCUIT PROTECTOR (MSCP)

2.7.1 General

Motor short-circuit protectors shall conform to UL 508 and shall be provided as shown. Protectors shall be used only as part of a combination motor controller which provides coordinated motor branch-circuit overload and short-circuit protection, and shall be rated in accordance with the requirements of NFPA 70.

2.7.2 Construction

Motor short-circuit protector bodies shall be constructed of high temperature, dimensionally stable, long life, nonhygroscopic materials. Protectors shall fit special MSCP mounting clips and shall not be interchangeable with any commercially available fuses. Protectors shall have 100 percent one-way interchangeability within the A-Y letter designations. All ratings shall be clearly visible.

2.7.3 Ratings

Voltage ratings shall be not less than the applicable circuit voltage. Letter designations shall be A through Y for motor controller Sizes 0, 1, 2, 3, 4, and 5, with 100,000 amperes interrupting capacity rating. Letter designations shall correspond to controller sizes as follows:

CONTROLLER SIZE	MSCP DESIGNATION
NEMA 0	A-N
NEMA 1	A-P
NEMA 2	A-S
NEMA 3	A-U
NEMA 4	A-W
NEMA 5	A-Y

2.8 MOLDED-CASE CIRCUIT BREAKERS

2.8.1 General

Molded-case circuit breakers shall conform to NEMA AB 1 and UL 489. Circuit breakers may be installed in panelboards, switchboards, enclosures, motor control centers, or combination motor controllers. Circuit breakers and circuit breaker enclosures located in hazardous (classified) areas shall conform to UL 877.

2.8.2 Construction

Molded-case circuit breakers shall be assembled as an integral unit in a supporting and enclosing housing of glass reinforced insulating material providing high dielectric strength. Circuit breakers shall be suitable for mounting and operating in any position. Lugs shall be listed for copper conductors only in accordance with UL 486E. Single-pole circuit breakers shall be full module size with not more than one pole per module. Multi-pole circuit breakers shall be of the common-trip type having a single operating handle such that an overload or short circuit on any one pole will result in all poles opening simultaneously. Sizes of 100 amperes or less may consist of single-pole breakers permanently factory assembled into a multi-pole unit having an internal, mechanical, nontamperable common-trip mechanism and external handle ties. All circuit breakers shall have a quick-make, quick-break overcenter toggle-type mechanism, and the handle mechanism shall be trip-free to prevent holding the contacts closed against a short-circuit or sustained overload. All circuit breaker handles shall assume a position between "ON" and "OFF" when tripped automatically.

All ratings shall be clearly visible.

2.8.3 Ratings

Voltage ratings shall be not less than the applicable circuit voltage. The interrupting rating of the circuit breakers shall be at least equal to the available short-circuit current at the line terminals of the circuit breaker and correspond to the UL listed integrated short-circuit current rating specified for the panelboards and switchboards. Molded-case circuit breakers shall have nominal voltage ratings, maximum continuous-current ratings, and maximum short-circuit interrupting ratings in accordance with NEMA AB 1. Ratings shall be coordinated with system X/R ratio.

2.8.4 Cascade System Ratings

Circuit breakers used in series combinations shall be in accordance with UL 489. Equipment, such as switchboards and panelboards, which house series-connected circuit breakers shall be clearly marked accordingly. Series combinations shall be listed in the UL Recognized Component Directory under "Circuit Breakers-Series Connected."

2.8.5 Thermal-Magnetic Trip Elements

Thermal magnetic circuit breakers shall be provided as shown. Automatic operation shall be obtained by means of thermal-magnetic tripping devices located in each pole providing inverse time delay and instantaneous circuit protection. The instantaneous magnetic trip shall be adjustable and accessible from the front of all circuit breakers on frame sizes above 150 amperes.

2.8.6 Solid-State Trip Elements

Solid-state circuit breakers shall be provided as shown. All electronics shall be self-contained and require no external relaying, power supply, or accessories. Printed circuit cards shall be treated to resist moisture absorption, fungus growth, and signal leakage. All electronics shall be housed in an enclosure which provides protection against arcs, magnetic interference, dust, and other contaminants. Solid-state sensing shall measure true RMS current with error less than one percent on systems with distortions through the 13th harmonic. Peak or average actuating devices are not acceptable. Current sensors shall be toroidal construction, encased in a plastic housing filled with epoxy to protect against damage and moisture and shall be integrally mounted on the breaker. Where indicated on the drawings, circuit breaker frames shall be rated for 100 percent continuous duty. Circuit breakers shall have tripping features as shown on the drawings and as described below:

a. Long-time current pick-up, adjustable from 50 percent to 100 percent of continuous current rating.

b. Adjustable long-time delay.

c. Short-time current pick-up, adjustable from 1.5 to 9 times long-time current setting.

d. Adjustable short-time delay.

e. Short-time I square times t switch.

f. Instantaneous current pick-up, adjustable from 1.5 to 9 times long-time current setting.

g. Ground-fault pick-up, adjustable from 20 percent to 60 percent of sensor rating, but in no case greater than 1200 amperes. Sensing of ground-fault current at the main bonding jumper or ground strap shall not be permitted.

h. Adjustable ground-fault delay.

2.8.7 Current-Limiting Circuit Breakers

Current-limiting circuit breakers shall be provided as shown. Current-limiting circuit breakers shall limit the let-through I square times t to a value less than the I square times t of one-half cycle of the symmetrical short-circuit current waveform. On fault currents below the threshold of limitation, breakers shall provide conventional overload and short-circuit protection. Integrally-fused circuit breakers shall not be used.

2.8.8 SWD Circuit Breakers

Circuit breakers rated 15 amperes or 20 amperes and intended to switch 277 volts or less fluorescent lighting loads shall be marked "SWD."

2.8.9 HACR Circuit Breakers

Circuit breakers 60 amperes or below, 240 volts, 1-pole or 2-pole, intended to protect multi-motor and combination-load installations involved in heating, air conditioning, and refrigerating equipment shall be marked "Listed HACR Type."

2.8.10 Motor Circuit Protectors (MCP)

Motor circuit protectors shall conform to NEMA AB 1 and UL 489 and shall be provided as shown. MCPs shall consist of an adjustable instantaneous trip circuit breaker in conjunction with a combination motor controller which provides coordinated motor circuit overload and short-circuit protection. Motor Circuit Protectors shall be rated in accordance with NFPA 70.

2.9 LOW-VOLTAGE POWER CIRCUIT BREAKERS

2.9.1 Construction

Low-voltage power circuit breakers shall conform to IEEE C37.13, ANSI C37.16, and NEMA SG 3 and shall be three-pole, single-throw, stored energy, manually operated, with drawout mounting. Solid-state trip elements which require no external power connections shall be provided. Circuit breakers shall have an open/close contact position indicator, charged/discharged stored energy indicator, primary disconnect devices, and a mechanical interlock to prevent making or breaking contact of the primary disconnects when the circuit breaker is closed. The circuit breaker enclosure shall be suitable for its intended location.

2.9.2 Ratings

Voltage ratings shall be not less than the applicable circuit voltage. Circuit breakers shall be rated for 100 percent continuous duty and shall have trip current ratings and frame sizes as shown. Nominal voltage

ratings, maximum continuous-current ratings, and maximum short-circuit interrupting ratings shall be in accordance with ANSI C37.16. Tripping features shall be as follows:

a. Long-time current pick-up, adjustable from 50 percent to 100 percent of sensor current rating.

b. Adjustable long-time delay.

c. Short-time current pick-up, adjustable from 1.5 to 9 times long-time current setting.

d. Adjustable short-time delay.

2.10 Omitted

2.11 Omitted

2.12 SWITCHGEAR PROTECTIVE RELAYS

Solid-state and Electromechanical and Microprocessor-based protective relays shall be as shown and shall be of a type specifically designed for use on power switchgear or associated electric power apparatus. Protective relays shall conform to IEEE C37.90. Relays and auxiliaries shall suitable for operation with the instrument transformer ratios and connections provided.

2.12.1 Construction

Relays for installation in metal-clad switchgear shall be of the semi-flush, rectangular, back-connected, dustproof, switchboard type. Cases shall have a black finish and window-type removable covers capable of being sealed against tampering. Relays shall be of a type that can be withdrawn, through approved sliding contacts, from fronts of panels or doors without opening current transformer secondary circuits, disturbing external circuits, or requiring disconnection of any relay leads. Necessary test devices shall be incorporated within each relay and shall provide a means for testing either from an external source of electric power or from associated instrument transformers. Each relay shall be provided with an operation indicator and an external target reset device. Relays shall have necessary auxiliaries for proper operation. Relays and auxiliaries shall be suitable for operation with the instrument transformer ratios and connections provided.

2.12.2 Ratings

Relays shall be the manufacturer's standard items of equipments with appropriate ranges for time dial, tap, and other settings. Relay device numbers shall correspond to the function names and descriptions of IEEE C37.2.

2.12.3 Overcurrent Relays

Overcurrent relays shall be as follows:

a. Phase overcurrent relays for main and tie circuit breakers shall be single-phases, nondirectional, induction or solid-state or microprocessor-based type, time delay, device 51.

b. Ground overcurrent relays for main circuit breakers shall be nondirectional type, time delay, device.

c. Ground overcurrent relays for tie circuit breakers shall be nondirectional type, time delay, device 51N, residually connected.

d. Phase overcurrent relays for feeder circuit breakers shall be single-phase, nondirectional type, device 50/51.

e. Ground overcurrent relays for feeder circuit breakers shall be nondirectional, plunger or solid-state or microprocessor-based type instantaneous.

2.12.4 Directional Overcurrent Relays

Directional overcurrent relays shall be as follows:

a. Directional phase overcurrent relays shall be single-phase, induction or solid-state or microprocessor-based type, with instantaneous units.

2.12.5 Automatic Reclosing Relay

Relay, device 79, shall be of the three-phase, four-reclosure type, providing immediate initial reclosure, and three time-delay reclosures. Adjustable time delays shall be 10 to 60 seconds for reset and 0 to 45 seconds for reclosing. Units shall have instantaneous trip lockout after any preset trip when closing in on a fault. Auxiliary devices shall provided for lockout when an associated circuit breaker is tripped after reclosures and automatically reset when an associated circuit breaker is not tripped after any reclosure.

2.12.6 Transformer Differential and Lockout Relays

Differential relays, device 87T, shall be of the three-phase or the single-phase differential type suitable for the protection of two-winding transformers, and shall be provided with a harmonic-restraint feature. Lockout relay, device 86T, shall be of the type which, when used in conjunction with the 87T relay, trips and locks out the indicated circuit breakers.

2.12.7 Bus Differential and Lockout Relays

Bus differential relay, device 87B, shall be of the three-phase or single-phase, high-speed impedance differential type suitable for protection of buses. Lockout relay, device 86B, shall be of a type which, when used in conjunction with the 87B relay, trips and locks out the indicated circuit breaker.

2.13 INSTRUMENT TRANSFORMERS

2.13.1 General

Instrument transformers shall comply with ANSI C12.11 and IEEE C57.13. Instrument transformers shall be configured for mounting in/on the device to which they are applied. Polarity marks on instrument transformers shall be visually evident and shown on the drawings.

2.13.2 Current Transformers

Unless otherwise indicated, bar, wound, or window-type transformers are acceptable; and except for window-type units installed over insulated buses, transformers shall have a BIL rating consistent with the rated BIL of the associated switchgear or electric power apparatus bushings, buses or conductors. Current transformers shall have the indicated ratios. Circuit protectors shall be provided across secondary leads of the current transformers to prevent the accidental open-circuiting of the transformers while energized. Each terminal of each current transformer shall be connected to a short-circuiting terminal block in the circuit interrupting mechanism cabinet, power transformer terminal cabinet, and in the associated instrument and relay cabinets.

2.14 COORDINATED POWER SYSTEM PROTECTION

Analyses shall be prepared to demonstrate that the equipment selected and system constructed meet the contract requirements for ratings, coordination, and protection. They shall include a load flow analysis, a fault current analysis, and a protective device coordination study. The studies shall be performed by a registered professional engineer with demonstrated experience in power system coordination in the last 3 years. The Contractor shall provide a list of references complete with points of contact, addresses and telephone numbers. The selection of the engineer is subject to the approval of the Contracting Officer.

2.14.1 Scope of Analyses

The fault current analysis, and protective device coordination study shall begin at: the source bus and extend down to system buses where fault availability is 10,000 amperes (symmetrical) for building/facility 600 volt level distribution buses.

2.14.2 Determination of Facts

The time-current characteristics, features, and nameplate data for each existing protective device shall be determined and documented. The Contractor shall coordinate with the commercial power company for fault current availability at the site.

2.14.3 Single Line Diagram

A single line diagram shall be prepared to show the electrical system buses, devices, transformation points, and all sources of fault current (including generator and motor contributions). A fault-impedance diagram or a computer analysis diagram may be provided. Each bus, device or transformation point shall have a unique identifier. If a fault-impedance diagram is provided, impedance data shall be shown. Location of switches, breakers, and circuit interrupting devices shall be shown on the diagram together with available fault data, and the device interrupting rating.

2.14.4 Fault Current Analysis

2.14.4.1 Method

The fault current analysis shall be performed in accordance with methods described in IEEE Std 242, and IEEE Std 399.

2.14.4.2 Data

Actual data shall be utilized in fault calculations. Bus characteristics and transformer impedance shall be those proposed. Data shall be documented in the report.

2.14.4.3 Fault Current Availability

Balanced three-phase fault, bolted line-to-line fault, and line-to-ground fault current values shall be provided at each voltage transformation point and at each power distribution bus. The maximum and minimum values of fault available at each location shall be shown in tabular form on the diagram or in the report.

2.14.5 Coordination Study

The study shall demonstrate that the maximum possible degree of selectivity has been obtained between devices specified, consistent with protection of equipment and conductors from damage from overloads and fault conditions. The study shall include a description of the coordination of the protective devices in this project. A written narrative shall be provided describing: which devices may operate in the event of a fault at each bus; the logic used to arrive at device ratings and settings; situations where system coordination is not achievable due to device limitations (an analysis of any device curves which overlap); coordination between upstream and downstream devices; and relay settings. Recommendations to improve or enhance system reliability, and detail where such changes would involve additions or modifications to the contract and cost damages (addition or reduction) shall be provided. Composite coordination plots shall be provided on log-log graph paper.

2.14.6 Study report

a. The report shall include a narrative describing: the analyses performed; the bases and methods used; and the desired method of coordinated protection of the power system.

b. The study shall include descriptive and technical data for existing devices and new protective devices proposed. The data shall include manufacturers published data, nameplate data, and definition of the fixed or adjustable features of the existing or new protective devices.

c. The report shall document utility company data including system voltages, fault MVA, system X/R ratio, time-current characteristic curves, current transformer ratios, and relay device numbers and settings.

d. The report shall contain fully coordinated composite time-current characteristics curves for each bus in the system, as required to ensure coordinated power system protection between protective devices or equipment. The report shall include recommended ratings and settings of all protective devices in tabulated form.

e. The report shall provide the calculation performed for the analyses, including computer analysis programs utilized. The name of the software package, developer, and version number shall be provided.

PART 3 EXECUTION

3.1 VERIFICATION OF DIMENSIONS

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

3.2 INSTALLATION

Protective devices shall be installed in accordance with the manufacturer's published instructions and in accordance with the requirements of NFPA 70 and IEEE C2.

3.3 FIELD TESTING

3.3.1 General

Field testing shall be performed in the presence of the Contracting Officer. The Contractor shall notify the Contracting Officer 14 days prior to conducting tests. The Contractor shall furnish all materials, labor, and equipment necessary to conduct field tests. The Contractor shall perform all tests and inspections recommended by the manufacturer unless specifically waived by the Contracting Officer. The Contractor shall maintain a written record of all tests which includes date, test performed, personnel involved, devices tested, serial number and name of test equipment, and test results.

3.3.2 Safety

The Contractor shall provide and use safety devices such as rubber gloves, protective barriers, and danger signs to protect and warn personnel in the test vicinity. The Contractor shall replace any devices or equipment which are damaged due to improper test procedures or handling.

3.3.3 Molded-Case Circuit Breakers

Circuit breakers shall be visually inspected, operated manually, and connections checked for tightness. Current ratings shall be verified and adjustable settings incorporated in accordance with the coordination study.

3.3.4 Power Circuit Breakers

3.3.4.1 General

The Contractor shall visually inspect the circuit breaker and operate the circuit breaker manually; adjust and clean primary contacts in accordance with manufacturer's published instructions; check tolerances and clearances; check for proper lubrication; and ensure that all connections are tight. For electrically operated circuit breakers, the Contractor shall verify operating voltages on closing and tripping coils. The Contractor shall verify fuse ratings in control circuits; electrically operate the breaker, where applicable; and implement settings in accordance with the coordination study.

3.3.4.2 Power Circuit Breaker Tests

The following power circuit breakers shall be tested in accordance with ANSI C37.50.

3.3.5 Protective Relays

Protective relays shall be visually and mechanically inspected, adjusted, tested, and calibrated in accordance with the manufacturer's published instructions. Tests shall include pick-up, timing, contact action, restraint, and other aspects necessary to ensure proper calibration and operation. Relay settings shall be implemented in accordance with the coordination study. Relay contacts shall be manually or electrically operated to verify that the proper breakers and alarms initiate. Relaying current transformers shall be field tested in accordance with IEEE C57.13.

-- End of Section --

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DIVISION 16 - ELECTRICAL

SECTION 16723

INTERIOR TELEPHONE SYSTEM

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SECTION 16723

INTERIOR TELEPHONE SYSTEM
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PART 1 GENERAL

1.1 REFERENCES

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

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1999) National Electrical Code

PART 2 PRODUCTS

2.1 TELEPHONE SYSTEM

Provide conduit system for telephone outlets. System shall be ready for cable installation use by others. Provide conduit system with pull wire or nylon cord for cable installation.

2.1.1 Conduit, Outlet Boxes and Cover

Provide boxes and conduit in accordance with Section 16110, "Interior Electrical Work." Mount box flush in finish walls at 16 inches from finish floor.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Telephone Outlets

Surface mount telephone outlets on interior surface of exterior walls and on other masonry walls. Provide surface metal raceway from telephone outlet box to 6 inches above suspended ceiling. Flush mount telephone outlets on other walls and partitions with 3/4 inch conduit in interior of partition.

3.2 GROUNDING

NFPA 70. Provide copper ground bus for equipment ground.

3.3 FIELD QUALITY CONTROL

Supply test equipment and personnel. Notify Contracting Officer 5 working days prior to field test.

-- End of Section --